10 NOISE

10.1 INTRODUCTION

This Chapter of the EIAR assesses the effects of the Development from noise impacts. This assessment was undertaken by Brendan O'Reilly of Noise & Vibration Consultants Limited. The assessment considers the potential effects during the following phases of the Development:

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

The Development refers to all elements of the application for the construction and operation of the wind farm including the grid connection, road traffic to site, peat disposal and upgrade to the Screebe Substation (**Chapter 2: Development Description**).

Common acronyms used throughout this EIAR can be found in **Appendix 1.4.**

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:

- **Appendix 10.1**: Photos of noise monitors in-situ
- **Appendix 10.2**: Wind speed calculations for Hub Height
- **Appendix 10.3**: Calibration certificates of noise instruments
- **Appendix 10.4**: Candidate turbine manufacturer's noise emission data

10.1.1 Statement of Authority

Brendan 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 Environmental Protection Agency.

Brendan has considerable experience in the assessment of noise impact and have compiled studies for in excess of 100 wind farm developments throughout Ireland, north and south.

10.1.2 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 noise and background noise as stated in the 2006 Guidelines. As discussed in ETSU-R-97[3] the LA90 is 1.5-2.5dBA less than the LAeq measured over the same period. In this assessment, the difference between LAeq and LA90 is given as 2dBA 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 9.1 gives a comparison of noise levels in our everyday environment.

Table 10.1: 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

[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.

[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

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

10.1.3 Assessment Structure

This assessment 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 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 Development, including a summary of the measures taken during design of the Development to minimise noise effects
- 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 EIA Development after mitigation measures have been implemented
- Cumulative Effects – identifying the potential for effects of the EIA Development to combine with those from other wind farm developments
- Summary of Effects
- Statement of Significance

10.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

10.2.1 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

10.2.2 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.

10.2.3 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)[6] (the 2006 Guidelines)
- Recent 2020 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).
- 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'[7] (the IOA Good Practice Guide)
- ISO 1996[8] Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures (ISO 1996)
- ETSU-R-97[9]: The Assessment & Rating of Noise from Wind Farms (ETSU-R-97)

10.2.3.1 Wind Energy Development Guidelines 2006

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

<u>General Noise Impact</u>

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

[6] Department of Environment, Heritage and Local Government: Wind Energy Development Guidelines, Guidelines for Planning Authorities 2006 Energy
[7] Institute of Acoustics (2013) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise
[8] ISO 1996/1- Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures
[9] ETSU-R-97: Acoustics-The Assessment & Rating of Noise from Wind Farms: ETSU for the DTI, UK, 1996

"*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."

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) L90,10min which 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

10.2.3.2 An Bord Pleanála

2020 An Bord Pleanála Decisions

Recent decisions by ABP gave limits (ABP-304807 and ABP-303592-19, dated 2020) in accordance with the 2006 Guidelines were as follows:

(a) between the hours of 0700 and 2300:

the greater of 5 dB(A) L90,10min above background noise levels, or

43 dB(A) L90, 10min, and

(b) 43 dB(A) L90,10min at all other times where wind speeds are measured at 10 metres above ground level.

10.2.3.3 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 site with no specific limits for night.

10.2.3.4 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, the assessment is based on the current guidance outlined in **Section 10.2.2.1**.

10.2.4 Desk Study

The three locations for noise monitoring were selected by inspection of site 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 3.7km of the wind farm.

The three locations are considered representative of the local noise environment.

10.2.5 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[10].(**Appendix 10.2**) gives the methodology to account for wind shear, calculation to hub height and to standardise 10m height wind speed.

[10] 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 Met Mast located within the Site during the noise survey was used for wind data measurements at heights of 80m and 60m with wind shear derived and used to calculate to the proposed turbine hub height wind speed of 104m.

The 104m hub height wind speed was then standardised to 10m height wind speed with the wind speed plotted against the 10 minute background noise data to derive a best fit polynomial curve.

10.2.6 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[11] 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. WindFarm V4 wind energy development 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:

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

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:

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

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

Where:

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 4m 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 emergency 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 10^0C and a relative humidity of 70% has been used for these predictions and are given in **Table 10.2** below. These values are recommended in the IOA Good Practice Guide.

Table 10.2: 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.

10.2.7 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 Temple Group[12] undertook a review of Renewable UK's Research into Amplitude Modulation and concluded the following:

The distinction between normal AM i.e., blade swish (NAM) and other AM (OAM) is important as they are caused by different mechanisms and have separate impacts. Normal AM (NAM) is a commonly occurring typical characteristic of wind turbine noise that occurs persistently for long periods. NAM or "swish" usually disappears at around 3 to 4 rotor lengths from the turbines, except in crosswind conditions.

Based on the evidence available, it was recognised that even at those wind farm sites where OAM has been reported to be an issue, its occurrence may be relatively infrequent.

[12] Report for Renewable UK by Temple Group (Dani Fliumicelli). *Summary of Research into Amplitude Modulation of Aerodynamic Noise from Wind Turbines*, Wind Turbine Amplitude Modulation: *Research to Improve Understanding as to the cause and Effect*, Dec'2013.

The study reports that the occurrence and intensity of OAM is dependent on a number of interacting factors that are specific to a location, and it is not feasible to reliably predict the occurrence of OAM at another location simply by cross checking whether similar conditions that arise at a location where OAM has occurred might arise at the new location.

Normal Amplitude Modulation (NAM) is a fundamental component of wind turbine noise and can be heard in proximity to virtually all wind turbine installations. The 2007[13] Salford University Report found instances of "enhanced" AM which occurred at larger distances, but relatively infrequently and at only a small minority of sites. These characteristics are consistent with and can be explained by OAM.

As described previously, many risk factors have been considered for OAM. However, no single item or specific combination of items have been found to be the controlling factors whereby the occurrence, duration and intensity of OAM at a particular location can be reliably predicted in advance of a wind turbine or wind farm being installed.

Salford University in 2007, found that out of 133 operational wind farms investigated, 27 were associated with noise complaints, but OAM was considered to be a factor in noise complaints at only four sites and a possible factor in a further eight locations.

10.2.8 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 thru 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 20Hz)) 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 20,000Hz and low frequency noise is generally from about 2 to 200Hz with infrasound typically of frequencies below 20Hz. There appears to be little or no agreement about the biological effects of low frequency noise

[13] Research into Aerodynamic Modulation of Wind Turbine Noise. Report by University of Salford

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*'[14]. 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 (and not alluded to by Leventhall) has been in the area of blasting (air overpressure) which falls into a very low frequency range (2-20Hz), 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 88dB, as below that value trigger can occur from relatively low wind speeds (a gust of wind at 9m/s equates to an air overpressure of 133dB).

The level of ground vibration from the operation of the wind farms is below human threshold of 0.2mm/s[15] at the base of a turbine.

<u>South Australian Environment Protection Authority (EPA) Infrasound Study</u>

A report released in January 2013 by the South Australian EPA[16] 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 contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment'*.

[14] ETSU W/13/00392/REP – '*Low Frequency Noise and Vibration Measurements at a Modern Wind Farm'.*
[15] 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
[16] http://www.epa.sa.gov.au/environmental_info/noise/wind_farms

Massachusetts Institute of Technology (MIT)

A report by an Independent Expert Panel prepared for Massachusetts Department of Health (2012)[17] which consisted of a panel that included seven individuals with backgrounds in public health, epidemiology, toxicology, neurology and sleep medicine, neuroscience, and mechanical engineering, all 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"[18] 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.

"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

[17] 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

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

the noise, and their autonomous nervous system did not respond to it. There were no differences between the results of the two groups."

10.2.9 Field Work

Baseline noise monitoring was undertaken at three locations between 26th October and 18th November 2021 (see **Figure 10.1**). The continuous monitoring period coincided with the wind speed monitoring over the same period and at the same 10-minute intervals. Noise data was recorded for a representative range of wind speeds during the monitoring period.

10.2.10 Consultation

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

10.2.11 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 Site;
- Prediction of the likely noise levels of wind turbines received at each receptor;
- Comparison of the predicted levels with noise limits; and
- The Onsite 38kV Substation is considered. However, it is discounted from the noise assessment as the noise emissions from this facility are very low (at less than 30dBA at 150m) compared to the wind turbines and will have negligible impact. Potential receptors in the area around the Development were initially identified from Ordnance Survey maps, google maps, EPA maps and Site visits. Background measurements were carried out at three locations shown in **Figure 10.1**.

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 11m/s at 10m 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 10.2.3.2**. 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 a candidate turbine, the Vestas V162-6.8 megawatts (MW) operating in unrestricted Mode PO6800 with serrated trailing edge (STE) as standard has been selected with a hub height of 104m for the EIA technical assessment. The tip of the blades with STE lowers noise emissions without reducing energy output. The selected turbine will have STE as standard.

A copy of the manufacturers noise specification of all turbines used in the assessment are given in the **Appendix 10.5**.

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 2dBA. However, as no uncertainty is given then an uncertainty value of 2dBA is given in both tables. **Table 10.3** gives the noise emission data of the V162 turbine at maximum sound power output at varying wind speed at hub height. **Table 10.4** gives the maximum sound power output at varying wind speed (presented at standardised 10m height) for the V162-6.8MW with a hub height of 104m. An uncertainty value of 2dBA is added to the data and a value of 2dBA is subtracted to account for conversion from LAeq to LA90 which is best practise.

Table 10.3: Noise Emission Data, Vestas V162-6.8MW, STE at Maximum Sound Power (LWA dB) at Hub Height at Varying Wind Speed

Hub Height Wind Speed, ms^{-1}	4	5	6	7	8	9	10
Sound Power Level, dB LWA at varying wind speeds	94.0	94.0	95.0	98.3	101.5	103.3	103.3
Uncertainty added and conversion of LAeq to LA90	94.0	94.0	95.0	98.3	101.5	103.3	103.3

Table 10.3: Cont'd: Noise Emission Data, Vestas V162-6.8MW, STE at Maximum Sound Power (LWA dB) at Hub Height at Varying Wind Speed

Hub Height Wind Speed ms^{-1}	11	12	13	14	15
Sound Power Level dB LWA, at Varying Wind Speed	103.4	103.8	104.1	104.3	104.5
Uncertainty added and Conversion of LAeq to LAeq	103.4	103.8	104.1	104.3	104.5

Table 10.4: Noise Emission Data, Vestas V162-6.8MW, STE at Maximum Sound Power (LWA dB) at Standardised 10m Height at Varying Wind Speed

Standardised 10m Height Wind Speed ms^{-1}	4	5	6	7	8	9	10	11
Sound Power Level dB LWA derived from 104m hub height	94.8	98.9	102.7	103.3	103.6	104.1	104.4	104.5
Uncertainty added and Conversion of LAeq to LAeq	94.8	98.9	102.7	103.3	103.6	104.1	104.4	104.5

The octave band values are given in **Table 10.5** with uncertainty values and conversion for LAeq to LA90 added as input to the prediction model. It is important to note that the maximum sound power level of a specific turbine does not change with variation in hub height, however minor variation occurs at the lower wind speeds with change in hub height. The proposed turbine for this development has no variation in hub height.

Table 10.5: Octave Band Spectrum of Vestas V162-6.8MW, STE at Maximum Sound Power (LWA dB) at 11m/s wind speed

Octave Band Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level, dB LWA at 11 ms^{-1}	87.5	95.4	98.7	99.2	97.6	93.2	85.7	75.0
Uncertainty added to octaves and conversion of LAeq to LA90	87.5	95.4	98.7	99.2	97.6	93.2	85.7	75.0

10.2.11.1 Cumulative Assessment

There is no operational or permitted wind farms within 4km of this development so the potential for cumulative impacts does not exist as audibility at this distance would be so low as not to be heard.

10.2.12 Construction Assessment Methodology

10.2.12.1 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)[19]. 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 deal with Noise[20].

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

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

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

Part 1 of BS5228 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 receptors to the 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 by 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

[19] National Roads Authority, *Guidelines for Noise and Vibration in National Road Schemes.*
[20] 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*.

- 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.

10.2.12.2 Construction and Decommissioning Noise Assessment Methodology

The NRA guidelines for construction noise which are considered acceptable are given in **Table 10.6**.

Table 10.6: 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 Galway County Council.

<u>Construction Times for The Development</u>

The construction times for this Development are:

> Monday to Friday: 07.00 to 19.00hrs, Saturday 08.00 to 13.00hrs 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 65dB during daytime, 55dB during evenings and weekends or 45dB at night.
- The total noise level (pre-construction ambient noise plus construction noise) exceeds the pre-construction noise level by 5dB 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 compound and turbine erection. There are 2 grid connection route options under consideration for the grid connection from the onsite 38kV substation. Option A will be an entirely underground line along public roads to the national grid at Screebe 110kV Substation (construction of the onsite substation will generate no more noise than construction of a small bungalow). Option B will follow much of the same route but with a section of overhead line from the N59, following an existing line, to connect back into the underground route along the R336.

The likely grid connection is Option A will involve laying cable underground and includes 5 locations where horizontal directional drilling (HDD) will be required.

Decommissioning will likely involve the remediation of Turbine Hardstand Areas and Turbine Foundations, where they will be covered in topsoil/peat 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 Development will be subject to the Health and Safety Authority Guidance[21] which states that for noise exposure noise levels likely to exceed 80 dBA (expressed as Lep,d 8 hour dBA) that there is the potential of risk of damage to hearing. All workers on site will be given guidance on how to comply with the 'First Action Level'.

10.2.13 Evaluation of Potential Effects

The potential impacts of construction are evaluated by comparing the predicted noise levels against the guideline limits given in **Table 10.6:** Noise levels that are acceptable based on the NRA guidelines**,** and sample criteria in Part 1 of BS 5228 in **Section 10.2.8.2**.

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

The potential operational impacts are evaluated by comparing the predicted noise levels against the day and night-time noise limits given in **Section 10.3.5**. The predicted noise levels are carried out according to the IOA Good Practice Guide as detailed in **Section 10.2.2.5** and potential impacts are assessed against the noise limits at the nearest receptors.

10.2.13.1 Sensitivity

The sensitivity of the Development during construction is based on the guideline values in **Table 10.6:** Noise levels that are acceptable based on the NRA guidelines**,** and sample criteria in Part 1 of BS 5228. The sensitivity of the Development during operation is based on the values in **Section 10.4.2** and **Section 10.4.4.3**.

10.2.13.2 Magnitude

The magnitude of potential impacts of construction is based on the values in **Table 10.9.** The magnitude of the Development during operation is based on the values in **Table 10.6**.

10.2.13.3 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 10.6** and sample criteria of in Part 1 of BS 5228.

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

10.3 BASELINE DESCRIPTION

10.3.1 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 Development.

10.3.2 Selection of Baseline Noise Survey Locations

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

10.3.3 Baseline Noise Survey

Baseline noise measurements were carried out continuously between 26th October and 18th November 2021 at receptor locations given in Table 7 (Photos of monitors in-situ in **Appendix 10.1**).

Table 10.7: Baseline Noise Survey

Location	ITM Reference	Description of Location
H30	502305E, 745888N	At 45m from end of house in field away from trees facing towards turbine location
H35	501458E, 747002N	At 7m from end of house in garden facing towards turbine location
H50	503264E, 748990N,	Across road 15m from front of house facing towards turbine location

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 Met Mast on the Development Site. The methodology is given in **Section 10.2.3.1**.
- 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 H30 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.

10.3.3.1 Instrumentation Used

The following instrumentation was used in the baseline survey measurements:

- Three Larson Davis Precision Integrating Sound Level Analyser/Data logger with 1/2" Condenser Microphones. All microphones were fitted with double skin windscreens based on that specified in W/31/00386/REP 'Noise Measurements in Windy Conditions[22]'.

- Calibration Type: Larson Davis Precision Acoustic Calibrator.
- Rain Gauge Type: TR-525met tipping bucket rain gauge, 0.2mm pulse with LOGBOX datalogger

All acoustic instrumentation was calibrated before and after the survey and the drift of calibration was less than 0.3dB within accepted guidelines. Survey measurement data and calibration certificates of the acoustic instruments are included in **Appendix 10.3**.

10.3.4 Prevailing Background Noise Levels

Table 10.8 gives the background noise levels obtained from quiet daytime and night-time measurement periods at three baseline measurement locations. H30, H35 and H50. The main noise sources are dominant by rivers, low road traffic on the N59 and wave movement on Lough Corrib. The area could not be defined as a low noise environment when the background is above 30dB LA90 at all locations at 4m/s and above except location H30 where it was marginally below 30dB LA90 by 0.2dB. All the receptors represented by H30 are within 0.8km of a National Primary Route and would be well above 30dB LA90 pre pandemic in quiet daytime.

Table 10.8: Prevailing Background Noise Levels

Monitoring Location		Prevailing Background (B/G) noise levels LA90dB, 10min Standardised Mean 10m Height Wind Speed, (m/s)							
		4	5	6	7	8	9	10	11
H30	Day	29.8	31.3	33.1	35.1	37.2	39.5	41.8	44.1
	B/G+5	34.8	36.3	38.1	40.1	42.2	44.5	46.8	49.1
H30	Night	26.3	27.4	28.9	30.7	32.8	35.1	37.5	40.1
	B/G+5	31.3	32.4	33.9	35.7	37.8	40.1	42.5	45.1
H35	Day	33.6	34.5	35.7	37.2	38.9	40.8	42.8	44.8
	B/G+5	38.6	39.4	40.7	42.2	43.9	45.8	47.8	49.8
H35	Night	33.4	33.9	34.8	35.9	37.2	38.8	40.5	42.4
	B/G+5	38.4	38.9	39.8	40.9	42.2	43.8	45.5	47.2
H50	Day	35.5	36.3	37.7	39.5	41.5	43.7	45.8	47.8
	B/G+5	40.5	41.3	42.7	44.5	46.5	48.7	50.8	42.8
H50	Night	35.8	36.6	37.8	39.4	41.2	43.4	45.7	48.2
	B/G+5	40.8	41.6	42.8	44.4	46.2	48.4	50.7	53.2

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

Location H30

The noise monitor was located away from trees which was close to the house with the main noise sources being road traffic and river flow. All receptors represented by H30 are within 0.8km of the N59 (National Primary Road) with very low traffic flow due to the pandemic.

Location H35

The noise monitor was located at the side of the house with the main noise source being the river which flows quite close to the local road. Wind effects on the wooded area west of the house also contributes at this location and at the houses further along the road.

Location 50

The noise monitor was located across the road from the house on a site at elevation marginally above the house facing towards the Development with the main noise source being water movement on the lough.

10.3.5 Noise Assessment Locations

The nearest receptors to the Development were selected for assessment and represent the properties most likely to be affected by potential effects. Measured background noise levels are representative of the background noise environments at the nearest properties to each monitoring location.

Should the predicted operational noise levels from the 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 Development will also comply, due to the attenuation of turbine noise levels with distance. The locations are given in **Table 10.7.**

10.3.6 Noise Limits

The noise limits for the Development are based on the limits in the 2006 Guidelines. Recent An Bord Pleanála limits were given as:

'Wind turbine noise arising from the proposed Development, by itself or in combination with other existing or permitted wind energy development in the vicinity, shall not exceed the greater of:

(a) 5 dB(A) above background noise levels or

(b) 43 dB(A) L90,10min

when measured externally at dwellings or other sensitive receptors'

As the area surrounding the development cannot be considered a low noise environment then a limit of 45 dB(A) L90,10min can be applied for daytime, however the layout and number of turbines has been designed to comply with a 43 dB(A) L90,10min for day and night with the noise levels assessed against this limit as per the requirements of the 2006 guidelines.

10.3.7 Development Design Mitigation

The preferred turbine model, the V162 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. Typically, STE reduces the noise levels by 2 to 3dBA depending on specific turbine used.

10.4 ASSESSMENT OF POTENTIAL EFFECTS

10.4.1 Construction Noise

10.4.1.1 Typical Construction and Decommissioning Noise Levels

As has been previously stated, the construction process associated with wind farms is not considered intensive and is temporary. The main noise sources will be associated with the construction of the Turbine Foundations, Turbine Hardstands, Grid connection and removal of spoil and spreading close to Maam Cross with considerably less impact from the development of Site Access Tracks, onsite 38kV Substation, upgrade to the ESB Screebe Substation, Control Building and Compound. Decommissioning noise levels are assumed to be in the same order as construction levels but of shorter duration.

The material for the Development will be imported from local quarries via the local road network with the main road traffic noise being generated for a short period with delivery of concrete for the Turbine Foundations to take 6 days. Delivery of the turbines to the Development will generate very low noise levels as the vehicles transporting will travel at low speed.

It is not possible to specify the precise noise levels of emissions from the construction plant and equipment until such time as a contractor is chosen and construction plant has been selected. However, **Table 10.9** indicates typical construction related noise levels for this type of Development activity. Predictions are made for the nearest receptor to the Development and receptors at varying distances from the grid connection.

Table10.9: Typical Noise Levels from Construction Works

Activity	L_{Aeq} at 10m
General Construction (pile driving, ready-mix trucks pouring concrete)	70-84dBA
Tracked excavator removing topsoil, subsoil for foundation	80- 87dBA
Rock breaker, mobile crusher, vibratory rollers, trucks loading and tipping material	82-89dBA
Grid Connection: Trenching Tracked excavator 14t, pneumatic breaker, vibratory roller 71t, tractor Horizontal directional drilling: Drill Rig (diesel), mud pump, diesel generator /tractor	70-74dBA 69-71dBA*
Spreading spoil, Tracked excavator and tractors	69-74
Road widening, Excavator and tractor trailer	70-74

*Recent measurements (2022) taken by author of HDD

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 3dBA where distances are more than 200m from a source and as zero within 200m -amelioration by barriers is not accounted for.

Table 9.10 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, Grid connection, spreading of spoil east of Maam Cross and 4 locations for widening of roads for turbine delivery to the site. The development of the Site Access Tracks, construction of the new Onsite 38kV Substation, works on the Screebe 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 and delivery of spoil to east of Maam Cross.

Road traffic is dealt with under a sub-heading within this section.

The maximum construction noise levels associated with the Development and Grid connection are listed in **Table 10.10.** 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 10.10**.

Table 10.10: Predicted Construction Noise Levels

Receptor	Activity taken as 100% per hour	Distance of Activity (m)	LAeq dB 1hr range
H35-nearest house to a turbine	Foundation works: trucks pouring concrete, large tracked excavator moving topsoil/subsoil	740	30-47
H35-nearest house to a turbine	Rock breaking, vibratory roller, trucks loading/tipping	740	42-49
Grid connection: Trenching Receptors at varying distances	Tracked excavator 14t, pneumatic breaker, vibratory roller 71t, tractor	20 40 80	64-68 58-62 52-56
*Horizontal directional drilling: Bridge 6 Bridges 8 and 13 Bridge 12 Bridge 17	Rig HPU (diesel), Mud Pump, Diesel generator	70 1200 1490 360	41-57 25-49 44-60 49-65
Spreading of spoil east of Maam Cross-nearest receptor at 65m	Excavator on tracks and two tractors/trailers	65 300 1100	53-61 32-39 29-36
Road widening at 4 locations for turbine delivery route with nearest receptor taken at 36m	Excavator and truck	36	59-63

*Noise levels taken in 2022 by author of this report

Construction Traffic

The delivery of turbines to the 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 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 10-11 hours).

Each turbine will require approximately 632m^3 of concrete while each ready-mix truck has a capacity of 8m^3. This results in 79 loads of concrete and 158 truck movements for each turbine. For delivery of concrete the timeframe envisaged for each turbine concrete pour is taken as 10 hrs. This equates to an average of 15.8 movements 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} is the sound power level of the truck, in decibels (dB); Q is 16 the number of vehicles per hour; V is 60, the average vehicle speed, in kilometres per hour (km/h); d is the distance of receiving position from the centre of haul road, in metres (m). LAeq = 105-33 +10log 16 – 10log60 – 10log20 = 53.2 LAeq 1hr. At 10m from the roadside the noise levels equates to 56.2 LAeq 1hr. The trucking for the concrete pour will extend for a total of 6 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.

Spoil delivery East of Maam Cross is expected to be at a rate of 30-31deliveries per day which equates to 60 to 61 movements. Operating over a 10hr day this equates to 6 movements/hr which results in a calculated LAeq 1hr of 49dBA at 20m and 52dBA at 10m from roadside. When the concrete pour for the turbine foundation occurs over the six day period at the same time as spoil delivery then the cumulative road traffic levels equate to (53.2+49) 54.6 LAeq 1hr at 20m and (56.2+ 52) 57.6 LAeq 1hr at 10m from road side. This temporary work is well below the limits for construction activity and insignificant.

Grid Connection-Cable laying along road by trenching

Cable laying and trenching will move along the grid route from the On-site 38kV Substation to the national grid at Screebe 110kV Substation which means maximum levels will pertain no more than one day equivalent (8 hours) at any single receptor except where horizontal drilling is required. The cable grid connection extends 18,650m with 1,450m within the site. Spoil material from the grid connection is predicted to generate 1,011 truck loads which is to be disposed at Carrowbrowne Recycling. This activity is planned to be completed in approximately 5 months. Truck movements predicted over a 40hr/week would result in less than 3 movements/hr. In terms of trenching and trucking the noise generated by this temporary activity is insignificant.

Construction noise levels are based on continuous operation. In practice, most plant will operate at a maximum level for short intervals. Where work is required at distances within 20m of a receptor an acoustic barrier will be provided which can be placed close to the source giving maximum attenuation (refer to BS 5228 for guidance on screening / barrier effects). When a noise source is completely obscured from a receptor by an acoustic barrier a minimum 10dBA reduction is obtained.

Grid Connection- HDD

HDD is required at five locations where the grid connection requires undergrounding. The nearest receptor to horizontal drilling activity is 70m from the Bridge 6 crossing with predicted noise levels at all five locations within NRA guidelines without any amelioration required, refer to **Table 10.10**. The works associated with this activity are temporary but expected to continue for less than 3 weeks at each location with all drilling activity to be carried out during daytime.

The predicted construction noise levels are within the NRA guidelines for daytime for all activity and are therefore considered as not significant.

Screebe ESB 110kV Substation

The Screebe Substation will require uprating the transformer from 31.5MVA to 63MVA, however construction works associated with the uprating will generate very low levels of noise levels. The uprating is dealt under operation of development.

10.4.1.2 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 3 days at any receptor. All predicted noise levels are well within NRA guidelines given as acceptable and are considered Construction noise is a temporary activity.

Ground vibration from rock breaking will be below the threshold of sensitivity to humans of 0.2mm/s peak particle velocity at all receptors[23]. The effects of noise and vibration from onsite construction activities are therefore considered not significant.

10.4.1.3 Description of Effects

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

[23] 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

Quality	Significance	Duration
Negative	Not Significant	Temporary

10.4.1.4 Decommissioning

Noise effects during the Decommissioning phase of the 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/peat unless there are environmental reasons to remove. It is likely that the duration of the Decommissioning phase will be of shorter duration than that during construction. Any legislation, guidance, or best practice relevant at the time of decommissioning will be complied with.

10.4.2 Predicted Operational Noise Levels

Table 10.11 gives the predicted noise levels at the nearest receptors to the Development at varying wind speeds for each receptor location. A noise contour map of the 6no. turbine Development at maximum sound power output at a wind speed of 8ms-1 at 10m height is presented in **Figure 10.1**. The contour map in **Figure 10.1** assumes that all turbines are simultaneously downwind to each location all of the time (continuously) which results is an overprediction of the noise levels.

Table 10.11: Predicted Noise Levels as LA90 at Varying Wind Speeds from the Development

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA
1	503167	743584	15.7	19.8	23.6	24.2	24.5	25.0	25.3	25.4
2	503259	743592	15.7	19.8	23.6	24.2	24.5	25.0	25.3	25.4
3	503428	743686	15.9	20.0	23.8	24.4	24.7	25.2	25.5	25.6
4	503355	743726	16.1	20.2	24.0	24.6	24.9	25.4	25.7	25.8
5	503328	743734	16.1	20.2	24.0	24.6	24.9	25.4	25.7	25.8
6	503179	743809	16.5	20.6	24.4	25.0	25.3	25.8	26.1	26.2
7	503102	743864	16.7	20.8	24.6	25.2	25.5	26.0	26.3	26.4
8	503229	743870	16.7	20.8	24.6	25.2	25.5	26.0	26.3	26.4
9	502983	743930	17.0	21.1	24.9	25.5	25.8	26.3	26.6	26.7
10	504171	744100	16.6	20.7	24.5	25.1	25.4	25.9	26.2	26.3
11	504144	744062	16.5	20.6	24.4	25.0	25.3	25.8	26.1	26.2

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA
12	504225	744102	16.5	20.6	24.4	25.0	25.3	25.8	26.1	26.2
13	504077	744141	16.9	21.0	24.8	25.4	25.7	26.2	26.5	26.6
14	504061	744184	17.1	21.2	25.0	25.6	25.9	26.4	26.7	26.8
15	504332	744232	16.8	20.9	24.7	25.3	25.6	26.1	26.4	26.5
16	502515	744790	20.9	25.0	28.8	29.4	29.7	30.2	30.5	30.6
17	502490	744824	21.1	25.2	29.0	29.6	29.9	30.4	30.7	30.8
18	504716	744997	18.6	22.7	26.5	27.1	27.4	27.9	28.2	28.3
19	504838	745030	18.3	22.4	26.2	26.8	27.1	27.6	27.9	28.0
20	505000	745216	18.3	22.4	26.2	26.8	27.1	27.6	27.9	28.0
21	502199	745261	23.2	27.3	31.1	31.7	32.0	32.5	32.8	32.9
22	504879	745261	18.9	23.0	26.8	27.4	27.7	28.2	28.5	28.6
23	505141	745305	18.1	22.2	26.0	26.6	26.9	27.4	27.7	27.8
24	504897	745329	19.0	23.1	26.9	27.5	27.8	28.3	28.6	28.7
25	501886	745414	23.2	27.3	31.1	31.7	32.0	32.5	32.8	32.9
26	501999	745485	24.0	28.1	31.9	32.5	32.8	33.3	33.6	33.7
27	502031	745483	24.1	28.2	32.0	32.6	32.9	33.4	33.7	33.8
28	502366	745792	27.5	31.6	35.4	36.0	36.3	36.8	37.1	37.2
29	502359	745866	28.2	32.3	36.1	36.7	37.0	37.5	37.8	37.9
30	502305	745888	28.1	32.2	36.0	36.6	36.9	37.4	37.7	37.8
31	501966	746276	29.0	33.1	36.9	37.5	37.8	38.3	38.6	38.7
32	501797	746572	29.3	33.4	37.2	37.8	38.1	38.6	38.9	39.0
33	501717	746730	29.5	33.6	37.4	38.0	38.3	38.8	39.1	39.2
34	501611	746774	28.9	33.0	36.8	37.4	37.7	38.2	38.5	38.6
35	501458	747002	28.5	32.6	36.4	37.0	37.3	37.8	38.1	38.2
36	501352	747084	27.8	31.9	35.7	36.3	36.6	37.1	37.4	37.5
37	501385	747078	28.1	32.2	36.0	36.6	36.9	37.4	37.7	37.8
38	501350	747134	27.9	32.0	35.8	36.4	36.7	37.2	37.5	37.6
39	501262	747108	27.0	31.1	34.9	35.5	35.8	36.3	36.6	36.7
40	501281	747175	27.3	31.4	35.2	35.8	36.1	36.6	36.9	37.0
41	506769	747672	14.2	18.3	22.1	22.7	23.0	23.5	23.8	23.9

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA
42	506467	747926	15.0	19.1	22.9	23.5	23.8	24.3	24.6	24.7
43	506415	748167	14.9	19.0	22.8	23.4	23.7	24.2	24.5	24.6
44	505845	748778	15.9	20.0	23.8	24.4	24.7	25.2	25.5	25.6
45	505799	748830	16.0	20.1	23.9	24.5	24.8	25.3	25.6	25.7
46	506179	748856	14.8	18.9	22.7	23.3	23.6	24.1	24.4	24.5
47	505897	748871	15.6	19.7	23.5	24.1	24.4	24.9	25.2	25.3
48	503225	748857	24.2	28.3	32.1	32.7	33.0	33.5	33.8	33.9
49	503295	748914	23.7	27.8	31.6	32.2	32.5	33.0	33.3	33.4
50	503264	748990	23.3	27.4	31.2	31.8	32.1	32.6	32.9	33.0
51	503279	749001	23.2	27.3	31.1	31.7	32.0	32.5	32.8	32.9
52	504754	749093	18.6	22.7	26.5	27.1	27.4	27.9	28.2	28.3
53	504622	749171	18.8	22.9	26.7	27.3	27.6	28.1	28.4	28.5
54	504729	749181	18.4	22.5	26.3	26.9	27.2	27.7	28.0	28.1
55	503359	749199	21.8	25.9	29.7	30.3	30.6	31.1	31.4	31.5
56	504812	749207	18.1	22.2	26.0	26.6	26.9	27.4	27.7	27.8
57	502034	749186	21.7	25.8	29.6	30.2	30.5	31.0	31.3	31.4
58	504473	749296	18.8	22.9	26.7	27.3	27.6	28.1	28.4	28.5
59	501654	749312	20.3	24.4	28.2	28.8	29.1	29.6	29.9	30.0
60	502176	749338	21.1	25.2	29.0	29.6	29.9	30.4	30.7	30.8
61	502207	749392	20.9	25.0	28.8	29.4	29.7	30.2	30.5	30.6
62	504216	749435	18.9	23.0	26.8	27.4	27.7	28.2	28.5	28.6
63	502443	749437	20.8	24.9	28.7	29.3	29.6	30.1	30.4	30.5
64	504185	749448	18.9	23.0	26.8	27.4	27.7	28.2	28.5	28.6
65	501434	749452	19.2	23.3	27.1	27.7	28.0	28.5	28.8	28.9
66	501408	749466	19.1	23.2	27.0	27.6	27.9	28.4	28.7	28.8
67	504078	749465	19.1	23.2	27.0	27.6	27.9	28.4	28.7	28.8
68	501122	749587	18.0	22.1	25.9	26.5	26.8	27.3	27.6	27.7
69	501109	749614	17.8	21.9	25.7	26.3	26.6	27.1	27.4	27.5
70	501034	749647	17.5	21.6	25.4	26.0	26.3	26.8	27.1	27.2
71	503493	743650	15.8	19.9	23.7	24.3	24.6	25.1	25.4	25.5

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s
House ID	**Easting**	**Northing**	**dBA**	**dBA**	**dBA**	**dBA**	**dBA**	**dBA**	**dBA**	**dBA**
72	504268	743314	14.0	18.1	21.9	22.5	22.8	23.3	23.6	23.7

10.4.3 Operational Noise Assessment

The assessment was made of the predicted operational noise levels from the Development based on the limits described in **Section 10.2.2.1** in the 2006 Guidelines and taking into consideration recent 2020 An Bord Pleanála decisions.

As can be seen from **Table 10.12** the predicted noise levels at all receptors are lower than the noise limits in all cases, 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 10.12: Margin between Predicted Noise Levels and Noise Limit of 43dBA

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA
1	503167	743584	-27.3	-23.2	-19.4	-18.8	-18.5	-18.0	-17.7	-17.6
2	503259	743592	-27.3	-23.2	-19.4	-18.8	-18.5	-18.0	-17.7	-17.6
3	503428	743686	-27.1	-23.0	-19.2	-18.6	-18.3	-17.8	-17.5	-17.4
4	503355	743726	-26.9	-22.8	-19.0	-18.4	-18.1	-17.6	-17.3	-17.2
5	503328	743734	-26.9	-22.8	-19.0	-18.4	-18.1	-17.6	-17.3	-17.2
6	503179	743809	-26.5	-22.4	-18.6	-18.0	-17.7	-17.2	-16.9	-16.8
7	503102	743864	-26.3	-22.2	-18.4	-17.8	-17.5	-17.0	-16.7	-16.6
8	503229	743870	-26.3	-22.2	-18.4	-17.8	-17.5	-17.0	-16.7	-16.6
9	502983	743930	-26.0	-21.9	-18.1	-17.5	-17.2	-16.7	-16.4	-16.3
10	504171	744100	-26.4	-22.3	-18.5	-17.9	-17.6	-17.1	-16.8	-16.7
11	504144	744062	-26.5	-22.4	-18.6	-18.0	-17.7	-17.2	-16.9	-16.8
12	504225	744102	-26.5	-22.4	-18.6	-18.0	-17.7	-17.2	-16.9	-16.8
13	504077	744141	-26.1	-22.0	-18.2	-17.6	-17.3	-16.8	-16.5	-16.4
14	504061	744184	-25.9	-21.8	-18.0	-17.4	-17.1	-16.6	-16.3	-16.2

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA
15	504332	744232	-26.2	-22.1	-18.3	-17.7	-17.4	-16.9	-16.6	-16.5
16	502515	744790	-22.1	-18.0	-14.2	-13.6	-13.3	-12.8	-12.5	-12.4
17	502490	744824	-21.9	-17.8	-14.0	-13.4	-13.1	-12.6	-12.3	-12.2
18	504716	744997	-24.4	-20.3	-16.5	-15.9	-15.6	-15.1	-14.8	-14.7
19	504838	745030	-24.7	-20.6	-16.8	-16.2	-15.9	-15.4	-15.1	-15.0
20	505000	745216	-24.7	-20.6	-16.8	-16.2	-15.9	-15.4	-15.1	-15.0
21	502199	745261	-19.8	-15.7	-11.9	-11.3	-11.0	-10.5	-10.2	-10.1
22	504879	745261	-24.1	-20.0	-16.2	-15.6	-15.3	-14.8	-14.5	-14.4
23	505141	745305	-24.9	-20.8	-17.0	-16.4	-16.1	-15.6	-15.3	-15.2
24	504897	745329	-24.0	-19.9	-16.1	-15.5	-15.2	-14.7	-14.4	-14.3
25	501886	745414	-19.8	-15.7	-11.9	-11.3	-11.0	-10.5	-10.2	-10.1
26	501999	745485	-19.0	-14.9	-11.1	-10.5	-10.2	-9.7	-9.4	-9.3
27	502031	745483	-18.9	-14.8	-11.0	-10.4	-10.1	-9.6	-9.3	-9.2
28	502366	745792	-15.5	-11.4	-7.6	-7.0	-6.7	-6.2	-5.9	-5.8
29	502359	745866	-14.8	-10.7	-6.9	-6.3	-6.0	-5.5	-5.2	-5.1
30	502305	745888	-14.9	-10.8	-7.0	-6.4	-6.1	-5.6	-5.3	-5.2
31	501966	746276	-14.0	-9.9	-6.1	-5.5	-5.2	-4.7	-4.4	-4.3
32	501797	746572	-13.7	-9.6	-5.8	-5.2	-4.9	-4.4	-4.1	-4.0
33	501717	746730	-13.5	-9.4	-5.6	-5.0	-4.7	-4.2	-3.9	-3.8
34	501611	746774	-14.2	-10.1	-6.2	-5.6	-5.3	-4.8	-4.6	-4.5
35	501458	747002	-14.5	-10.4	-6.6	-6.0	-5.7	-5.2	-4.9	-4.8
36	501352	747084	-15.3	-11.2	-7.3	-6.7	-6.5	-6.0	-5.7	-5.6
37	501385	747078	-14.9	-10.8	-7.0	-6.4	-6.1	-5.6	-5.3	-5.2
38	501350	747134	-15.2	-11.1	-7.2	-6.6	-6.3	-5.8	-5.6	-5.5
39	501262	747108	-16.0	-11.9	-8.1	-7.5	-7.2	-6.7	-6.4	-6.3
40	501281	747175	-15.7	-11.6	-7.8	-7.2	-6.9	-6.4	-6.1	-6.0
41	506769	747672	-28.8	-24.7	-20.9	-20.3	-20.0	-19.5	-19.2	-19.1
42	506467	747926	-28.0	-23.9	-20.1	-19.5	-19.2	-18.7	-18.4	-18.3
43	506415	748167	-28.1	-24.0	-20.2	-19.6	-19.3	-18.8	-18.5	-18.4
44	505845	748778	-27.1	-23.0	-19.2	-18.6	-18.3	-17.8	-17.5	-17.4

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA
45	505799	748830	-27.1	-23.0	-19.2	-18.6	-18.3	-17.8	-17.5	-17.4
46	506179	748856	-28.2	-24.1	-20.3	-19.7	-19.4	-18.9	-18.6	-18.5
47	505897	748871	-27.4	-23.3	-19.5	-18.9	-18.6	-18.1	-17.8	-17.7
48	503225	748857	-18.8	-14.7	-10.9	-10.3	-10.0	-9.5	-9.2	-9.1
49	503295	748914	-19.3	-15.2	-11.4	-10.8	-10.5	-10.0	-9.7	-9.6
50	503264	748990	-19.8	-15.7	-11.9	-11.3	-11.0	-10.5	-10.2	-10.1
51	503279	749001	-19.9	-15.8	-12.0	-11.4	-11.1	-10.6	-10.3	-10.2
52	504754	749093	-24.4	-20.3	-16.5	-15.9	-15.6	-15.1	-14.8	-14.7
53	504622	749171	-24.2	-20.1	-16.3	-15.7	-15.4	-14.9	-14.6	-14.5
54	504729	749181	-24.6	-20.5	-16.7	-16.1	-15.8	-15.3	-15.0	-14.9
55	503359	749199	-21.2	-17.1	-13.3	-12.7	-12.4	-11.9	-11.6	-11.5
56	504812	749207	-24.9	-20.8	-17.0	-16.4	-16.1	-15.6	-15.3	-15.2
57	502034	749186	-21.3	-17.2	-13.4	-12.8	-12.5	-12.0	-11.7	-11.6
58	504473	749296	-24.3	-20.2	-16.4	-15.8	-15.5	-15.0	-14.7	-14.6
59	501654	749312	-22.7	-18.6	-14.8	-14.2	-13.9	-13.4	-13.1	-13.0
60	502176	749338	-21.9	-17.8	-14.0	-13.4	-13.1	-12.6	-12.3	-12.2
61	502207	749392	-22.1	-18.0	-14.2	-13.6	-13.3	-12.8	-12.5	-12.4
62	504216	749435	-24.1	-20.0	-16.2	-15.6	-15.3	-14.8	-14.5	-14.4
63	502443	749437	-22.2	-18.1	-14.3	-13.7	-13.4	-12.9	-12.6	-12.5
64	504185	749448	-24.1	-20.0	-16.2	-15.6	-15.3	-14.8	-14.5	-14.4
65	501434	749452	-23.8	-19.7	-15.9	-15.3	-15.0	-14.5	-14.2	-14.1
66	501408	749466	-23.9	-19.8	-16.0	-15.4	-15.1	-14.6	-14.3	-14.2
67	504078	749465	-23.9	-19.8	-16.0	-15.4	-15.1	-14.6	-14.3	-14.2
68	501122	749587	-25.1	-21.0	-17.2	-16.6	-16.3	-15.8	-15.5	-15.4
69	501109	749614	-25.2	-21.1	-17.3	-16.7	-16.4	-15.9	-15.6	-15.5
70	501034	749647	-25.5	-21.4	-17.6	-17.0	-16.7	-16.2	-15.9	-15.8
71	503493	743650	-27.3	-23.2	-19.4	-18.8	-18.5	-18.0	-17.7	-17.6
72	504268	743314	-29.0	-24.9	-21.1	-20.5	-20.2	-19.7	-19.4	-19.3

A noise contour map of the cumulative effects of all six turbines is presented with a maximum sound power output at a wind speed of 11ms^{-1} at 10m height in **Figure 10.1**. The contour map in **Figure 10.1** assumes that all turbines are simultaneously downwind at the same time to each location which results in an overprediction of the noise levels.

Charts 10.1 to **10.6** of this section plots the derived background noise levels, background plus 5 trendline with the predicted noise levels against a noise limit of 43dB(A).

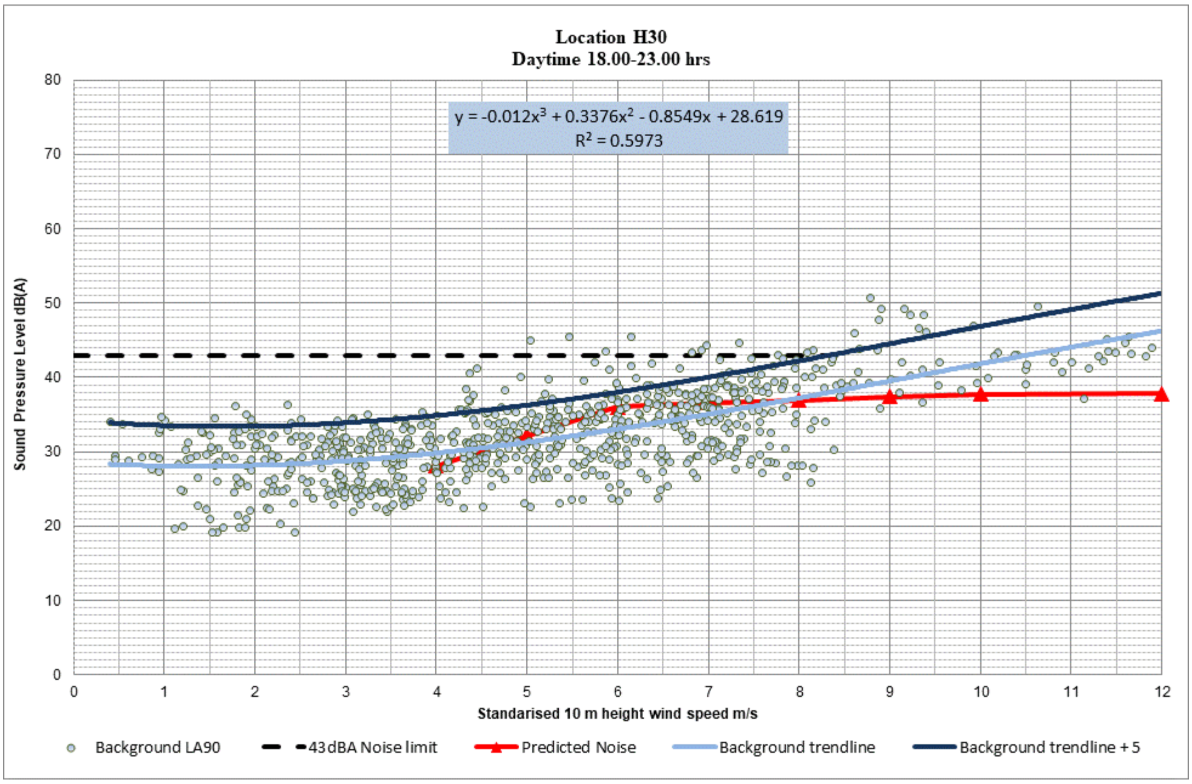

Chart 10.1: H30 for daytime, background noise level, predicted level and assessment limit

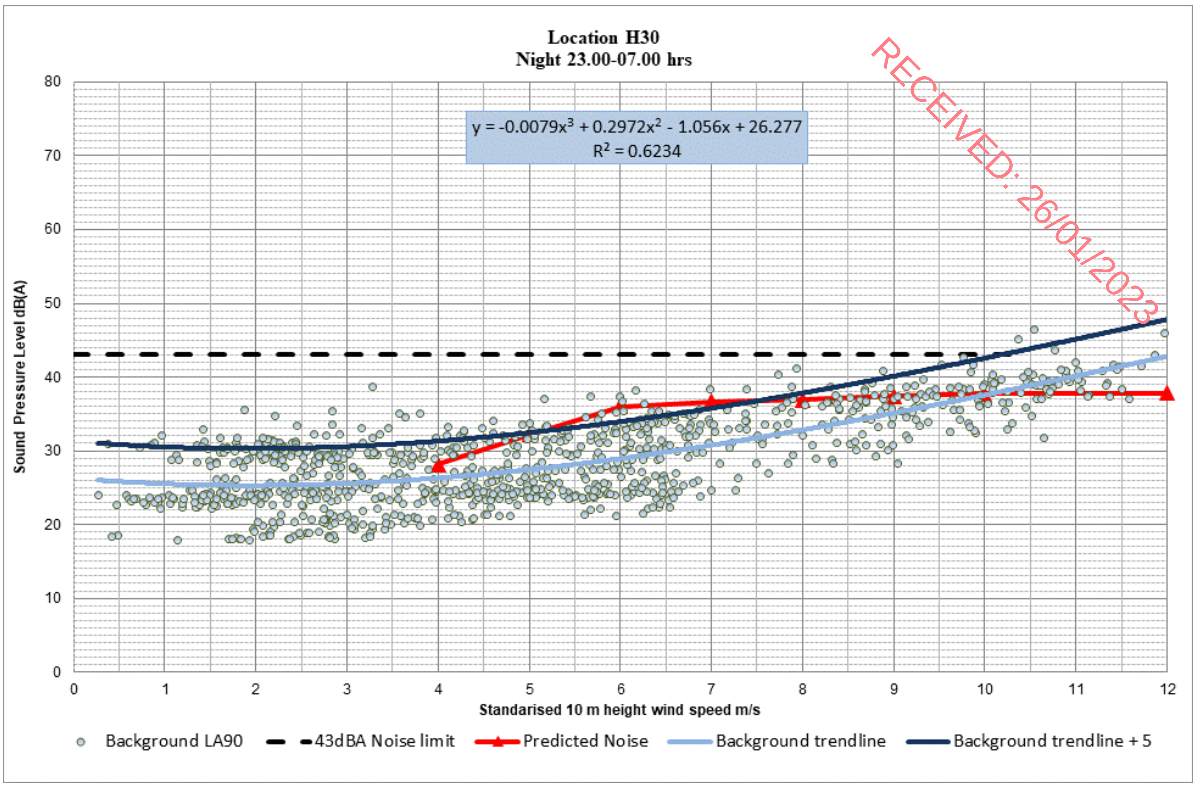

Chart 10.2: H30 for night-time, background noise level, predicted level and assessment limit

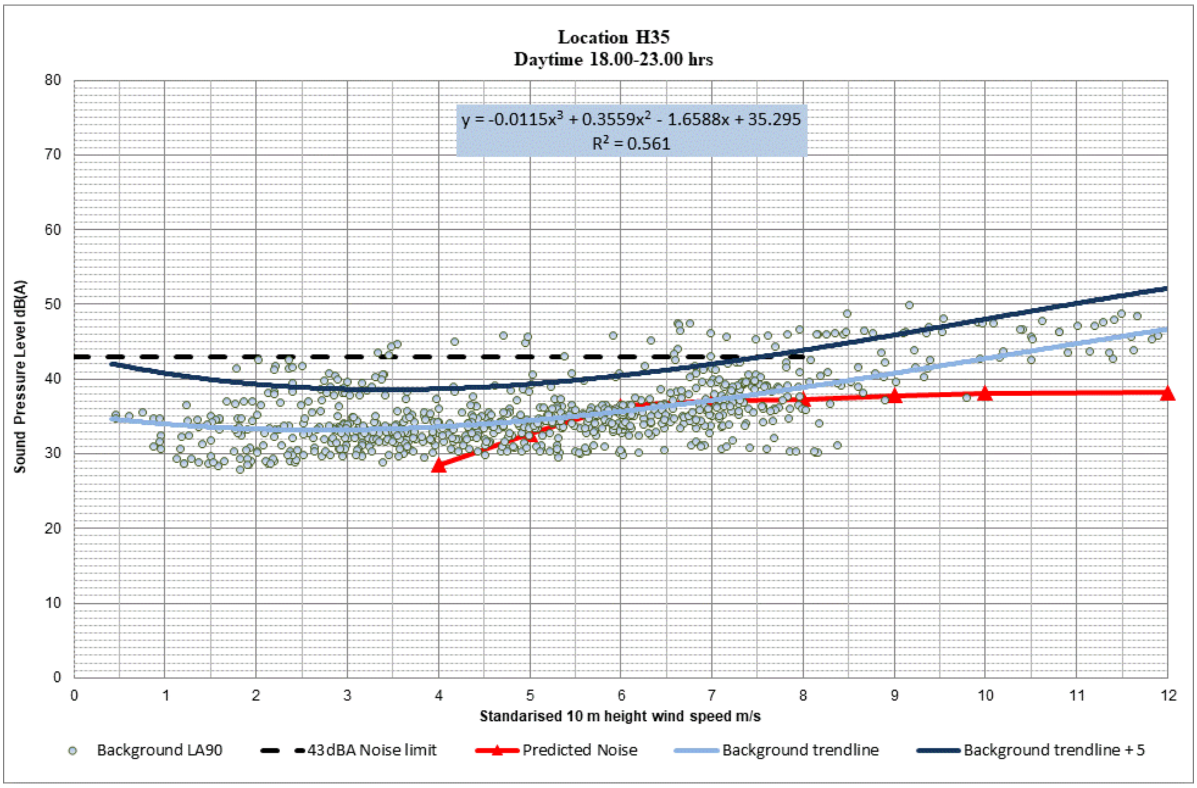

Chart 10.3: H35 for daytime, background noise level, predicted level and assessment limit

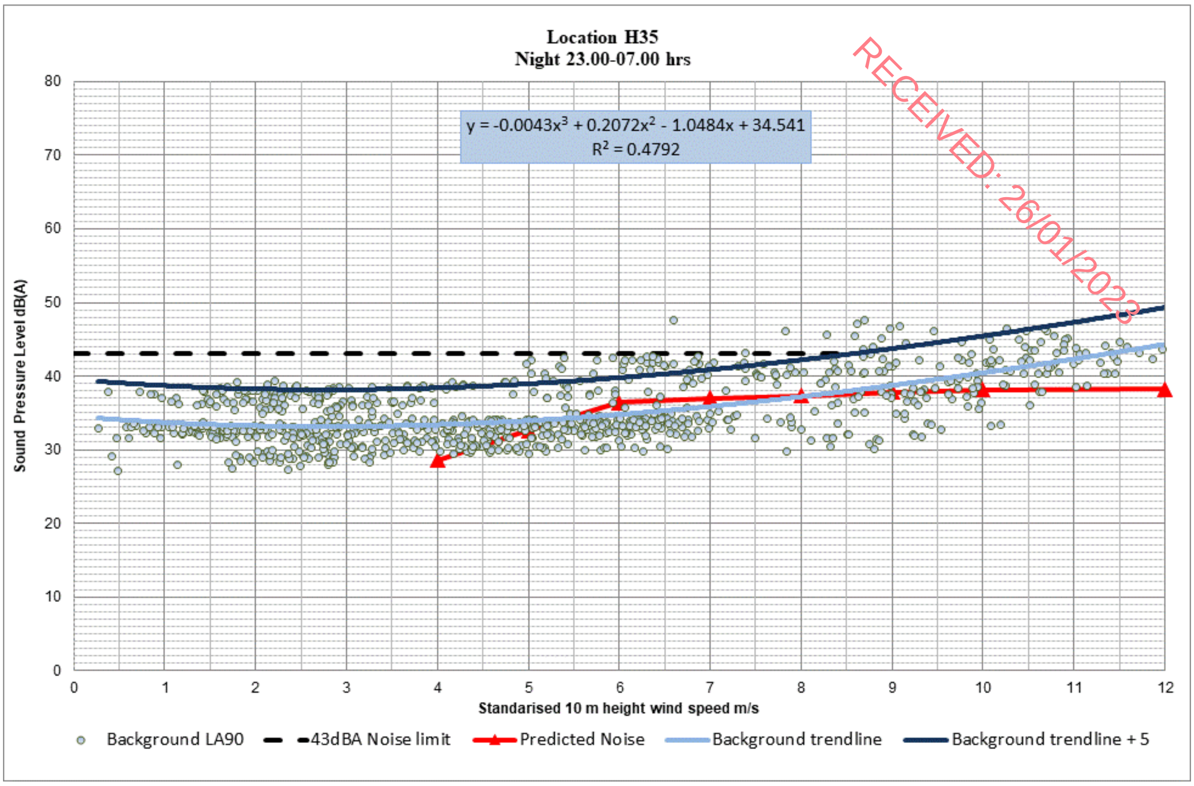

Chart 10.4: H35 for night-time, background noise level, predicted level and assessment limit

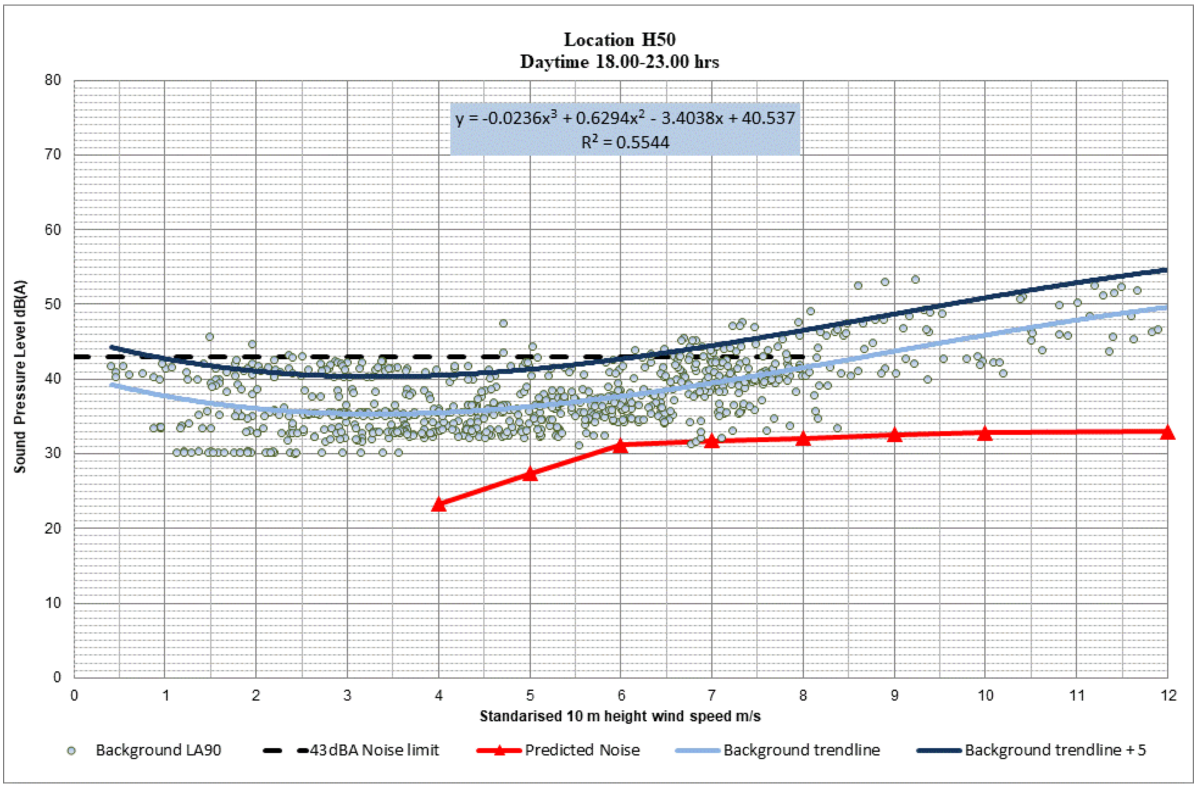

Chart 10.5: H50 for daytime, background noise level, predicted level and assessment limit

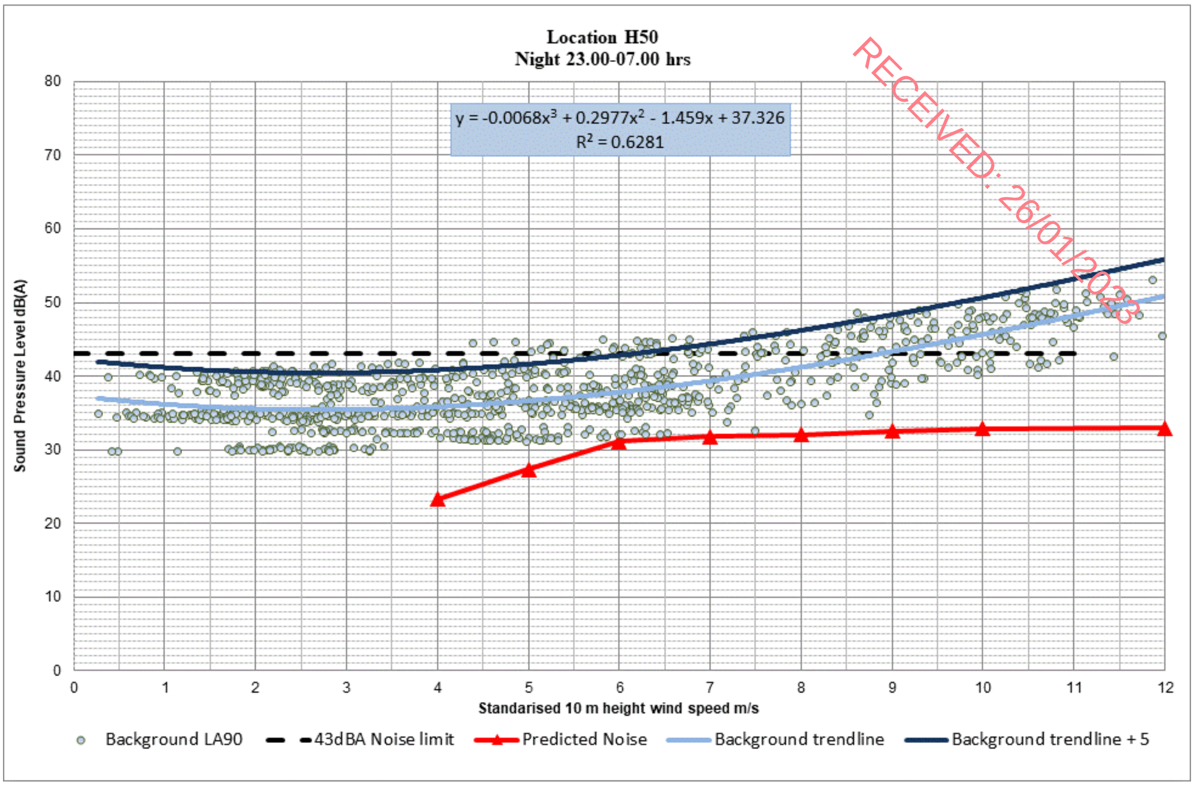

Chart 10.6: H50 for night-time, background noise level, predicted level and assessment limit

10.4.4 Cumulative Effects Assessment

There is no operating, consented, or application stage wind farms within 4km of the Development so the potential for cumulative impacts is considered negligible.

10.4.5 Screebe ESB Substation

The Screebe Substation would require uprating of the existing 31.5MVA transformer to 63MVA. There are different types of transformers available of which ESB are familiar with and with varying noise emissions. Uprating of the station will be carried out under the control of ESB who have considerable expertise in the installation and operation of such plant. ESB have a history of being able to locate such plant close to receptors in a way that audibility is not an issue. There are a number of ways to reduce transformer noise emissions one being the use of a housing envelope. A concrete/block structure will typically give a transmission loss of 25 to 30dBA. The upgrade should be planned to not increase the noise levels at any receptor.

10.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

10.5.1 Construction 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 Development shall be limited to working times given and any controls incorporated in any planning permission.

During the Decommissioning phase of the Development, noise levels are likely be no more than predicted in **Table 10.10,** 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.

10.5.1.1 Residual Construction and Decommissioning Effects

The residual effects are the same as the Construction and Decommissioning effects identified in this assessment.

10.5.2 Operational Noise Mitigation

The Development has been designed to comply with the 2006 noise Guidelines and recent 2020 An Bord Pleanála noise limits. The operational noise emissions are predicted to be compliant and well within these guidelines with no special mitigation required apart from fitting rotors with STE which is now considered best practice.

All turbines will have STE fitted as standard to reduce noise emission levels. Mitigation is not considered necessary.

10.5.2.1 Residual Operational Effects

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

10.5.3 Cumulative Effects

There is no operating consented, or application stage wind farms within 4km of the Development. There are no industrial development within 2km of the wind farm that would increase the noise levels at receptors and this was obvious from visits to the nearest receptors. The potential for cumulative impacts is considered negligible.

10.6 SUMMARY OF EFFECTS

Table 10.13 below summarises the effects.

Table 10.13: Summary of Effects

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

10.7 STATEMENT OF SIGNIFICANCE

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

The effects of noise from the operation of the Development has been assessed using the 2006 Guidelines with the methodology described in ETSU-R-97 and the IOA Good Practice Guide. Noise levels during operation of the Development have been predicted using the best practice of calculation technique, compared with the noise limits in the 2006 Guidelines and recent 2020 An Bord Pleanála limits and found to be compliant.

There are no cumulative effects as there is no operational, permitted, or application stage wind farm within 4km of the Development.

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 required.

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