11 NOISE AND VIBRATION

11.1 INTRODUCTION

This chapter of the EIAR assesses the effects of the Project from noise and vibration impacts. The Project refers to all elements of the application for the construction, operation and decommissioning of the proposed Wind Farm including the Grid Connection, road traffic to the Site, and the 110kV Substation (**Chapter 2: Project Description**). The assessment considers the potential effects during the following phases of the Project:

- Construction of the Project
- Operation and maintenance of the Project
- Decommissioning of the Project

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

- **Appendix 11.1:** Photos of noise monitors in-situ
- **Appendix 11.2**: Methodology for calculating wind shear, different hub heights and standardising hub height wind speed
- **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
- **Appendix 11.4**: SoundPlan noise outputs
- **Appendix 11.5**: Calibration certificates of noise instruments
- **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 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. Mark has been responsible for undertaking and reviewing noise impact assessments on numerous large scale wind farms throughout Ireland.

Brendan O'Reilly carried out the baseline study. 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 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.

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 noise and background noise as stated in the Wind Energy Development Guidelines 2006 and the Draft Revised Wind Energy Development Guidelines December 2019. As discussed in

[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.

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 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 350m	35-45
Busy road at 5 km	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

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 Project 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 sensitive receptors could be affected by the Project, including a summary of the measures taken during design of the Project 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 Project after mitigation measures have been implemented
- Cumulative Effects – identifying the potential for effects of the Project to combine with those from other wind farm developments
- Summary of Significant Effects
- Statement of Significance

11.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

11.2.1 Assessment Structure

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 Project 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 An Coimisiún Pleanála Decisions on Noise Limits
- WHO 2018 Environmental Noise Guidelines for European Region (WHO 2018)[6]
- 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
[6] World Health Organization (2018) Environmental Noise Guidelines for the European Region

- Institute of Acoustics Statement in Relation to Wind Farm Noise[7], December 2024
- 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'[8] (the IOA Good Practice Guide)
- ISO 1996[9] Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures (ISO 1996)
- ETSU-R-97[10]: The Assessment & Rating of Noise from Wind Farms (ETSU-R-97)
- Assessment and Rating of Wind Turbine Noise[11]
- Institute of Acoustics Amplitude Modulation Working Group[12], WSP Turbine AM Review[13] and IEC 61400[14]
- National Roads Authority (NRA) Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004 (the NRA Guidelines)[15].
- BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites: *Code of Practice for Basic Information and Procedures for Noise Control*[16].
- Limerick Development Plan 2022-2028[17].
- Cork County Development Plan 2022-2028[18].

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."

[7] Wind Turbine Noise | Institute of Acoustics , Dec 2024
[8] Institute of Acoustics (2013) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise
[9] ISO 1996/1- Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures
[10] ETSU-R-97: Acoustics-The Assessment & Rating of Noise from Wind Farms: ETSU for the DTI, UK, 1996
[11] Assessment and Rating of Wind Turbine Noise, Department for Energy Security & Net Zero (Draft) July 2025
[12] 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
[13] Wind Turbine AM Review, Phase 2 Report, Department of Energy & Climate Change, WSP/Parsons Brinckerhoff, August 2016
[14] 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
[15] National Roads Authority, *Guidelines for Noise and Vibration in National Road Schemes.*
[16] 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*.
[17] Limerick Development Plan 2022-2028. Volume 1: Written Statement
[18] Cork County Development Plan 2022. Volume One: Main Policy Material

<u>Measurement Units</u>

"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."

<u>Specific Noise Limits</u>

"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 Coimisiún Pleanála

<u>An Coimisiún Pleanála Decisions</u>

Recent decisions by ACP gave limits (ABP-309306-21, dated 26 September 2022, ABP-

319216, dated 2 April 2025, ABP-312659, dated 25 February 2025) in accordance with the 2006 Guidelines and were as follows:

(a) between 7am and 11pm:

(i) 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,

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

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

The most recent conditions (ABP-318689-23 from June 2025) presents a variation on the noise limits in Condition 11. The noise limits are similar, but this decision incorporates the requirement for a noise monitoring programme:

11. Noise levels generated by the windfarm following commissioning by itself or in combination with other existing or permitted wind energy development in the vicinity, when measured externally at noise sensitive location the windfarm following commissioning by itself or in combination with other existing or permitted wind energy development in the vicinity, when measured externally at noise sensitive locations, shall not exceed:

a) For the daytime period 0700 to 2300, in quiet environments, where background noise is less than 30dB(A)L90 T10, a maximum noise level of 40dB(A)L90T10,

b) For daytime periods, 0700 to 2300, where the background noise level exceeds 30dB(A)L90 T10, the greater of 45dB(A)L90 T10, or 5dB(A) above background Levels

c) For the nighttime period 2300 to 0700, for all noise environments, 43dB(A)L90T10

Prior to the commissioning of the windfarm, the developer shall submit and agree in writing with the planning authority a Noise Compliance Monitoring Programme (NCMP) for the operational windfarm. The NCMP shall include a detailed methodology for all sound measurements, including frequency of monitoring and recording of results, which shall be made publicly available. The results of the initial noise compliance monitoring to be submitted to and agreed in writing with the planning authority within 12 months of commissioning of the wind farm. The NCMP shall be fully implemented during the operation of the windfarm.

Reason: in order to protect the amenities of noise sensitive properties in the vicinity of the development.

11.2.3.3 Limerick Development Plan 2022-2028

The Project shall be located in County Limerick. Therefore, the Limerick Development Plan 2022-2028 has been considered. The Limerick Development Plan 2022-2028 outlines the vision and development strategy of Limerick County Council to 2028 and beyond.

The location of the Project is in a "Preferred Area" for wind energy locations. Limerick County Council is guided by the 2006 Guidelines and the DRWEDG 2019 with regard to wind energy developments, detailing[19]:

> *Noise levels, including the addition of any penalties for special audible characteristics, shall comply with current guidelines*
>
> *Any proposed lower fixed noise limit for night-time noise sensitive properties shall not exceed 38dB(A) L90 or 5dB(A) above background noise levels, whichever is the greater."*

These two criteria suggest that where special characteristics or rated levels are to be considered the rated noise levels should comply with the existing WEDG06 and ACP criteria identified above, but where it is a fixed LA90 limit the 38dB or 5dB above the background applied. This is consistent with the conservative consideration of the maximum 5dB penalty difference between the rated level and measured LA90, but it does provide a different night-time limit level when comparing the County Development Plan to the ACP criteria or the WEDG06.

In addition, the Limerick Development Plan 2022-2028 details assessment of[20]:

"Noise and mitigation measures for sensitive receptor locations such as residences"
"Background noise surveys shall be carried out in accordance with A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013)"

11.2.3.4 Cork County Development Plan 2022-2028

The Project location is in a close proximity to County Cork. The Cork County Development Plan 2022-2028 has therefore also been taken into consideration. The Wind Energy Strategy of the Cork County Development Plan 2022-2028 uses the guidance provided in

[19] Limerick Development Plan 2022-2028. Volume 1: Written Statement
[20] Limerick Development Plan 2022-2028. Volume 1: Written Statement

the 2006 Guidelines, identifying the most suitable locations for wind energy development[21].

11.2.3.5 World Health Guidelines (WHO) 2018

The most recent WHO 2018 Guidelines: 'Environmental Noise Guidelines for the European Region'[22] 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.

RPS[23] were requested by the Department of Communications, Climate Action and Environment to carry out a comparison between the WHO recommended level of 45dB Lden level in the WEDG limit level of 43dBLA90.

The limit levels in the WEDG are a worst-case limit when a turbine is operating at full power, while the WHO limits are average levels. RPS considered the percentage of times when the turbines were operating at their maximum levels, based on typical Irish wind speed measurements and concluded:

> *It is reasonable to conclude from both these calculations that the annual average noise output from wind turbines in Ireland will be sufficiently lower than the maximum rated sound power to be consistent with the WHO guidelines.*

Based on this, we consider that compliance with the limit levels in the WEDG is consistent with the recommended levels in the 2018 WHO document.

11.2.3.6 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.

[21] Cork County Development Plan 2022. Volume One: Main Policy Material
[22] World Health Organization (2018) Environmental Noise Guidelines for the European Region
[23] MGE0713RP0001F01, Draft Wind Energy Guidelines – Wind Turbine Analysis, RPS Nov 2018

11.2.3.7 Institute of Acoustics Statement in Respect of Wind Farm Noise

The Institute of Acoustics is the professional body in Ireland and the UK for those working in the field of acoustics. In December 2024 they issued a statement with regard to Amplitude Modulation, Infrasound, Low Frequency Noise and vibration, as presented below:

Amplitude Modulation

'Amplitude Modulation' (AM) is a feature of the character of wind farm noise caused by the cyclical nature of the blades. An understanding of the causal mechanisms has been gained in recent years, along with control methods to help assist with sites where AM can lead to complaints. An IOA endorsed metric was published in 2016 and can be found at: [http://ioa.org.uk/publications/wind-turbine-noise]. A sample planning condition was proposed by IOA members which was published in the IOA bulletin (November-December 2017 issue).

Infrasound

The IOA is aware that there is some information presented at planning inquiries suggesting the potential for physiological health effects from infrasound from wind turbines. It is current advice to members that there is no need to assess infrasound as part of the noise impact assessment process, as the absolute levels are well below those reported to trigger physiological health effects based on peer reviewed research to date.

Low Frequency Noise

The IOA is aware that there is some information presented at planning inquiries suggesting the potential for physiological health effects from low frequency noise from wind turbines. It is current advice to members that there is no need to assess low frequency noise as part of the noise impact assessment process, as the absolute levels, whilst potentially audible at typical receptor distances, are well below those reported to trigger physiological health effects based on peer reviewed research to date.

Vibration

Vibration from operational wind turbines has been measured by extremely sensitive measurement equipment such as seismic arrays. but in terms of human perception, measured vibration levels are well below perception thresholds even on the actual wind *turbine sites. There is, therefore, no need to assess vibration affecting people for operational wind turbine developments.*

11.2.4 Desk Study

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

The four noise monitoring locations in **Table 11.10** are considered representative of the local noise environment. They were set-up in line with the Institute of Acoustics Good Practice Guide and geographically sited to obtain noise measurements all across the Site. Appendix 11.1 shows the set-up and location of each monitoring location.

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[24].(**Appendix 11.2**) gives the methodology to account for wind shear, calculation to hub height and to standardise 10m height wind speed.

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 95m hub height of the proposed wind turbines 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.

11.2.6 Prediction of Wind Turbine Noise Levels

The predicted noise levels follow the methodology given in the IOA Good Practice Guide. Noise level calculations complies with the ISO 9613-2[25] which provides a prediction of noise levels likely to occur under worst-case down-wind conditions.

[24] 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

[25] ISO 9613-2:2024 Acoustics -Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation

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. SoundPLAN software package was used to calculate the noise level at the noise sensitive receptors. SoundPLAN has been used across the world for over 30 years for noise predictions and has been accepted across Ireland and the rest of Europe as an appropriate tool for prediction modelling.

The SoundPLAN 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:

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.

Section 11.2.7 and 11.2.8 below further address Amplitude Modulation and low frequency noise.

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:

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 noise sensitive 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 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 10^0C 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 turbines, including the proposed site, where the air flow to the blades is not interrupted by the tower structure. Instead, with modern turbines where the air flow to the blades is not interrupted by the tower structure, the primary mechanism in wind turbine AM arises from the uninterrupted flow of air over, under and around the blades

The most recent information in relation to 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 an evolution of the Institute of Acoustics Reference Method (IoA RM) to quantify the AM level along with the penalty scheme as shown in Figure 11.1 below.

The introduction to the IEC states:

> *The primary objective of this document is to establish uniform measurement and data analysis techniques to facilitate the evaluation of the A-weighted sound pressure level, or other acoustical properties, attributable to wind turbines at representative far-field locations*

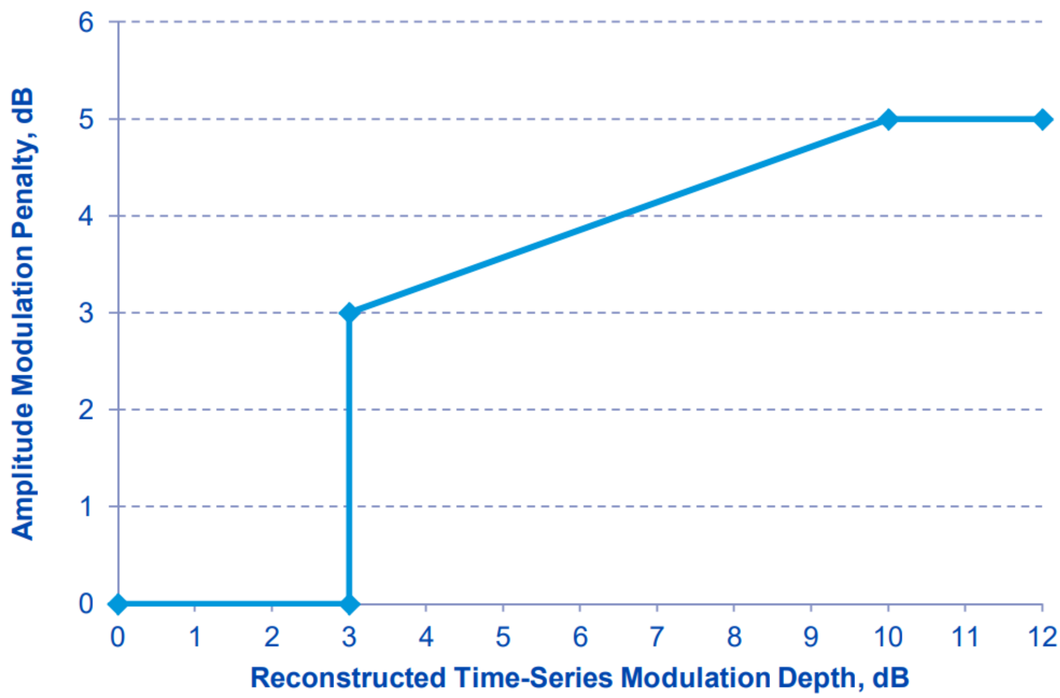
The IEC relies on the IoA RM for calculation of the reconstructed time-series. The modulation depth for the 10 s block is calculated by subtracting the 5th percentile (L95) of the reconstructed time-series from the 95th percentile (L5) in the manner of the maximum of the entire 10-second time-series minus the minimum of the same. This will tend to represent the highest typical modulation in the 10-s block.

At the time of writing, the most recent guidance document is the Assessment and Rating of Wind Turbine Noise, which is currently in Draft format, but proposes to replace the 1996 ETSU-R-97 document. In relation to AM it follows a similar approach as the IoA RM and the IEC document in terms of the quantification of AM and noise character. It describes a similar approach where:

> *Noise shall be 'rated' by adding a character correction which can be applied during assessment of compliance of a particular wind farm with its site-specific noise limits.*

The rating scheme referenced is the same as Figure 11.1 below:

Figure 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, IEC 61400 and Draft Assessment and Rating of Wind Turbine Noise documents all allows quantification of all aspects of AM and the penalty scheme identified above allows quantification of the mitigation required, if any. An appropriate penalty can be added onto the measured LA90 noise level, to allow direct comparison to an overall applicable noise limit.

It can also allow a quantification of the mitigation required to reduce the rated noise levels from turbines, if exceedances are identified post the wind farm becoming operational.

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 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 are differing views about the biological effects of low frequency noise or infrasound on human health. The balance of the evidence is there are no serious consequences to health from exposure to infrasound.

This is view is endorsed by the IoA Policy statement (Section 11.2.3.5) which advises members that there is no need to assess either Low Frequency Noise or Infrasound as the absolute levels are well below the levels reported to trigger health effects.

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*'[26]. 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".*

[26] ETSU W/13/00392/REP – '*Low Frequency Noise and Vibration Measurements at a Modern Wind Farm*'.

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 (2-20Hz), although with a considerably higher magnitude.

The level of ground vibration from the operation of the wind farms is below human threshold of 0.2mm/s[27] at the base of a turbine, therefore it would be significantly lower at the receptor locations.

The IoA policy statement (Section 11.2.3.5) which advises members:

> *Vibration from operational wind turbines has been measured by extremely sensitive measurement equipment such as seismic arrays. but in terms of human perception, measured vibration levels are well below perception thresholds even on the actual wind turbine sites. There is, therefore, no need to assess vibration affecting people for operational wind turbine developments.*

South Australian Environment Protection Authority (EPA) Infrasound Study

A report released in January 2013 by the South Australian EPA[28] 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'*.

Massachusetts Institute of Technology (MIT)

A report by an Independent Expert Panel prepared for Massachusetts Department of Health (2012)[29] consisted of a panel that included seven individuals with backgrounds in public health, epidemiology, toxicology, neurology and sleep medicine, neuroscience, and

[27] 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
[28] http://www.epa.sa.gov.au/environmental_info/noise/wind_farms
[29] 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

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

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

11.2.9 Field Work

Baseline noise monitoring was undertaken between 20th February and 19th March 2023 (see Appendix 11.1). An additional noise monitoring period was undertaken between 29th January and 1st March 2024. This additional period was only completed for NML 2 in order to gather sufficient data, during the initial noise monitoring period NML 2 was damaged. The continuous monitoring periods coincided with the wind speed monitoring over the same period at the same 10-minute intervals using a LiDAR located at the same location as NML 1 used for the noise monitoring. Noise data was recorded for a representative range of wind speeds during the monitoring period.

Since completion of the baseline noise monitoring, there has been no significant development in the locality of the Project, therefore baseline noise levels shall not be markedly different than those obtained during the original baseline noise monitoring. .

11.2.10Consultation

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.

11.2.11Noise Assessment Methodology

In summary, the assessment process comprised:

- Identification of potential noise sensitive 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 sensitive receptor; and
- Comparison of the predicted levels with noise limits in **Section 11.3**.

Potential noise sensitive receptors in the area around the Project were initially identified from Geodirectory, Ordnance Survey maps, google maps, EPA maps and Site visits. Background measurements were carried out at the four locations as detailed in **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 8m/s at 10m height and generates the highest noise level for that individual turbine specification.

The method of predicting noise levels of wind turbines at noise sensitive receptors is discussed in **Section 11.2.6**. This method was applied to the calculations for both contour plots and individual sensitive 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, one candidate turbine, the Vestas V150 - 6.0 megawatts (MW) operating in standard operating mode PO6000, has been selected with a hub height of 95m for the EIA technical assessment. The tip of the blades with Serrated Trailing Edge (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 4m/s to 12m/s was input into the noise model.

It is important to note that for this Project, the proposed turbine has no variation in hub height. However, turbines located within the flood zone are up to 2m higher due to a raised foundation plinth. These turbines shall all have the same sound power level at all wind speeds. Therefore, the noise emission data detailed in **Table 11.3, Table 11.4 and Table 11.5** is valid for all proposed turbines to be installed.

A copy of the manufacturers noise specification for the turbine model used in the assessment are given in the **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 2dBA. However, as no uncertainty is given in the manufacturer's data sheet, an uncertainty value of 2dBA is applied in line with the IOA GPG. **Table 11.3** gives the noise emission data for the turbine up to maximum sound power output at varying wind speed at 95m hub height. **Table 11.4** gives the maximum sound power output at varying wind speed (presented at standardised 10m height) for both turbines with a hub height of 95m. A value of 2dBA is subtracted to account for conversion from LAeq to LA90 which is best practise.

Table 11.3: Noise Emission Data, Vestas V150-6.0MW, STE at Maximum Sound Power (LWA dB) at Hub Height 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	94.0	96.9	99.9	102.7	104.6	104.8	104.9	104.9
Uncertainty added and conversion of LAeq to LA90	92.2	94.0	96.9	99.9	102.7	104.6	104.8	104.9	104.9

Table 11.4: Noise Emission Data, Vestas V150-6.0MW, 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 99m hub height	96.1	100.3	103.8	104.8	104.9	104.9	104.9	104.9	104.9
Uncertainty added and Conversion of LAeq to LA90	96.1	100.3	103.8	104.8	104.9	104.9	104.9	104.9	104.9

The octave band values are given in **Table 11.5** for the V150-6.0MW with uncertainty values and conversion for LAeq to LA90 added as input to the prediction model.

Table 11.5: Octave Band Spectrum of Vestas V150-6.0MW, STE at Maximum Sound Power (LWA dB) at 8m/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	85.5	93.3	98.2	100.1	99.0	94.8	87.7	77.6	**104.9**
Uncertainty added to octaves and conversion of LAeq to LA90	85.5	93.3	98.2	100.1	99.0	94.8	87.7	77.6	

There shall also be an onsite 110kV substation. The final equipment manufacturer has yet to be confirmed, but there will be one transformer onsite which will generate noise. Based on our review of typical transformers associated with wind farms, we have assumed that the maximum noise levels that will be generated are presented below with the noise levels associated with the ancillary equipment presented in Table 11.6. The noise levels at the receptor locations will be reduced as a result of the proposed permanent spoil area (berm), but to ensure the assessment remains conservative the bund has not been considered in the assessment.

Table 11.6: Frequency Spectrum Octave Data

Octave Band Frequency (Hz)	63	125	250	500	1k	2k	4k	8k	L_{WA}
Transformer	48.3	63.3	67.3	70.3	61.3	54.3	52.3	45.3	**73**

11.3 NOISE LIMITS

The method of deriving operational noise limits, described in **Section 11.2.3.1,** is based on the Wind Energy Development Guidelines 2006 and limits specified in recent An Coimisiún Pleanála decisions as discussed in **Section 11.2.3.2.** The noise limits for the Garrane Green Energy Project are designed to meet both sets of conditions:

An Coimisiún Pleanála Condition 1:

(a) between 7am and 11pm:

(i) 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,

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

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

Or An Coimisiún Pleanála Condition 2:

a) *For the daytime period 0700 to 2300, in quiet environments, where background noise is less than 30dB(A)L90 T10, a maximum noise level of 40dB(A)L90T10,*
b) *For daytime periods, 0700 to 2300, where the background noise level exceeds 30dB(A)L90 T10, the greater of 45dB(A)L90 T10, or 5dB(A) above background Levels*
c) *For the nighttime period 2300 to 0700, for all noise environments, 43dB(A)L90T10*

The variation in Condition 1 and 2 can create a slight difference for day-time noise limits. This wind farm has been designed to comply with the lowest limit level at each wind speed for either condition.

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

11.4 CONSTRUCTION ASSESSMENT METHODOLOGY

11.4.1 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)[34]. 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[35].

11.4.2 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.

11.4.3 BS 5228-1:2009+A1:2014 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 residents to the Project
- 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

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

[35] 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*.

- 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 noise sensitive 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.

11.4.4 BS 5228-2: 2009+A1: 2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites

Part 2 of BS5228 deals with vibration. **Table 11.7** below presents 'Guidance on effects of vibration levels' as per BS5228:2009 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration. The table outlines the impact of vibration when it reaches certain levels of peak particle velocity (PPV) measured in millimetres per second (mm/s).

Table 11.7: Guidance on effects of vibration levels

Vibration Level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations from most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Construction vibration is usually only significant from compacting or piling activities in close proximity to adjacent sensitive receptors.

Table 11.8 details distances at which certain activities give rise to a just perceptible level of vibration, these figures are based on historical measurements from sites similar to the proposed.

Table 11.8: Historical field measurements

Activity	Distance from activity when vibration may just become perceptible (m) metres
Piling	25 – 30
Excavation	10 – 15
Heavy Vehicles (e.g. dump trucks)	5 – 10
Hydraulic Breakers	15 - 20

The construction site boundary is 529m from the nearest receptor (H28). Therefore, construction activity in relation to the Project will not produce any negative impact by way of vibration on any of the sensitive receptors.

Surface plant such as excavators, compressors and generators are not recognised as sources of high levels of vibration. Even at a close distance of 10m, PPV levels are significantly less than 5mm/s. For example, a bulldozer would generate a PPV of approximately 0.6mm/s and a 'heavy lorry on poor road surface' would generate a PPV of less than 0.1mm/s. These values are well below limits at which cosmetic building damage becomes likely (15mm/s).

On the basis of this evidence, the potential for impacts from construction vibration have not been considered further. Furthermore, the operation of the Project will also not pose any vibration impact on the nearby sensitive receptors and therefore has not been assessed in any further detail.

11.4.5 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 Limerick City and County Council.

Construction Times for The Project

The construction times for this Project 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 Project, 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 Access Tracks, temporary construction compound, turbine erection and the construction of the 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. Access Tracks will likely be left in-situ for use by the landowners. Wind Farm Internal 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 Project will be subject to the Health and Safety Authority Guidance[36] which states that for noise exposure noise levels likely to exceed 80dBA (expressed as Lep,d 8 hour dBA) 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'.

11.5 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 11.4.3**. The potential operational impacts are evaluated by comparing the predicted noise levels against the day and night-time noise limits given in **Section 11.6.6**. The predicted noise levels are carried out 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 sensitive receptor locations.

11.5.1 Sensitivity

The sensitivity of the Project 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 Project during operation is based on the values in **Section 11.6.6** and **Section 11.7.2**.

11.5.2 Magnitude

The magnitude of potential impacts of construction is based on the values in **Table 11.14**. The magnitude of the Project during operation is based on the values in **Table 11.17**.

11.5.3 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.

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

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

11.6 BASELINE DESCRIPTION

11.6.1 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 unoccupied dwellings, were identified from maps. Sensitive receptor locations were verified through visits to the area surrounding the Project.

11.6.2 Selection of Baseline Noise Survey Locations

Four Baseline noise survey locations were selected on the basis of the location of the noise sensitive receptors relative to the turbine layout. The coordinates of these locations have been provided in **Table 11.10**, with photos of monitors in-situ in **Appendix 11.1**.

11.6.3 Baseline Noise Survey

Baseline noise measurements were carried out continuously between 20th February and 19th March 2023, with a second measurement period completed between 29th January and 1st March 2024 at the receptor locations given in **Table 11.10** This second measurement period was completed due to damage of the monitors at one of the noise monitoring locations – NML 2 – Mic 9 (Photos of monitors in-situ in **Appendix 11.1**).

Table 11.10: Baseline Noise Survey

Location	ITM Reference	Description of Location
NML 1	553843, 626164	Main noise sources being local traffic on the N20 and elevated noise levels from the farm unit at milking times in the early morning and afternoon.
NML 2	555163, 625692	Monitor located in a field approx. 120m west of the closest property with main noise sources being local traffic and wind effects on vegetation.
NML 3	554936, 627492	Monitor located at the rear of the house with main noise sources being local traffic.
NML 4	553458, 627547	Monitor located approximately 75m from the main road with main noise sources being local traffic on the N20.
LiDAR	553922, 626150	At the same location as NML 1.

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 Project 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 in a proximity to NML 1 – Mic 831 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.

11.6.3.1 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[37]'.
- 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, which is within accepted guidelines. Survey measurement data and calibration certificates of the acoustic instruments are included in **Appendix 11.5**.

11.6.4 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 location. The main noise sources are low road traffic noise from the N20, and some low intensity agriculture activity in the surrounding

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

farms. The area is not defined as a low noise environment as the background is above 30dB LA90 during the day for all locations at all wind speeds.

Table 11.11: Prevailing Background Noise Levels

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	Day	44.8	46.0	47.2	48.1	48.7	48.9	48.5	47.4	45.5
	B/G+5	49.8	51.0	52.2	53.1	53.7	53.9	53.5	52.4	50.5
NML 1	Night	30.7	32.2	33.6	35.0	36.4	37.8	39.5	41.3	43.3
	B/G+5	35.7	37.2	38.6	40.0	41.4	42.8	44.5	46.3	48.3
NML 2	Day	35.1	35.3	35.7	36.2	36.8	37.6	38.5	39.4	40.5
	B/G+5	40.1	40.3	40.7	41.2	41.8	42.6	43.5	44.4	45.4
NML 2	Night	32.1	32.0	32.2	32.7	33.3	34.2	35.3	36.7	38.3
	B/G+5	37.1	37.0	37.2	37.7	38.3	39.2	40.3	41.7	43.3
NML 3	Day	30.8	32.9	35.0	37.2	39.3	41.5	43.7	45.8	47.8
	B/G+5	35.8	37.9	40.0	42.2	44.3	46.5	48.7	50.8	52.8
NML 3	Night	26.0	28.4	30.8	33.3	35.8	38.3	40.7	43.0	45.2
	B/G+5	31.0	33.4	35.8	38.3	40.8	43.3	45.7	48.0	50.2
NML 4	Day	42.9	44.2	45.4	46.7	47.9	49.2	50.4	51.7	52.9
	B/G+5	47.9	49.2	50.4	51.7	52.9	54.2	55.4	56.7	57.9
NML 4	Night	33.6	35.7	37.9	40.0	42.1	44.3	46.4	48.5	50.7
	B/G+5	38.6	40.7	42.9	45.0	47.1	49.3	51.4	53.5	55.7

11.6.5 Noise Assessment Locations

There are no operational wind farms within 5km of the proposed Project. Therefore, the monitoring locations were chosen to allow for representative background noise levels to be obtained surrounding the proposed Project, in a variety of locations.

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

11.6.6 Noise Limits

The noise limits for the Project are based on the limits contained within the most recent An Coimisiún Pleanála, which reflects the requirements of the Wind Energy Development Guidelines, or reduces them in certain situations. The design limit are presented in **Section 11.3**.

Based on the background levels obtained at each monitoring location **Table 11.11** shows the noise limit in the vicinity of each monitoring location, as well as being graphically being shown in **Figure 11.2-5.**

Where receptors are financially involved in the Project, a 45dBA 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	11	12
NML 1	CDN1 Day	40	51	52.2	53.1	53.7	53.9	53.5	52.4	50.5
	CDN2 Day	49.8	51	52.2	53.1	53.7	53.9	53.5	52.4	50.5
	Night Limit	43	43	43	43	43	43	43	43	43
NML 2	CDN1 Day	40	45	45	45	45	45	45	45	45.4
	CDN2 Day	45	45	45	45	45	45	45	45	45.4
	Night Limit	43	43	43	43	43	43	43	43	43
NML 3	CDN1 Day	40	45	45	45	45	46.5	48.7	50.8	52.8
	CDN2 Day	45	45	45	45	45	46.5	48.7	50.8	52.8
	Night Limit	43	43	43	43	43	43	43	43	43
NML 4	CDN1 Day	40	49.2	50.4	51.7	52.9	54.2	55.4	56.7	57.9
	CDN2 Day	47.9	49.2	50.4	51.7	52.9	54.2	55.4	56.7	57.9
	Night Limit	43	43	43	43	43	43	43	43	43

Figure 11.2: NML1 Limits

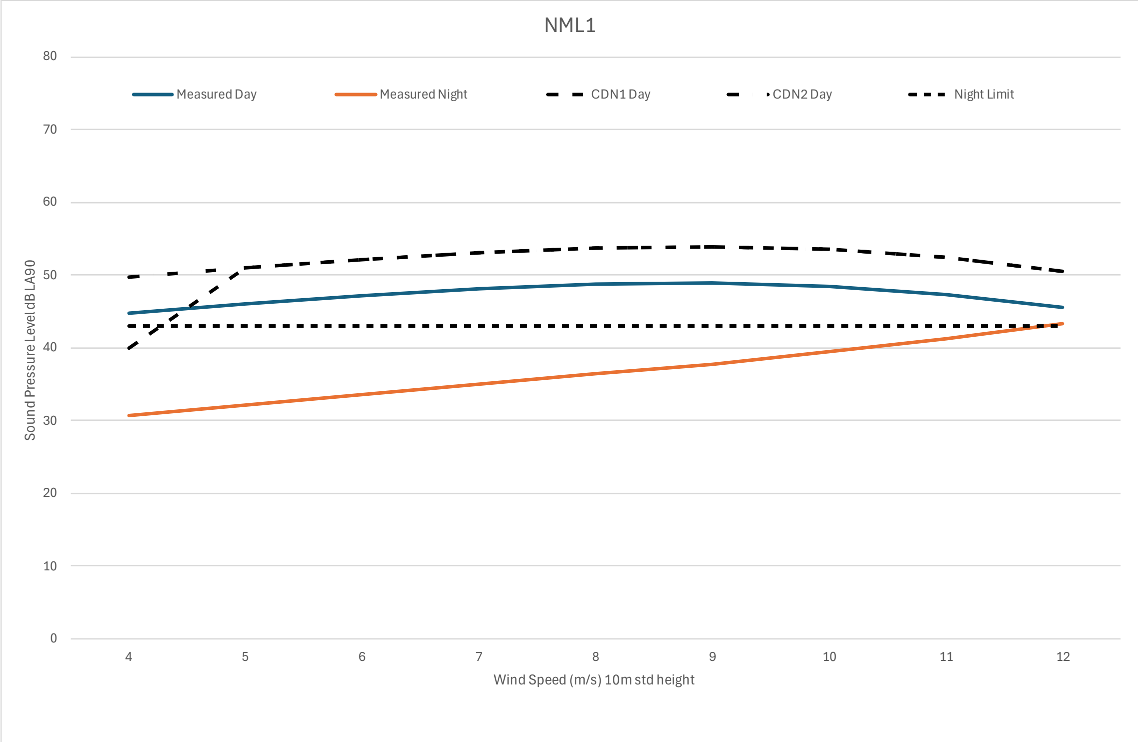


Figure 11.3: NML2 Limits

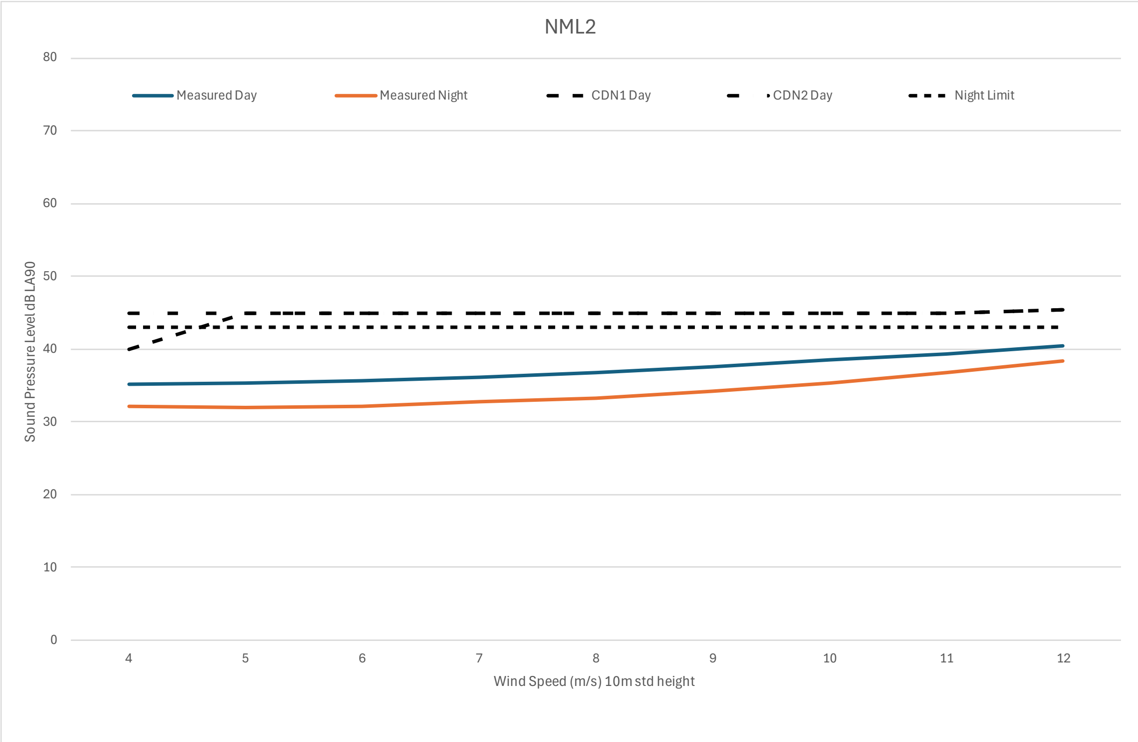


Figure 11.4: NML3 Limits

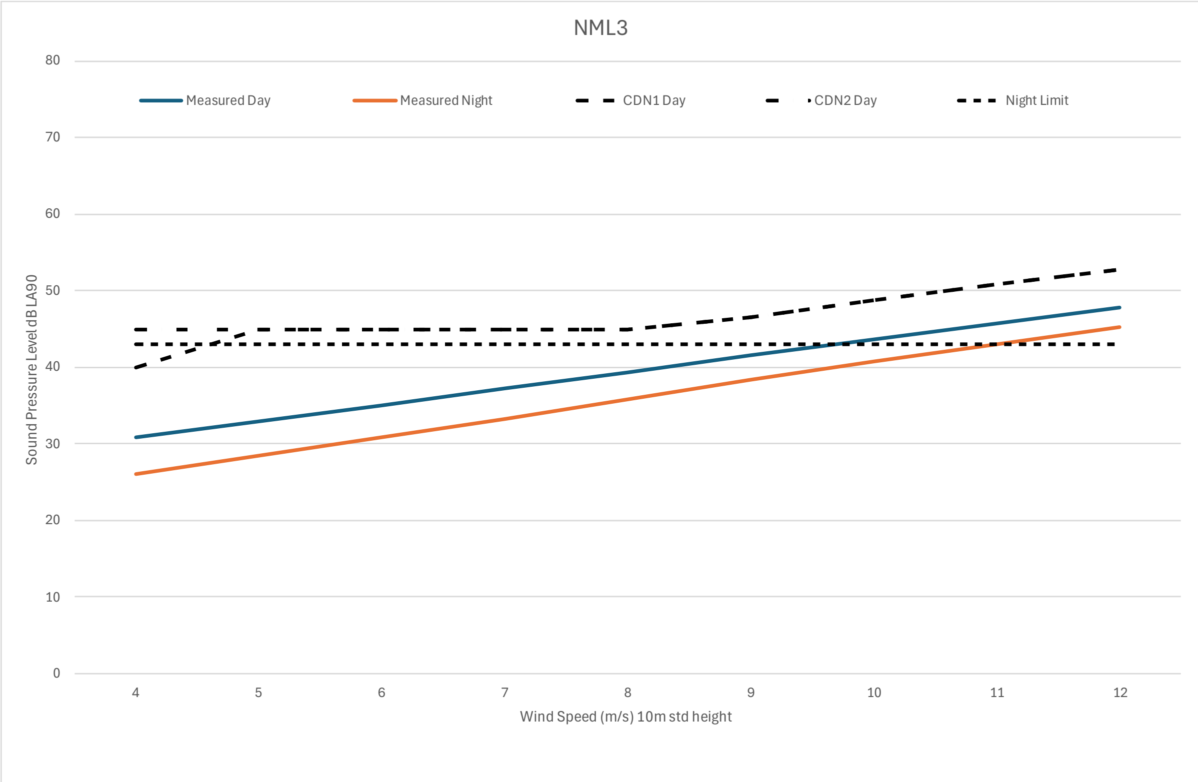
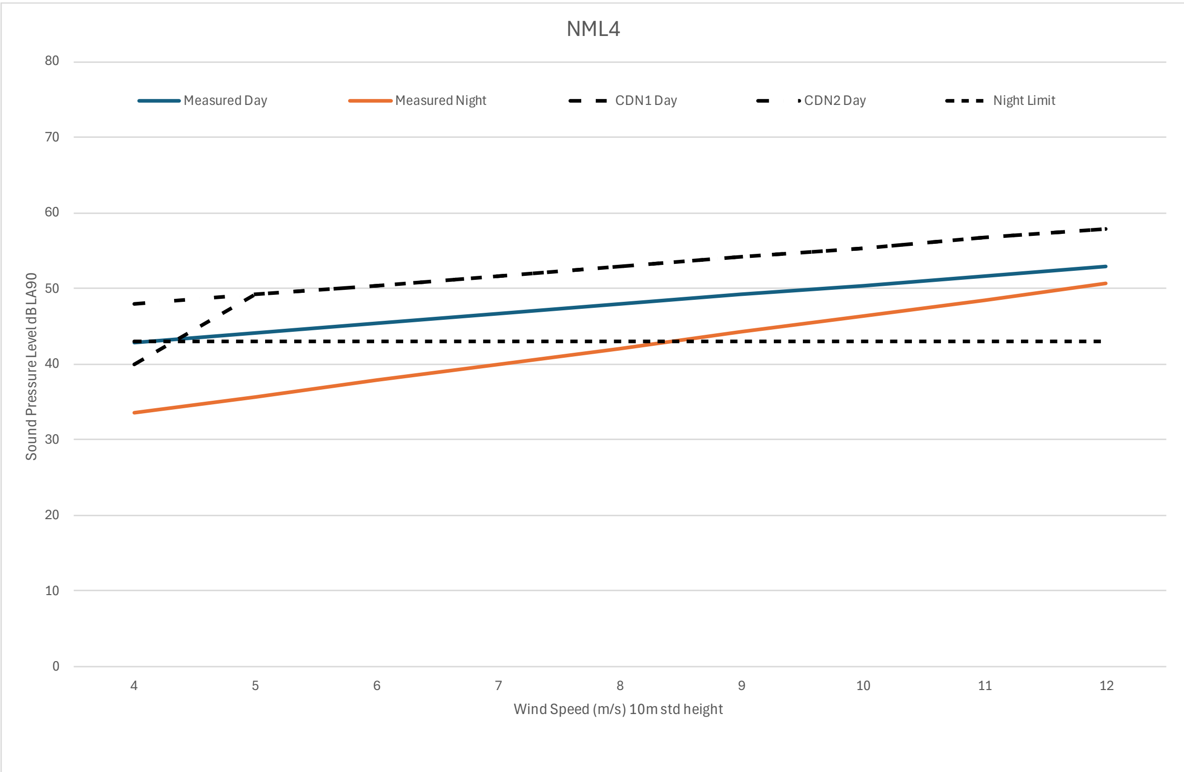


Figure 11.5: NML4 Limits



11.6.7 Project Design Mitigation

The candidate turbine model, the Vestas V150-6.0MW will be fitted with Serrated Trailing Edges (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. The candidate turbine for the proposed Project, the Vestas V150 - 6.0 megawatts (MW) operating in unrestricted mode PO6000, has been selected with a hub height of 95m, STE reduces the noise levels by 2.8dBA.

11.7 ASSESSMENT OF POTENTIAL EFFECTS

11.7.1 Construction Noise

11.7.1.1 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 noise sensitive receptors.

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 Access Tracks, temporary construction compound, turbine erection and the construction of the Substation.

The main construction traffic to the Site will be during a very short period where ready-mix trucks deliver concrete for the turbine bases and end mast foundation bases. While delivery of material from local quarries for upgrade of Access Tracks, Turbine Hardstands, temporary construction compound and the 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 site from a different route than leaving the Site, thereby reducing traffic noise at noise sensitive 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 noise sensitive receptors along the Turbine Delivery Route.

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 noise sensitive receptors nearest to the Turbine Foundation / Turbine Hardstands activity, compound development and for noise sensitive receptors at varying distance from the Grid Connection.

Table 11.13: 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 and excavator loading	82-89dBA
Vibrating rollers including tipping material	76-86dBA
Grid Connection: Trenching Tracked excavator 14t, pneumatic breaker, vibratory roller 71t, tractor	71-74dBA
Excavator loading / tipping, excavator and Vibratory roller	80- 87dBA

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 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, Grid Connection and Access Tracks. The construction of the new onsite Substation 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 in **Chapter 17 Traffic and Transport**.

The maximum construction noise levels associated with the Project 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)	529m to H28	33-47dBA
Substation - General Construction (pile driving, ready-mix trucks pouring concrete)	210m to H14	41-55dBA
Compound - General Construction (pile driving, ready-mix trucks pouring concrete)	185m to H13	42-56dBA
Tracked excavator removing topsoil, subsoil for foundation	529m to H28	43-50dBA
Rock breaker and excavator loading at nearest turbine T3	529m to H28	45-52dBA
Vibrating rollers including tipping material set down area close to T3	529m to H28	39-49dBA
Grid Connection: Trenching Tracked excavator 14t, pneumatic breaker, vibratory roller 71t, tractor	At varying distances along route: 15m 20m 40m 80m	64.5-67.5dBA 62-65dBA 55-59dBA 49.9-52.9dBA
Construction of compound (loading / tipping, excavator and Vibratory roller)	529m to nearest receptor	43-50dBA

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 hours).

Each turbine will require approximately 960m^3 of concrete while each ready-mix truck has a capacity of 8m^3. This results in 120 loads of concrete and 240 truck movements for each turbine. For delivery of concrete the timeframe envisaged for each turbine concrete pour is taken as 10 hours. This equates to an average of 24 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} = the sound power level of the truck, in decibels (dB);

Q = 16.2, 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 +10log16.2 – 10log60 – 10log20 = 53.3 LAeq 1hr.

At 10m from the roadside the noise levels equate to 56.3 LAeq 1hr. The trucking for the concrete pour will extend for a total of 9 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- 'Loop-in'

The Substation shall connect with the existing overhead line between Charleville and Killonan via a 'Loop-in' connection.

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

11.7.1.2 Assessment of Construction Noise

The higher levels predicted noise levels at the receptor locations are from the 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 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 9 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[38]. The effects of noise and vibration from onsite construction activities are therefore considered not significant.

11.7.1.3 Description of Effects – Construction

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

Table 11.15: Description of Effects – Construction

Quality	Significance	Duration
Negative	Not Significant	Temporary

11.7.1.4 Decommissioning

Noise effects during the decommissioning phase of the Project are likely to be of a similar nature to that during construction but of shorter duration. It is likely that Access Tracks and Turbine Foundations (excluding plinths) will be left in place and covered over with topsoil 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. Refer to the Decommissioning Plan contained in the CEMP in **Appendix 2.1**.

[38] 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

11.7.1.5 Description of Effects – Decommissioning

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

Table 11.16: Description of Effects – Decommissioning

Quality	Significance	Duration
Negative	Not Significant	Temporary

11.7.2 Predicted Operational Noise Levels

Table 11.17 gives the predicted noise levels at the nearest noise sensitive receptors to the Project, including 9no. proposed turbines and substation at varying wind speeds for each sensitive receptor location. Traffic noise in the operational phase of the Project has been screened out as there will be no change in the day-to-day activity. A noise contour map of the 9no. proposed turbine locations at maximum sound power output, at a wind speed of 8ms-1, at 10m height and the operational substation is presented in **Appendix 11.4**. The contour map in **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.

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

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H1	554880	628252	30.9	35.1	38.6	39.6	39.7
H2	554888	628084	32	36.2	39.7	40.7	40.8
H3	554900	628066	32.1	36.3	39.8	40.8	40.9
H4	555027	627905	32	36.2	39.7	40.7	40.8
H5	555240	627178	32.4	36.6	40.1	41.1	41.2
H6	555060	626744	34.1	38.3	41.8	42.8	42.9
H7	555064	626710	34.1	38.3	41.8	42.8	42.9
H8	555036	626560	34.2	38.4	41.9	42.9	43
H9	555009	626535	34.5	38.7	42.2	43.2	43.3
H10	555064	626420	33.8	38	41.5	42.5	42.6
H11	555144	626440	33	37.2	40.7	41.7	41.8
H12	555311	626153	30.9	35.1	38.6	39.6	39.7

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H13	555230	626109	31.6	35.8	39.3	40.3	40.4
H14	555316	625807	29.7	33.9	37.4	38.4	38.5
H15	555287	625667	29.2	33.4	36.9	37.9	38
H16	555341	625613	28.6	32.8	36.3	37.3	37.4
H17	555294	625553	28.6	32.8	36.3	37.3	37.4
H18	555363	625557	28.1	32.3	35.8	36.8	36.9
H19	554894	625138	27.7	31.9	35.4	36.4	36.5
H20	553730	625373	28.8	33	36.5	37.5	37.6
H21	553732	625401	29	33.2	36.7	37.7	37.8
H22	553723	625439	29.2	33.4	36.9	37.9	38
H23	553684	625455	29.1	33.3	36.8	37.8	37.9
H24	553576	625954	31.8	36	39.5	40.5	40.6
H25	553564	626024	32.1	36.3	39.8	40.8	40.9
H26	553523	626045	31.9	36.1	39.6	40.6	40.7
H27	553476	626025	31.4	35.6	39.1	40.1	40.2
H28	553823	626162	35.4	39.6	43.1	44.1	44.2
H29	553540	626150	32.7	36.9	40.4	41.4	41.5
H30	553398	626746	33.7	37.9	41.4	42.4	42.5
H31	553269	626932	32.9	37.1	40.6	41.6	41.7
H32	553138	627815	31.4	35.6	39.1	40.1	40.2
H33	553432	628092	32.6	36.8	40.3	41.3	41.4
H34	553472	628145	32.5	36.7	40.2	41.2	41.3
H35	553594	628314	31.9	36.1	39.6	40.6	40.7
H36	553496	628888	26.9	31.1	34.6	35.6	35.7
H37	553417	628895	26.6	30.8	34.3	35.3	35.4
H38	553408	628989	26	30.2	33.7	34.7	34.8
H39	553317	628912	26.2	30.4	33.9	34.9	35
H40	553243	628918	25.9	30.1	33.6	34.6	34.7
H41	553195	628918	25.7	29.9	33.4	34.4	34.5

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H42	553083	628876	25.5	29.7	33.2	34.2	34.3
H43	552555	628796	23.8	28	31.5	32.5	32.6
H44	552843	628949	24.3	28.5	32	33	33.1
H45	553104	628962	25.2	29.4	32.9	33.9	34
H46	553180	628973	25.4	29.6	33.1	34.1	34.2
H47	553207	628979	25.4	29.6	33.1	34.1	34.2
H48	553255	628993	25.5	29.7	33.2	34.2	34.3
H49	553297	628999	25.6	29.8	33.3	34.3	34.4
H50	553346	629006	25.7	29.9	33.4	34.4	34.5
H51	553383	629014	25.7	29.9	33.4	34.4	34.5
H52	553304	629363	23.6	27.8	31.3	32.3	32.4
H53	553278	629381	23.5	27.7	31.2	32.2	32.3
H54	553335	629449	23.2	27.4	30.9	31.9	32
H55	554134	629799	22.2	26.4	29.9	30.9	31
H56	555098	629084	24.8	29	32.5	33.5	33.6
H57	555364	629097	23.9	28.1	31.6	32.6	32.7
H58	555390	629025	24.2	28.4	31.9	32.9	33
H59	555469	628874	24.6	28.8	32.3	33.3	33.4
H60	555054	629026	25.2	29.4	32.9	33.9	34
H61	554860	629084	25.4	29.6	33.1	34.1	34.2
H62	554888	629028	25.7	29.9	33.4	34.4	34.5
H63	554866	629027	25.7	29.9	33.4	34.4	34.5
H64	554893	628983	25.9	30.1	33.6	34.6	34.7
H65	554820	628948	26.3	30.5	34	35	35.1
H66	554892	628945	26.2	30.4	33.9	34.9	35
H67	554821	628916	26.5	30.7	34.2	35.2	35.3
H68	554894	628914	26.3	30.5	34	35	35.1
H69	554895	628896	26.5	30.7	34.2	35.2	35.3
H70	554896	628865	26.6	30.8	34.3	35.3	35.4

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H71	554897	628843	26.8	31	34.5	35.5	35.6
H72	554835	628820	27.1	31.3	34.8	35.8	35.9
H73	554841	628768	27.4	31.6	35.1	36.1	36.2
H74	554855	628718	27.7	31.9	35.4	36.4	36.5
H75	554859	628679	28	32.2	35.7	36.7	36.8
H76	554857	628646	28.2	32.4	35.9	36.9	37
H77	554919	628640	28	32.2	35.7	36.7	36.8
H78	554917	628608	28.2	32.4	35.9	36.9	37
H79	554920	628577	28.4	32.6	36.1	37.1	37.2
H80	554842	628561	28.8	33	36.5	37.5	37.6
H81	554924	628547	28.6	32.8	36.3	37.3	37.4
H82	554923	628506	28.9	33.1	36.6	37.6	37.7
H83	555521	627035	30	34.2	37.7	38.7	38.8
H84	555675	626883	28.8	33	36.5	37.5	37.6
H85	555486	625350	26.4	30.6	34.1	35.1	35.2
H86	555752	625386	25.2	29.4	32.9	33.9	34
H87	555276	625271	27	31.2	34.7	35.7	35.8
H88	555282	625237	26.8	31	34.5	35.5	35.6
H89	555214	625291	27.5	31.7	35.2	36.2	36.3
H90	555100	625105	26.8	31	34.5	35.5	35.6
H91	555158	624925	25.4	29.6	33.1	34.1	34.2
H92	555116	624927	25.6	29.8	33.3	34.3	34.4
H93	555080	624847	25.2	29.4	32.9	33.9	34
H94	555145	624809	24.8	29	32.5	33.5	33.6
H95	555146	624751	24.4	28.6	32.1	33.1	33.2
H96	555157	624716	24.2	28.4	31.9	32.9	33
H97	555179	624692	24	28.2	31.7	32.7	32.8
H98	555187	624571	23.4	27.6	31.1	32.1	32.2
H99	555084	624586	23.7	27.9	31.4	32.4	32.5

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H100	555111	624486	23.1	27.3	30.8	31.8	31.9
H101	555207	624459	22.8	27	30.5	31.5	31.6
H102	555240	624229	21.6	25.8	29.3	30.3	30.4
H103	555243	624179	21.4	25.6	29.1	30.1	30.2
H104	555218	624155	21.3	25.5	29	30	30.1
H105	555204	624128	21.2	25.4	28.9	29.9	30
H106	554958	624059	21.2	25.4	28.9	29.9	30
H107	554715	624231	22.3	26.5	30	31	31.1
H108	556449	625525	22.3	26.5	30	31	31.1
H109	556550	625710	22.2	26.4	29.9	30.9	31
H110	556215	625831	24.1	28.3	31.8	32.8	32.9
H111	556159	625837	24.4	28.6	32.1	33.1	33.2
H112	556578	625923	22.5	26.7	30.2	31.2	31.3
H113	556599	625945	22.4	26.6	30.1	31.1	31.2
H114	556572	626054	22.7	26.9	30.4	31.4	31.5
H115	556616	626114	22.6	26.8	30.3	31.3	31.4
H116	556317	627957	23.7	27.9	31.4	32.4	32.5
H117	555977	627810	25.8	30	33.5	34.5	34.6
H118	554398	624130	21.9	26.1	29.6	30.6	30.7
H119	553973	624509	23.8	28	31.5	32.5	32.6
H120	553980	624618	24.4	28.6	32.1	33.1	33.2
H121	553983	624659	24.7	28.9	32.4	33.4	33.5
H122	553969	624681	24.8	29	32.5	33.5	33.6
H123	553949	624741	25.1	29.3	32.8	33.8	33.9
H124	553920	624803	25.5	29.7	33.2	34.2	34.3
H125	553883	624787	25.3	29.5	33	34	34.1
H126	553784	624959	26.2	30.4	33.9	34.9	35
H127	553824	624994	26.5	30.7	34.2	35.2	35.3
H128	553581	625285	27.6	31.8	35.3	36.3	36.4

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H129	553548	625272	27.4	31.6	35.1	36.1	36.2
H130	553611	625269	27.6	31.8	35.3	36.3	36.4
H131	553544	625245	27.2	31.4	34.9	35.9	36
H132	553590	624880	25.2	29.4	32.9	33.9	34
H133	553509	624616	23.6	27.8	31.3	32.3	32.4
H134	553489	624615	23.5	27.7	31.2	32.2	32.3
H135	553509	624594	23.5	27.7	31.2	32.2	32.3
H136	553510	624573	23.3	27.5	31	32	32.1
H137	553505	624543	23.2	27.4	30.9	31.9	32
H138	553499	624499	23	27.2	30.7	31.7	31.8
H139	553498	624452	22.7	26.9	30.4	31.4	31.5
H140	553707	624380	22.7	26.9	30.4	31.4	31.5
H141	553526	625626	29.4	33.6	37.1	38.1	38.2
H142	553525	625656	29.6	33.8	37.3	38.3	38.4
H143	553309	625911	29.7	33.9	37.4	38.4	38.5
H144	553099	625852	28.1	32.3	35.8	36.8	36.9
H145	553059	625838	27.8	32	35.5	36.5	36.6
H146	552986	625827	27.3	31.5	35	36	36.1
H147	552952	625823	27.1	31.3	34.8	35.8	35.9
H148	552918	625819	26.9	31.1	34.6	35.6	35.7
H149	552886	625819	26.8	31	34.5	35.5	35.6
H150	552849	625810	26.5	30.7	34.2	35.2	35.3
H151	552816	625804	26.3	30.5	34	35	35.1
H152	552783	625796	26.1	30.3	33.8	34.8	34.9
H153	552674	625732	25.4	29.6	33.1	34.1	34.2
H154	552640	625726	25.2	29.4	32.9	33.9	34
H155	552609	625715	25	29.2	32.7	33.7	33.8
H156	552582	625698	24.8	29	32.5	33.5	33.6
H157	552342	625547	23.3	27.5	31	32	32.1

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H158	552479	625729	24.4	28.6	32.1	33.1	33.2
H159	552515	625744	24.6	28.8	32.3	33.3	33.4
H160	552538	625763	24.8	29	32.5	33.5	33.6
H161	552524	625802	24.8	29	32.5	33.5	33.6
H162	552580	625766	25	29.2	32.7	33.7	33.8
H163	552611	625778	25.2	29.4	32.9	33.9	34
H164	552634	625795	25.4	29.6	33.1	34.1	34.2
H165	552660	625810	25.5	29.7	33.2	34.2	34.3
H166	552684	625829	25.7	29.9	33.4	34.4	34.5
H167	552722	625832	25.9	30.1	33.6	34.6	34.7
H168	552735	625858	26.1	30.3	33.8	34.8	34.9
H169	552643	626033	26.1	30.3	33.8	34.8	34.9
H170	552912	625870	27.1	31.3	34.8	35.8	35.9
H171	552971	625896	27.5	31.7	35.2	36.2	36.3
H172	553012	625899	27.8	32	35.5	36.5	36.6
H173	553040	625891	27.9	32.1	35.6	36.6	36.7
H174	553061	625903	28.1	32.3	35.8	36.8	36.9
H175	551915	626500	23.2	27.4	30.9	31.9	32
H176	552310	626979	25.7	29.9	33.4	34.4	34.5
H177	552837	626717	28.9	33.1	36.6	37.6	37.7

11.7.3 Operational Noise Assessment

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

As can be seen from **Table 11.17** that the predicted noise levels are higher than the night-time noise limit of 43 dB at two noise sensitive receptors at certain wind speeds – H9 and H28. It has been confirmed by the Developer that H28 is an involved landowner, to which a 45dB limit may be applied. Therefore, there is not an exceedance at this receptor, leaving an exceedance of the limits at only one property.

The predicted noise levels are lower than the noise limits at all remaining noise sensitive 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 noise sensitive receptors, i.e. the worst-case scenario has been modelled.

Table 11.18: Margin between Predicted Noise Levels and 43dBA Noise Limit

	ING	ING	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H1	554880	628252	-12.1	-7.9	-4.4	-3.4	-3.3
H2	554888	628084	-11	-6.8	-3.3	-2.3	-2.2
H3	554900	628066	-10.9	-6.7	-3.2	-2.2	-2.1
H4	555027	627905	-11	-6.8	-3.3	-2.3	-2.2
H5	555240	627178	-10.6	-6.4	-2.9	-1.9	-1.8
H6	555060	626744	-8.9	-4.7	-1.2	-0.2	-0.1
H7	555064	626710	-8.9	-4.7	-1.2	-0.2	-0.1
H8	555036	626560	-8.8	-4.6	-1.1	-0.1	0
H9	555009	626535	-8.5	-4.3	-0.8	0.2	0.3
H10	555064	626420	-9.2	-5	-1.5	-0.5	-0.4
H11	555144	626440	-10	-5.8	-2.3	-1.3	-1.2
H12	555311	626153	-12.1	-7.9	-4.4	-3.4	-3.3
H13	555230	626109	-11.4	-7.2	-3.7	-2.7	-2.6
H14	555316	625807	-13.3	-9.1	-5.6	-4.6	-4.5
H15	555287	625667	-13.8	-9.6	-6.1	-5.1	-5
H16	555341	625613	-14.4	-10.2	-6.7	-5.7	-5.6
H17	555294	625553	-14.4	-10.2	-6.7	-5.7	-5.6
H18	555363	625557	-14.9	-10.7	-7.2	-6.2	-6.1
H19	554894	625138	-15.3	-11.1	-7.6	-6.6	-6.5
H20	553730	625373	-14.2	-10	-6.5	-5.5	-5.4
H21	553732	625401	-14	-9.8	-6.3	-5.3	-5.2

	ING	ING	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H22	553723	625439	-13.8	-9.6	-6.1	-5.1	-5
H23	553684	625455	-13.9	-9.7	-6.2	-5.2	-5.1
H24	553576	625954	-11.2	-7	-3.5	-2.5	-2.4
H25	553564	626024	-10.9	-6.7	-3.2	-2.2	-2.1
H26	553523	626045	-11.1	-6.9	-3.4	-2.4	-2.3
H27	553476	626025	-11.6	-7.4	-3.9	-2.9	-2.8
H28	553823	626162	-7.6	-3.4	0.1	1.1	1.2
H29	553540	626150	-10.3	-6.1	-2.6	-1.6	-1.5
H30	553398	626746	-9.3	-5.1	-1.6	-0.6	-0.5
H31	553269	626932	-10.1	-5.9	-2.4	-1.4	-1.3
H32	553138	627815	-11.6	-7.4	-3.9	-2.9	-2.8
H33	553432	628092	-10.4	-6.2	-2.7	-1.7	-1.6
H34	553472	628145	-10.5	-6.3	-2.8	-1.8	-1.7
H35	553594	628314	-11.1	-6.9	-3.4	-2.4	-2.3
H36	553496	628888	-16.1	-11.9	-8.4	-7.4	-7.3
H37	553417	628895	-16.4	-12.2	-8.7	-7.7	-7.6
H38	553408	628989	-17	-12.8	-9.3	-8.3	-8.2
H39	553317	628912	-16.8	-12.6	-9.1	-8.1	-8
H40	553243	628918	-17.1	-12.9	-9.4	-8.4	-8.3
H41	553195	628918	-17.3	-13.1	-9.6	-8.6	-8.5
H42	553083	628876	-17.5	-13.3	-9.8	-8.8	-8.7
H43	552555	628796	-19.2	-15	-11.5	-10.5	-10.4
H44	552843	628949	-18.7	-14.5	-11	-10	-9.9
H45	553104	628962	-17.8	-13.6	-10.1	-9.1	-9
H46	553180	628973	-17.6	-13.4	-9.9	-8.9	-8.8
H47	553207	628979	-17.6	-13.4	-9.9	-8.9	-8.8
H48	553255	628993	-17.5	-13.3	-9.8	-8.8	-8.7
H49	553297	628999	-17.4	-13.2	-9.7	-8.7	-8.6
H50	553346	629006	-17.3	-13.1	-9.6	-8.6	-8.5

	ING	ING	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H51	553383	629014	-17.3	-13.1	-9.6	-8.6	-8.5
H52	553304	629363	-19.4	-15.2	-11.7	-10.7	-10.6
H53	553278	629381	-19.5	-15.3	-11.8	-10.8	-10.7
H54	553335	629449	-19.8	-15.6	-12.1	-11.1	-11
H55	554134	629799	-20.8	-16.6	-13.1	-12.1	-12
H56	555098	629084	-18.2	-14	-10.5	-9.5	-9.4
H57	555364	629097	-19.1	-14.9	-11.4	-10.4	-10.3
H58	555390	629025	-18.8	-14.6	-11.1	-10.1	-10
H59	555469	628874	-18.4	-14.2	-10.7	-9.7	-9.6
H60	555054	629026	-17.8	-13.6	-10.1	-9.1	-9
H61	554860	629084	-17.6	-13.4	-9.9	-8.9	-8.8
H62	554888	629028	-17.3	-13.1	-9.6	-8.6	-8.5
H63	554866	629027	-17.3	-13.1	-9.6	-8.6	-8.5
H64	554893	628983	-17.1	-12.9	-9.4	-8.4	-8.3
H65	554820	628948	-16.7	-12.5	-9	-8	-7.9
H66	554892	628945	-16.8	-12.6	-9.1	-8.1	-8
H67	554821	628916	-16.5	-12.3	-8.8	-7.8	-7.7
H68	554894	628914	-16.7	-12.5	-9	-8	-7.9
H69	554895	628896	-16.5	-12.3	-8.8	-7.8	-7.7
H70	554896	628865	-16.4	-12.2	-8.7	-7.7	-7.6
H71	554897	628843	-16.2	-12	-8.5	-7.5	-7.4
H72	554835	628820	-15.9	-11.7	-8.2	-7.2	-7.1
H73	554841	628768	-15.6	-11.4	-7.9	-6.9	-6.8
H74	554855	628718	-15.3	-11.1	-7.6	-6.6	-6.5
H75	554859	628679	-15	-10.8	-7.3	-6.3	-6.2
H76	554857	628646	-14.8	-10.6	-7.1	-6.1	-6
H77	554919	628640	-15	-10.8	-7.3	-6.3	-6.2
H78	554917	628608	-14.8	-10.6	-7.1	-6.1	-6
H79	554920	628577	-14.6	-10.4	-6.9	-5.9	-5.8

	ING	ING	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H80	554842	628561	-14.2	-10	-6.5	-5.5	-5.4
H81	554924	628547	-14.4	-10.2	-6.7	-5.7	-5.6
H82	554923	628506	-14.1	-9.9	-6.4	-5.4	-5.3
H83	555521	627035	-13	-8.8	-5.3	-4.3	-4.2
H84	555675	626883	-14.2	-10	-6.5	-5.5	-5.4
H85	555486	625350	-16.6	-12.4	-8.9	-7.9	-7.8
H86	555752	625386	-17.8	-13.6	-10.1	-9.1	-9
H87	555276	625271	-16	-11.8	-8.3	-7.3	-7.2
H88	555282	625237	-16.2	-12	-8.5	-7.5	-7.4
H89	555214	625291	-15.5	-11.3	-7.8	-6.8	-6.7
H90	555100	625105	-16.2	-12	-8.5	-7.5	-7.4
H91	555158	624925	-17.6	-13.4	-9.9	-8.9	-8.8
H92	555116	624927	-17.4	-13.2	-9.7	-8.7	-8.6
H93	555080	624847	-17.8	-13.6	-10.1	-9.1	-9
H94	555145	624809	-18.2	-14	-10.5	-9.5	-9.4
H95	555146	624751	-18.6	-14.4	-10.9	-9.9	-9.8
H96	555157	624716	-18.8	-14.6	-11.1	-10.1	-10
H97	555179	624692	-19	-14.8	-11.3	-10.3	-10.2
H98	555187	624571	-19.6	-15.4	-11.9	-10.9	-10.8
H99	555084	624586	-19.3	-15.1	-11.6	-10.6	-10.5
H100	555111	624486	-19.9	-15.7	-12.2	-11.2	-11.1
H101	555207	624459	-20.2	-16	-12.5	-11.5	-11.4
H102	555240	624229	-21.4	-17.2	-13.7	-12.7	-12.6
H103	555243	624179	-21.6	-17.4	-13.9	-12.9	-12.8
H104	555218	624155	-21.7	-17.5	-14	-13	-12.9
H105	555204	624128	-21.8	-17.6	-14.1	-13.1	-13
H106	554958	624059	-21.8	-17.6	-14.1	-13.1	-13
H107	554715	624231	-20.7	-16.5	-13	-12	-11.9
H108	556449	625525	-20.7	-16.5	-13	-12	-11.9

	ING	ING	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H109	556550	625710	-20.8	-16.6	-13.1	-12.1	-12
H110	556215	625831	-18.9	-14.7	-11.2	-10.2	-10.1
H111	556159	625837	-18.6	-14.4	-10.9	-9.9	-9.8
H112	556578	625923	-20.5	-16.3	-12.8	-11.8	-11.7
H113	556599	625945	-20.6	-16.4	-12.9	-11.9	-11.8
H114	556572	626054	-20.3	-16.1	-12.6	-11.6	-11.5
H115	556616	626114	-20.4	-16.2	-12.7	-11.7	-11.6
H116	556317	627957	-19.3	-15.1	-11.6	-10.6	-10.5
H117	555977	627810	-17.2	-13	-9.5	-8.5	-8.4
H118	554398	624130	-21.1	-16.9	-13.4	-12.4	-12.3
H119	553973	624509	-19.2	-15	-11.5	-10.5	-10.4
H120	553980	624618	-18.6	-14.4	-10.9	-9.9	-9.8
H121	553983	624659	-18.3	-14.1	-10.6	-9.6	-9.5
H122	553969	624681	-18.2	-14	-10.5	-9.5	-9.4
H123	553949	624741	-17.9	-13.7	-10.2	-9.2	-9.1
H124	553920	624803	-17.5	-13.3	-9.8	-8.8	-8.7
H125	553883	624787	-17.7	-13.5	-10	-9	-8.9
H126	553784	624959	-16.8	-12.6	-9.1	-8.1	-8
H127	553824	624994	-16.5	-12.3	-8.8	-7.8	-7.7
H128	553581	625285	-15.4	-11.2	-7.7	-6.7	-6.6
H129	553548	625272	-15.6	-11.4	-7.9	-6.9	-6.8
H130	553611	625269	-15.4	-11.2	-7.7	-6.7	-6.6
H131	553544	625245	-15.8	-11.6	-8.1	-7.1	-7
H132	553590	624880	-17.8	-13.6	-10.1	-9.1	-9
H133	553509	624616	-19.4	-15.2	-11.7	-10.7	-10.6
H134	553489	624615	-19.5	-15.3	-11.8	-10.8	-10.7
H135	553509	624594	-19.5	-15.3	-11.8	-10.8	-10.7
H136	553510	624573	-19.7	-15.5	-12	-11	-10.9
H137	553505	624543	-19.8	-15.6	-12.1	-11.1	-11

	ING	ING	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H138	553499	624499	-20	-15.8	-12.3	-11.3	-11.2
H139	553498	624452	-20.3	-16.1	-12.6	-11.6	-11.5
H140	553707	624380	-20.3	-16.1	-12.6	-11.6	-11.5
H141	553526	625626	-13.6	-9.4	-5.9	-4.9	-4.8
H142	553525	625656	-13.4	-9.2	-5.7	-4.7	-4.6
H143	553309	625911	-13.3	-9.1	-5.6	-4.6	-4.5
H144	553099	625852	-14.9	-10.7	-7.2	-6.2	-6.1
H145	553059	625838	-15.2	-11	-7.5	-6.5	-6.4
H146	552986	625827	-15.7	-11.5	-8	-7	-6.9
H147	552952	625823	-15.9	-11.7	-8.2	-7.2	-7.1
H148	552918	625819	-16.1	-11.9	-8.4	-7.4	-7.3
H149	552886	625819	-16.2	-12	-8.5	-7.5	-7.4
H150	552849	625810	-16.5	-12.3	-8.8	-7.8	-7.7
H151	552816	625804	-16.7	-12.5	-9	-8	-7.9
H152	552783	625796	-16.9	-12.7	-9.2	-8.2	-8.1
H153	552674	625732	-17.6	-13.4	-9.9	-8.9	-8.8
H154	552640	625726	-17.8	-13.6	-10.1	-9.1	-9
H155	552609	625715	-18	-13.8	-10.3	-9.3	-9.2
H156	552582	625698	-18.2	-14	-10.5	-9.5	-9.4
H157	552342	625547	-19.7	-15.5	-12	-11	-10.9
H158	552479	625729	-18.6	-14.4	-10.9	-9.9	-9.8
H159	552515	625744	-18.4	-14.2	-10.7	-9.7	-9.6
H160	552538	625763	-18.2	-14	-10.5	-9.5	-9.4
H161	552524	625802	-18.2	-14	-10.5	-9.5	-9.4
H162	552580	625766	-18	-13.8	-10.3	-9.3	-9.2
H163	552611	625778	-17.8	-13.6	-10.1	-9.1	-9
H164	552634	625795	-17.6	-13.4	-9.9	-8.9	-8.8
H165	552660	625810	-17.5	-13.3	-9.8	-8.8	-8.7
H166	552684	625829	-17.3	-13.1	-9.6	-8.6	-8.5

	ING	ING	4m/s	5m/s	6m/s	7m/s	8+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA
H167	552722	625832	-17.1	-12.9	-9.4	-8.4	-8.3
H168	552735	625858	-16.9	-12.7	-9.2	-8.2	-8.1
H169	552643	626033	-16.9	-12.7	-9.2	-8.2	-8.1
H170	552912	625870	-15.9	-11.7	-8.2	-7.2	-7.1
H171	552971	625896	-15.5	-11.3	-7.8	-6.8	-6.7
H172	553012	625899	-15.2	-11	-7.5	-6.5	-6.4
H173	553040	625891	-15.1	-10.9	-7.4	-6.4	-6.3
H174	553061	625903	-14.9	-10.7	-7.2	-6.2	-6.1
H175	551915	626500	-19.8	-15.6	-12.1	-11.1	-11
H176	552310	626979	-17.3	-13.1	-9.6	-8.6	-8.5
H177	552837	626717	-14.1	-9.9	-6.4	-5.4	-5.3

There are twenty-nine properties within 5dB of the 43dB lower fixed 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 IoA GPG. 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.

If AM is identified as requiring a penalty, based on Figure 11.1, then the turbine operational modes will be reduced to ensure the overall measured level, plus the penalty comply with the overall limit level.

11.7.4 Vibration

Vibration from operational wind turbines has been measured by extremely sensitive measurement equipment such as seismic arrays, but in terms of human perception, measured vibration levels are well below perception thresholds even on the actual wind turbine sites.

There is, therefore, no need to assess vibration affecting people for operational wind turbine developments.

11.7.5 Cumulative Effects Assessment

The IoAGPG advises at Section 5.1.4:

> *During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary.*

The sensitive receptors with the highest predicted noise levels from this site are between 700m and 1km from the site. The contribution from the nearest wind turbines in the wider area would be expected to be in the region of 17dB lower at these properties, as there are no wind farms or single operational turbines within 5km of the Project,

Therefore a cumulative effects assessment was not undertaken.

11.8 MITIGATION MEASURES AND RESIDUAL EFFECTS

11.8.1 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 Project shall be limited to working times given in BS 5228 and any controls incorporated in any planning permission.

During the Decommissioning phase of the Project, 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 are a temporary day time activity.

11.8.1.1 Residual Construction and Decommissioning Effects

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

11.8.2 Operational Noise Mitigation

The Project has been designed to comply with the 2006 Guidelines and noise limits attached as conditions to recent 2022 An Coimisiún Pleanála decisions. The operational noise emissions from the Project exceeds the night-time noise limit of 43dB at one sensitive receptor (H9) at wind speeds of 7m/s and greater.

Therefore, mitigation measures are required for exceedances at one sensitive receptor, which have been detailed in **Section 11.8.4.2** below.

11.8.2.1 Residual Operational Effects

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

If AM is identified as an issue post the Project becoming operational, then mitigation can be incorporated into the site to ensure the limits are being complied with, as detailed in **Section 11.2.7**.

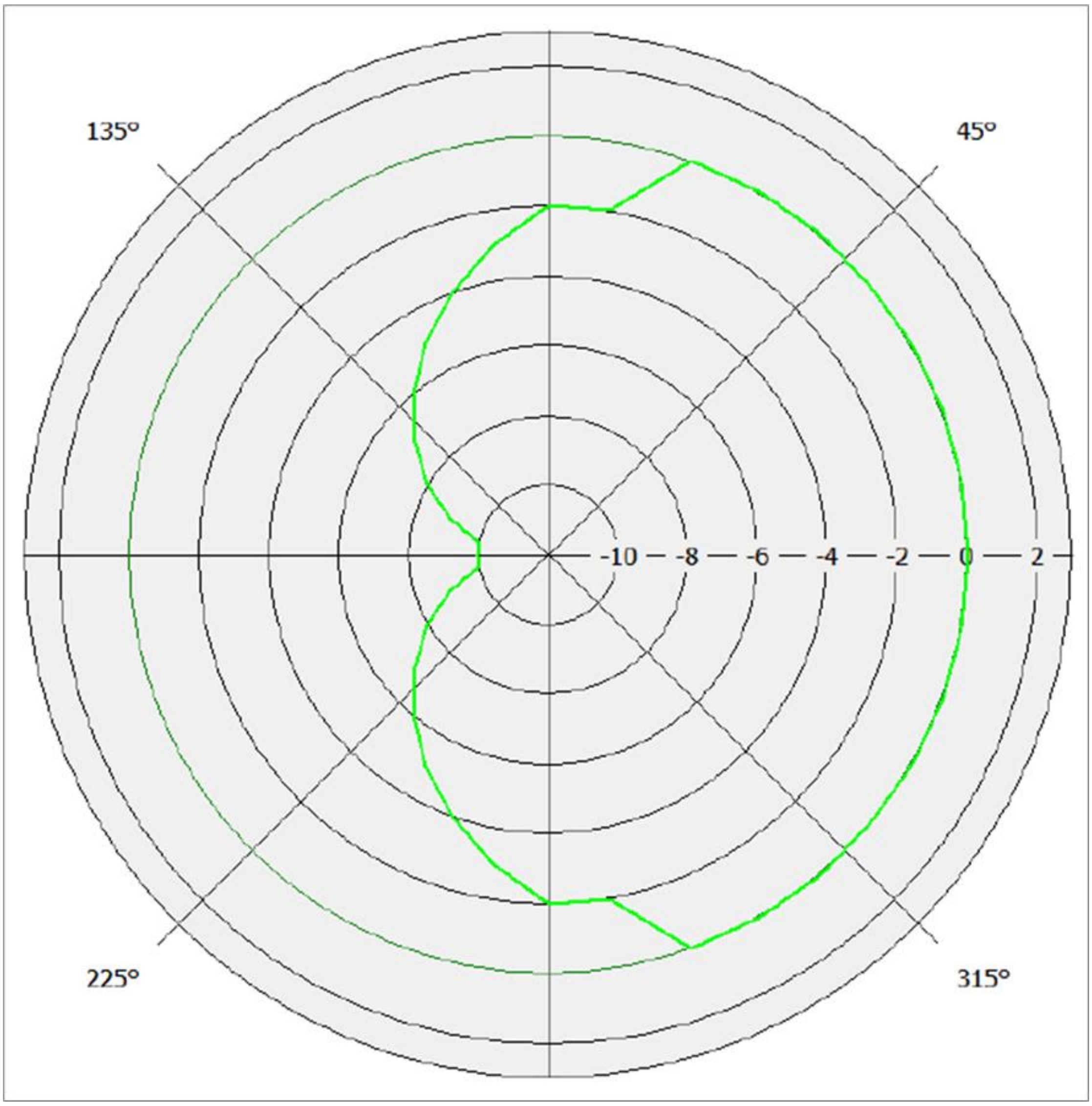
11.8.3 Cumulative Effects

There were no wind farms or operational wind turbines within 5km of the Project, therefore a cumulative assessment was not required to be undertaken.

11.8.4 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 effects from wind turbines the IOA GPG, the predicted noise levels were reduced by 2dB when the wind is in the region 80 - 90° from downwind, with a 10dB reduction to the predicted noise levels when in an upwind direction. A typical directivity plot is presented in **Figure 11.6** below.

Figure 11.6: 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.

11.8.4.1 Vestas V150 – Candidate

Table 11.19: Proposed Impact of Directivity Assessment at receptor in exceedance (8m/s)

Wind Direction (Blowing Towards)	H9
0	43.3
45	42.7
90	41
135	38
180	36.7
225	39.1
270	41.9
315	43
Limit	**43**

11.8.4.2 Vestas V150 – Curtailment

It can be seen from **Table 11.19** above that when directivity is considered, there are exceedances of the night-time limit of 43dB at H9 with one wind direction. Therefore, it is necessary for a curtailment strategy to be developed to ensure the Project will comply with the limits set out above.

Turbines T2 and T3 shall be operated in Sound Optimised Mode SO0 during certain conditions. Sound Optimised Mode SO0 has a lower maximum Sound Power Level at hub height of 104dB, compared to the maximum Sound Power Level of 104.9 dB when the proposed turbines are operating in Mode PO6000. This curtailment strategy shall ensure compliance with the 43dB night-time limit and shall be implemented during the following conditions: the night-time period, from wind speeds of 8-12m/s and for wind blowing towards the East(from 315 degrees to 45 degrees as per **Figure 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)
H9	East	43.3	43	0.3

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

11.8.5 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 noise sensitive receptors is given below.

Table 11.21: Description of Effects – Operational Noise

Quality	Significance	Duration
Negative	Not Significant	Long Term

11.9 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

11.10 STATEMENT OF SIGNIFICANCE

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

The effects of noise from the operation of the Project has been assessed using 2006 Guidelines with the methodology described in ETSU-R-97 and the IOA Good Practice Guide. Noise levels during operation of the Project have been predicted using the best practice of calculation technique. They have been compared with the noise limits in the 2006 Guidelines and recent 2022 An Coimisiún Pleanála limits 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 wind direction and energy output.

The operational noise levels predicted at the nearest noise sensitive receptors are orders of magnitude below the level at which risk of hearing damage, or indeed negative health effects are possible. Therefore, the noise levels predicted at the nearest noise sensitive receptors may be deemed not significant.

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