

Environmental Impact Assessment Report

Lemanaghan Wind Farm,
Co. Offaly

Chapter 12 Noise and Vibration



Table of Contents

12.	NOISE & VIBRATION	12-1
12.1	Introduction	12-1
12.1.1	Statement of Authority	12-1
12.2	Fundamentals of Acoustics	12-2
12.3	Assessment Methodology	12-3
12.3.1	Environmental Protection Agency (EPA) Description of Effects	12-3
12.3.2	Guidance Documents and Assessment Criteria	12-3
12.3.3	Study Area	12-21
12.3.4	Background Noise Survey	12-23
12.3.5	Analysis of Survey Data	12-32
12.3.6	Construction Noise Calculations	12-34
12.3.7	Operational Noise Calculations	12-34
12.3.8	Modelling Calculation Parameters	12-36
12.4	Existing Environment	12-36
12.4.1	Derived Background Noise Levels	12-36
12.4.2	Summary of Derived Background Noise Levels	12-45
12.4.3	Wind Turbine Noise Limits	12-46
12.4.4	Noise Limits for Fixed Plant	12-48
12.5	Likely Significant Effects	12-48
12.5.1	Do-nothing Scenario	12-48
12.5.2	Construction Phase	12-49
12.5.3	Operational Phase	12-63
12.5.4	Decommissioning Phase	12-67
12.6	Mitigation Measures	12-68
12.6.1	Construction	12-68
12.6.2	Operational Phase	12-68
12.6.3	Decommissioning Phases	12-69
12.6.4	Monitoring	12-70
12.6.5	Operational Phase Vibration	12-70
12.7	Residual Effects	12-71
12.7.1	Construction Phase	12-71
12.7.2	Operational Phase	12-73
12.7.3	Decommissioning Phase	12-73
12.8	Cumulative Effects	12-74
12.8.1	Wind Turbine Noise	12-74
12.8.2	Noise from Fixed Plant Operation	12-74
12.8.3	Construction and Decommissioning	12-74
12.9	Difficulties Encountered During the Preparation of this Chapter	12-75
12.10	Interactions	12-75
12.11	Summary	12-75
12.12	EIA Classification Summary	12-76

GLOSSARY OF TERMS

Term	Definition
A – Weighting	The “A” suffix denotes the fact that the sound levels have been “A-weighted” in order to account for the non-linear nature of human hearing.
Background Noise	The noise level rarely fallen below in any given location over any given time period, often classed according to daytime, evening or nighttime periods. The $L_{A90,10min}$ is the parameter that is used to define the background noise level in this instance. L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.
dB (decibel)	The unit normally employed to measure the magnitude of sound. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 μ pa)
dB(A)	An ‘A-weighted decibel’ – a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. A – Weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies
Hub Height Wind Speed	The wind speed at the centre of the turbine rotor
Hertz (Hz)	The unit of sound frequency in cycles per second
$L_{Aeq,T}$	This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background
L_{AF90}	Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the “Fast” time weighting
L_{den}	Refers to the L_{Aeq} noise levels over a whole day, but with a penalty of 10 dB(A) for night-time noise (23:00-07:00) and 5 dB(A) for evening noise (19:00-23:00), also known as the day evening night noise indicator
Low Frequency Noise	LFN - noise which is dominated by frequency components towards the lower end of the frequency spectrum
Noise	Sound that evokes a feeling of displeasure in the environment in which it is heard, and is therefore unwelcomed by the receiver

Noise Sensitive Location (NSL)	Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels
Octave band	A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards
Pascal (Pa)	Pascal is a unit of pressure and so sound pressures are measured in Pascals
Sound Power Level (L_W)	<p>The sound power level radiated by a source is defined as:</p> $L_W = 10 \log_{10} \left(\frac{W}{W_0} \right) \text{ dB}$ <p>where W is the acoustic power of the source in Watts (W) and W_0 is a reference sound power chosen in air to be 10^{-12} W</p>
Sound Pressure Level (L_p)	<p>The sound pressure level at a point is defined:</p> $L_p = 20 \log_{10} \left(\frac{P}{P_0} \right) \text{ dB}$ <p>where P is the sound pressure and P_0 is a reference pressure for propagation of sound in air and has a value of 2×10^{-5} Pa</p>
Tonal	Sounds which cover a range of only a few Hz which contains a clearly audible tone i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'
10 Minute Average Wind Speed (m/s)	The wind speed measured by an anemometer at a specified height above ground level, averaged over a 10-minute period
Wind Shear	The increase of wind speed with height above ground

GLOSSARY OF ACRONYMS

Acronym	Definition
AM	Amplitude Modulation
AMWG	Amplitude Modulation Working Group
BERR	UK Department of Business, Enterprise and Regulatory Reform
CLG	UK Department of Communities and Local Government
CNT	Construction noise threshold
dB	decibels

DECC	UK Government Department of Energy and Climate Change
DEFRA	UK Department of Environment Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
GDG	WHO Guideline Development Group
IEC	International Electrotechnical Commission
IOA	Institute of Acoustics
MIET	Institution of Engineering and Technology
NG3	<i>Guidance Note for Noise Assessment of Wind Turbine Operations</i>
NML	Noise Monitoring Location
NRA	National Roads Authority
NSL	Noise-sensitive location
PPV	Peak Particle Velocity
SPL	Sound Pressure Levels
WHO	World Health Organisation

12. NOISE & VIBRATION

12.1 Introduction

This chapter of the EIAR describes the assessment undertaken of the potential noise and vibration effects on local residential amenity from the proposed Lemanaghan Wind Farm, Co. Offaly (the Proposed Project). As detailed in Section 1.1.1 in Chapter 1, for the purposes of this EIAR, the various project components are described and assessed using the following references: ‘Proposed Project’, ‘Proposed Wind Farm’, ‘Proposed Grid Connection’, ‘Proposed Project site’, and ‘site’.

The Proposed Project includes for 15 no. wind turbines, associated access tracks and hardstands, onsite 220kV substation, Overhead Line (OHL) cabling, peat deposition areas, meteorological mast, internal roads, borrow pits, temporary construction compounds, underground internal cabling, and all ancillary works and apparatus. A full description of the Proposed Project is provided in Chapter 4 of this EIAR.

Noise and vibration impact assessments have been prepared for the construction, operational, and decommissioning phases of the Proposed Project at noise sensitive locations (NSLs). To inform this assessment, baseline noise levels have been surveyed at eight representative NSLs surrounding the Proposed Project site. Noise predictions for the nearest NSLs have been prepared for all key elements of the Proposed Project that have the potential for noise and vibration impacts and effects.

For a glossary of terms used in this chapter please refer to Appendix 12-1.

12.1.1 Statement of Authority

This chapter of the EIAR has been prepared by the following staff of AWN Consulting Ltd:

Miguel Cartuyvels (Acoustic Consultant) holds a BEng (Hons) in Industrial Engineering and is a member (AMIOA) of the Institute of Acoustics. Miguel previously worked in the construction industry and has worked in the field of acoustics since 2021, where he has contributed to numerous projects related to environmental surveying, noise modelling, and impact assessment for various sectors, including wind energy, industrial, commercial, and residential.

Alistair Maclaurin (Senior Acoustic Consultant) holds a BEng (Hons) in Sound Engineering, MSc in Applied Acoustics and has completed the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control. He has been working in the field of acoustics since 2008 and is a member of the Institute of Engineers Ireland (MIEI) and the Institute of Acoustics (MIOA). He has extensive knowledge and experience in relation to commissioning noise monitoring and impact assessment of wind farms as well as a detailed knowledge of acoustic standards and proprietary noise modelling software packages. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects within Ireland.

This chapter of the EIAR has been reviewed by the following staff of AWN Consulting Ltd:

Mike Simms (Principal Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering and is a member of the Institute of Acoustics (MIOA) and of the Institution of Engineering and Technology (MIET). Mike has worked in the field of acoustics for over 20 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, wind energy, industrial, commercial, and residential.

12.2

Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The human audible range of sounds expressed in terms of Sound Pressure Levels (SPL) is 0dB (for the threshold of hearing) to 120 dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3 dB.

The frequency of sound is the rate at which a sound wave oscillates is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250Hz. In order to rank the SPL of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 Acoustics. Normal Equal-loudness Level Contours has been found to provide the best correlations with human response to perceived loudness. SPLs measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 12-1.

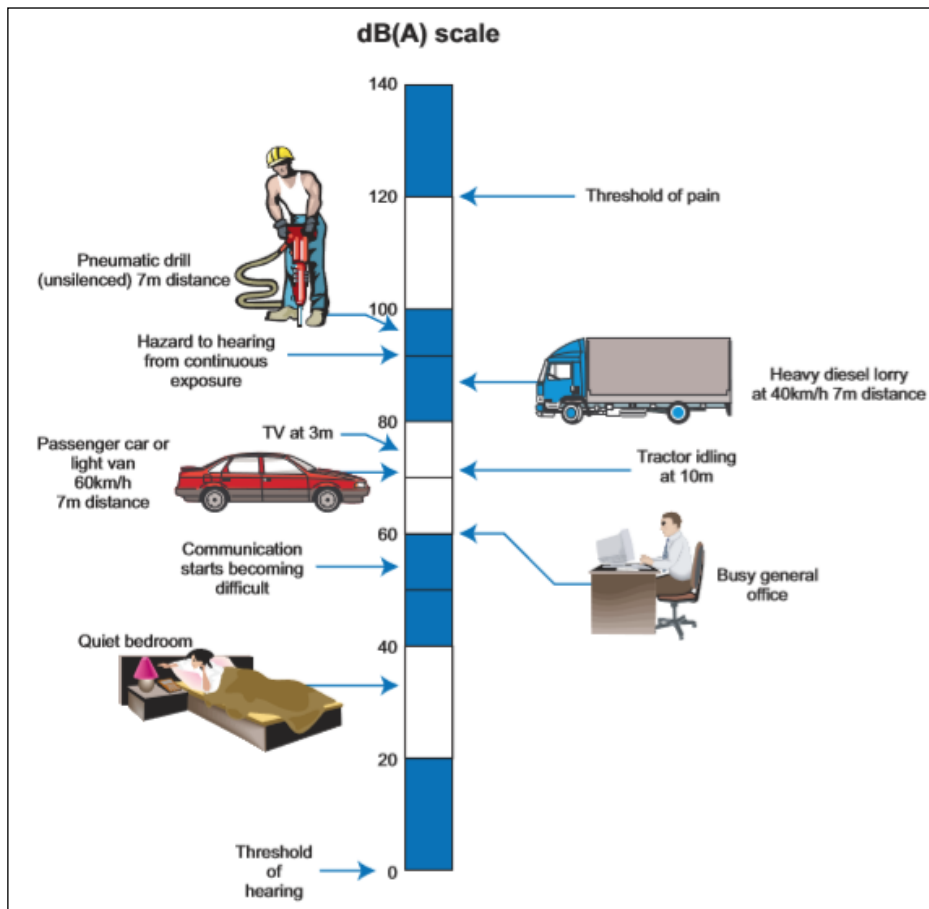


Figure 12-1 The level of typical common sounds on the dB(A) scale (National Roads Authority (NRA) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (NRA, 2014)

For a glossary of terms used in this chapter please refer to Appendix 12-1.

12.3 Assessment Methodology

The assessment of effects for the Proposed Project has been undertaken with reference to the most relevant guidance documents relating to environmental noise and vibration.

The outline methodology adopted for this assessment is summarised as follows:

- Review of best practice guidance to identify appropriate noise and vibration criteria for the construction, operational and decommissioning phases;
- Characterise the receiving environment through baseline noise surveys at various NSLs surrounding the Proposed Project site;
- Undertake predictive calculations to assess the potential effects associated with the construction phase of the Proposed Project;
- Undertake predictive calculations to assess the potential effects associated with the operation of the Proposed Project at NSLs;
- Undertake predictive calculations to assess the potential effects associated with the decommissioning of the Proposed Project at NSLs;
- Specify mitigation measures to reduce, where necessary, the identified potential outward effects relating to noise and vibration from the Proposed Project; and,
- Describe the significance of the residual noise and vibration effects associated with the Proposed Project.

12.3.1 Environmental Protection Agency (EPA) Description of Effects

The significance of effects of the Proposed Project shall be described in accordance with the EPA guidance document *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EIAR)* (EPA, 2022). Details of the methodology for describing the significance of the effects are provided in Section 1.6.2 of Chapter 1: Introduction.

The effects associated with the Proposed Project are described in the relevant sections of this chapter in accordance with the EPA guidance set out in Chapter 1: Introduction of the EIAR.

12.3.2 Guidance Documents and Assessment Criteria

The following sections review best practice guidance that is commonly adopted in relation to renewable energy developments such as the one under consideration here.

The following guidance documents have been consulted when preparing this chapter of the EIAR:

- EPA Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2022);
- Wind Energy Development Guidelines for Planning Authorities, Department of the Environment, Heritage, and Local Government (2006) (the DoEHLG 2006 Guidelines) with cognisance of *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (Draft DoHPLG 2019 Guidelines);
- The Assessment and Rating of Noise from Wind Farms, Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) (1996);
- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise and its Supplementary Guidance Notes (IOA GPG) (2013);

- Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA) (2004 and 2014).
- British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise;
- British Standard BS 5228-2:2009+A1:2014 Code of practice for vibration control on construction and open sites – Vibration;
- British Standard BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration (BSI, 1993);
- Design Manual for Roads and Bridges (DMRB) Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (Highways England 2020);
- ISO 1996: 2017: Acoustics – Description, measurement, and assessment of environmental noise; ISO 9613-2: 1996 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO, 1996);
- ISO 9613-2: 2024 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO, 2024);
- EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (EPA, 2011);
- EPA document ‘Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016);
- World Health Organisation (WHO) Environmental Noise Guidelines for the European Region (2018);
- Department for Business, Energy & Industrial Strategy Wind Turbine AM Review: Phase 2 Report Project Number: 3514482A Issue: 3 Issued August 2016
- BS4142:2014 + A1:2019. Methods for rating and assessing industrial and commercial sound

12.3.2.1 Construction and Decommissioning Phase - Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a renewable energy development of this scale may be found in the ‘*British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites*’ – Noise (BS5228-1).

The approach adopted here calls for the designation of an NSL into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. Threshold noise values are applied to each category. Exceedances (construction noise only) of the threshold value, at the facade of a NSL during construction, indicates a potential significant noise impact associated with the construction activities. The threshold values are applicable to both construction and decommissioning noise. It should be noted that this assessment method is only valid for residential properties. The threshold values recommended by BS5228-1 are depicted in Table 12-1 which, if exceeded, potentially signify a significant effect as recommended by BS 5228-1.

Table 12-1 Example Threshold of Potential Significant Effect at Noise Sensitive Locations

Assessment category and threshold value period (T)	Threshold values, $L_{Aeq,T}$ dB		
	Category A Note A	Category B ^{Note B}	Category C ^{Note C}
Night-time (23:00 to 07:00hrs)	45	50	55

Assessment category and threshold value period (T)	Threshold values, $L_{Aeq,T}$ dB		
	Category A Note A	Category B ^{Note B}	Category C ^{Note C}
Evenings and weekends ^{Note D}	55	60	65
Daytime (07:00 – 19:00hrs)	65	70	75

Note A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

Note B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

Note C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

The following method should be applied:

For each period (e.g., daytime) the ambient noise level is determined and rounded to the nearest 5 dB. At some sensitive properties, especially those situated near busy roads, ambient noise levels are anticipated to be relatively high. However, given the rural nature of the site in general, reference has been made to the quietest properties near the development which have daytime ambient noise levels typically in the range of 30 to 50 dB $L_{Aeq,1hr}$. Therefore, for the purposes of this assessment, as a precautionary approach, all properties will be afforded a ‘Category A’ designation for initial assessing of construction noise impacts.

BS 5228-1 states that:

If the site noise level exceeds the appropriate category value [the CNT], then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect.

Please see Section 12.5.2 for the detailed assessment in relation to the construction of the Proposed Project.

Interpretation of the CNT

In order to assist with interpretation of the construction noise thresholds (CNT), Table 12-2 includes guidance as to the likely magnitude of impact associated with construction activities, relative to the CNT. This guidance is derived from guidance in the document published by Highways England (now National Highways) *Design Manual for Roads and Bridges Sustainability & Environment Appraisal LA 111 Noise and Vibration* (Revision 2) (hereafter referred to as DMRB). Table 3.16 therein has been and adapted to include the relevant significance effects from EPA (2022).

Table 12-2 Description of the magnitude of impacts. Adapted from DMRB Table 3.16

Construction Noise Level	Magnitude of Impact (DMRB)	EPA Significance of Effect	Determination
Below or equal Baseline Noise Level	Negligible	Not Significant	Depending on CNT, Construction noise level and baseline noise level
Above Baseline and below or equal to CNT	Minor	Slight – Moderate	

Above CNT and below or equal to CNT + 5dB	Moderate	Moderate – Significant	
Above CNT + 5dB	Major	Significant – Very Significant	

The adapted DMRB Guidance outlined will be used to assess the predicted construction noise levels at NSLs and comment on the likely effects during the construction phase.

12.3.2.2 Construction and Decommissioning Phase - Additional Vehicular Activity on Public Roads

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that traffic from the Proposed Project site will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the Proposed Project.

For the assessment of potential noise impacts from construction related traffic along public roads it is proposed to adopt guidance from Highways England (now National Highways) ‘*Design Manual for Roads and Bridges Sustainability & Environment Appraisal LA 111 Noise and Vibration (Revision 2)*’ (DMRB Guidance).

Table 12-3 taken from DMRB Guidance offers guidance as to the likely short-term impact associated with any change in traffic noise level.

Table 12-3 Classification of magnitude of traffic noise changes in the short-term (Source DMRB, 2020)

Change in Sound Level (dB(A))	Subjective Reaction	DMRB Magnitude of Impact (Short-term)	EPA Significance of Effect
Less than 1 dB	Inaudible	Negligible	Imperceptible
1.0 – 2.9	Barely Perceptible	Minor	Not Significant
3.0 – 4.9	Perceptible	Moderate	Slight, Moderate
≥5	Clearly audible	Major	Significant

The DMRB Guidance will be used to assess the predicted increases in traffic levels on public roads associated with the Proposed Project (this includes the Turbine Delivery Route (TDR)) and comment on the likely ‘short-term’ impacts during the construction phase. Where a major or moderate impact is identified due to the change in traffic noise level, reference will be made to the overall predicted noise level from construction/decommissioning traffic in the context of the construction noise threshold values outlined previously in this section.

12.3.2.2.1 Consideration of Duration When Assessing Effects

Section 3.19 of the DMRB Guidance states that both the construction and decommissioning noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights; or,
- A total number of days exceeding 40 in any 6 consecutive months.

12.3.2.3 Construction and Decommissioning Phase – Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. With respect to the Proposed Project, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (1993); and
- BS 5228 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (2009+A1:2014).

Human Perception

It is acknowledged that humans are particularly sensitive to vibration stimuli and that any perception of vibration may lead to concern. In the case of traffic, vibration is perceptible at around 0.5mm/s and may become disturbing or annoying at higher magnitudes. Higher levels of vibration, however, are typically tolerated for single events or events of short duration. For example, during piling, one of the primary sources of vibration during construction, vibration levels may typically be tolerated at up to 2.5mm/s. This guidance is applicable to the daytime only; it is unreasonable to expect people to be tolerant to such activities during the night-time (or if they are trying to sleep during the daytime).

BS 5228-2 also provides a useful guide relating to the assessment of human response to vibration in terms of the peak particle velocity (PPV). Table 12-4 below summarises the range of vibration values and the associated potential effects on humans.

Table 12-4 Human perception to vibration

Vibration Level, mm/s PPV	Likely Effect (DMRB)	Significance Ratings (EPA)
≥10	Major	Moderate to Significant to Very Significant
≥1 to <10	Moderate	Moderate to Significant
≥0.3 to <1	Minor	Not Significant to Slight
≥0.14 to 0.3	Negligible	Imperceptible to Not significant
Less than 0.14		Imperceptible

Structural Damage

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above.

BS 5228-2 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e., non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage, these limits may be reduced further. In addition, where continuous vibration is generated, the limits discussed above may need to be reduced by 50%.

The Transport Infrastructure Ireland (TII) ‘Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes’ (TII, 2014) (NRA Guidelines) also contains information on the permissible construction vibration levels during the construction phase as shown in Table 12-5.

Table 12-5 Allowable Transient Vibration at Properties

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

Following review of the suggested vibration criteria discussed above from BS7385, BS5228-2 and the NRA Guidelines, the values in Table 12-5 from the NRA Guidelines are considered appropriate for this assessment.

12.3.2.4 Operational Phase Noise – Wind Turbines

The noise assessment documented in this chapter is based on guidance in relation to acceptable levels of noise from wind farms as contained in the DoEHLG 2006 Guidelines published by the Department of the Environment, Heritage and Local Government in 2006. The DoEHLG 2006 Guidelines are based on detailed recommendations set out in the Department of Trade and Industry (UK) Energy Technology Support Unit (ETSU) publication ‘The Assessment and Rating of Noise from Wind Farms’ (1996) (ETSU-R-97). The ETSU document has been used to supplement the guidance contained within the DoEHLG 2006 Guidelines, where appropriate and necessary.

12.3.2.4.1 Wind Energy Development Guidelines for Planning Authorities

Section 5.6 of the DoEHLG 2006 Guidelines addresses noise and outlines the appropriate noise criteria in relation to wind farm developments.

The following extracts from this document should be considered:

“An appropriate balance must be achieved between power generation and noise impact.”

While this comment is noted it should be stated that the DoEHLG 2006 Guidelines give no specific advice in relation to what constitutes an ‘appropriate balance’. In the absence of this, guidance will be taken from alternative and appropriate publications.

“In the case of wind energy development, a noise sensitive location includes any occupied house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational importance. Noise limits should apply only to those areas frequently used for relaxation of activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed.”

The issues identified in this extract have been incorporated into the assessment to determine the applicable turbine noise limits set out below in Section 12.4.3.

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

This represents the commonly adopted daytime noise criterion curve in relation to wind farm developments. However, an important caveat should be noted as detailed in the following extract.

“However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the $L_{A90, 10min}$ of the wind energy development be limited to an absolute level within the range of 35 – 40dB(A).”

In relation to nighttime periods the following guidance is given:

“A fixed limit of 43dB(A) will protect sleep inside properties during the night.”

This limit is defined in terms of the $L_{A90,10min}$ parameter. This represents the commonly adopted nighttime noise criterion curve in relation to wind farm developments.

In summary, the DoEHLG 2006 Guidelines outline the following guidance to identify appropriate wind turbine noise criteria curves at NSLs:

- An appropriate absolute limit level in the range of 35 – 40 dB $L_{A90,10min}$ for quiet daytime environments with background noise levels of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), for daytime environments with background noise levels of not less than 30 dB $L_{A90,10min}$ and;
- 43 dB $L_{A90,10min}$ for nighttime periods.

While the caveat of an increase of 5dB(A) above background for night-time operation is not explicit within the DoEHLG 2006 Guidelines, an allowance for same is commonly applied in noise assessments prepared and is accepted as detailed in numerous examples of planning conditions issued by An Coimisiún Pleanála (ACP).

12.3.2.4.2 **The Assessment and Rating of Noise from Wind Farms – ETSU-R-97**

The core of the noise guidance contained within the DoEHLG 2006 Guidelines is based on the ETSU publication ‘*The Assessment and Rating of Noise from Wind Farms*’ (ETSU-R-97).

ETSU-R-97 advises regulating wind turbine noise by establishing noise limits at the properties most sensitive to noise. The document suggests that applying fixed noise limits across all wind speeds may not be appropriate for wind turbine projects. Instead, it recommends setting noise limits in relation to the prevailing background noise levels at sensitive locations. A crucial step in assessing noise for wind turbine projects involves identifying the existing background noise levels through on-site surveys.

Page 58 of ETSU-R-97 states: “...absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question...”. Therefore, the noise contribution from all wind turbine projects (existing, permitted and proposed) in the area should be included in the assessment.

The ETSU-R-97 guidance allows for a higher level of turbine noise operation at properties that have an involvement in the Proposed Project, both as a higher fixed level of 45 dB L_{A90} and/or a higher level above the prevailing background noise level.

12.3.2.4.3 **Institute of Acoustics Good Practice Guide**

The guidance contained within the institute of Acoustics (IOA) document ‘*A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*’ (2013) (IOA GPG) and Supplementary Guidance Notes are considered to represent best practice and have been adopted for this assessment. The IOA GPG states, that at a minimum continuous background noise

monitoring should be carried out for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e., from cut-in speeds to the wind speed that generate the highest sound power output from the proposed turbine(s)). Background noise measurements (i.e., $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of a wind turbine project. Regression analysis is used on the data sets to calculate background noise levels at different wind speeds, the resulting background noise curve can be used to establish appropriate turbine noise criteria at each location.

The noise levels associated with the wind turbines are predicted in accordance with ISO 9613-2. This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity, and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds, and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

The IOA GPG states in Section 4.4.1: ‘Predictions made using the ISO 9613-2 standard relate to “worst-case” conditions (typically downwind propagation from source to receiver and/or downward refraction under temperature inversions). When considering cumulative noise impacts, the effects of propagation in different wind directions can be considered. Any such direction attenuation factors, if used, should be clearly stated in any assessment’.

For guidance on the methodology for the background noise survey and operational phase impact assessment for wind turbine noise, the IOA GPG has been adopted.

The IOA GPG states that cumulative noise exceedances should be avoided and where an existing, permitted, or proposed project is at the noise limit, any new turbine noise sources should be designed to be 10 dB below the limit value. Reference will be made to this guidance when considering potential cumulative impacts from any other existing, permitted or proposed wind farms in the surrounding environment. In the first instance, to determine if they need to be included in the wind turbine noise assessment or if they can be scoped out of the cumulative assessment.

Section 5.1 of the IOA GPG provide criteria to determine if a cumulative turbine noise assessment is necessary:

”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.

5.1.5 Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary.”

An appraisal of the study area to determine whether a cumulative turbine noise impact assessment is required is presented Section 12.3.3.

12.3.2.4.4 **Future Potential Guidance Changes**

In December 2019, the Draft DoHPLG 2019 Guidelines were published for consultation and at the time of writing, the final guidelines have yet to be published. It is important to note that during the public consultation on the Draft DoHPLG 2019 Guidelines, several concerns relating to the proposed approach of the Draft DoHPLG 2019 Guidelines have been expressed by various parties. Specific concerns expressed by a group of acoustic professionals working in the field are most relevant. The group was made up of acousticians who act for wind farm developers, Councils, Government bodies and residents’ groups (all of whom are members of the Institute of Acoustics, IOA). The group contained several of the authors / contributors to ETSU-R-97, the IOA GPG and the IOA Amplitude

Modulation Working Group, which are all referenced extensively in the draft guidelines. A statement from the cross-party group can be reviewed at:

<https://www.ioa.org.uk/wind-energy-development-guidelines-wedg-consultation-irish-department-housing-planning-community-and>

A copy of the group's consultation response can be viewed at:

<https://tneigroup-com.stackstaging.com/wp-content/uploads/2022/05/WEDG-consultation-joint-response-R0.pdf>

The following statement is of note from the group consultation response:

“a number of acousticians working in the field have raised serious concerns over the significant amount of technical errors, ambiguities and inconsistencies in the content of the draft WEDG and these were highlighted during the consultation process by a group of acousticians”

The following statements was submitted by the Minister for Housing, Local Government and Heritage during a Dail Eireann Debates on 15 October 2025¹

‘My Department is currently undertaking a focused review of the 2006 Wind Energy Development Guidelines. The review is addressing a number of key aspects of the Guidelines including noise, setback distance, shadow flicker, community obligation, community dividend and grid connections.

My Department, in conjunction with the Department of Climate, Energy and the Environment (DCEE), which has primary responsibility for environmental noise matters, has been working to advance guidance on the noise aspect of the Guidelines, which is highly technical in nature. The two Departments have been engaging on proposals regarding the measurement and assessment of noise from wind turbines to ensure they are robust and fit for purpose having regard to, inter alia, the revised 2030 target to generate up to 80% of our electricity from renewable sources.

Further to this engagement, DCEE, in the context of its environmental noise remit, appointed noise consultants in May 2023 to inform any amendments to the noise aspect of the Guidelines. This work is now substantially complete.

My Department, in conjunction with DCEE, will make any further changes to the draft Guidelines which are deemed necessary or appropriate in the wake of this work to ensure that the finalised Guidelines, once issued, are fit for purpose to provide guidance in line with renewable energy and climate targets, whilst having appropriate regard to the impacts of wind energy development.

The evolving policy and technical context including the new Planning and Development Act 2024 and the recent revision of the National Planning Framework (NPF) reinforces the need to ensure that the finalised Guidelines, once issued, are fit for purpose.

In addition to this work, and in line with EU Directive requirements, a strategic environmental assessment (SEA) is being carried out on the draft Guidelines as part of the review process. In this regard, my Department intends to undertake a public consultation on updated draft Guidelines as part of the SEA process whereby all interested parties will have an opportunity to submit observations on the draft Guidelines. Finalised Guidelines will be prepared following detailed analysis and consideration of the submissions received during the consultation phase.

¹ Wind Energy Guidelines – Wednesday, 15 October 2025 – Parliamentary Questions (34th Dáil) – Houses of the Oireachtas
<https://www.oireachtas.ie/en/debates/question/2025-10-15/192/>

My Department notes the commitment in the recently published Programme for Government 2025 – Securing Ireland’s Future to prioritise the publication of the Wind Energy Development Guidelines, having regard to international best practice and standards. In light of this commitment, my Department is working towards concluding the finalisation of review of the Guidelines as a matter of priority, having regard to the intended public consultation and the impact of associated reforms and reviews including the revision of the NPF.

The current 2006 Wind Energy Development Guidelines remain in force, pending the finalisation of the review.’

The assessment of wind turbine noise presented in this EIAR is based on the guidance outlined in the DoEHLG 2006 Guidelines and has been supplemented with best practice guidance from ESTU-R-97 and the IOA GPG. If updated wind energy guidelines are published during the application process for the Proposed Project it is anticipated that any relevant changes affecting this Noise & Vibration Assessment will be addressed through an appropriate planning condition, or where a supplementary assessment is necessary, through provision of additional information.

12.3.2.4.5 **World Health Organisation (WHO) Noise Guidelines for the European Region**

The WHO ‘*Environmental Noise Guidelines for the European Region*’ (2018) provide guidance on protecting human health from exposure to environmental noise. They set health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise. Recommendations are rated as either ‘strong’ or ‘conditional’.

A strong recommendation, “*can be adopted as policy in most situations*” whereas a conditional recommendation, “*requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply*”.

The objective of the WHO Environmental Noise Guidelines for the European Region is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The WHO Environmental Noise Guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels (defined in Appendix 12-1), above which there is risk of adverse health risks.

In relation to wind turbine noise, the WHO Guideline Development Group (GDG) state the following:

*“For average noise exposure, the GDG **conditionally** recommends reducing noise levels produced by wind turbines below 45 dB L_{den} , as wind turbine noise above this level is associated with adverse health effects.*

No recommendation is made for average night noise exposure L_{night} of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.

*To reduce health effects, the GDG **conditionally** recommends that policy-makers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another.”*

The quality of evidence used for the WHO Environmental Noise Guidelines research is stated as being ‘Low’, the recommendations are therefore conditional.

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national, and international level, thus shall be considered by Irish policy makers for any future revisions of Wind Energy Development Guidelines.

There is potential for increased uncertainty due to the parameter used by the WHO for assessment of exposure (i.e., L_{den}), which it is acknowledged may be a poor characterisation of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes, as stated below, from within the WHO Environmental Noise Guidelines:

“Even though correlations between noise indicators tend to be high (especially between L_{Aeq} -like indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes.”

“...Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region.”

It is considered that the conditional WHO recommended average noise exposure level (i.e., 45 dB L_{den}), if applied as target noise criteria for an existing or proposed wind turbine development in Ireland, should be done with caution. The conditional WHO recommendation for average noise exposure level (i.e., 45 dB L_{den}) may be a poor characterisation of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes.

12.3.2.4.6 **Low Frequency Noise and Infrasound**

Low Frequency Noise is noise that is dominated by frequency components less than approximately 200 Hz whereas infrasound is typically described as sound at frequencies below 20 Hz.

As stated in the Institute of Acoustics Statement in Respect of Wind Farm Noise Assessment, although there is some information presented at planning enquiries suggesting the potential for physiological health effects from infrasound and low frequency, it is current advice to members of the IOA that there is no need to assess low frequency noise or infrasound².

In relation to infrasound, the following extract from the EPA document ‘Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites’ (NG3) (EPA, 2011) is noted here: “There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw “downwind” turbines where the blades were positioned downwind of the tower which resulted in a characteristic “thump” as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e., the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature.”

² www.ioa.org.uk/sites/default/files/IOA%20Statement%20-%20Wind%20Farm%20Noise%20Assessment%20Dec%202024.pdf

The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. The article notes the following with respect to infrasound:

“Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.

Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view.”

The article concludes that:

“from examination of reports of the studies referred to above, and other reports widely available on internet sites, we conclude that there is no robust evidence that low frequency noise (including ‘infrasound’) or ground -borne vibration from wind farms, generally has adverse effects on wind farm neighbours”.

A report released in January 2013 by the South Australian Environment Protection Authority namely, ‘*Infrasound levels near windfarms and in other environments*’ (EPA, 2013) found that the level of infrasound from wind turbines is insignificant and no different to any other source of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people.

The EPA’s study concluded that the level of infrasound at houses near wind turbines was no greater than in other urban and rural environments, and stated that:

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

In conclusion, low frequency noise and infrasound associated with wind turbines is expected to be below perceptibility thresholds and are not likely to result in any significant effects at NSLs. There are no criteria proposed for assessing low-frequency noise or infrasound as part of the EIAR; this approach is standard practice in Ireland when assessing wind turbine noise at planning stage.

12.3.2.4.7 **Amplitude Modulation**

In the context of this assessment, amplitude modulation (AM) is defined in the IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document ‘*A Method for Rating Amplitude Modulation in Wind Turbine*’ (IOA, 2016) as:

“Periodic fluctuations in the level of audible noise from a wind turbine (or wind turbines), the frequency of the fluctuations being related to the blade passing frequency (BPF) of the turbine rotor(s).”

It is now generally accepted that there are two mechanisms which can cause amplitude modulation:

- ‘Normal’ AM, and;
- ‘Other’ AM (sometimes referred to ‘Excessive’ AM).

In both cases, the result is a regular fluctuation in amplitude at the Blade Passing Frequency (BPF) of the wind turbine blades (the rate at which the blades of the turbine pass a fixed point). For example, a three-bladed turbine rotating at 20 rpm, equates to a modulation frequency of 1 Hz.

‘Normal’ AM An observer at ground level close to a wind turbine will experience ‘blade swish’ because of the directional characteristics of the noise radiated from the trailing edge of the blades as it rotates towards and then away from the observer.

This effect is reduced for an observer on or close to the turbine axis and therefore would not generally be expected to be significant at typical separation distances, at least on relatively level sites.

The RenewableUK AM project (RenewableUK, 2013) has coined the term ‘normal’ AM (NAM) for this inherent characteristic of wind turbine noise, which has long been recognised and was discussed in ETSU-R-97 in 1996.

‘Other’ AM In some cases AM is observed at large distances from a wind turbine (or turbines). The sound is generally heard as a periodic ‘thumping’ or ‘whoomphing’ at relatively low frequencies.

On sites where it has been reported, occurrences appear to be occasional, although they can persist for several hours under some conditions, dependent on atmospheric factors, including wind speed and direction.

It was proposed in the RenewableUK 2013 study that the fundamental cause of this type of AM is transient stall conditions occurring as the blades rotate, giving rise to the periodic thumping at the blade passing frequency.

Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances.

The RenewableUK AM project report adopted the term ‘Other AM’ (OAM) for this characteristic. The terms ‘enhanced’ or ‘excess’ AM (EAM) have been used by others, although such definitions do not distinguish between the source mechanisms and presuppose a ‘normal’ level of AM, presumably relating back to blade swish as described in ETSU-R-97.

Frequency of Occurrence of AM

Research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report ‘*Research into Aerodynamic Modulation of Wind Turbine Noise*’ (2007). The conclusions of this report were that aerodynamic modulation was only considered to be an issue at four, and a possible issue at a further eight, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the four sites where AM was confirmed as an issue, it was considered that conditions associated with AM might occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system.

It is not possible to predict an occurrence of AM at the planning stage. While OAM can occur, it is noted that the research has shown that it is a rare event associated with a limited number of wind farms.

RenewableUK Research Document states the following in relation to this matter:

- Page 68 Module F *“even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent.”*
- Page 6 Module F *“It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months.”*
- Page 61 Module F *“There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site’s general characteristics or on the known characteristics of the wind turbines to be installed.”*

Concluding Comments on AM

It is essential to recognise that AM is an intrinsic feature of wind turbine noise. A distinction must be made between ‘Normal’ AM, which is generated by all wind turbines, generally limited in magnitude and reduces with separation distance, and ‘Other’ or ‘Excessive’ AM, which can be more pronounced and potentially intrusive. As normal AM is assumed to be part of normal wind turbine noise, the noise limits set out in applicable guidelines discussed in this section take this into account and are relatively stringent as a result. Excessive AM, should it occur, may lead to additional impacts at sensitive receptors in some cases. The term AM is commonly used without these descriptions; however, where AM is referenced in this chapter, it should be understood to refer to unacceptable or Excessive AM with the potential to result in additional adverse impacts, unless otherwise stated.

Research and guidance in the field of wind turbine noise AM is ongoing with the most notable recent publications discussed below.

The Institute of Acoustics (IOA) Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) published, ‘*A Method for Rating Amplitude Modulation in Wind Turbine Noise*’ (August 2016) (The Reference Method). The document proposes an objective method for measuring and rating AM. The AMWG however does not propose what level of AM is likely to result in adverse community response or propose any limits for controlling AM. The purpose of the AMWG was to use existing research to develop a Reference Methodology for the measurement and rating of amplitude modulation.

In August 2016, the UK Government Department of Energy and Climate Change (DECC), prepared by WSP Parsons Brinckerhoff, published ‘*Wind turbine AM review: Phase 2 report*’. (3514482A Issue 3.) The objective of this report was to recommend how Excessive AM might be controlled through the use of a planning condition. The report recommended the use of a penalty scheme as a potential planning condition for AM to cover periods of complaints due to unacceptable AM. This penalty scheme is based on the AMWG method and other potential AM rating methods were dismissed as not sufficiently robust. The report included the following caveat:

“Any condition developed using the elements proposed in this study should be subject to a period of testing and review. The period should cover a number of sites where the condition has been implemented and would be typically in the order of 2-5 years from planning approval being granted.”

It is noted that the WSP report recommended that Excessive AM be controlled specifically during period of complaints. The key point is that while excessive amplitude modulation (AM) may occur during the operation of the wind farm, it may not necessarily result in any adverse impacts. As per the discussion on the research presented previously in this section, Excessive/Other AM is considered an atypical phenomenon, and the duration, conditions and specific location or locations at which it presents cannot be predicted in the planning stage. For these reasons, the assessment of AM is typically

triggered in response to complaints where the contributing factors aligning to the period of the complaint such as meteorological conditions and turbine operations can be investigated.

The International Electrotechnical Commission (IEC) published ‘*Technical Specification 61400-11-2 (Edition 1.0, 2024) Wind Energy Generation Systems – Part 11-2: Acoustic noise measurement techniques – Measurement of wind turbine sound characteristics in receptor position*’, in 2024. This document introduces a standardised methodology for measuring and rating AM at receptor locations. The method broadly aligns with the AMWG approach but includes some minor differences.

To date there is no clear industry consensus on how AM should be regulated or managed through the planning stage. In the absence of clear policy in Ireland to control AM from wind turbines, the commitments outlined in the Section 12.6.2.2, which refer to the NCMP presented in Appendix 16-6 are considered to represent best practice and will be adopted in the event that a complaint relating excessive AM is reported.

12.3.2.5 Operational Phase Noise – Proposed Grid Connection

The Proposed Grid Connection will connect the Proposed Wind Farm into the national grid via the existing Shannonbridge-Maynooth 220kV OHL in the townland of Cooldorragh, measuring approximately 0.8km in total length (comprising 0.4km of double-looped OHL from the proposed steel masts for loop-in/loop-out of the existing OHL). For the proposed on-site 220kV substation (fixed mechanical and electrical plant), the impact will be determined with reference to the following best practice guidance.

12.3.2.5.1 BS4142

BS 4142:2014+A1:2019 ‘*Methods for rating and assessing industrial and commercial sound*’ is considered the best practice method for analysing fixed plant sound emissions to residential receptors. BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

For a BS 4142 assessment it is necessary to compare the measured external background sound level (i.e., the $L_{A90,T}$ level measured in the absence of plant items) to the rating level ($L_{Ar,T}$) of the various plant items, when operational. Where sound emissions are found to be tonal, impulsive, intermittent or to have other sound characteristics that are readily distinctive against the residual acoustic environment, BS 4142 recommends that penalties be applied to the specific level to arrive at the rating level.

The subjective method for applying a penalty for tonal sound characteristics outlined in BS 4142 recommends the application of a 2 dB penalty for a tone which is just perceptible at the receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible. In relation to intermittency, BS 4142 recommends that if the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied. The following definitions as discussed in BS 4142 as summarised below:

“*ambient sound level, $L_{Aeq,T}$* *equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at any given time, usually from many sources near and far, at the assessment location over a given time interval, T.*

residual sound level, $L_{Aeq,T}$ *equivalent continuous A-weighted sound pressure level of the residual sound (i.e., ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound) at the assessment location over a given time interval, T.*

<i>specific sound level, $L_{Aeq, T}$</i>	<i>equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T.</i>
<i>Rating level, $L_{Ar, T}$</i>	<i>specific sound level plus any adjustment for the characteristic features of the sound.</i>
<i>background sound level, $L_{A90, T}$</i>	<i>A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.”</i>

To establish an initial estimate of impact, BS 4142 states the following:

“Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level and consider the following:

- a. Typically, the greater this difference, the greater the magnitude of the impact.*
- b. A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
- c. A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
- d. The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*

Note: Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.”

BS 4142 contains the following pertinent factor that must be considered with respect to the context of the sound, which is relevant to this assessment as the background noise levels are typically low at NSLs during periods of low wind speeds:

“The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.”

Noise measurement results presented in Section 12.3.4 indicate that the background noise levels in the area can be considered low, and further guidance is sought to determine relevant absolute noise thresholds.

12.3.2.5.2 **EPA NG4**

NG4 is commonly used in Ireland to determine suitable noise thresholds for licensed industrial sites and is also commonly used to determine suitable noise thresholds for plant noise. The NG4 approach to determining suitable noise thresholds is presented below:

Quiet Area

The following points assess whether the site is considered a quiet area based on the criteria outlined in EPA's Guidance.

- At least 3km from urban area with a population >1,000 people;
- At least 3km away from any local industry;
- At least 5km away from any National Primary Route

The site is located next to the N62 National Road, hence, the site is not considered a quiet area.

Areas of low background noise

In order to establish whether the NSLs would be considered 'low background noise' areas as defined in the EPA publication, 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities 2016' (NG4) guidance, the noise levels measured during the environmental noise survey need to satisfy the following criteria:

- Arithmetic Average of L_{A90} During Daytime Period ≤ 40 dB L_{A90} , and;
- Arithmetic Average of L_{A90} During Evening Period ≤ 35 dB L_{A90} , and;
- Arithmetic Average of L_{A90} During Night-time Period ≤ 30 dB L_{A90} .

Table 12-6 outlines the noise criteria detailed in the NG4 for areas of low background noise and all other areas.

Table 12-6 NG4 Approach for Determining Appropriate Noise Criteria

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}^3$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night Noise Criterion, dB $L_{Aeq,T}$ (23:00 to 07:00hrs)
Areas of Low Background Noise	45	40	35
All other Areas	55	50	45

It is important to consider the likelihood of adverse noise impacts when assessing noise from fixed plant. The NG4 guidance refers to the assessment method prescribed in 'Methods for rating and assessing industrial and commercial sound' BS 4142 that can be used to assess the likelihood of complaints from specific plant noise sources.

In light of the above guidance from EPA's NG4 and BS 4142, an absolute threshold of 35 dB L_{Aeq} is proposed for fixed plant. This threshold is in line with the guidance from NG4 for areas of low background noise. During the detailed design, acoustic features such as tonality, impulsivity and intermittency, will be considered in the context of the character assessment framework contained in BS 4142. Where these acoustic features are present, the Rating Level should be controlled to avoid adverse impacts at NSLs in accordance with BS 4142. Where background noise levels are elevated at specific NSLs, i.e. greater than 30 dB L_{A90} , a higher absolute threshold, of up to 5 dB above the background level, may be acceptable.

³ The Rated Noise Level, equal to the L_{Aeq} during a specified time interval (T), plus specified adjustments for tonal character and/or impulsiveness of the sound.

12.3.2.6 Operational Phase - Vibration

Vibration generated from the operation of a wind turbine unit will decrease significantly with distance. A report from Germany published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016, *‘Low frequency noise incl. infrasound from wind turbines and other sources’* conducted vibration measurements study for an operational Nordex N117 – 2.4 MW wind turbine. The report concluded that at distances of less than 300 m from the turbine vibration levels had dropped so far that they could no longer be differentiated from the background vibration levels.

The shortest distance from any proposed turbine within the Proposed Wind Farm to the nearest NSL is in excess of 896 m (distance from turbine T10 to NSL ref. H003). This setback distance complies with the four-times tip height setback requirement as set out in the Draft DoHPLG 2019 Guidelines. At that distance, the level of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria are not specified for the operational phase of the Proposed Wind Farm.

In addition, the Institute of Acoustics Statement in Respect of Wind Farm Noise Assessment⁴, mentioned above, states that vibration from operational wind turbines measured under sensitive equipment were well below the perception thresholds for human perception. Therefore, it is concluded that there is no need to assess vibration effects from operational wind farms.

There is no anticipated source of vibration from the proposed onsite 220kV substation. Furthermore, given that the shortest distance to the nearest NSL from the proposed onsite 220kV substation, i.e., H335, is over 355m north, it can be concluded that any vibration levels from the proposed onsite 220kV substation will be well below any thresholds for perceptibility.

12.3.2.7 Additional traffic on surrounding roads

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that the small amount of traffic from the development will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the development. In order to assist with the interpretation of the noise associated with additional vehicular traffic on public roads, Table 12-7, taken from DMRB) *Sustainability & Environment Appraisal LA 111 Noise and Vibration* Revision 2 (UK Highways Agency, 2020) offers guidance as to the likely degree of impact associated with any long-term change in traffic noise level.

Table 12-7 Significance in Change of Noise Level

Change in Sound Level (dB)	Subjective Reaction	DMRB Magnitude of Impact	EPA Significance of Effect
0	Inaudible	No impact	Imperceptible
0.1 – 2.9	Barely Perceptible	Negligible	Not significant
3 – 4.9	Perceptible	Minor	Slight, Moderate
5 – 9.9	Up to a doubling of loudness	Moderate	Significant
10+	Doubling of loudness and above	Major	Very significant

⁴ IOA (2024) Institute of Acoustics Statement in Respect of Wind Farm Noise Assessment
<<https://www.ioa.org.uk/sites/default/files/IOA%20Statement%20-%20Wind%20Farm%20Noise%20Assessment%20Dec%202024.pdf>>

The guidance outlined in Table 12-7 will be used to assess the predicted increases in traffic levels on public roads associated with the Proposed Project and comment on the likely long-term impacts during the operational phase.

12.3.2.8 **Comment on Potential Human Health Impacts from Wind Turbine Noise**

For details of potential health impacts associated with the Project refer to Section 5.4.5 of Chapter 5: Population and Human Health of this EIAR.

12.3.3 **Study Area**

The study area for the noise and vibration impact assessment was defined by the area where there is potential for noise and vibration impacts at NSLs associated with the Proposed Project during the construction, operational, and decommissioning phases.

12.3.3.1 **Construction and Decommissioning Study Area**

During the construction and decommissioning phases, noise could occur at any location within the Proposed Project site and along public roads where there are increases in traffic associated with the Proposed Project. There is also a potential for noise impacts from HGVs along the TDR and construction haul routes (Section 4.7 in Chapter 4).

NSLs in proximity to specific construction activities and those situated along haul routes have the most potential to experience noise and vibration from the Proposed Project. Taking account of the works associated with the construction and decommissioning phases, the study area is based on the nearest NSLs to the working areas, these distances are in a range between 31 m for the internal roads, and over 830 m for the borrow pit as indicated in Section 12.5.2 and representative of the closest identified NSL or at defined set back distances from the proposed works.

12.3.3.2 **Operational Phase Study Area**

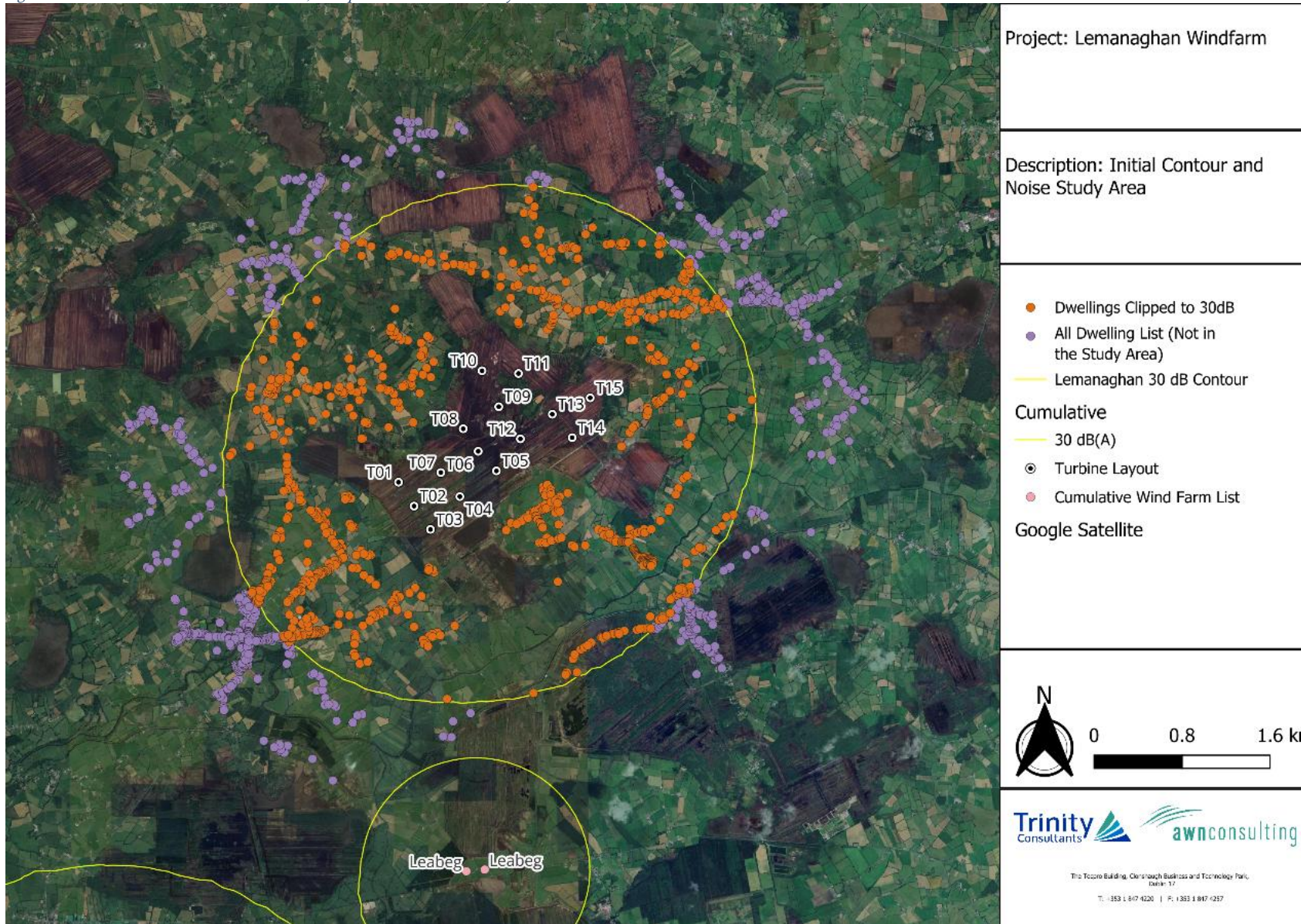
In line with best practice guidance, the operational phase study area should cover, at a minimum, the area predicted to exceed 35 dB L_{A90} from all existing, permitted, and proposed wind turbines. Wind farms located within a 25 km radius from the Proposed Wind Farm were initially considered as part of the preliminary assessment. However, following further evaluation, all other wind farm developments were excluded from the defined Operational Study Area, as outlined in Section 12.3.7. It is noted that Bellair Wind Farm is currently at an early pre planning stage. If permitted, the wind farm would be located to the north of the Proposed Project site, however, as detailed information (i.e., turbine locations, number of turbines and dimensions) was not available in the public domain during the writing of this assessment, this is also not included in the operational study area or in the cumulative assessment.

The selected study area for the operational phase of this Proposed Project covers the area predicted to exceed 30 dB L_{A90} at the maximum predicted noise emission level which is 10 dB lower than the lower threshold of 40 dB L_{A90} used in this assessment, approximately an offset of 4.5km from T06. This is considered a conservative approach to determining the assessment study area.

Figure 12-2 presents the relevant noise contours maps which identify the operational phase study area.

The NSLs identified within this study area have also been considered in the assessment of operational noise from proposed fixed plant (proposed onsite 220kV substation).

Figure 12-2 Presentation of Turbine Locations, Receptor Locations and Study Area



12.3.3.3 Operational Traffic Study Area

Based on information in Chapter 15, it is estimated that 1-2 vehicles will access the site on a daily basis. In terms of the additional traffic on local roads that will be generated as a result of the Proposed Project, the following comment is presented: Considering that in order to increase traffic noise levels by 1dB traffic volumes would need to increase by the order of 25%, therefore it is predicted that the additional traffic introduced onto the local road network due to the Proposed Project will not result in a significant noise impact. The resultant noise impact is neutral, imperceptible and long-term.

12.3.4 Background Noise Survey

A background noise survey was undertaken to establish typical background noise levels at representative NSLs surrounding the Proposed Project site. The background noise survey was conducted through installing unattended sound level meters at 8 no. representative locations in the surrounding area.

All measurements for the background noise surveys have been collected in accordance with the IOA GPG and accompanying Supplementary Guidance Note 1: Data Collection (2014) discussed in the following sections.

12.3.4.1 Choice of Measurement Locations

The noise monitoring locations (NMLs) were identified by preparing a preliminary noise model contour at an early stage of the assessment. Any NSL that fell inside the predicted 35 dB L_{A90} noise contour was considered for noise monitoring in line with current best practice guidance outlined in the IOA GPG. The selection of representative noise monitoring locations was informed by a site visit and supplemented by reviewing aerial images of the study area and other online sources of information (e.g., Google Earth and OSI Maps).

The co-ordinates for selected locations for the NMLs are outlined in Table 12-8 and identified on a map in Figure 12.3.

Table 12-8 Noise Measurement Location Coordinates

Location	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
NML1 (H085)	614,214	728,744
NML2 (H025)	613,216	727,095
NML3 (within the site)	616,409	727,553
NML4 (H011)	616,883	730,153
NML5 (H111)	618,973	729,990
NML6 (H026)	617,302	727,197
NML7 (H077)	613,662	726,078
NML8 (H003)	614,814	729,539

The noise environment has been observed during equipment installations, site visits to maintain the equipment, and equipment collections. In general, the significant noise sources in the area were noted to be local and distant traffic movements, wind generated noise from local foliage and other typical anthropogenic sources typically found in such rural settings.

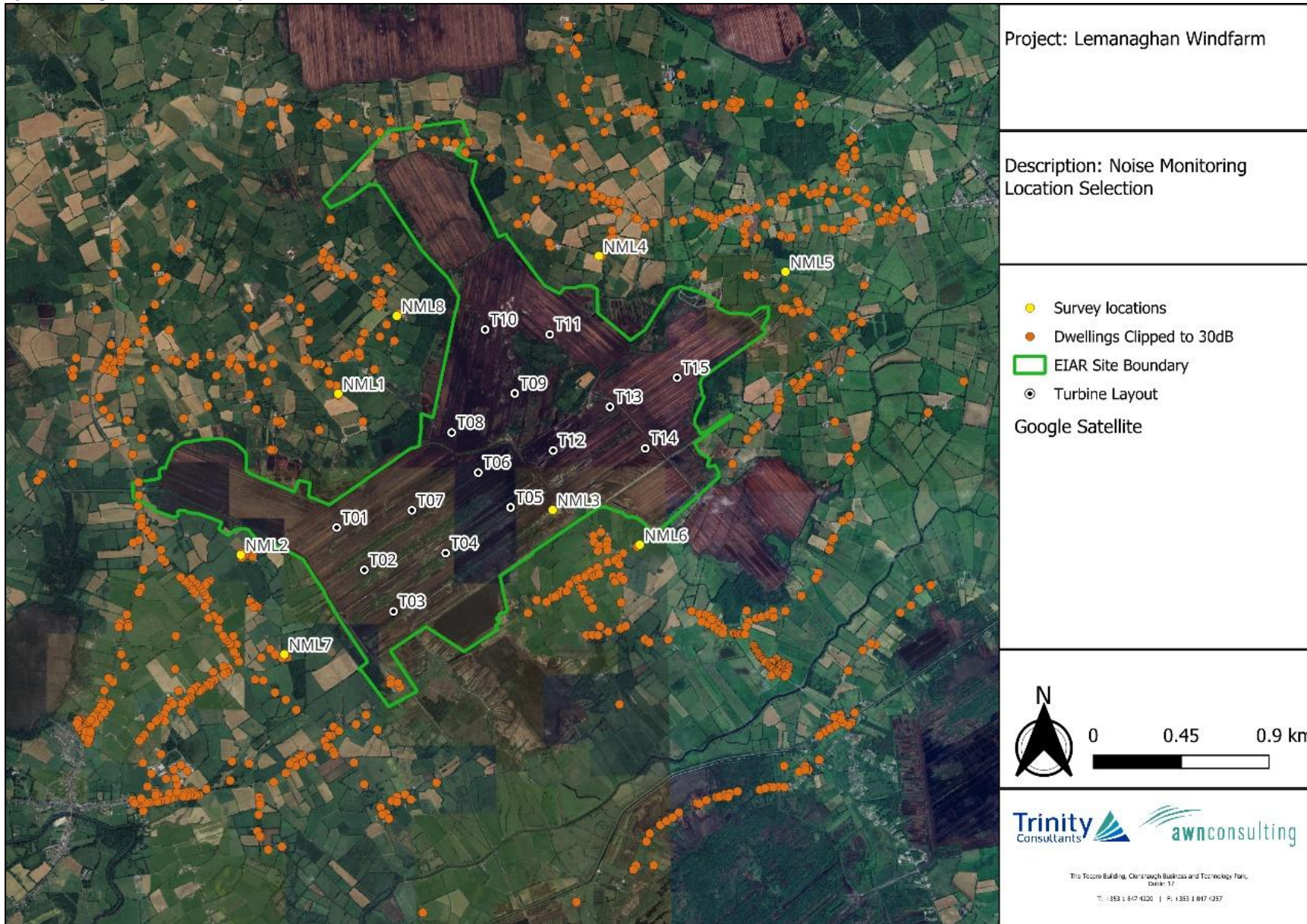
Site visits by survey personnel were carried out during the morning and afternoon time; during these visits, primary noise sources contributing to noise build-up were noted. In respect of night-time periods, when noise due to traffic on local roads, agricultural activities and other sources tend to reduce, there was no indication of any significant local night-time sources of noise at any location.

It is important to note that any noise from the existing wind turbines in the area should not form part of the background noise environment at NSLs. This topic is discussed further later in this section.

No significant sources of vibration were noted at any of the survey locations.

Figure 12-3 shows a map of the NMLs, Plate 12-1 to Plate 12-8 illustrate the installed noise monitoring kits at each NML.

Figure 12.3 Map of Noise Monitoring Locations



12.3.4.1.1 **NML1**

The sound meter at NML1 was installed in the garden to the rear of the property. There were no significant or atypical noise sources noted at this location. Cattle and birdsong were noted, with some distant and infrequent road traffic noise in the background.



Plate 12-1 Noise monitor Installed at NML1

12.3.4.1.2 **NML2**

The sound meter at NML2 was installed in the garden to the rear of the property. At the time of installation noise sources were noted as birdsong and farming equipment in the distance.



Plate 12-2 Noise monitor Installed at NML2

12.3.4.1.3 **NML3**

The sound meter at NML3 was installed on Bord na Móna land within the site to measure the background noise levels in the area where the nearest properties were not accessible. Birdsong noises were noted at this location, with infrequent road traffic noise also audible.



Plate 12-3 Noise monitor Installed at NML3

12.3.4.1.4 **NML4**

The sound meter at NML4 was installed in the garden to the front of the property. Birdsong and infrequent road traffic was noted.



Plate 12-4 Noise monitor Installed at NML4

12.3.4.1.5 **NML5**

The sound meter at NML5 was installed in the garden to the back of the property. Birdsong and infrequent road traffic was noted.



Plate 12-5 Noise monitor Installed at NML5

12.3.4.1.6 **NML6**

The sound meter at NML6 was installed in the garden to the left of the property. Birdsong and infrequent road traffic was noted.



Plate 12-6 Noise monitor Installed at NML6

12.3.4.1.7 **NML7**

The sound meter at NML7 was installed in the garden to the rear of the property. Birdsong was noted.



Plate 12-7 Noise monitor Installed at NML7

12.3.4.1.8 **NML8**

The sound meter at NML8 was installed in the garden to the front of the property. Birdsong and infrequent road traffic was noted.



Plate 12-8 Noise monitor Installed at NML8

12.3.4.2 Survey Periods

The survey duration for each noise monitor was on average six weeks, or until such time that enough data points were captured at each survey location. Section 2.9.1 of the IOA GPG states:

“The duration of a background noise survey is determined only by the need to acquire sufficient valid data over the range of wind speeds (and directions, if relevant). It is unlikely that this requirement can be met in less than 2 weeks.”

An ongoing review of the survey data was conducted at regular intervals to establish when adequate data had been captured. Noise measurements were undertaken at relevant monitoring locations over the periods outlined in Table 12-9.

Table 12-9 Noise Measurement Periods

Location	Survey Period	
	Start Date	End Date
NML-1 (H085)	1 September 2021	15 October 2021
NML-2 (H025)	1 September 2021	15 October 2021
NML-3 ⁵ (within the site)	1 September 2021	21 November 2021
NML-4 (H011)	15 October 2021	21 November 2021
NML-5 (H111)	27 September 2021	5 November 2021
NML-6 (H026)	1 September 2021	15 October 2021
NML-7 (H077)	15 October 2021	21 November 2021
NML-8 (H003)	15 October 2021	21 November 2021

A variety of wind speed and weather conditions were encountered over the survey periods in question. Figure 12-4 shows the distribution of wind speed and direction recorded at the Met Mast unit for all periods of day and night between 1 September 2021 and 15 October 2025. The wind speed data presented below relates to a turbine hub height of 145 m.

⁵ Equipment was removed by third party between 8 September and 5 November 2021

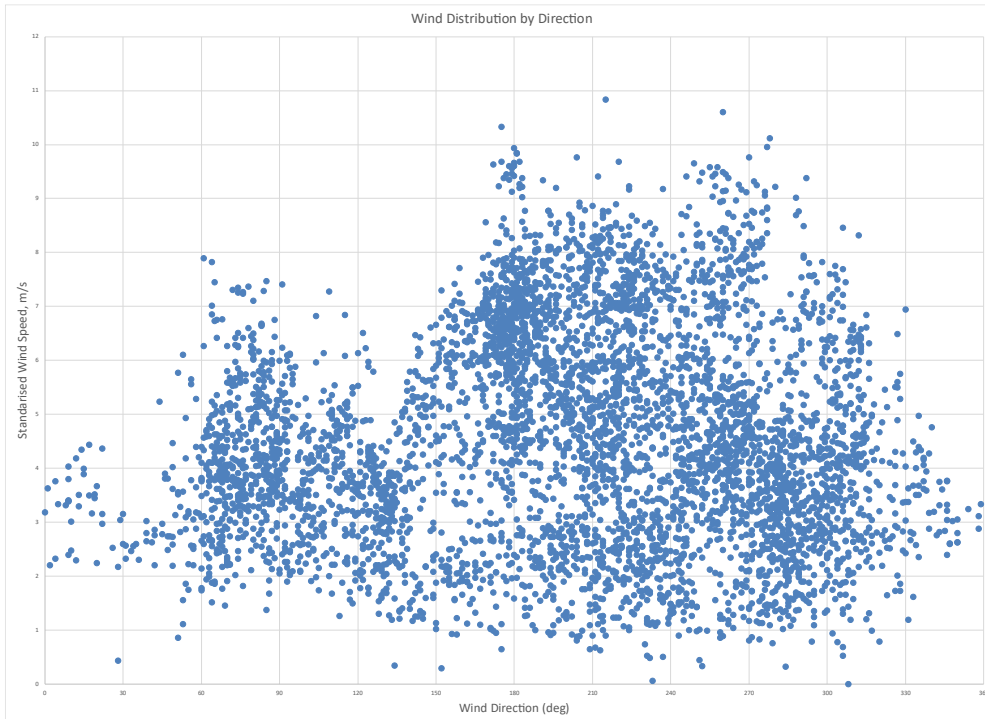


Figure 12-4 Distribution of Wind Speeds and Direction at Mast unit during Survey Period

It is confirmed that survey periods were of sufficient duration to measured adequate data to derive a suitable representation of typical background at all locations in accordance with guidance contained within the IOA GPG.

12.3.4.3 Instrumentation

Table 12-10 confirms the details of the instrumentation installed at each location.

Table 12-10 Details of Noise Measurement Instrumentation

Location Reference	Equipment Make and Model	Serial Number
NML1 (H085)	RION NL-52	186670
NML2 (H025)	RION NL-52	564808
NML3 (within the site)	RION NL-52	386771
NML4 (H011)	RION NL-52	564808
NML5 (H111)	RION NL-52	386771
NML6 (H026)	RION NL-52	998411
NML7 (H077)	RION NL-52	998411
NML8 (H003)	RION NL-52	186670

Before, after and during each survey period, the measurement instrument was checked and calibrated using a Brüel & Kjær type 4231 Sound Level Calibrator. All calibration drifts were less than +/- 0.5 dB. Copies of the relevant calibration certificates are included in Appendix 12-2.

Rainfall was logged and recorded using rain gauges installed at NML1, NML6 and NML8. The rainfall data allows for the identification of periods of rainfall so that they can be removed from the noise monitoring data sets, in line with best practice, when calculating the prevailing background noise levels at the various locations. This data is used across all used noise monitoring locations.

An existing meteorological mast is present onsite for this phase of the development and will be decommissioned during the construction phase. Wind speed measurements made at 100 m and 80 m were used to correct the wind speed up to a provisional assessment hub height (HH) at 145 m, as per the methodology outlined in the IOA GPG. The calculated HH wind speeds were then corrected to the 'standardised' 10 m wind speed in accordance with the IOA GPG. The 'standardised' wind speed is the accepted industry standard in Ireland and the UK for referencing for wind speeds with respect to wind turbines.

Table 12-11 Coordinates of Existing Anemometry Mast

Item	Coordinates (ITM)	
	Easting	Northing
Existing Anemometry Mast	616,127	728,471

12.3.5 Analysis of Survey Data

12.3.5.1 Measurement Procedure

Measurements were conducted at all locations over the survey periods outlined in Table 12-9. Data samples for all measurements (noise, rainfall, and wind) were logged continuously at 10-minute interval periods for the duration of the survey. The $L_{Aeq,10min}$ and $L_{A90,10min}$ noise parameters were measured in this instance and the results were saved to the instrument memory for later analysis.

Survey personnel noted potential primary noise sources contributing to noise build-up during the installation and removal of the sound level meters from site. Description of the observed noise environment at each of the monitoring locations is presented in Section 12.3.4.

12.3.5.2 Atypical Noise Data

The data sets have been filtered to remove issues such as the dawn chorus and the influence of other atypical noise sources. An example of atypical sources would be short, isolated periods of raised noise levels attributable to local sources, agricultural activity, boiler flues, operation of gardening equipment, etc. In addition, sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have also been removed from the data sets.

12.3.5.3 Assessment Periods

The results presented in the following sections refer to the noise data collated during 'quiet periods' of the day and night as defined in the IOA GPG. These periods are defined as follows:

Daytime Amenity hours are:

- all evenings from 18:00 to 23:00hrs;
- Saturday afternoons from 13:00 to 18:00hrs, and;
- all day Sunday from 07:00 to 18:00hrs.

Night time hours are 23:00 to 07:00hrs.

The assessment methods outlined above are in line with the guidance contained in the IOA GPG.

12.3.5.4 Noise from Existing Turbines

An appraisal of the wider study area has identified the existing Leabeg Wind Farm hosts the closest operational turbine to the Proposed Wind Farm, located approximately 6 km to the south of the closest proposed turbine (T03). In addition, and at further distances, other existing wind farms such as Meenwaun Wind Farm and Cloghan Wind Farm were considered in the appraisal. Review of the data confirmed that none of the above wind farms or single turbines impacted the baseline noise level and were subjectively inaudible at all locations when attending the noise survey locations.

12.3.5.5 Consideration of Wind Shear

As part of a robust wind farm noise assessment due consideration should be given to the issue of wind shear. It is standard procedure to reference noise data to standardised 10 metre wind speed. Wind shear has been considered in this assessment in accordance with the guidance contained in the IOA GPG, ‘*Supplementary Guidance Note (SGN) 4: Wind Shear*’, July 2014. This Supplementary Guidance Noise presents the following equations in relation to the derivation of a standardised wind speed at 10 m above ground level:

Equation A

this uses the following equation:

Shear Exponent
 Profile:

$$U = U_{ref} \left[\frac{H}{H_{ref}} \right]^m$$

Where:

U calculated wind speed.

U_{ref} measured wind speed.

H height at which the wind speed will be calculated.

H_{ref} height at which the wind speed is measured.

m shear exponent.

Equation B

this uses the following equation:

Roughness Length
 Shear Profile:

$$U_1 = U_2 \frac{\ln(H_1/z)}{\ln(H_2/z)}$$

Where:

H₁ the height of the wind speed to be calculated (10m)

H₂ the height of the measured wind speed.

U₁ the wind speed to be calculated.

- U_2 the measured wind speed.
- z the roughness length.

Note: A roughness length of 0.05m is used to standardise hub height wind speeds to 10m height in the IEC 61400-11:2003 standard, regardless of what the actual roughness length seen on a site may have been. This ‘normalisation’ procedure was adopted for comparability between test results for different turbines.

The derived background noise level at integer wind speeds (standardised 10 m height) is dependent on the specific hub height; an assessment hub height of 145 m has been used for the purposes of this assessment. Any reference to wind speed in the following sections of this chapter should be understood to be the standardised 10 m height wind speed reference unless otherwise stated.

12.3.6 Construction Noise Calculations

A variety of items of plant will be used for the purposes of site preparation, construction, and site works. There will be vehicular movements to and from the site that will make use of existing roads. There is the potential for generation of significant levels of noise from these activities.

Due to the nature of construction activities, it is difficult to calculate the actual magnitude of emissions to the local environment in the absence of details on the specific plant items and methods to be employed. The standard best practice approach is to predict typical noise levels at the NSLs using guidance set out in British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*.

The methodology adopted for the assessment of construction noise is to analyse the various elements of the construction phase in isolation. For each element, the typical construction noise sources are assessed along with typical sound pressure levels and spectra from BS 5228-1 at various distances from these works.

12.3.7 Operational Noise Calculations

A series of computer-based prediction models have been prepared to quantify the potential turbine noise level associated with the operational phase of the Proposed Project on the receiving environment. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

12.3.7.1 Noise Prediction Software

The selected software, DGMR ‘iNoise Enterprise (Version 2024.3)’ calculates noise levels in accordance with *ISO 9613: ‘Acoustics – Attenuation of sound during propagation outdoors. Part 2: Engineering method for the prediction of sound pressure levels outdoors’* (ISO, 2024).

iNoise is a proprietary noise calculation package for computing noise levels and propagation of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated considering a range of factors affecting the propagation of sound, including:

- The magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- The distance between the source and receiver;
- The presence of obstacles such as screens or barriers in the propagation path in line with IoA GPG recommendations;

- > The presence of reflecting surfaces;
- > The hardness of the ground between the source and receiver;
- > Attenuation due to atmospheric absorption; and
- > Meteorological effects such as temperature and humidity.

12.3.7.2 Noise Prediction Model – Input Data and Assumptions

Information available for the site was input into the iNoise noise modelling software using the ISO 9613: ‘Acoustics – Attenuation of sound outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors’ (ISO, 2024). The input data and assumptions made are described in the following sections.

12.3.7.3 Proposed Turbine Details

The proposed turbine is a Vestas V150 at 145 m hub height. This turbine is considered representative of the type of turbine that would be installed on the site taking into consideration the proposed dimensions and the nominal generation capacity.

While the noise profile of the Vestas V150 wind turbine has been used for the purposes of this assessment, the exact make and model of the turbine installed on the site will be dictated by a competitive procurement process but will adhere to the specifications and parameters (i.e. Tip Height, Hub Height and Rotor Diameter).

In terms of predicting noise levels at noise-sensitive locations the turbine noise emission levels can be defined by two parameters:

- > The hub height (HH)
- > Rotor diameter, and
- > The sound power noise emissions at various wind speeds.

Sound power levels for the Vestas V150 referenced to wind speeds at standardised 10 m height (calculated in accordance with the IOA GPG), are presented in Table 12-12.

Table 12-12 Sound Power Level Spectra for Vestas V150 with a hub height of 145 m

Wind Speed (m/s)	Octave Band Centre Frequency (Hz)								dB L _{WA}
	63	125	250	500	1000	2000	4000	8000	
3	87.0	88.4	87.0	84.6	87.0	85.6	81.9	65.6	94.8
4	84.2	90.2	89.7	88.2	90.4	89.7	82.7	68.9	97.1
5	85.6	94.2	95.2	93.8	95.7	95.4	88.0	74.2	102.2
6	88.2	96.3	96.4	96.5	98.2	97.9	91.4	77.6	104.5
7	88.3	96.2	97.0	97.5	98.5	98.2	91.8	77.6	104.9
8	88.2	95.6	96.8	97.4	98.6	98.5	92.2	76.8	104.9
9	88.6	95.5	96.1	96.9	98.8	99.0	92.6	79.6	104.9

Table 4-1 in Chapter 4 (Description of the Proposed Project) details the co-ordinates and elevations of the 15 no. turbines of the Proposed Wind Farm.

The manufacturer's turbine sound power levels outlined in Table 12-12 are presented in terms of the L_{WA} parameter. As per best practice guidance contained within the IOA GPG, an allowance for uncertainty in the measurement of turbine source levels of +2 dB is applied in modelling to all turbine sound power levels presented in Table 12-12.

As explained in Section 12.3.2.4, the criteria are couched in terms of a L_{A90} criterion. Best practice guidance in the IOA GPG states that " L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB". A 2 dB reduction has therefore been applied in the noise model calculation. All predicted noise levels in this chapter are presented in terms of L_{A90} parameter, i.e., this reduction of 2 dB is applied in the noise prediction modelling.

Best practice dictates that if any tonal component be present, a penalty must be applied to the predicted noise levels. The magnitude of this penalty, as outlined in ETSU-R-97, corresponds to the extent by which the tonal component exceeds the threshold of audibility. In this assessment no tonal penalty has been applied to the predicted noise levels. A warranty will be provided by the manufacturers of the selected turbine which will be used to ensure that the noise output (including any tonal penalty, if applicable) will not exceed the conditioned noise limits or that noise reduced operational modes could be used to control any potential exceedance.

12.3.8 Modelling Calculation Parameters

Prediction calculations for turbine noise have been conducted in accordance with ISO 9613: 'Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation' (2024).

Appendix 12-3 provides comprehensive details of noise prediction calculation settings, the NSL and turbine co-ordinates. The previously presented Figure 12-2 presents the turbine locations, study area and receptor locations taken account of for this assessment.

12.4 Existing Environment

This section of the chapter documents the typical background noise levels measured in the vicinity of the NSLs in closest proximity to the Proposed Wind Farm.

12.4.1 Derived Background Noise Levels

The following section presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and nighttime periods. These levels have been derived using regression analysis carried out on the data sets measured in line with best practice guidance presented in Section 12.3.2.4.

12.4.1.1 NML1

Figure 12-5 and Figure 12-6 show the derived daytime and night-time background noise level for NML 1.

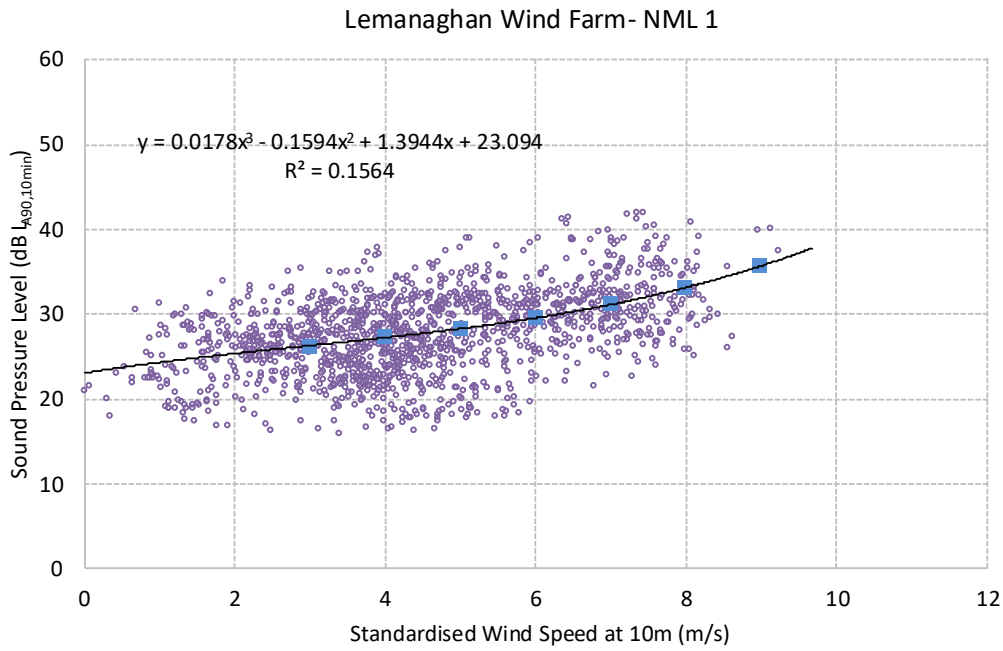


Figure 12-5 NML1 Daytime

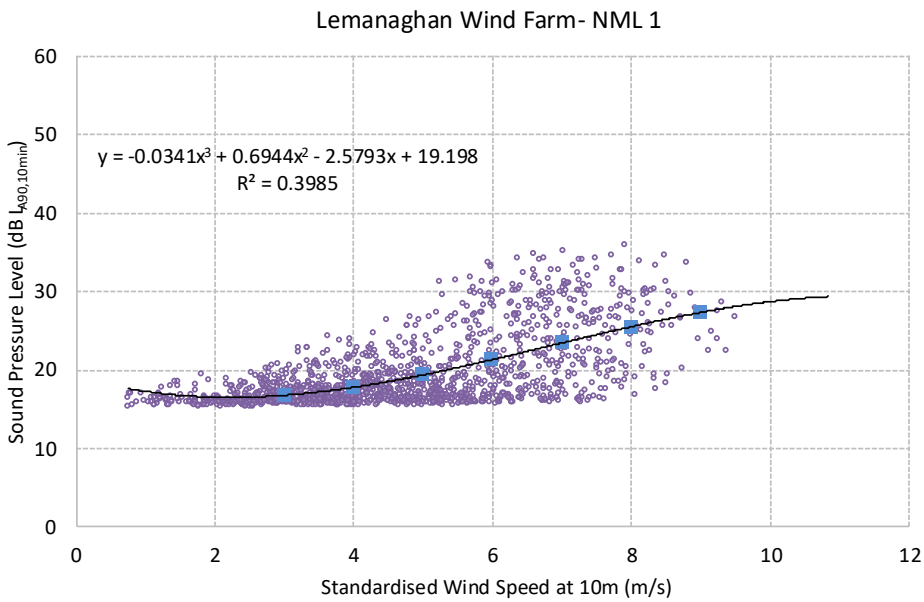


Figure 12-6 NML1 Night

12.4.1.2 NML2

Figure 12-7 and Figure 12-8 show the derived daytime and night-time background noise level for NML 2.

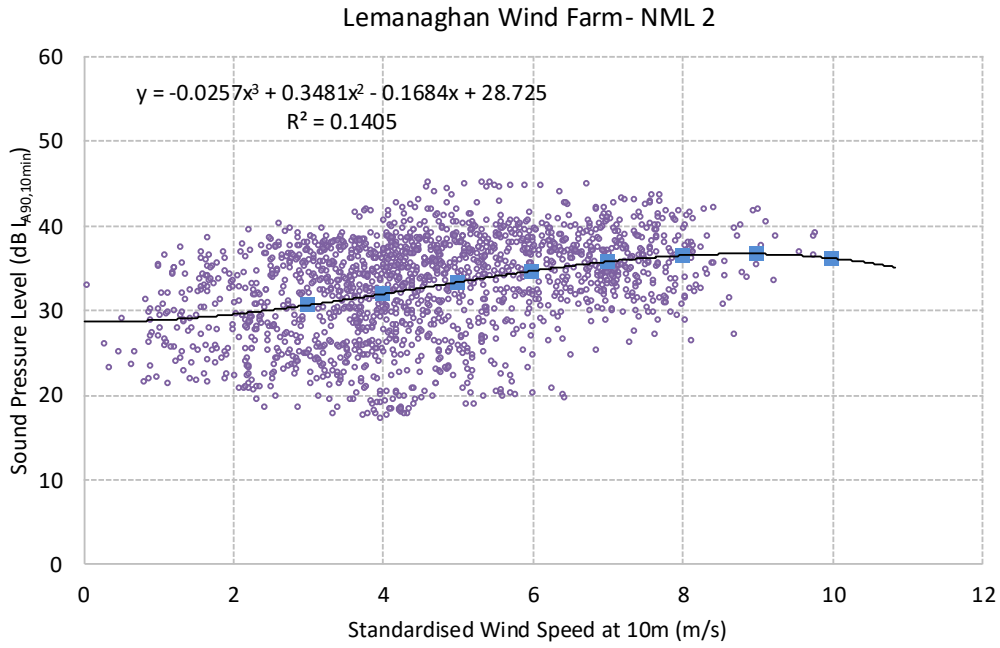


Figure 12-7 NML2 Daytime

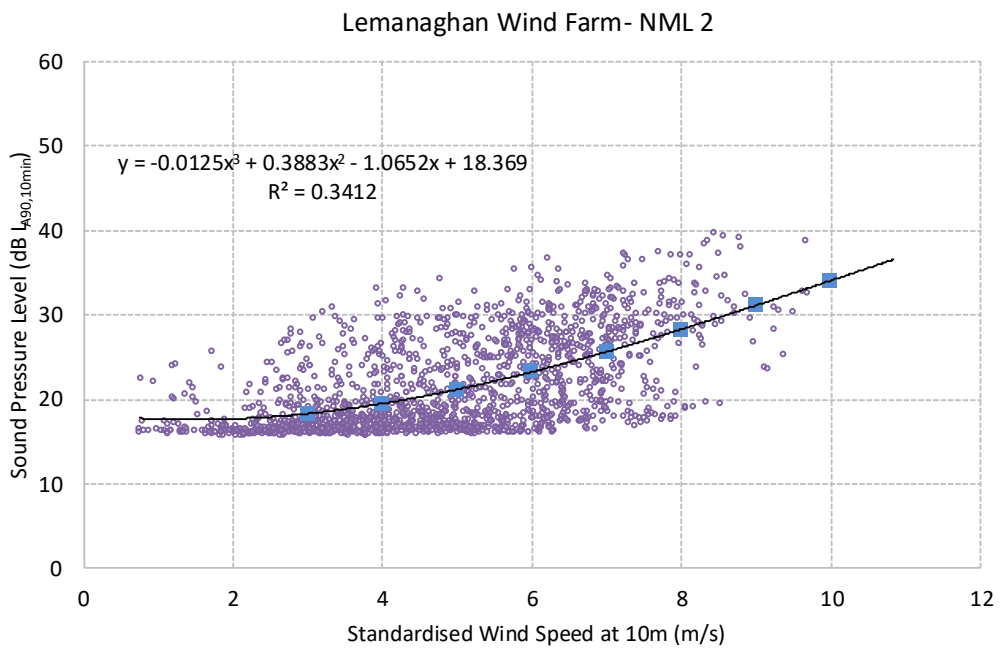


Figure 12-8 NML2 Night

12.4.1.3 NML3

Figure 12-9 and Figure 12-10 show the derived daytime and night-time background noise level for NML 3.

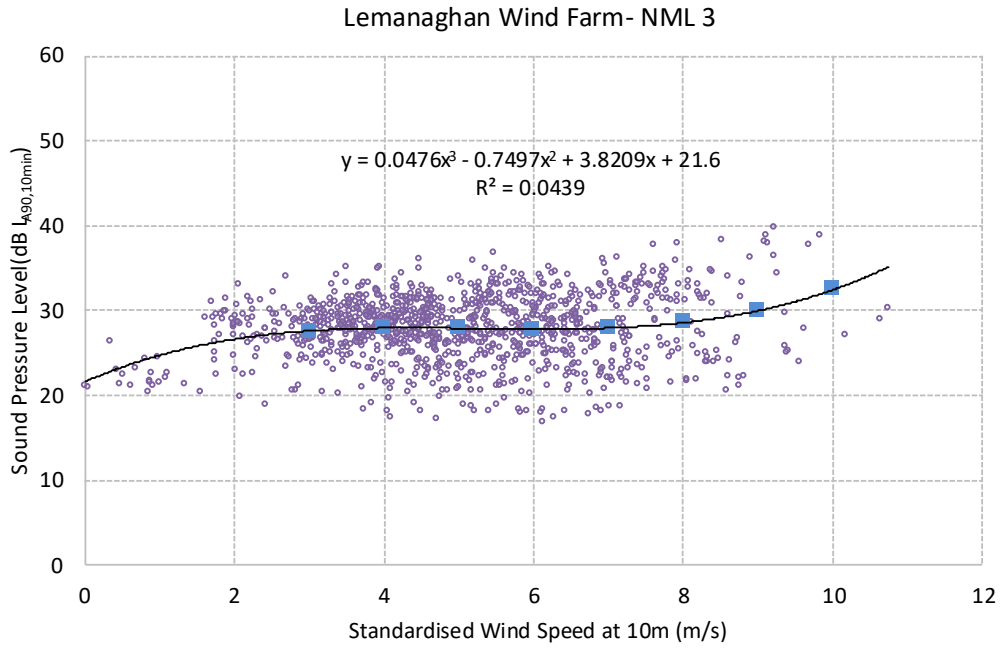


Figure 12-9 NML3 Daytime

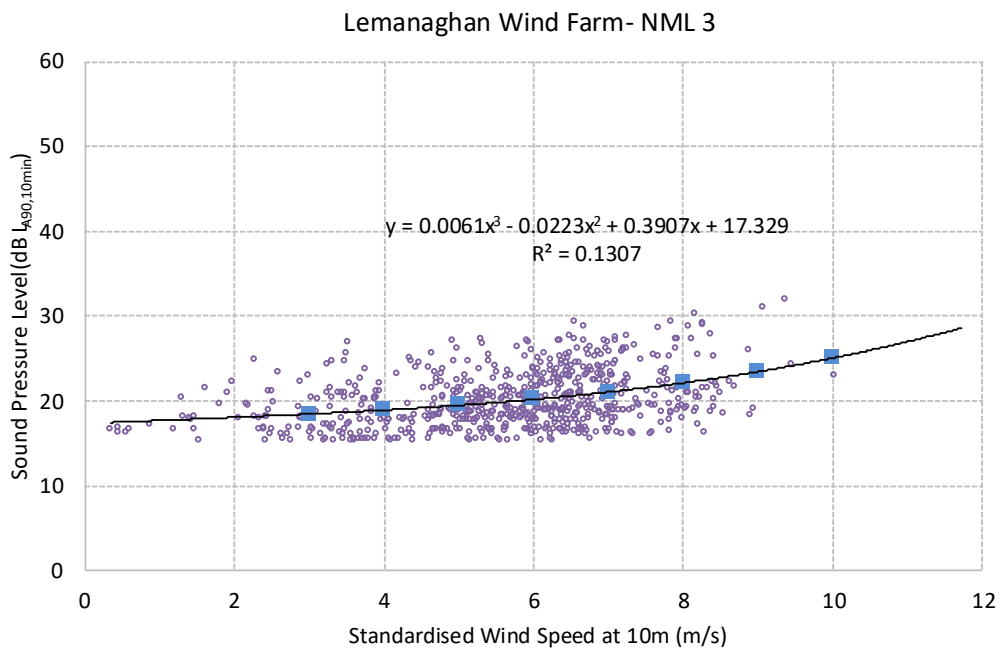


Figure 12-10 NML3 Night

12.4.1.4 NML4

Figure 12-11 and Figure 12-12 show the derived daytime and night-time background noise level for NML 4.

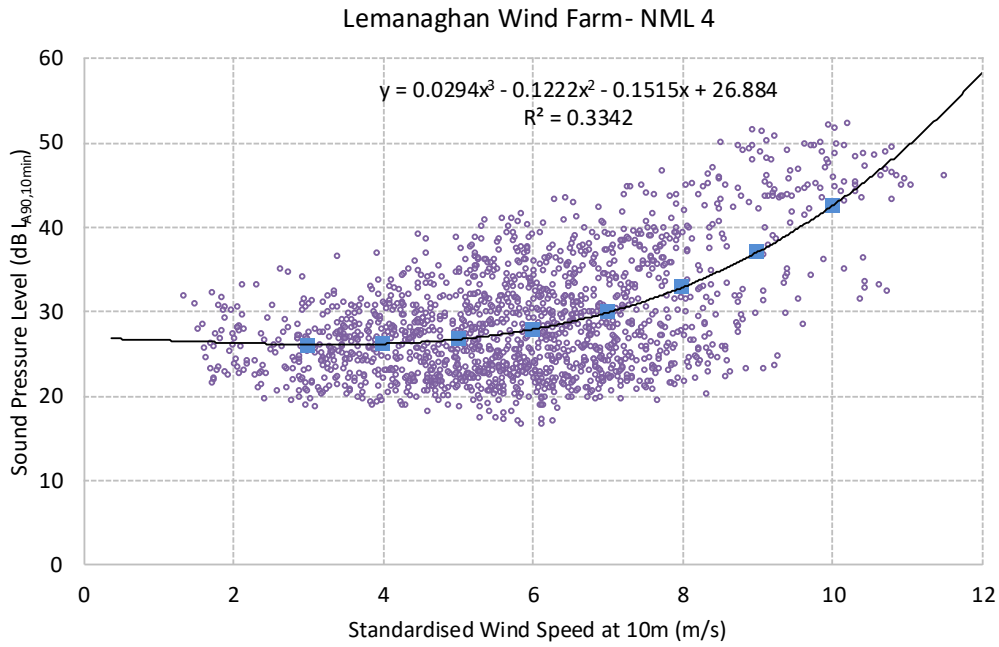


Figure 12-11 NML4 Daytime

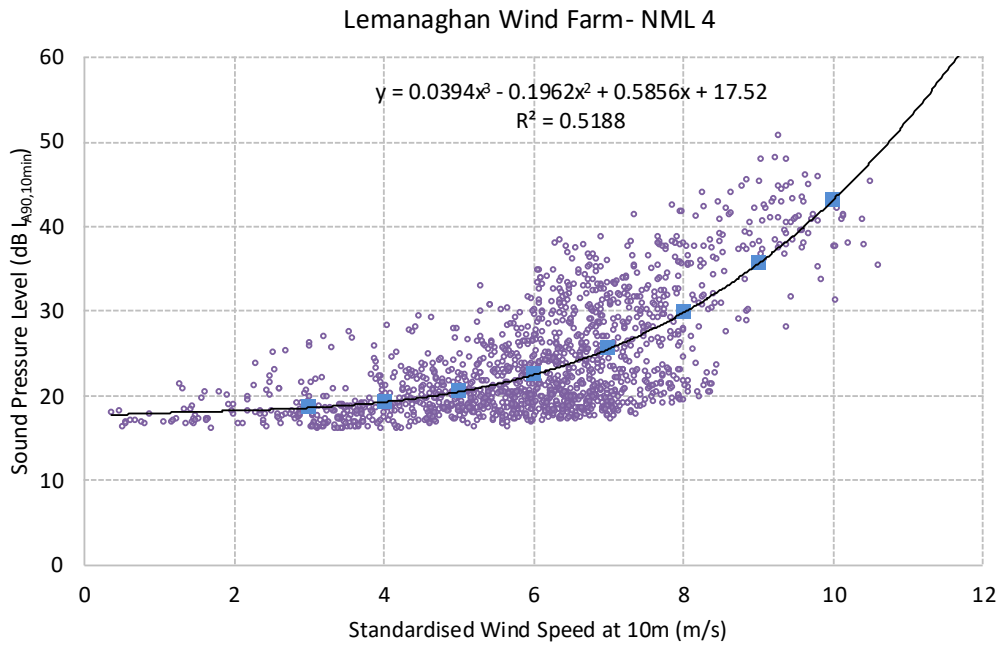


Figure 12-12 NML4 Night

12.4.1.5 NML5

Figure 12-13 and Figure 12-14 show the derived daytime and night-time background noise level for NML 5.

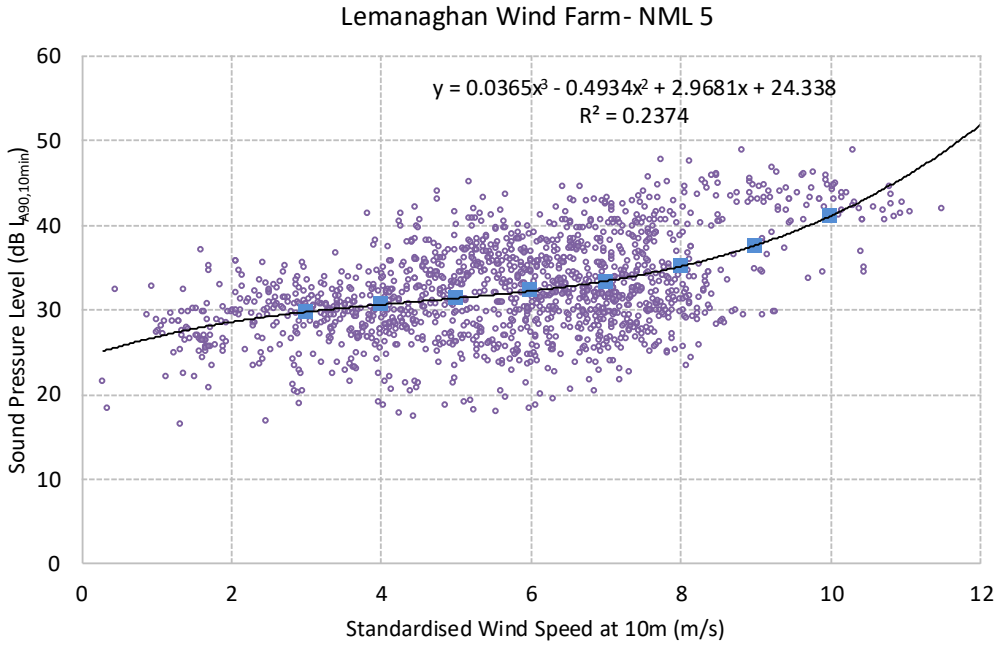


Figure 12-13 NML5 Daytime

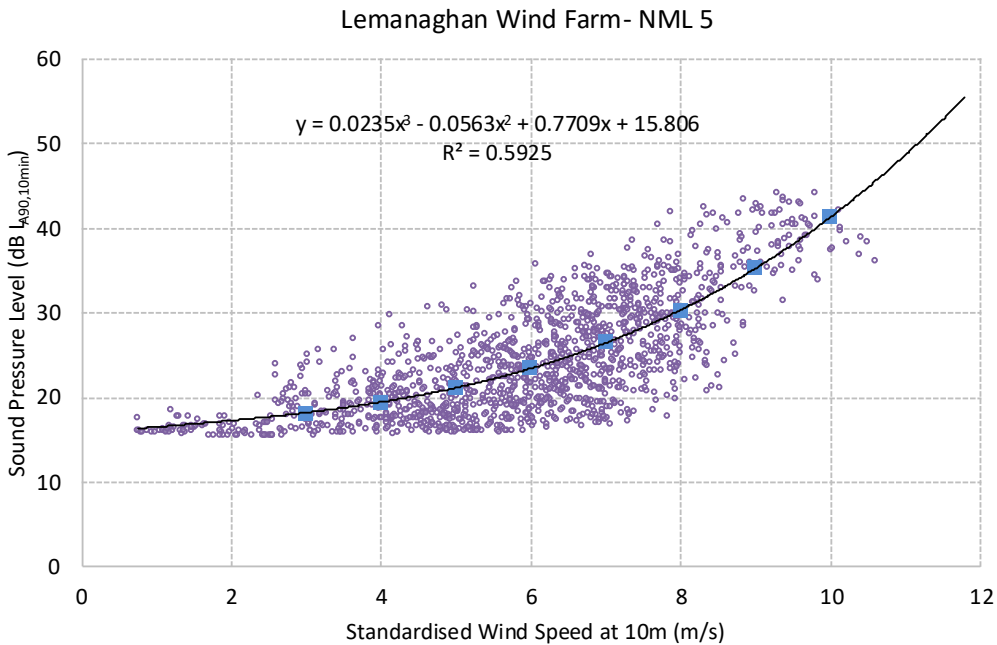


Figure 12-14 NML5 Night

12.4.1.6 NML6

Figure 12-15 and Figure 12-16 show the derived daytime and night-time background noise level for NML 6.

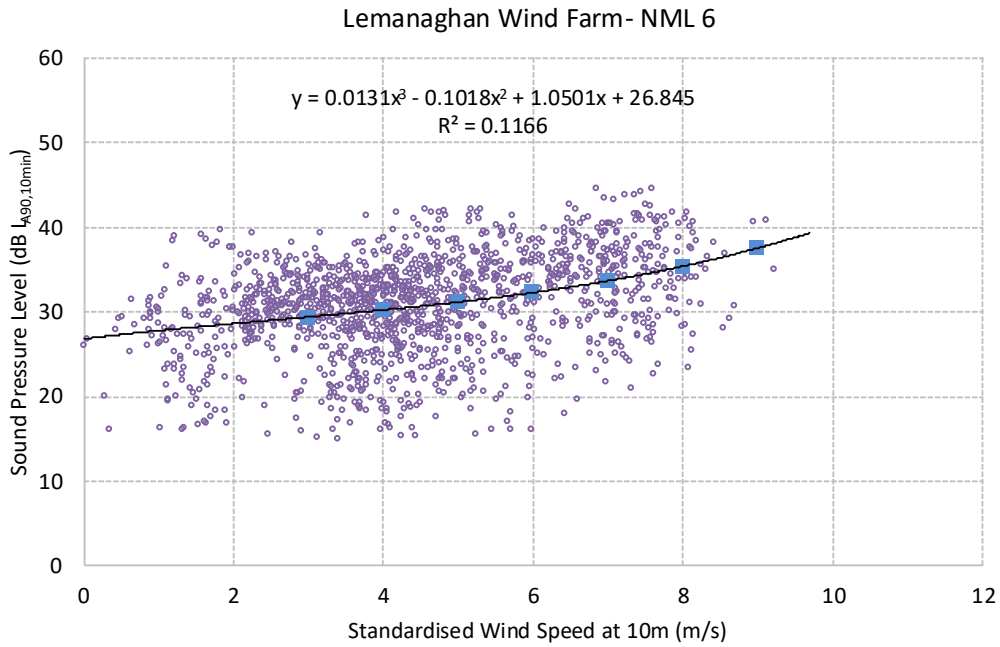


Figure 12-15 NML6 Daytime

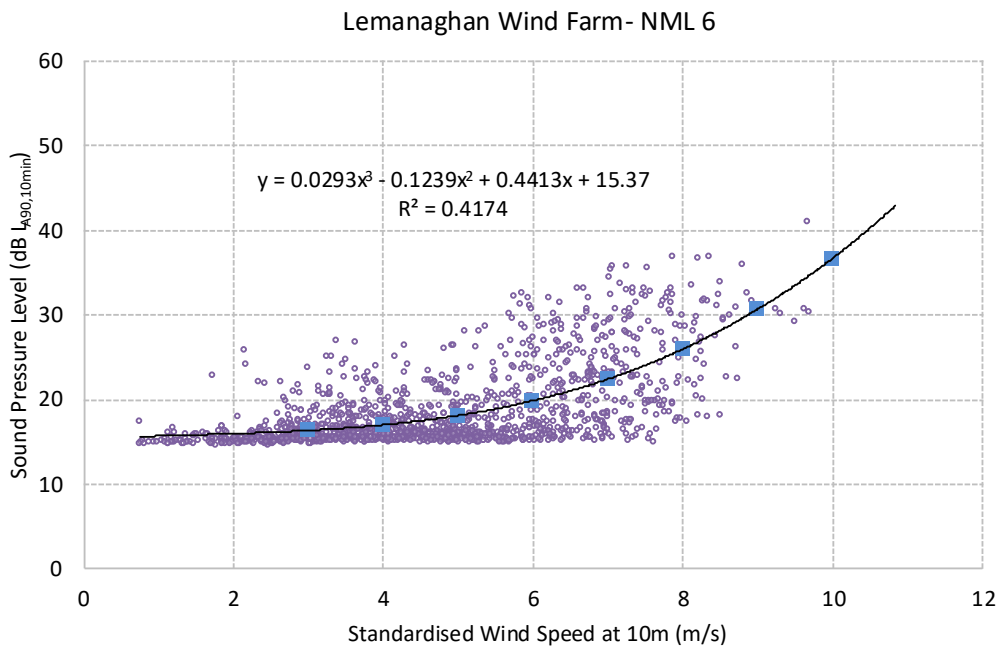


Figure 12-16 NML6 Night

12.4.1.7 NML7

Figure 12-17 and Figure 12-18 show the derived daytime and night-time background noise level for NML 7.

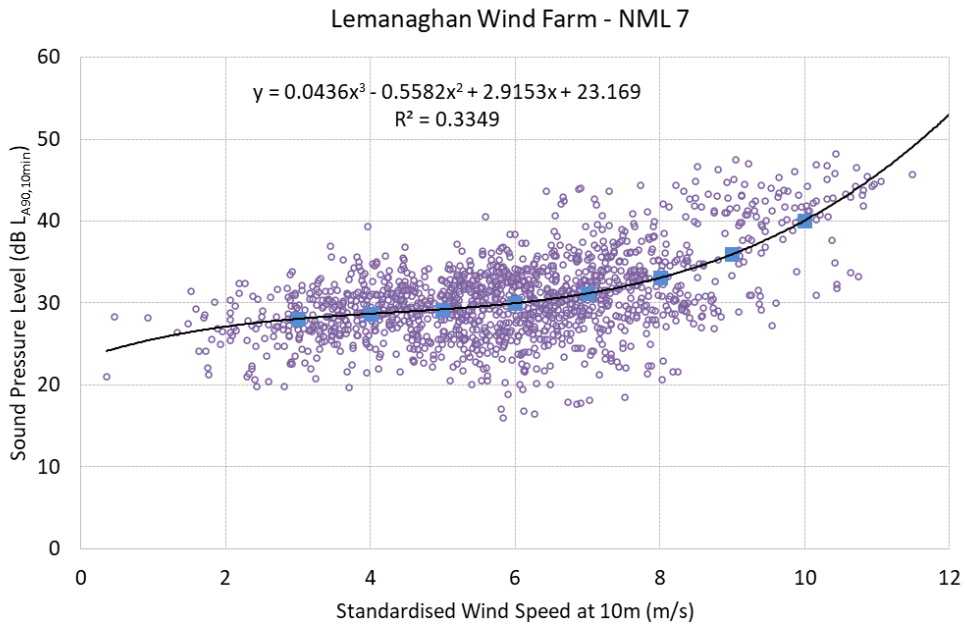


Figure 12-17 NML7 Daytime

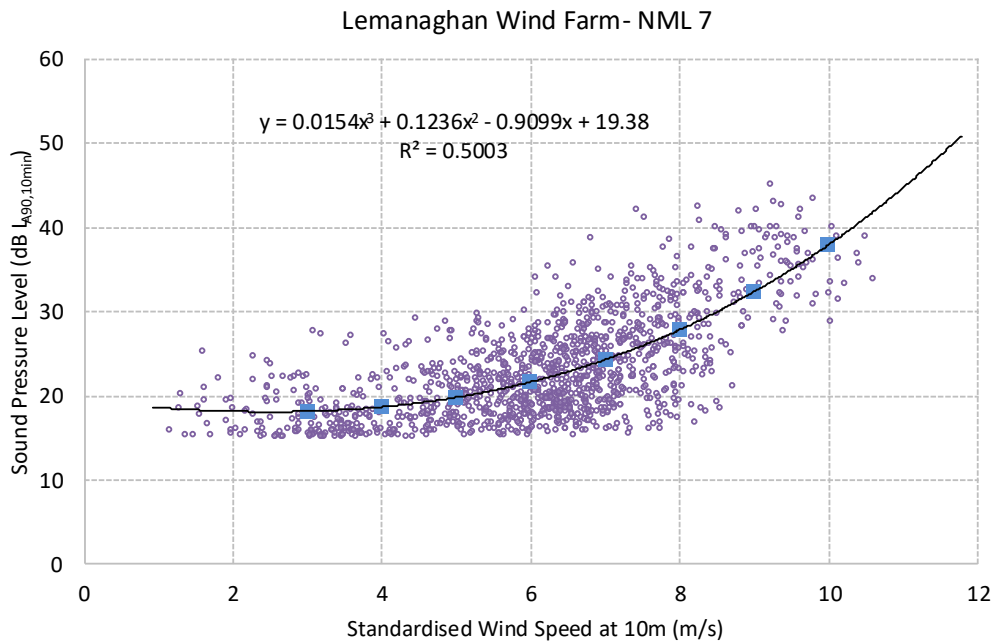


Figure 12-18 NML7 Night

12.4.1.8 **NML8**

Figure 12-19 and Figure 12-20 show the derived daytime and night-time background noise level for NML 8.

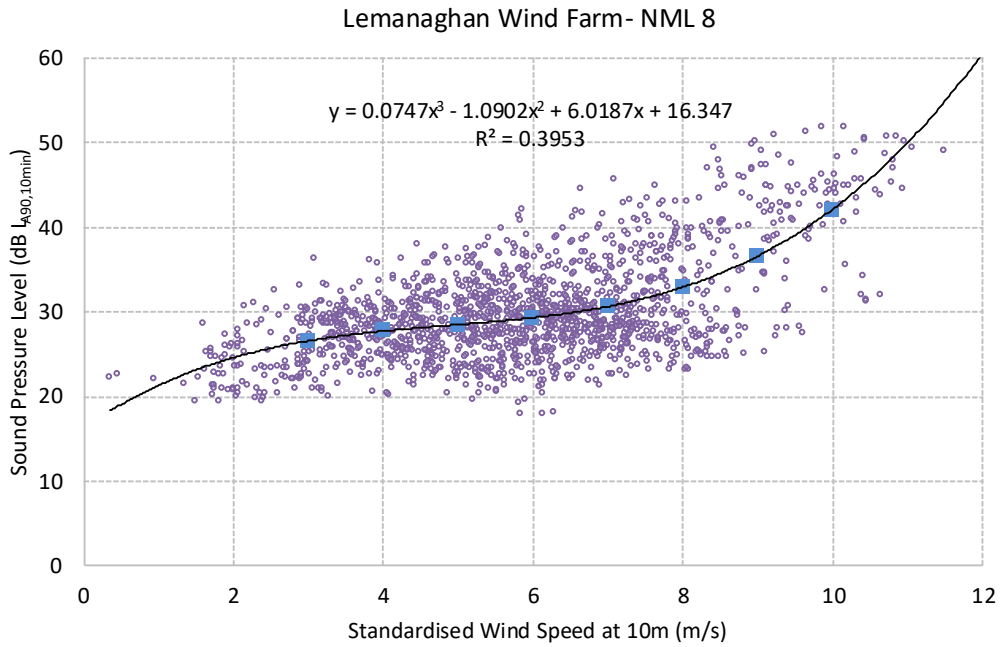


Figure 12-19 NML8 Daytime

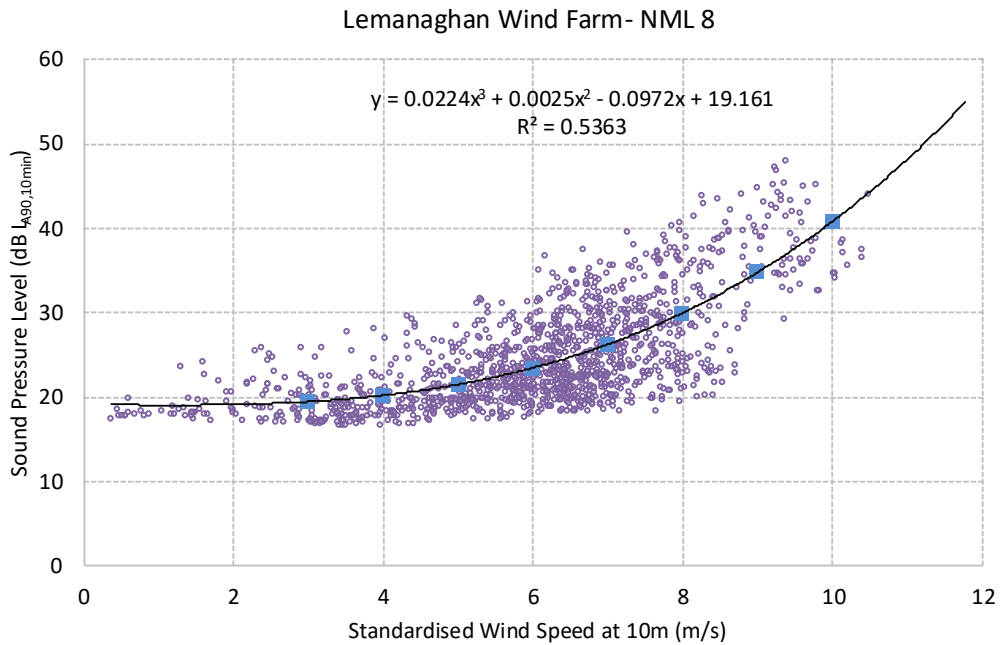


Figure 12-20 NML8 Night

12.4.2 Summary of Derived Background Noise Levels

Table 12-13 and Table 12-14 present the various derived $L_{A90,10min}$ noise levels for each of the NMLs for daytime quiet periods and night-time periods. These levels have been derived using regression analysis carried out on the datasets measured in line with best practice guidance contained in the IOA GPG and its SGN No. 2 Data Collection.

Table 12-13 Derived Background Noise Levels of $L_{A90,10min}$ for Various Wind Speeds - Daytime

Locations	Period	Background Noise Levels dB L_{A90} at standardised 10m height wind speed m/s for 145 m Hub Height							
		3	4	5	6	7	8	9	10
NML1 (H085)	Daytime	26.3	27.3	28.3	29.6	31.2	33.2	35.7	38.9
NML2 (H025)	Daytime	30.7	32.0	33.4	34.7	35.8	36.5	36.7	36.7
NML3 (within the site)	Daytime	27.6	27.9	27.9	27.8	27.9	28.6	30.0	32.5
NML4 (H011)	Daytime	26.1	26.2	26.7	27.9	29.9	32.9	37.1	42.6
NML5 (H111)	Daytime	29.8	30.6	31.4	32.3	33.4	35.2	37.7	41.1
NML6 (H026)	Daytime	29.4	30.3	31.2	32.3	33.7	35.4	37.6	40.2
NML7 (H077)	Daytime	28.1	28.7	29.2	30.0	31.2	33.1	36.0	40.1
NML8 (H003)	Daytime	26.6	27.8	28.5	29.3	30.7	32.9	36.6	42.2

Table 12-14 Derived Background Noise Levels of $L_{A90,10min}$ for Various Wind Speeds - Night-time

Locations	Period	Background Noise Levels dB L_{A90} at standardised 10m height wind speed m/s for 145 m Hub Height							
		3	4	5	6	7	8	9	10
NML1 (H085)	Night-time	16.8	17.8	19.4	21.4	23.5	25.5	27.4	28.7
NML2 (H025)	Night-time	18.3	19.5	21.2	23.3	25.7	28.3	31.2	34.1
NML3 (within the site)	Night-time	18.5	18.9	19.5	20.2	21.0	22.1	23.5	25.1

Locations	Period	Background Noise Levels dB L _{A90} at standardised 10m height wind speed m/s for 145 m Hub Height							
		3	4	5	6	7	8	9	10
NML4 (H011)	Night-time	18.6	19.2	20.5	22.5	25.5	29.8	35.6	43.1
NML5 (H111)	Night-time	18.2	19.5	21.2	23.5	26.6	30.5	35.4	41.4
NML6 (H026)	Night-time	16.4	17	18.1	19.9	22.5	26.0	30.7	36.7
NML7 (H077)	Night-time	18.2	18.7	19.8	21.7	24.3	27.9	32.4	38.0
NML8 (H003)	Night-time	19.5	20.2	21.5	23.5	26.3	30.0	34.8	40.8

12.4.3 Wind Turbine Noise Limits

With respect to the relevant guidance documents outlined in Section 12.3.2, noise criteria curves have been established for the Proposed Project. The criteria curves have been derived following a detailed review of the background noise data conducted at representative NSLs described in Section 12.4.2.

This set of criteria adopted is in line with the intent of the applicable DoEHLG 2006 Guidelines and is comparable to noise planning conditions applied to similar sites previously granted planning permission by ACP and local planning authorities in Ireland. For the Proposed Project, it is considered that a lower daytime threshold of 40 dB L_{A90,10min} for low noise environments where the background noise is less than 30 dB(A) is appropriate in respect of the following points:

- The EPA document ‘Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)’ proposes a daytime noise criterion of 45 dB(A) in ‘areas of low background noise’. Turbine noise limits are detailed in terms of the L_{A90} parameter while the NG4 daytime limit is detailed in terms of the L_{Aeq}. The accepted difference between the L_{Aeq} and L_{A90} for wind turbine noise assessments is 2 dB, i.e., 45 dB L_{Aeq} equates to 43 L_{A90}. This approach infers a 3 dB difference when accounting for difference parameters between the NG4 limits and the DoEHLG 2006 Guidelines limits. The proposed lower threshold daytime criterion for wind turbine noise here is 3 dB more stringent than the equivalent daytime noise limit for areas of low background noise outlined in NG4.
- A lower threshold of 40 or 43 dB is commonly adopted in planning conditions for similar developments that have been granted planning permission by ACP and local planning authorities in recent years for example, Derrinlough Wind Farm (ACP Ref: 306706-20) Derryadd Wind Farm (ACP Ref: PL14.303592), Coole Wind Farm (ACP Ref: PL25M.300686) Cloncreen Wind Farm (ACP Ref: PA0047), Borrisbeg Wind Farm (ACP-318704-23) and Ballivor Wind Farm (ACP-316212-23).

The proposed turbine noise criteria summarised below should apply at all NSLs within the study area. The proposed turbine noise limits shall be cumulative and relate to noise from the contribution of all operational wind turbines.

In summary, the operational noise limits proposed for the Proposed Wind Farm are:

- 40 dB $L_{A90,10min}$ for daytime in quiet environments with typical background noise of less than 30 dB $L_{A90,10min}$.
- 45 dB $L_{A90,10min}$ for daytime in environments with typical background noise greater than or equal to 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB(A) above background noise (whichever is the higher); and
- 43 dB $L_{A90,10min}$ for night-time periods or a maximum increase of 5 dB(A) above background noise (whichever is the higher).

Day and nighttime noise criteria curves have been determined from review of the derived background noise levels at 8 no. NSLs surrounding the Proposed Wind Farm and are presented in the relevant sections of this chapter.

12.4.3.1 Assigning Turbine Noise Limits

The derived turbine noise limits have been assigned to the various NSLs where noise monitoring has been undertaken. Where background noise measurements have been conducted in the vicinity and/or are judged to be typical/indicative of the background noise levels at other locations, these can be assigned to the nearby representative location for the purposes of setting appropriate turbine noise limits for the assessment. That approach is in line with best practice guidance set out in the IOA GPG.

For the purpose of this assessment, a conservative 'envelope review' will be applied to all non-surveyed locations. The envelope review is a conservative approach that adopts the lowest noise criteria derived from the measured background noise levels and applies it to all non-surveyed locations. This is not to say that this is the actual background noise at these locations. Table 12-15 outlines the operational noise criteria for each measurement location. Turbine noise limits have been established for wind speeds between 3 and 9 m/s, covering the range from turbine cut-in up to the point where the turbine reaches its maximum sound power level.

In the absence of measured background noise data above 9 m/s, a conservative approach assumes that the background noise levels derived at 9 m/s apply at higher wind speeds. However, it is expected that as wind speeds increase beyond 9 m/s, background noise levels will also rise.

Table 12-15 Proposed Noise Criteria Curves

Location	Period	Turbine Noise Limits $L_{A90, 10min}$ Levels (dB) at Various Standardised 10m Height Wind Speeds)						
		3	4	5	6	7	8	9
NML 1 (H085)	Day	40	40	40	40	45	45	45
	Night	43	43	43	43	43	43	43
NML 2 (H025)	Day	45	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43
NML 3 (within the site)	Day	40	40	40	40	40	40	45
	Night	43	43	43	43	43	43	43
NML 4 (H011)	Day	40	40	40	40	40	45	45
	Night	43	43	43	43	43	43	43
NML 5 (H111)	Day	40	45	45	45	45	45	45

Location	Period	Turbine Noise Limits $L_{A90, 10min}$ Levels (dB) at Various Standardised 10m Height Wind Speeds)						
		3	4	5	6	7	8	9
	Night	43	43	43	43	43	43	43
NML 6 (H026)	Day	40	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43
NML 7 (H077)	Day	40	40	40	45	45	45	45
	Night	43	43	43	43	43	43	43
NML 8 (H003)	Day	40	40	40	40	45	45	45
	Night	43	43	43	43	43	43	43

12.4.4 Noise Limits for Fixed Plant

Based on a review of the measured noise from the background noise survey (Section 12.4.2), the NSLs in the vicinity of the site are defined as areas of low background noise as per the NG4 guidance. As the proposed substation will operate on a 24-hour basis, the potential impact during night-time periods governs the assessment. A nighttime criterion of 35 dB $L_{Aeq,T}$ is considered appropriate for the operation of the substation. The substation design will ensure that the noise emissions do not exceed a rated level of 35 dB $L_{Ar,T}$ accounting for audible tones or impulsive characteristics at the nearest NSLs. 35 dB $L_{Ar,T}$ is considered a low level of noise.

In accordance with to the guidance from the BS4142 standard, discussed in Section 12.3.2.5.1, it is considered that the proposed absolute criterion of 35 dB $L_{Aeq,T}$ for noise from the substation is robust and should prevent adverse impacts at NSLs.

12.5 Likely Significant Effects

12.5.1 Do-nothing Scenario

If the Proposed Project were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence (Ref. P0-500-01), and therefore, ongoing site management and environmental monitoring would continue. Please note, if the Proposed Project were not to proceed, the implementation of peatland rehabilitation plans as required under IPC License would occur. These land uses and activities will also continue if the Proposed Project does proceed.

If the Proposed Project is not progressed, the existing noise environment is expected to remain unchanged. Any increases in traffic volumes on the local road network would not be expected to result in a significant change to the overall ambient and background noise levels within the study area.

However, if the Proposed Project were not to proceed, the opportunity to capture part of Offaly's valuable renewable energy resource would be lost, as would opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

12.5.2 Construction Phase

Construction noise prediction calculations have been conducted using the assessment methodology outlined and discussed in Sections 12.3.2.1 to Section 12.3.2.3. The source noise levels referred to in this section are indicative of the type of plant items and activities associated with the construction of the Proposed Project.

The highest predicted noise levels are expected to occur for short periods of time at a limited number of properties. Construction noise levels will be lower than these levels for most of the time at most properties in the vicinity of the Proposed Project.

There are several stages and elements associated with the construction phase of the Proposed Project which will include but are not limited to the following:

- Construction of new entrance(s) and hardcore existing entrance, construction of internal roads;
- Excavation and operation of borrow pits;
- Construction of turbines and hardstand areas;
- Construction of temporary construction compounds;
- Enhancement and Mitigation Areas;
- Construction of substation;
- Grid Connection and OHL Cabling.

Chapter 4 Description of the Proposed Project has detailed information on each of these elements.

In general, the distances between the construction activities associated with the Proposed Project and the nearest NSLs are such that there is no anticipated significant noise or vibration impacts at the NSLs. The following sections present an assessment of the main stages of the construction phase that have the potential for associated noise and vibration effects, all other stages and elements are considered unlikely to have any significant noise and vibration effects namely, temporary construction compounds, amenity tracks, amenity car parks, anemometry mast, security cabins and temporary accommodating works for the TDR.

Construction activities will be carried out during normal daytime working hours (i.e., weekdays 07:00hrs – 19:00hrs and Saturdays 07:00hrs – 14:00hrs). However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (e.g., concrete pours) or to accommodate delivery of large turbine components along public routes it could be necessary on occasion to work outside of these hours. Any such out of hours working will be agreed in advance with the Local Authority.

12.5.2.1 General Construction of Turbines, Hardstand Areas and Anemometry Mast

12.5.2.1.1 Noise

Several noise sources that would be expected on a construction site of this nature have been identified and predictions of the potential noise emissions have been calculated at the nearest NSL. In this instance the closest noise sensitive receptors are Locations H003 and H002 which are situated approximately 896 m and 897 m respectively from the proposed turbine T10 and T05. The distance between the existing met mast and the proposed anemometry mast are respectively 1378 m and 786 m from the nearest NSL (H012 and H005, respectively).

Table 12-16 outlines the typical construction noise levels associated with the proposed works for this element of the construction. Calculations have assumed an on-time of 66% for each item of plant, i.e.,

that the item is operational for 8 hours over a 12-hour assessment period, and soft ground type (0% reflection).

Table 12-16 Typical Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB L _{Aeq,T}) ⁶	Predicted Noise Level (dB L _{Aeq,T}) at distance (896m)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials within the site	79	26
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for turbine foundations	75	22
Excavator Mounted Rock Breaker (C9.12)	Rock Breaking	85	32
General Construction (Various)	All general activities plus deliveries of materials and plant to the site	84	31
Concrete Mixer Truck and Concrete Pump (C.4.27)	Foundations	79	26
Dumper Truck (C.4.4)	Removing peat and spoil and transporting fill and other materials.	76	23
Mobile Telescopic Crane (C.4.39)	Installation of nacelles	77	24
JCB (D.8.13)	Road surfacing.	82	29
Vibrating Rollers (D.8.29)	For services, drainage and landscaping.	77	24
Cumulative Construction Noise Level			37

At 896 m from the works the predicted noise levels from construction activities are in the range of 22 to 32 dB L_{Aeq,T} with a total theoretical precautionary cumulative construction level of the order of 37 dB L_{Aeq,T}. In all instances the predicted noise levels at the nearest NSLs are below the adopted significance threshold outlined in Table 12-1 (Category A – 65 dB L_{Aeq,T} during daytime periods). This assessment is considered representative of worst-case construction noise levels at NSLs.

⁶ All plant noise levels are derived from BS5228: Part 1

There is no item of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the thresholds outlined in Table 12-1 and this finding is valid should all items of plant operate simultaneously. No specific mitigation measures are required.

12.5.2.1.2 **Vibration**

Rock breaking activity will likely generate the highest levels of vibrations through the ground. Empirical data for this activity is not provided in BS 5228-2, however the likely level of vibration from this activity is expected to be substantially below the vibration criteria for building damage on experience from other sites. AWN Consulting Ltd (the author of this chapter) has previously conducted vibration measurements under controlled conditions, during trial construction works on a sample site where rock breaking was carried out. The trial construction works consisted of the use of the following plant and equipment when measured at various distances:

- Three tonne hydraulic breaker on small CAT tracked excavator
- Six tonne hydraulic breaker on large Liebherr tracked excavator.

Vibration measurements were conducted during various staged activities and at various distances. Peak vibration levels during staged activities using the three-tonne breaker ranged from 0.48 PPV (mm/s) to 0.25 PPV (mm/s) at distances of 10m to 50m respectively from the breaking activities. Using a six-tonne breaker, measured vibration levels ranged between 1.49 PPV (mm/s) to 0.24 PPV (mm/s) at distances of 10m to 50m respectively. While these measurements relate to breaking of concrete, the range of values recorded provides some context in relation to typical ranges of vibration generated by construction-breaking activity. The levels measured at up to 50m from the activity are significantly below the assessment threshold set out in Table 12-5.

Due to the distance of the proposed works from sensitive locations vibration effects are not likely to occur at any NSL.

12.5.2.1.3 **Description of Effects**

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects (outlined in Section 1.7.2 of Chapter 1), the likely potential effects at the nearest NSL, under a theoretical precautionary scenario, associated with construction of proposed turbines and hardstanding areas are described as follows:

Quality	Significance	Duration
Negative	Not Significant	Short Term

The above effect should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

12.5.2.2 **Construction of Internal Roads and Amenity Track**

It is proposed to construct new internal roads and amenity track, as well as upgrade existing internal roads for internal access within the site and for the purposes of amenity. Review of the internal road and amenity track layout has identified that the nearest NSL to any point of the Proposed Project is approximately 31 m to receptor H345. All other locations are at greater distances with the majority at significantly greater distances. The full description of the new road is outlined in Chapter 4 Description of the Proposed Project.

Table 12-17 Indicative Noise Levels from Construction Plant at Various Distances from Internal Roads and Amenity Track

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB L _{Aeq,T}) ⁷	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB L _{Aeq,T}) at 31 m	Predicted Noise Level at Stated Distance from Edge of Works (dB L _{Aeq,T}) at 70 m
Tracked Excavator (C.4.64)	75	63	56
HGV Movement (C.2.30)	79	67	60
Vibrating Rollers (D.8.29)	77	64	57
Dumper Truck (C.4.4)	76	65	58
Cumulative Total	–	71	64

The table shows that at 31 m, noise levels exceed the construction noise thresholds in Table 12-1, however, as these works will progress along the road the precautionary impacts predicted will reduce. Works will therefore be in proximity to the closest NSLs for a limited period and giving consideration to the temporal criteria detailed in Section 12.3.2.2.1 there is unlikely to be a significant effect at the closest NSL. At 70 m distance or more, the noise levels due to construction of internal roads are below the adopted significance threshold outlined in Table 12-1 (Category A – 65 dB L_{Aeq,T} during daytime periods).

12.5.2.2.1 **Vibration**

During the construction of the amenity and internal roads, the activity that will the most likely generate the highest levels of vibration are the vibratory rollers used for compacting the surfaces. An assessment has been undertaken to determine the vibration impact at the nearest receiver based on *BS5228-2 Table E-1 Empirical predictors for ground borne vibration arising from mechanized construction works*. In this instance, the characteristics assumed as a representative vibratory roller are:

- number of drums: 2,
- vibration amplitude: 0.91 mm,
- drum width: 1.68 m.

At a distance of 31 m from the selected machinery, the calculated vibration levels for a steady state operation in ppv, have the following probability distribution:

- a 50% chance of exceeding 0.49 mm/s
- a 33% chance of exceeding 0.94 mm/s
- a 5% chance of exceeding 1.81 mm/s

Based on the above assumption, as these values are well within 8mm/s vibration criteria presented in Section 12.3.2.6, there will be no significant vibration impacts associated with the construction phase of the Proposed Project and therefore no specific mitigation measures will be required. Due to the distance of the proposed works from sensitive locations, vibration effects are not likely to occur at any NSL.

⁷ All plant noise levels are taken from BS5228: Part 1

12.5.2.2.2 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. Any exceedance would be short term, and therefore not significant. With respect to the EPA’s criteria for description of effects, the likely potential effects, under a theoretical precautionary scenario, at the nearest NSL associated with construction of internal roads are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

The above effect should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

12.5.2.3 Borrow Pit Excavation and Reinstatement

12.5.2.3.1 Noise

To inform this aspect of the proposal, a noise assessment has been undertaken to consider the impacts of rock breaking and land clearing. In this instance the theoretical precautionary scenario will be rock breaking due to higher noise levels of source plant that will be in operation for this activity. The rock breaking activity assessment has been based on the following assumptions:

- 1 mobile crusher and 1 rock breaker will be used at each borrow pit location;
- The plant will operate simultaneously in the vicinity of the proposed borrow pit location

Table 12-18 outlines the assumed noise levels for the plant items as extracted from BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

Table 12-18 Plant Noise Emissions

Location	Plant Sound Power level (dB L _{WA}) ⁸								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Crusher (C.1.14)	95	98	98	106	103	100	95	86	110
Rock Breaker (C.9.12)	93	101	104	114	115	116	113	106	121
HGV Movement (C.2.30)	77	88	95	93	93	92	86	76	98
Dump Truck (C.4.4)	87	92	99	97	102	99	94	85	105
Semi-mobile screen/stockpiler (C.10.14)	69	82	96	99	103	101	99	88	107

⁸ All plant noise levels are derived from BS5228: Part 1

Location	Plant Sound Power level (dB L _{WA}) ⁸								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Tracked Excavator (C.2.21)	77	88	95	93	93	92	86	76	99

A noise model prediction model has been prepared to consider the expected noise emissions from the proposed construction works at borrow pits as outlined above. A percentage on-time of 66% has been used for the noise calculations.

The nearest NSL to the proposed borrow pit location is NSL 75, which lies approximately 1071 m to the southwest of BP1 (see Table 4-5 in Chapter 4). Consequently, the resulting noise levels at the NSL is predicted to be low. The predicted levels at the closest NSL assuming all plant operates simultaneously is 45 dB L_{Aeq}, which is 20 dB below the adopted criteria of 65 dB L_{Aeq,T}. It is expected that construction works at the borrow pits will only occur during daytime periods.

12.5.2.3.2 **Vibration**

Due to the distance of the proposed works at borrow pits from NSLs, vibration effects are not likely to occur at any NSL.

12.5.2.3.3 **Description of Effects**

The predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential associated effects at the nearest NSLs, under a theoretical precautionary scenario, associated with operation of borrow pits are described follows:

Quality	Significance	Duration
Negative	Not Significant	Short Term

12.5.2.4 **Peat Deposition Areas**

12.5.2.4.1 **Noise**

Peat Deposition Areas (PDAs) are proposed as part of the Proposed Wind Farm. The nearest NSLs to any of the proposed PDAs are H335 and H060 at distances of 480 m and 544 m respectively from the PDA located south of the proposed onsite 220kV substation. The construction machinery to be used in these areas presented in Table 12-19.

Table 12-19 Typical Construction Noise Emission Levels – Peat Deposition Areas

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L _{Aeq,T}) ⁹	Predicted Noise Level at 480 m
Tracked Excavator (C.4.64)	75	39

⁹ All plant noise levels are derived from BS 5228: Part 1

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L _{Aeq,T}) ⁹	Predicted Noise Level at 480 m
Dumper Truck (C.4.39)	7	41
Total Construction Noise		43

These levels of noise are within the construction noise criterion outlined in Section 12.3.2.1, (Category A – 65 dB L_{Aeq,T} during daytime periods) therefore it is concluded that there will be no significant noise impact associated with the peat deposition areas, therefore no specific mitigation measures are required.

12.5.2.4.2 **Vibration**

Due to the distance of the proposed PDAs from NSLs, and nature of the proposed works, vibration effects are not likely to occur at any NSL.

12.5.2.4.3 **Description of Effects**

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects, the likely potential associated effects at the nearest NSLs, under a theoretical precautionary scenario, associated with the proposed PDAs are described are below:

Quality	Significance	Duration
Negative	Not significant	Short-term

12.5.2.5 **Temporary Construction Compounds**

12.5.2.5.1 **Noise**

There are 5 no. temporary construction compounds (TCC) proposed as part of the Proposed Wind Farm. The nearest NSLs to any of the proposed TCC are H1614 and H0345 at a distance of 252 m and 266 m respectively from the proposed compound located northwest of the proposed T01, near the swan wetland enhancement area (see Chapter 4). It is unlikely that any construction machinery will be used at any of these construction compounds with the exception of an excavator and a crane to install the containers. The construction machinery to be used in these areas presented in Table 12-20.

Table 12-20 Typical Construction Noise Emission Levels – Temporary Construction Compounds

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L _{Aeq,T}) ¹⁰	Predicted Noise Level at 252 m
Tracked Excavator (C.4.64)	75	45
Tower Crane (C.4.49)	77	47

¹⁰ All plant noise levels are derived from BS 5228: Part 1

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L _{Aeq,T}) ¹⁰	Predicted Noise Level at 252 m
Total Construction Noise		49

These levels of noise are within the construction noise criterion outlined in Section 12.3.2.1, (Category A – 65 dB L_{Aeq,T} during daytime periods) therefore it is concluded that there will be no significant noise impact associated with the temporary construction compound areas, therefore no specific mitigation measures are required.

12.5.2.5.2 **Vibration**

Due to the distance of the proposed compounds from NSLs, and nature of the proposed works, vibration effects are not likely to occur at any NSL.

12.5.2.5.3 **Description of Effects**

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects, the likely potential associated effects at the nearest NSLs, under a theoretical precautionary scenario, associated with the proposed TCCs are described below:

Quality	Significance	Duration
Negative	Not significant	Short-term

12.5.2.6 **Biodiversity Management and Enhancement Areas**

A Biodiversity Management and Enhancement Plan (BMEP) is proposed to offset the loss of habitats identified within the Proposed Project site and further enhance the biodiversity of the site and its environs. Part of this enhancement areas include flooding of several areas (whooper swan area) and mowing of land for lapwing birds; and vegetation removal and replanting.

12.5.2.6.1 **Noise**

The nearest NSLs to any of the proposed enhancement areas is H1614 at a distance of approximately 265 m from the whooper swan area located northwest of the proposed T01. The construction machinery to be used in these areas presented in Table 12-21.

Table 12-21 Typical Construction Noise Emission Levels – Enhancement Areas

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L _{Aeq,T}) ¹¹	Predicted Noise Level at 252 m
Tracked Excavator (C.4.64)	75	44
Electric Water Pump (C.11.3)	69	38
Total Construction Noise		45

These levels of noise are within the construction noise criterion outlined in Section 12.3.2.1, (Category A – 65 dB L_{Aeq,T} during daytime periods) therefore it is concluded that there will be no significant noise impact associated with the biodiversity management areas, therefore no specific mitigation measures are required.

12.5.2.6.2 **Vibration**

Due to the distance of the proposed biodiversity management areas from NSLs, and nature of the proposed works, vibration effects are not likely to occur at any NSL.

12.5.2.6.3 **Description of Effects**

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects, the likely potential associated effects at the nearest NSLs, under a theoretical precautionary scenario, associated with the proposed ecological and ornithological enhancement and mitigation are described below:

Quality	Significance	Duration
Negative	Not significant	Short-term

12.5.2.7 **Substation and Ancillary Construction Works**

12.5.2.7.1 **Noise**

The nearest NSL to the proposed onsite 220kV substation is NSL 335, which is at approximately 355 m northeast. The proposed telecoms tower and nearest proposed new steel mast are approximately 367 m and 377 m from NSL 335. Under a theoretical precautionary scenario, i.e., assuming the same construction activities as outlined in Table 12-16 above, it is predicted that the likely precautionary noise levels from construction activities associated with the onsite 220kV substation and ancillary will be in the order of 54 dB L_{Aeq,T} at the nearest NSL. This level of noise is well below the significance threshold of 65 dB L_{Aeq,T}, therefore no specific mitigation measures are required.

12.5.2.7.2 **Vibration**

Due to the distance of the proposed works associated with the proposed onsite 220kV substation from NSLs, vibration effects are not likely to occur at any NSL.

12.5.2.7.3 **Description of Effects**

¹¹ All plant noise levels are derived from BS 5228: Part 1

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with the construction of the substation are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

12.5.2.8 Proposed Grid Connection and OHL Cabling Construction

The Proposed Grid Connection includes an overhead line (OHL) cabling from the proposed onsite 220kV substation, in the townland of Cooldorragh, Co. Offaly, and will require a break in the existing Shannonbridge-Maynooth 220kV OHL to facilitate the Proposed Wind Farm connection to the national electricity grid. The full description of the cable route is outlined in Chapter 4 of this EIAR. Review of the Proposed Grid Connection has identified that the nearest NSL (H385) is approximately 194 m from the Proposed Grid Connection OHL cabling.

12.5.2.8.1 Noise

Table 12-22 outlines the typical construction noise levels associated with the proposed works associated with the construction of the Proposed Grid Connection. Calculations have assumed an on-time of 66% for each item of plant, i.e., that the item is operational for 8 hours over a 12-hour assessment period. Note the plant items and activities are indicative and based on conservative assumption to be representative of a reasonable worst case.

Table 12-22 Indicative Noise Levels from Construction Plant at Various Distances from the Proposed Grid Connection OHL Cabling

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L _{Aeq,Thr})	Calculated Construction Noise Level dB L _{Aeq,T} at distance from works (m)		
		100 m	200 m	300 m
HGV Movement (C.2.30)	79	53	47	42
Tracked Excavator (C.4.64)	75	49	43	38
Excavator Mounted Rock Breaker (C9.12)	85	59	53	48
General Construction (Various)	84	58	52	47
Concrete Mixer Truck and Concrete Pump (C.4.27)	79	53	47	42

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L _{Aeq,Thr})	Calculated Construction Noise Level dB L _{Aeq,T} at distance from works (m)		
		100 m	200 m	300 m
Dumper Truck (C.4.4)	76	50	44	39
Mobile Telescopic Crane (C.4.39)	77	51	45	40
Dewatering Pumps (D.7.70)	81	55	49	44
Vibrating Rollers (D.8.29)	77	51	45	41
Total Construction Noise	–	64	58	53

The construction activities for the Proposed Grid Connection OHL cabling and associated infrastructure such as the proposed new steel masts and all ancillary infrastructure will vary and will not be continuous in nature. The noise levels are not expected to exceed the thresholds outlined in Section 12.3.2.2.1. Therefore, a significant effect is not expected at any NSL from the Proposed Grid Connection works, and specific mitigation measures are not required.

12.5.2.8.2 **Vibration**

Due to the distance of the proposed works associated with the onsite substation from NSLs, vibration effects are not likely to occur at any NSL.

12.5.2.8.3 **Description of Effects**

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects, the potential associated effects at the nearest NSLs, under a theoretical precautionary scenario, associated with the Proposed Grid Connection OHL cabling route and associated infrastructure are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

12.5.2.9 **Construction Traffic**

This section has been prepared in order to review potential noise impacts associated with construction traffic on the local road network. The information presented in Chapter 15 Material Assets – Traffic and Transportation has been used to inform the assessment here. The following situations are commented upon here:

- Stage 1: Concrete Foundation Delivery

- > Stage 2: Site Preparation and General Construction works
- > Stage 3: Turbine Delivery – Abnormal Loads
- > Stage 4: Turbine Delivery – Standard Loads

Changes in the traffic noise levels associated with the additional traffic for each of the construction stages listed above have been calculated for several routes.

Table 12-23 presents a summary of the data used for the calculations in this assessment. The traffic figures have been derived from the traffic data in Chapter 15 with conversions applied for the passenger car unit (PCU) factors.

Table 12-23 Assumptions for Construction Traffic Noise Assessment

Route	Stage	LGV	HGV
1 – N52 between Tullamore and Kilbeggan	Existing	15269	1097
	Existing + 1	15339	1257
	Existing + 2	15339	1156
	Existing + 3	15314	1103
	Existing + 4	15314	1099
2 – N52 southwest of Tullamore	Existing	8231	452
	Existing + 1	8301	612
	Existing + 2	8301	511
	Existing + 3	8276	458
	Existing + 4	8276	454
3 – N52 between Birr and Kilcormac	Existing	4175	310
	Existing + 1	4245	369
	Existing + 2	4220	316
	Existing + 3	4245	470
	Existing + 4	4220	311
4 – N62 south of Ferbane	Existing	7583	518
	Existing + 1	7653	678
	Existing + 2	7653	578
	Existing + 3	7628	524

Route	Stage	LGV	HGV
	Existing + 4	7628	520
5 – R436 east of Ferbane	Existing	3792	121
	Existing + 1	3862	281
	Existing + 2	3862	181
	Existing + 3	3837	127
	Existing + 4	3837	123
	6 – N62 north of Ferbane	Existing	7845
Existing + 1		7915	652
Existing + 2		7915	552
Existing + 3		7890	498
Existing + 4		7890	494

Based on the assumptions presented above changes in noise level based on the existing flows have been estimated and is presented in Table 12-24.

Table 12-24 Estimated Changes in Traffic Noise Levels

Route	Stage	Change in Traffic Noise Level dB(A)	Potential Significance of Effect
1 – N52 between Tullamore and Kilbeggan	1	0.5	Imperceptible
	2	0.2	Imperceptible
	3	0.0	Imperceptible
	4	0.0	Imperceptible
2 – N52 southwest of Tullamore	1	1.1	Not Significant
	2	0.4	Imperceptible
	3	0.0	Imperceptible
	4	0.0	Imperceptible
	1	0.7	Imperceptible

Route	Stage	Change in Traffic Noise Level dB(A)	Potential Significance of Effect
3 – N52 between Birr and Kilcormac	2	0.1	Imperceptible
	3	1.5	Not Significant
	4	0.0	Imperceptible
4 – N62 south of Ferbane	1	1.0	Imperceptible
	2	0.4	Imperceptible
	3	0.0	Imperceptible
	4	0.0	Imperceptible
5 – R436 east of Ferbane	1	2.8	Not Significant
	2	1.3	Not Significant
	3	0.2	Imperceptible
	4	0.1	Imperceptible
6 – N62 north of Ferbane	1	1.0	Not Significant
	2	0.4	Imperceptible
	3	0.0	Imperceptible
	4	0.0	Imperceptible

The increase in noise levels due to additional construction traffic on each of the routes is predicted to be less than 2 dB or less for the majority of routes and stages. The following comments are made on route link 5 where the predicted change is higher than 2 dB:

- During Stage 1, the predicted change in noise levels at road link 5 is in the range +1 to +2.9 dB $L_{Aeq,1hr}$. However, the predicted noise levels of existing and construction traffic are in the range 61 to 64 dB $L_{Aeq,1hr}$.
- These predicted noise levels are within the Construction Noise Threshold of 65 dB $L_{Aeq,1hr}$ presented in Section 12.3.2.1 and therefore the noise effect of construction traffic is considered not significant.

Description of Effects

With respect to the EPA criteria for description of effects, the potential effects at the NSL associated with the additional traffic generated during the construction phase are as described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

12.5.3 Operational Phase

12.5.3.1 Assessment of Wind Turbine Noise

Using the assessment methodology described in Section 12.3.7 the predicted turbine noise levels have been calculated at all NSLs within the study area of the Proposed Project. A precautionary omnidirectional turbine noise prediction assessment has been carried out using the ISO 9613-2 calculation standard and best practice guidance for turbine noise prediction contained in the IOA GPG. These calculations are based on theoretical precautionary conditions favourable to noise propagation, i.e., downwind propagation from source to receiver and/or downward refraction under temperature inversions.

The results of the noise prediction models have been compared against the lowest turbine noise limits that have been presented in Section 12.4.3, which have been derived in accordance with the criteria set out in Section 12.3.2.4.

At all NSLs the worst omnidirectional cumulative turbine noise levels are below the noise criterion curves. Appendix 12-5 presents the predicted omnidirectional turbine results at all NSLs in tabulated form.

Table 12-25 presents the result of the turbine noise predictions and assessment review at 15 no. locations with the highest levels of wind turbine noise predicted, at all other location the maximum turbine noise levels are predicted to be less than 40 dB L_{A90}. Noise contours for the omnidirectional rated power wind speed (i.e., highest noise emission) are presented in Appendix 12-4.

Table 12-25 Predicted Noise Levels

NSL Ref	Parameter	Predicted Noise Level dB L _{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
H002	Predicted	31.2	32.4	37.1	39.3	39.7	39.6	39.3
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H006	Predicted	30.9	32.1	36.8	39	39.4	39.2	39
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–

NSL Ref	Parameter	Predicted Noise Level dB L _{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
H007	Predicted	30.8	32.1	36.8	38.9	39.3	39.2	39
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H009	Predicted	29.8	31	35.6	37.8	38.2	38.1	37.8
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H012	Predicted	31.1	32.3	37	39.2	39.6	39.5	39.3
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H014	Predicted	30.1	31.2	35.9	38.1	38.5	38.3	38.1
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H015	Predicted	30.5	31.7	36.3	38.5	38.9	38.8	38.5
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43

NSL Ref	Parameter	Predicted Noise Level dB L _{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Night-time Excess	-	-	-	-	-	-	-
H016	Predicted	29.8	30.9	35.5	37.6	38.1	37.9	37.7
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H018	Predicted	29.7	30.8	35.5	37.6	38	37.9	37.6
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H019	Predicted	30.3	31.4	36.1	38.2	38.7	38.5	38.3
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H030	Predicted	30.5	31.6	36.3	38.5	38.9	38.8	38.5
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H031	Predicted	29.7	30.8	35.5	37.6	38	37.9	37.6
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-

NSL Ref	Parameter	Predicted Noise Level dB L _{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H038	Predicted	29.8	30.9	35.5	37.7	38.1	37.9	37.7
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H0041	Predicted	30.2	31.4	36.1	38.2	38.6	38.5	38.3
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H049	Predicted	30	31.1	35.8	37.9	38.4	38.2	38
	Daytime Criterion	40	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-

12.5.3.1.1 Description of Effects

The predicted noise levels associated with the proposed turbines are within best practice noise criteria therefore it is not considered that a significant effect is associated with turbine noise from the Proposed Wind Farm.

While noise levels at low wind speeds will increase due to the Proposed Project and specifically the operation of the turbines, the predicted levels will remain low, albeit new sources of noise will be introduced to the soundscape.

With respect to the EPA's criteria for description of effects, the potential effects, under a theoretical precautionary scenario, at the most impacted NSLs associated with operation of the proposed turbine of the Proposed Wind Farm are described as follows:

Quality	Significance	Duration
Negative	Not Significant	Long Term

The above effect should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

12.5.3.2 Fixed Plant Noise

12.5.3.2.1 Onsite 220kV Substation

Details of the proposed onsite 220kV substation are described in Chapter 4. The onsite substation will be operational 24/7 and the noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with the operation of the proposed onsite 220kV substation at the nearest NSL including night-time hours when background noise is lower.

The noise emission level associated with a substation that would support a renewable energy development of this nature is the order of 92 dB(A) L_w .

Noise prediction model calculations for the operation of the proposed onsite 220kV substation have been undertaken in accordance with ISO 9613: ‘Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation’ (2024). The predicted noise level from the operation of the proposed onsite 220kV substation at the nearest NSL (H0335 at approximately 355 m northeast) is 33 dB $L_{Aeq,T}$. This level of noise is low, and it is concluded that there will be no significant noise emissions from the operation of the proposed onsite 220kV substation at any NSL. Furthermore, the predicted noise level is well below the criterion for fixed mechanical plant outlined in Section 12.3.2.5 and will not result in any adverse impacts at nearby NSLs. During the detailed design, acoustic features from the proposed onsite 220kV substation such as tonality, impulsivity and intermittency, will be considered in the context of the character assessment framework contained in BS-4142. Where these acoustic features are present, the Rating Level should be controlled to avoid adverse impacts at NSLs in accordance with BS-4142. rated level at all NSL are below the limits indicated in Section 12.3.2.5.

12.5.3.2.2 Description of Effects

With respect to the EPA’s criteria for description of effects, the potential effects, under a theoretical precautionary scenario, at the nearest NSLs associated with the operation of the fixed mechanical and electrical plant at the proposed onsite 220kV substation is described below.

Quality	Significance	Duration
Negative	Not Significant	Long Term

12.5.4 Decommissioning Phase

In relation to the decommissioning phase, similar overall noise levels as those calculated for the construction phase would be expected, as similar tools and equipment will be used. The noise and vibration impacts associated with any decommissioning of the Proposed Wind Farm can be considered comparable to those outlined in relation to the construction phase (as per Section 12.5.2.1) albeit less works will be required as only above ground structures will be removed. Turbine and mast foundations will remain underground, and cable ducting will remain in situ. Foundations for 3 no. temporary construction compounds will be utilised for amenity car parks with 2 no. temporary construction compound foundations being left in situ; please see Section 4.4.1.5 of Chapter 4 for further information on temporary construction compounds. The OHL cabling to the existing OHL from the proposed

onsite 220kV substation will remain in place. Refer to Section 4.13 of Chapter 4 for full details on decommissioning. The predicted noise levels are expected to be below the appropriate Category A value (i.e., 65 dB L_{Aeq,T}) at all NSLs for the decommissioning phase, the impact is not significant.

12.5.4.1.1 Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects, the likely potential associated effects at the nearest noise sensitive locations associated with construction of turbines and hardstanding areas are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

12.6 Mitigation Measures

The assessment of potential effects has demonstrated that the Proposed Project is expected to comply with the identified criteria for the construction, operational and decommissioning phases of the Proposed Project and therefore no specific mitigation measures are required other than best practice guidance and methods outlined below.

12.6.1 Construction

The assessment of potential impacts presented in Section 12.5.2 has demonstrated that the Proposed Project is expected to comply with the noise and vibration criteria during the construction phase and therefore no specific mitigation measures are required

The contract documents will specify that the Contractor undertaking the construction works will be obliged to adopt best practice noise abatement measures contained in British Standard BS 5228-1:2009+A1:2014 ‘Code of practice for noise and vibration control on construction and open sites – Noise’ and BS 5228-2:2009+A1:2014 ‘Code of practice for noise and vibration control on construction and open sites – Vibration’.

To ameliorate any potential noise impacts that may present during the construction phase, a schedule of noise control measures has been formulated in accordance with best practice guidance, and the contract documents will require the Contractor to implement these measures. These are outlined in the Construction and Environmental Management Plan (CEMP) (Appendix 4-4) with a Draft Noise Complaint Management Protocol for addressing AM or tonality presented in Appendix 12-6.

12.6.2 Operational Phase

12.6.2.1 Wind Turbine Noise

An assessment of the operational wind turbine noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 12.3.2.4. The findings of the assessment, presented in Section 12.5.3.1 has confirmed that the predicted operational noise levels associated with the Proposed Project will be within best practice turbine noise criteria at all locations with no significant cumulative impacts or effects.

The findings of the assessment confirmed that the predicted operational noise levels from the Proposed Project will be within the relevant best practice noise criteria for the detailed potential turbine specification. Therefore, no specific mitigation measures are required.

If alternative turbine models are considered for the Proposed Wind Farm, an updated noise assessment will be prepared to confirm that the noise emissions will comply with the noise criteria outlined in Section 12.4.3 and/or the relevant operational criteria associated with the grant of planning for the Proposed Project.

12.6.2.2 Amplitude Modulation and Tonality

In the event of a complaint indicating potential excessive amplitude modulation or tonality associated with the Proposed Project, the Developer will fully investigate the complaint through review of the meteorological periods and conditions during which the reported AM or tonality occurs. A noise monitoring protocol would be established, in consultation with the relevant local authorities, which would set out the location and analysis methodology to be employed for the noise monitoring (Refer to Section 12.6.4.2). This can be secured via a planning condition.

If an ongoing issue with Excessive AM is established, a mitigation strategy to reduce the level of AM will be implemented through engineering methods, operational changes and/or curtailment of specific turbines. The operator would first appoint a qualified acoustic consultant to objectively assess the level of AM in accordance with the methods outlined in the Institute of Acoustics IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group Final Report: A Method for Rating Amplitude Modulation in Wind Turbine Noise (9 August 2016) or subsequent revisions.

The measurement method outlined in the IOA AMWG document, known as the 'Reference Method', provide a robust and reliable indicator of AM and yield important objective information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including methods, determined to minimise the occurrence of excessive AM. These mitigation measures, if required, will consist of either turbine blade modifications or the implementation of operational controls for the relevant turbine type, which will include operating turbines in different operational modes or turbine curtailment under specific operational conditions and may in very unlikely circumstance require turning specific turbine off under certain conditions. The aim of the mitigation would be to minimise adverse impacts from excessive AM associated with the proposed project as much as is reasonably practicable.

If the complaints suggest the potential occurrence of clearly audible tonality in the wind turbine noise, the audibility of the tones will be investigated from measured data with a robust, objective method such as that included in ISO 1996-2:2017 with modifications in IEC 61400-11-2. If the rated level of the wind farm is above the limit, then the operator would investigate and implement measures to reduce the rated level to below the limit. This may involve engineering methods, operational changes and/or (in very unlikely circumstance) curtailment of specific turbines.

The commitment outlined to control amplitude modulation (AM) from wind turbines are considered best practice. The proposed approach provides a clear commitment that additional adverse impacts from excessive amplitude modulation (AM) or tonality associated with the operation of the proposed project will be effectively managed and minimised by the operator.

12.6.2.3 Fixed Plant

The assessment of noise from the operation of fixed plant at the proposed onsite 220kV substation is predicted to comply with the proposed criteria in Section 12.3.2.6. Therefore, no specific mitigation measures are required.

12.6.3 Decommissioning Phases

The contract documents will specify that the Contractor undertaking the decommissioning works will be obliged to adopt best practice noise abatement measures contained in British Standard BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites –

Noise and BS 5228-2:2009+A1:2014 ‘Code of practice for noise and vibration control on construction and open sites – Vibration’.

No specific mitigation measures are required for decommissioning. To ameliorate any potential noise impacts that may present during the decommissioning phase, a schedule of noise control measures has been formulated in accordance with best practice guidance. These are outlined in the CEMP (Appendix 4-4) that has been prepared for the Proposed Project.

12.6.4 Monitoring

12.6.4.1 Noise Compliance Monitoring Plan

Noise Compliance Monitoring refers to testing the wind turbine noise levels due to the Proposed Project against the planning conditions, in terms of overall noise levels.

Prior to the commissioning of the wind farm, the developer will submit a Noise Compliance Monitoring Programme to the planning authority for written agreement. The Noise Compliance Monitoring Programme will include a detailed methodology for the noise measurements, procedures for recording results and locations at which noise is to be monitored.

Compliance noise surveys will be undertaken to verify compliance with any noise conditions applied to the development. It is common practice to commence surveys within six months of a wind farm being commissioned. The guidance outlined in the IOA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be implemented.

In the unlikely event that an exceedance of the noise criteria is identified as part of the commissioning assessment and relevant corrective actions taken. For example, implementation of noise reduced operational modes resulting in curtailment of turbine operation can be implemented for specific turbines in specific wind conditions to ensure turbine noise levels are within the relevant noise criterion or conditions turbine noise limits. Such curtailment can be applied using the wind farm SCADA system with a marginal reduction of the wind turbine performance. After the implementation of the mitigation measures, the noise survey will be repeated to confirm compliance with the planning conditions.

12.6.4.2 Noise Complaint Management Protocol

In the event of a noise-related complaint associated with the operation of the Proposed Project, the Operator will fully investigate the complaint in accordance with the agreed Noise Compliant Management Protocol.

In the event of a complaint associated with noise for example, tonality or amplitude modulation from the proposed project, in line with the Noise Compliant Management Protocol documents to be submitted and agreed with the local authority), the operator will fully investigate the complaint through review of the meteorological periods and conditions.

A Draft Noise Complaint Management Protocol for addressing AM or tonality is presented in Appendix 12-6. A final version of this protocol will be contained within the Noise Compliance Monitoring Plan to be agreed the relevant Local Authority and/or Authorities.

12.6.5 Operational Phase Vibration

No significant vibration effects are associated with the operation of the site at any of the receivers.

12.7 Residual Effects

This section summarises the likely residual noise and vibration effects associated with the Proposed Project following the implementation of mitigation measures.

12.7.1 Construction Phase

During the construction phase of the Proposed Project, there will be some impacts on nearby NSLs due to noise and vibration emissions from site traffic and other construction activities. However, given the distances between the main construction works and the NSLs, the short-term duration of the construction phase, and the assessment's findings that the expected noise and vibration emissions will be below the identified noise or temporal threshold and limit values, the impacts will not be significant.

With respect to the EPA Guideline criteria for description of effects, in terms of these construction activities, the potential effects, under a theoretical precautionary scenario, at the nearest NSLs associated with the various elements of the construction phase are described below.

12.7.1.1 General Construction of Turbines, Hardstand Areas and Anemometry Mast

Quality	Significance	Duration
Negative	Not Significant	Short Term

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. The described effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

12.7.1.2 Construction of Internal Roads and Amenity Track

Quality	Significance	Duration
Negative	Not Significant	Short-Term

The likely predicted noise and vibration effects are slightly above the limits, however, due to the short duration and nature of the works, the effects are not significant. The described effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

12.7.1.3 Borrow Pit Excavation and Reinstatement

Quality	Significance	Duration
Negative	Not Significant	Short Term

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. The described effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

12.7.1.4 Peat Deposition Areas

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the proposed peat deposition areas are described as described below:

<i>Quality</i>	<i>Significance</i>	<i>Duration</i>
Negative	Not significant	Short-term

12.7.1.5 Temporary Construction Compounds

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the proposed peat deposition areas are described as described below:

<i>Quality</i>	<i>Significance</i>	<i>Duration</i>
Negative	Not significant	Short-term

12.7.1.6 Biodiversity and Enhancement Areas

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA’s criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the proposed deposition areas are described as described below:

<i>Quality</i>	<i>Significance</i>	<i>Duration</i>
Negative	Not significant	Short-term

12.7.1.7 Substation and Ancillary Construction Works

<i>Quality</i>	<i>Significance</i>	<i>Duration</i>
Negative	Not Significant	Short Term

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. The described effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

12.7.1.8 Grid Connection and OHL Cabling Construction

<i>Quality</i>	<i>Significance</i>	<i>Duration</i>
Negative	Not Significant	Short Term

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. The described effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

12.7.1.9 Construction Traffic

Quality	Significance	Duration
Negative	Not Significant	Short Term

The likely predicted noise effects due to construction traffic are below the limits and/or thresholds identified.

12.7.2 Operational Phase

12.7.2.1 Wind Turbine Noise

The predicted noise levels associated with the Proposed Project will be within best practice noise criteria curves recommended in line with DoEHLG 2006 Guidelines it is not considered that a significant effect is associated with the Proposed Project.

While noise levels at low wind speeds will increase due to the Proposed Project and specifically the operation of the turbines, the predicted levels will remain low, albeit new sources of noise will be introduced into the soundscape.

The predicted residual operational turbine noise effects are summarised as follows at the nearest NSLs.

Quality	Significance	Duration
Negative	Not Significant	Long Term

The above effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

12.7.2.2 Substation and Ancillary Works Operation

The residual effects at the nearest NSLs of the proposed onsite 220kV substation and all ancillary infrastructure are described as follows:

Quality	Significance	Duration
Negative	Not Significant	Long Term

12.7.3 Decommissioning Phase

During the decommissioning phase of the Proposed Wind Farm, there will be some effect on nearby NSLs due to noise emissions from site traffic and other on-site activities. Similar overall noise levels as those calculated for the construction phase would be expected, as similar tools and equipment will be used. The noise and vibration impacts associated with any decommissioning of the Proposed Wind Farm are considered to be comparable to those outlined in relation to the construction of the Proposed Wind Farm.

With respect to the EPA (2022) criteria for description of effects, the anticipated associated effects at the nearest noise sensitive locations associated with the decommissioning phase is not significant and are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

12.8 Cumulative Effects

12.8.1 Wind Turbine Noise

Existing permitted and proposed wind farm developments with the potential for cumulative impacts were considered as part of the turbine noise impact assessment. A review of existing, proposed and permitted wind turbine developments in the wider study area has been undertaken in accordance with the guidance contained in the IOA GPG (considering the existing Leabeg Wind Farm, the existing Meenwaun Wind Farm, the existing Cloghan Wind Farm, operational Derrinlough Wind Farm, permitted Cush Wind Farm, proposed Umma More Wind Farm, permitted Kilbeggan turbine, and permitted Lea Mor turbine). Please note, the proposed Bellair Wind Farm will be located north of the Proposed Wind Farm, the exact turbine numbering, locations, and dimensions is currently not available in the public domain and therefore the proposed Bellair Wind Farm has not been included in this cumulative assessment. The results of the cumulative review showed that due to distances and sound power levels of the other wind farms, no interactions between the proposed Lemanaghan and any other wind farm occurred at the different NSLs, and a cumulative operational assessment was not required. Therefore, a full noise assessment has been undertaken in accordance with the IOA GPG.

12.8.2 Noise from Fixed Plant Operation

There are no other industrial noise sources of fixed mechanical and electrical plant in the vicinity of the nearest NSLs to the proposed onsite 220kV substation that are expected to have any cumulative noise impacts at NSLs. The background noise survey (refer to Section 12.3.4) that was undertaken in the vicinity of the Proposed Wind Farm did not identify any steady industrial plant noise sources in the receiving environment. Therefore, the potential for any cumulative noise effects is Not Significant.

The operation of the substation is 33 dB $L_{Aeq,T}$ at the nearest NSL. The predicted noise cumulative noise levels are within the criterion for fixed machinal plant outlined in Section 12.3.2.5 and unlikely to result in any adverse impacts at nearby NSLs. Plant will be selected such that the rated level is compliant with the limits at all NSLs taking into account the inherent tonality of the transformers. At NSLs further from the proposed onsite 220kV substation the noise levels will be lower.

12.8.3 Construction and Decommissioning

It is not anticipated that there will be any other activities that would give rise to significant cumulative noise effects during the construction or decommissioning phases. The predicted noise emissions for the Proposed Project are not of enough magnitude to cause an increase in the cumulative construction noise emissions exceeding the threshold for significant impacts at any NSL.

The predicted noise levels from construction activity would need to be well in excess of 55 dB $L_{Aeq,T}$ at an NSL in order for a potential cumulative construction noise increase to exceed the noise thresholds. The assessment in Section 12.5.2.1, 12.5.2.3 and 12.5.2.4 confirms that the predicted noise levels from activities at static construction sites at any NSL are ≤ 55 dB $L_{Aeq,T}$, therefore the potential for any cumulative noise effect from all of the proposed activities occurring simultaneously or with construction activities from other developments is unlikely and not significant.

Construction activities that will progress over a defined route are predicted to exceed the construction noise threshold at the closest receptor locations, however, given the duration of the activities outside

each individual NSL, the temporal criteria are not likely to be exceeded and hence higher cumulative noise levels for those periods would not cause an additional effect.

12.9 Difficulties Encountered During the Preparation of this Chapter

There were no difficulties or limitations encountered when undertaking this assessment.

12.10 Interactions

The potential interaction between noise and vibration and other specialist chapters in the EIAR is primarily limited to Chapter 5 (Population & Human Health), Chapter 6 (Biodiversity) and Chapter 15 (Material Assets). This chapter has been prepared in consideration of and in conjunction with the relevant elements of these chapters. For example, noise and vibration impacts associated with the Proposed Project have been fully considered within this Chapter of the EIAR. However, commentary on the impact assessment and related noise levels are also summarised specifically with respect to potential human health impacts in Chapter 5 and with respect to potential biodiversity impacts in Chapter 6. The traffic flow projections associated with the Proposed Project provided in Chapter 15 has been utilised in the calculations in Section 12.5.2.9 of this Chapter.

12.11 Summary

When considering a renewable energy development of this nature, the potential noise and vibration effects on the surroundings must be considered for three stages: the short-term construction phase and decommissioning phases, and the long-term operational phase.

The assessment of construction noise and vibration and has been conducted in accordance with best practice guidance contained in *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise* and *BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration*.

Residual noise associated with the construction and decommissioned phases have been predicted to be not significant after consideration of impacts and duration, in line with the identified criteria. The associated noise and vibration levels are not likely to cause significant effect at any NSL.

Based on detailed information on the site layout, turbine noise emission levels and turbine hub height, turbine noise levels have been predicted at NSLs for a range of operational wind speeds. The predicted noise levels associated with the Proposed Project will be within the best practice noise limits recommended in DoEHLG 2006 Guidelines. Therefore, it is not considered that a significant effect is associated with the Proposed Project.

Operational noise from the proposed onsite 220kV substation has been assessed and found to be within the adopted criteria.

No significant vibration effects are associated with the operation of the site.

Therefore, it is not considered that a significant effect is associated with the Proposed Project.

EIA Classification Summary

Please see the below table for a summary of all identified impacts for the Proposed Project relating to noise and vibration.

Table 12-26 Impact Assessment Classification Summary

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
Construction Phase				
General Construction of Turbines, Hardstand Areas, and Anemometry Mast	Short-term, Not Significant, Negative	Section 12.6.1 – None Required	Short-term, Not Significant, Negative	Not Significant
Construction of Internal Roads and Amenity Track	Short-Term, Not Significant, Negative	Section 12.6.1 – None Required	Temporary, Not Significant, Negative	Not Significant
Borrow Pit Excavation and Reinstatement	Short-Term, Not Significant, Negative	Section 12.6.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Peat Deposition Areas	Short-Term, Not Significant, Negative	Section 12.6.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Temporary Construction Compounds	Short-Term, Not Significant, Negative	Section 12.6.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Biodiversity Management and Enhancement Areas	Short-Term, Not Significant, Negative	Section 12.6.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Substation and Ancillary Construction Works	Short-Term, Not Significant, Negative	Section 12.6.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Proposed Grid Connection and OHL Cabling Construction	Short-Term, Not Significant, Negative	Section 12.6.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Construction Traffic	Short-Term, Not Significant, Negative	Section 12.6.1 – None Required	Short-Term, Not Significant, Negative	Not Significant

Operational Phase				
Assessment of Wind Turbine Noise	Long-Term, Not Significant, Negative	Section 12.6.2.1 Section 12.6.2.2	Long-Term, Not Significant, Negative	Not Significant
Fixed Plant Noise	Long-Term, Not Significant, Negative	Section 12.6.3	Long-Term, Not Significant, Negative	Not Significant
Decommissioning Phase				
Proposed Wind Farm	Short-Term, Slight, Negative	Section 12.6.4	Short-Term, Slight, Negative	Not Significant