

## 12. NOISE AND 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 Maughanaclea Renewable Energy Development, Co. Cork (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', 'Site', 'Proposed Wind Farm', 'Proposed Wind Farm site', 'proposed turbines', and the 'Proposed Grid Connection'.

The Proposed Project includes 14 no. wind turbines, associated access tracks and hardstands, onsite 110kV substation, 110kV underground cabling, peat and spoil management areas, meteorological mast, internal access roads, borrow pits, temporary construction compounds, biodiversity enhancement areas, 33kV underground 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 six representative NSLs surrounding the Proposed Wind Farm 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.

This chapter is supported by material in the following appendices:

- Appendix 12-1: Glossary of Acoustic Terms
- Appendix 12-2: Noise Study Area
- Appendix 12-3: Noise Modelling Parameters
- Appendix 12-4: Predicted Noise Levels
- Appendix 12-5: Predicted Noise Contour
- Appendix 12-6: Calibration Certification
- Appendix 12-7: Protocol for Management of Complaints

#### 12.1.1 Statement of Authority

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

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.

Miguel Cartuyvels (Acoustic Consultant) holds a BEng (Hons) in Industrial Engineering and is a member (TechIOA) 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.

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.

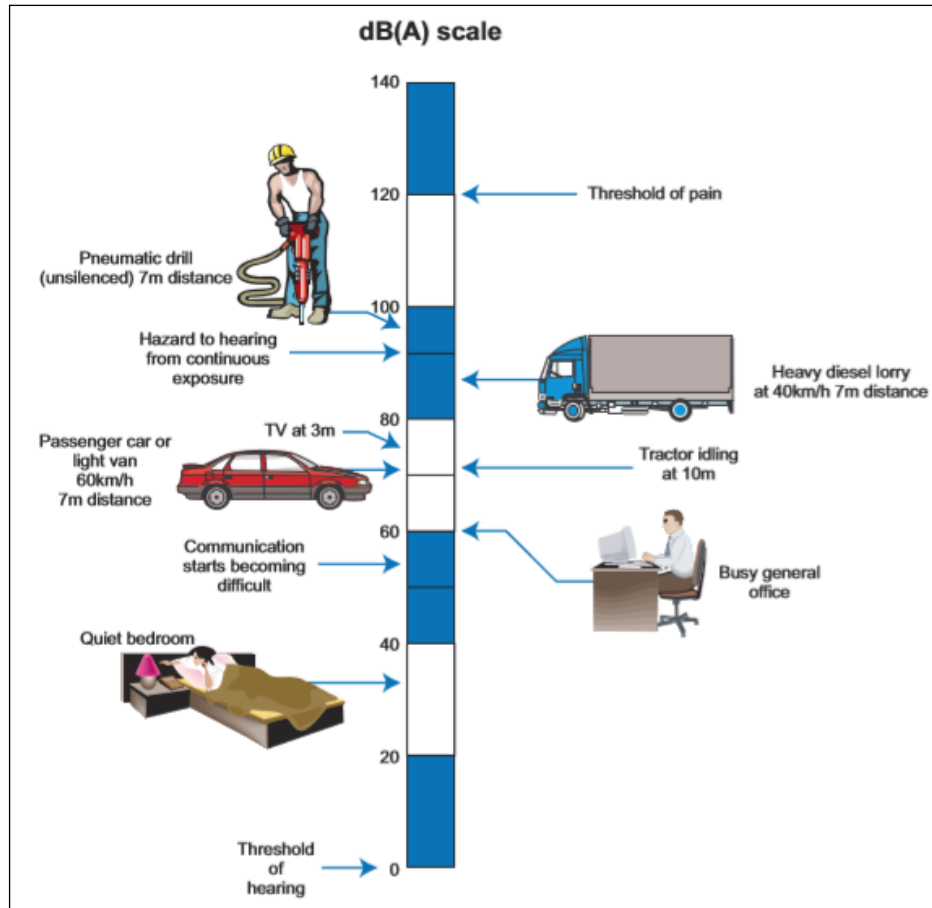


Figure 12-1 The level of typical common sounds on the dB(A) scale (National Roads Authority (NRA) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (NRA, 2014)

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 Wind Farm 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 1.7.2 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 Guidelines (DoEHLG, 2006)') with cognisance of *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (the 'Draft Guidelines (DoHLGH 2019)');
- 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).
- Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes, Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA) (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 groundborne vibration (BSI, 1993);
- Design Manual for Roads and Bridges (DMRB) Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (National England (now National Highways) 2020);
- ISO 1996: 2017: Acoustics – Description, measurement, and assessment of environmental noise;
- 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

### 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 (BS5528-1).

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. A threshold noise value is 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 <sup>Note B</sup>	Category C <sup>Note C</sup>
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends <sup>Note D</sup>	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.

It should be noted that this assessment method is only proposed for residential properties. 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 12.6.2 for the detailed assessment in relation to the construction of the Proposed Project.

### Linear Construction Works

Due to the linear progressive nature of the construction works associated with the Proposed Grid Connection, a fixed noise limit is proposed. This is deemed appropriate in that noise from associated construction activities is variable and typically occurs for a short period of time only and is at its highest when closest to the NSL. As the works progress, construction noise levels at the NSL will reduce due to the works taking place at greater distances, resulting overall in shorter periods of exposure to noise impacts.

In relation to an appropriate fixed noise limit value, BS 5228-1 paragraph E.2 states:

*"Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut."*

Paragraph E.2 goes on to state:

*"Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:*

- *70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;*
- *75 decibels (dBA) in urban areas near main roads in heavy industrial areas"*.

Transport Infrastructure Ireland (formerly NRA) (TII) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes* (TII, 2014)

The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document '*Good Practice Guidance for the Treatment of Noise and Vibration in National Road Schemes*' (NRA, 2014) proposes daytime period (Monday to Friday 0700 – 1900 hrs) construction noise limits of 70 dB  $L_{Aeq,1hr}$  and 65 dB  $L_{Aeq,1hr}$  for Saturdays between 0800 – 16:30hrs.

Considering the above guidance, a construction noise threshold of 70 dB  $L_{Aeq,1hr}$  is proposed for linear construction activities on weekdays (i.e. Proposed Grid Connection). Noise levels above 70 dB  $L_{Aeq,1hr}$  would indicate a potential significant impact depending on the duration and frequency of occurrence (Section 12.3.2.1.3 below).

### 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 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 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	No Change	Imperceptible
1.0 – 2.9	Barely Perceptible	Minor	Not Significant
3.0 – 4.9	Perceptible	Moderate	Slight, Moderate
≥5	Up to a doubling of loudness	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).

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 by up to 50%. 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 12-4.

Table 12-4 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 12-4 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 Guidelines (DoEHLG, 2006). The Guidelines (DoEHLG, 2006) are based on detailed recommendations set out in ETSU-R-97. The ETSU-R-97 document has been used to supplement the guidance contained within the Guidelines (DoEHLG, 2006), where appropriate and necessary.

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

The core of the noise guidance contained within the Guidelines (DoEHLG, 2006) 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<sub>A90</sub> and/or a higher level above the prevailing background noise level.

#### 12.3.2.4.2 *Institute of Acoustics Good Practice Guide*

The original ETSU-R-97 concepts underwent a thorough standardisation and modernisation in 2013 with publication of the IOA GPG including 6 Supplementary Guidance Notes published in 2014. These documents bring together the combined experience of acoustic consultants in the UK and Ireland in the application of the assessment methods. Numerous improvements in the accuracy and robustness are described including the treatment of wind shear and the general adaptation to larger wind turbines. The guidance contained within IOA GPG is considered to represent best practice and has been adopted in this assessment.

#### 12.3.2.4.3 *Background Noise Surveys*

The IOA GPG provided guidance on the duration and requirements for background noise surveys and 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<sub>A90</sub>,10min) should be related to wind speed measurements that are collated at the site of the wind turbine development. 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.

For guidance on the methodology for the background noise survey, the IOA GPG has been adopted.

#### 12.3.2.4.4 *Noise Prediction Calculations*

The noise levels associated with the wind turbines should be calculated 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. The IOA GPG states that 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 operational impact assessment for wind turbine noise, the IOA GPG has been adopted.

#### 12.3.2.4.5 **Cumulative Assessment Screening**

Existing, permitted and proposed wind turbine developments must be considered cumulatively in the noise impact assessment. To determine where a particular wind farm development needs to be included in the assessment or whether it can be scoped out, a '10 dB rule' is applied.

Section 5.1 of the IOA GPG provides 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."*

In the first instance the study area must be defined, the IOA GPG states that the 'study area' for background noise surveys (and noise assessment) should, as a minimum, be the area within which noise levels from the proposed, consented and existing wind turbines is greater than 35 dB L<sub>A90</sub>.

In some circumstances the cumulative 35 dB L<sub>A90</sub> area may extend beyond the area where the proposed turbines will have any significant effect. This initial study area can be refined by applying the '10 dB rule' such that the following statement is true:

- The study area for operational turbine noise can be defined as the area within which predicted turbine noise levels from the proposed, consented, and existing wind turbines is greater than 35 dB L<sub>A90</sub>, and the predicted noise from the proposed turbines in isolation is 10 dB below the fixed lower threshold for turbine noise proposed for the Proposed Project.

For example, where a fixed lower threshold of 40 dB applies, the maximum extent of the study area for the Proposed Project will correspond to the 30 dB L<sub>A90</sub> noise contour of the proposed turbines in isolation.

An appraisal of the study area to determine whether a cumulative turbine noise impact assessment is required is presented Section 12.4.1.

#### 12.3.2.4.6 **Wind Energy Guidelines for Planning Authorities**

Section 5.6 of the Guidelines (DoEHLG, 2006) 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 Guidelines (DoEHLG, 2006) 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 12.5.3.

*“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 night time 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 night time noise criterion curve in relation to wind farm developments.

In summary, the Guidelines (DoEHLG, 2006) 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  $L_{A90}$  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 night time periods.

While the caveat of an increase of 5dB(A) above background for night-time operation is not explicit within the Guidelines (DoEHLG, 2006), 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.

### 12.3.2.4.7 **Future Potential Guidance Changes**

In December 2019, the Draft Revised Wind Energy Development Guidelines (hereafter referred to as the Draft Guidelines (DoHPLG, 2019)) 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 Guidelines (DoHPLG, 2019), several concerns relating to the proposed approach of the Draft

Guidelines (DoHPLG, 2019) 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 Good Practice Guide (IOA GPG) and the IOA Amplitude Modulation Working Group, which are all referenced extensively in the draft guidelines. Comment on the statement from the 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 19 June 2025<sup>1</sup>

*“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 the Climate, Energy and 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.*

*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, including in relation to noise annoyance.*

*The evolving policy and technical context including the new Planning and Development Act 2024, which was signed by the President on 17 October 2024, and the 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*

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<sup>1</sup> <https://www.oireachtas.ie/en/debates/question/2025-06-19/308/>

*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.*

*More generally, with regard to the planning process and ensuring that the views of communities concerning wind energy developments are heard and given appropriate consideration, I wish to highlight that public participation is a crucial element of all substantive decision-making processes under the Planning and Development Act 2000, and the recently enacted Planning and Development Act 2024. As part of the process to review city and county development plans, it is open to members of the public to make an observation or submission on the draft development plan. The development plan sets out land use zoning objectives and outlines the types of potential development, including ancillary developments, which might be suitable for a particular area, and may include objectives for wind energy development. In addition, it is open to any member of the public to make an observation or submission on a planning application, including in relation to a proposed wind energy development, and the planning authority is statutorily obliged to consider such observation or submission before making a decision on the application.*

*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 finalisation of associated reforms and reviews including the revision of the NPF. When finalised, the revised Guidelines will be issued under section 28 of the Planning and Development Act 2000, as amended or, subject to commencement of the Planning and Development Act 2024, as a National Planning Statement, as appropriate. 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 Guidelines (DoEHLG, 2006) 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 the noise will be addressed through an appropriate planning condition, or where a supplementary assessment is necessary, through provision of additional information.

#### 12.3.2.4.8 **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 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 Irish National 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.

### 12.3.2.4.9 **Low Frequency Noise and Infrasond**

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. 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.”*

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.”*

These conclusions have been reinforced by more recent studies and reviews. For example, a study for the National Institute for Public Health and the Environment (RIVM) in the Netherlands published in 2020 concluded in this regard that:

*“Although low frequency sound and infrasound might have other effects than ‘normal’ sound has, these effects are highly unlikely at sound levels typical for wind turbines. Brain studies show that low frequency and infrasound are processed in the same parts of the brain as ‘normal’ sound and there is no evidence that infrasound elicits any reaction at sub-audible levels.”*

An Australian study funded by the National Health and Medical Research Council of Australia (NHMRC), was also recently published in the *Environmental Health Perspectives* (EHP) journal, published by the United States National Institute of Environmental Health. The study considered the effects, including in particular on sleep, to exposing people to 72 hours of infrasound (designed to simulate a wind turbine infrasound signature). The study was based on a highly robust double-blind randomised controlled study and concluded that:

*“Our findings did not support the idea that infrasound causes WTS [Wind Turbine Syndrome]. High level, but inaudible, infrasound did not appear to perturb any physiological or psychological measure tested in these study participants.”*

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published on the IOA website stated the following in relation to Infrasound and Low Frequency noise:

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

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.

#### 12.3.2.4.10 **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 a three-bladed turbine rotating at 20 rpm, this 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 ‘whoomping’ 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, primarily downwind of the rotor blade.

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 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 critical in the discussion of amplitude modulation (AM) to recognise that it is an inherent characteristic of wind turbine noise. A distinction must be made between ‘Normal’ AM, which is a regular fluctuation in noise levels, and ‘Other’ or ‘Excessive’ AM, which can be more pronounced and potentially disruptive. Normal AM is typically expected and accounted for in noise assessments, whereas Excessive AM should it occur may require additional mitigation measures due to its potential impact on nearby residents. 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 adverse impacts, unless otherwise stated.

Research and Guidance in the field of wind turbine noise AM is ongoing with publications being issued by the Institute of Acoustics in IOA AMWG in 2016. The IOA AMWG proposes an objective method for measuring and rating AM known as the Reference Method. The IOA AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of AM.

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 (IEC, 2024). This document introduces a standardised methodology for measuring and rating AM at receptor locations. The method aligns with the AMWG approach but includes several enhancements. While not formal guidance, it may be adopted as best practice and incorporated by regulatory authorities in future guidance.

A 2016 report commissioned by the UK government BEIS AM Review Phase 2 recommended the use of a penalty scheme as a potential planning condition for AM to cover periods of complaints due to unacceptable AM. 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.”

To date there is no clear industry consensus on how AM should be regulated or managed through the planning stage. In the absence of an accepted and robust planning conditions to control AM from wind turbines, the commitments outlined in the Section 12.7.4.2 are considered to represent best practice to control AM and will be adopted in the event that an complaint relating to excessive AM being reported from the Proposed Wind Farm.

### 12.3.2.5 Operational Phase Noise – Fixed Plant Items

The proposed wind turbines will connect to the proposed 110kV onsite substation via 33kV underground cabling. It is proposed to connect the proposed 110kV onsite substation to the existing 110kV Dunmanway substation via 110kV underground electrical cabling, i.e. the Proposed Grid Connection. The Proposed Grid Connection is c.20.5km in length. The Dunmanway 110kV substation is located approximately 13.5km southeast of the Proposed Wind Farm site. For the proposed 110KV onsite substation (fixed mechanical and electrical plant), it is proposed to set fixed noise limits in accordance with the following best practice guidance.

#### 12.3.2.5.1 EPA NG4

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

Table 12-5 outlines the noise criteria detailed in the NG4 for areas of low background noise and all other areas.

Table 12-5 NG4 Approach for Determining Appropriate Noise Criteria

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night 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 4142:2014 that can be used to assess the likelihood of complaints from specific plant noise sources

### 12.3.2.5.2 Other Guidance – BS4142

BS 4142:2014 is the industry standard method for analysing fixed plant sound emissions to residential receptors. BS 4142:2014 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 4142:2014 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 4142:2014 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 4142:2014 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 4142:2014 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 4142:2014 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.

specific sound level,  $L_{Aeq, T}$                       equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T.

Rating level,  $L_{Ar,T}$                                       specific sound level plus any adjustment for the characteristic features of the sound.

*background sound level,  $L_{A90,T}$       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.”*

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.”*

BS4142:2014 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 NSL's 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.”*

In light of the above guidance from EPA's NG4 and BS4142:2014, it is considered that the proposed absolute criterion of 35 dB  $L_{Aeq,T}$  across all NSLs for noise from the substation and any other fixed plant items is robust to prevent adverse impacts at NSLs. This criterion is intended to apply consistently across every NSL included in the assessment.

### 12.3.2.6 Operational Phase - Vibration

Vibration generated from the operation of a wind turbine unit will decrease rapidly with distance. Typically, at 100 m from a 1 MW turbine unit the level of vibration associated with a turbine is the order of 10-5 mm/s.

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 turbine within the Proposed Wind Farm to the nearest NSL is in excess of 682 m (distance from turbine T03 to NSL ref. H002). This setback distance complies with the four-times tip height setback requirement as set out in the Draft Guidelines (DoHPLG, 2019). 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.

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published on the IOA website stated the following in relation to Vibration:

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

There are no other sources likely to give rise to any perceptible vibration at NSLs during the operation of the Proposed Project. The assessment of operational phase vibration has therefore been scoped out of this assessment.

## 12.4 Assessment Methodology

### 12.4.1 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.

#### 12.4.1.1 Construction and Decommissioning Study Area

During the construction and decommissioning phases, noise could occur at any location within the Proposed Wind Farm 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 4.6 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 63 m for the internal roads, and over 325 m for the substation as indicated in Section 12.6.2.5 and representative of the closest identified NSL or at defined set back distances from the proposed works.

#### 12.4.1.2 Operational Phase Study Area

As described in Section 12.3.2.4.5 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. Due to the potential for cumulative effects with other existing wind farm developments, the study area for the operational phase was determined as the area predicted to exceed 30 dB  $L_{A90}$  at the maximum predicted turbine noise emission level from the Proposed Project in isolation. Refer to Figure 12-2 which displays the relevant noise contours maps which identify this area.

The NSLs identified within this study area have been considered in the assessment of operational noise from the proposed fixed plant items i.e. the substation.



considered for noise monitoring in line with current best practice guidance outlined in the IOA GPG. The selection of the noise monitoring locations (NMLs) 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 12-6 and identified on a map in Figure 12-3.

Table 12-6 Noise Measurement Location Coordinates

Location	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
NML1 (H014)	510903	557426
NML2 (H003)	512696	558516
NML3 (H015)	508289	556567
NML4 (H041)	509410	554281
NML5 (H031)	509380	556279
NML6 (H018)	512172	559913

Site visits by survey personnel were carried out during morning and afternoon periods; during these visits, primary noise sources contributing to noise environment were noted as occasional local traffic noise, birdsongs, local foliage moving with the wind and distant agricultural activity. In addition, during the installation, wind turbine noise was not audible at any location. 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. No sources of vibration were noted at any of the survey locations.

In general, the significant noise sources in the area were noted to be local and distant traffic movements, agricultural and farming typical noises, activity in and around the residences, wind generated noise from local foliage and other typical anthropogenic sources typically found in such rural settings.

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 noise sensitive locations. The existing Shehy More Wind Farm was not audible during any of the site visits to the Site. However, directional filtering has been undertaken at NML4 and NML6 to account for potential contributions from existing wind farms.

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 12-6 illustrate the installed noise monitoring kits at each NML

Figure 12-3 Map of Noise Monitoring Locations



### 12.4.2.1.1 **NML1**

The sound meter at NML1 was installed in a field adjacent to the driveway 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

### 12.4.2.1.2 **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

### 12.4.2.1.3 **NML3**

The sound meter at NML3 was installed at the boundary of the field to the rear of the property. Birdsong noises were noted at this location, with infrequent road traffic noise also audible.



Plate 12-3 Noise monitor Installed at NML3

12.4.2.1.4 **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

12.4.2.1.5 **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

#### 12.4.2.1.6 **NML6**

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



Plate 12-6 Noise monitor Installed at NML6

#### 12.4.2.2 **Survey Periods**

The survey duration was typically six weeks, or until such time that enough data points were captured at each survey locations. 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 12-7.

Table 12-7 Noise Measurement Periods

Location	Survey Period	
	Start Date	End Date
NML1 (H014)	28 March 2025	08 May 2025
NML2 (H003)	28 March 2025	08 May 2025
NML3 (H015)	28 March 2025	08 May 2025
NML4 (H041)	28 March 2025	08 May 2025
NML5 (H013)	28 March 2025	08 May 2025
NML6 (H018)	28 March 2025	08 May 2025

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 temporary met mast for all periods of day and night between 28 March 2025 and 08 May 2025. The wind speed data presented below relates to a turbine hub height of 102.5 m.

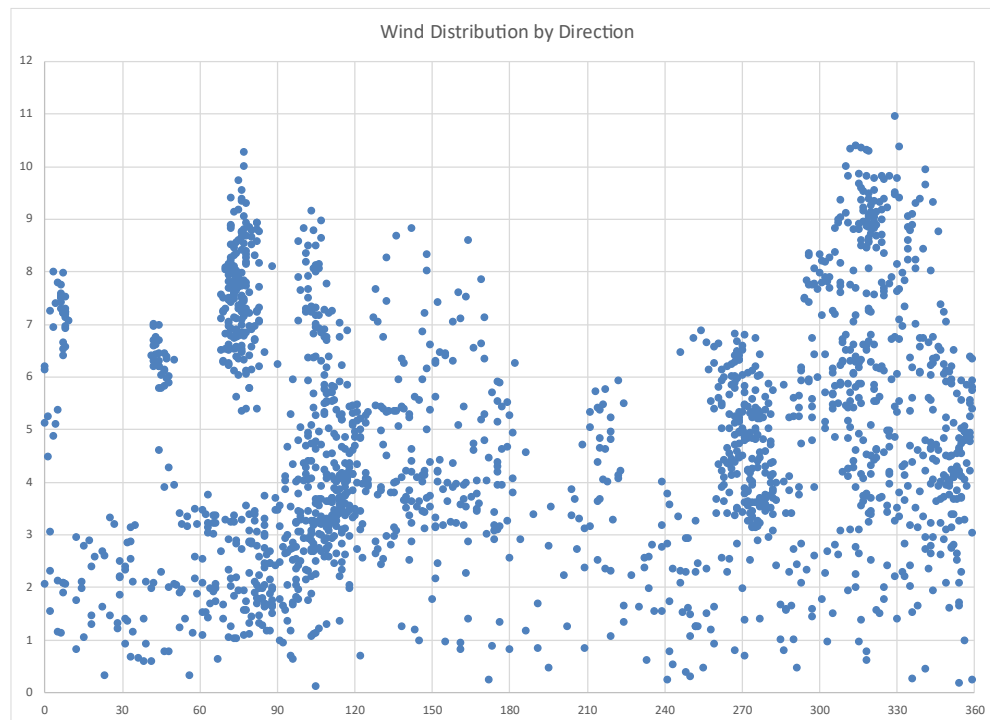


Figure 12-4 Distribution of Wind Speeds and Direction at LiDAR unit during Survey Period

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.

### 12.4.2.3 Instrumentation

Table 12-8 confirms the details of the instrumentation installed at each location.

Table 12-8 Details of Noise Measurement Instrumentation

Location Reference	Equipment Make and Model	Serial Number
NML1 (H014)	Rion NL-52	386771
NML2 (H003)	Rion NL-52	186668
NML3 (H015)	Rion NL-52	998409
NML4 (H041)	Rion NL-52	564808
NML5 (H013)	Rion NL-52	186671
NML6 (H018)	Rion NL-52	186672

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 +/- 0.1 dB. Copies of the relevant calibration certificates are included in Appendix 12-6.

Rainfall was monitored and logged using two Texas Instruments TR-525 data loggers that were installed at Locations NML2 and NML5 over the duration of the survey. 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.

A temporary met mast was installed onsite for this phase of the development and will be decommissioned during the construction phase. Wind speed measurements made at 80 m and 65 m were used to correct the wind speed up to a provisional assessment hub height (HH) at 102.5 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 industry standard for referencing for wind speeds with respect to wind turbines.

Table 12-9 Coordinates of Existing Anemometry Mast

Item	Coordinates (ITM)	
	Easting	Northing
Met Mast	508,003	555,559

## 12.4.3 Analysis of Survey Data

### 12.4.3.1 Measurement Procedure

Measurements were conducted at all locations over the survey periods outlined in Table 12-7. 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 12.4.2.1.

### 12.4.3.2 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.

### 12.4.3.3 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.

### 12.4.3.4 Noise from Existing Turbines

An appraisal of the wider study area identified the operational Shehy More Wind Farm for which the closest turbine is located approximately 2.6 km to the northeast of the closest proposed turbine (T01). Review of the site notes and data confirmed that the above wind farm did not have a significant impact on the baseline noise level and were inaudible at all locations when attending the noise survey locations. However, the wind farm has been included in the overall assessment of cumulative noise levels presented within this chapter.

### 12.4.3.5 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<sub>ref</sub> measured wind speed.

H height at which the wind speed will be calculated.

H<sub>ref</sub> 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:

H<sub>1</sub> the height of the wind speed to be calculated (10m)

H<sub>2</sub> the height of the measured wind speed.

U<sub>1</sub> the wind speed to be calculated.

U<sub>2</sub> 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 102.5 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.

## 12.4.4 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.

## 12.4.5 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.

### 12.4.5.1 Noise Prediction Software

The selected software, DGMR ‘*iNoise Enterprise (Version 2024.3)*’ calculates noise levels in accordance with ISO 9613: ‘*Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation*’ (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;
- 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 wind gradient, temperature gradient and humidity (these have significant impacts at distances greater than approximately 400 m).

### 12.4.5.2 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: General method of calculation*’ (ISO, 2024). The input data and assumptions made are described in the following sections.

### 12.4.5.3 Proposed Turbine Details

The proposed turbine is a Nordex N133 at 102.5 m hub height. This turbine is considered representative of the type of turbine that would be installed on the Proposed Wind Farm site taking into consideration the proposed dimensions and the nominal generation capacity.

While the noise profiles of the Nordex N133 wind turbine has been used for the purposes of this assessment, the exact make and model of the turbine installed on the Proposed Wind Farm site will be dictated by a competitive procurement process but will adhere to the specifications and parameters set out above.

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), and
- > The sound power noise emissions at various wind speeds.

Sound power levels for the Nordex N133 referenced to wind speeds at standardised 10 m height (calculated in accordance with the IOAGPG), are presented in Table 12-10.

Table 12-10 Sound Power Level Spectra for Nordex N133 with a hub height of 102.5 m

Wind Speed (m/s)	Octave Band Centre Frequency (Hz)								dB L <sub>WA</sub>
	63	125	250	500	1000	2000	4000	8000	
3	74.8	81.8	85.6	86.5	87	85.7	81.4	72.2	93.1
4	76.5	83.5	87.3	88.2	88.7	87.4	83.1	73.9	94.8
5	82.0	89.0	92.8	93.7	94.2	92.9	88.6	79.4	100.3
6	85.8	92.8	96.6	97.5	98	96.7	92.4	83.2	104.1
7	86.3	93.3	97.1	98	98.4	97.2	92.9	83.7	104.5
8	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6	104.5
9	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6	104.5

Table 4-1 in Chapter 4: Description of the Proposed Project details the co-ordinates and elevations of the 14 no. turbines of the Proposed Wind Farm.

The manufacturer’s turbine sound power levels outlined in Table 12-10 are presented in terms of the L<sub>Aeq</sub> 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 12-10.

As explained in Section 12.3.2, the criteria are couched in terms of a L<sub>A90</sub> criterion. Best practice guidance in the IOA GPG states that “L<sub>A90</sub> levels should be determined from calculated L<sub>Aeq</sub> 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<sub>A90</sub> parameter, i.e., this reduction of 2 dB is applied in the noise prediction modelling.

Best practice specifies that should any tonal component be present, a penalty shall be added to the predicted noise levels. The level of this penalty is described in ETSU-R-97 and is related to the level by which any tonal components exceed audibility. For the purposes of this assessment a tonal penalty has not been included within the predicted noise levels. A warranty will be provided by the manufacturers of the selected turbine to ensure that the noise output will not require a tonal noise correction under best practice guidance.

#### 12.4.5.4 Cumulative Turbine Details

The following tables outline the sound power levels of the cumulative wind farms included in the assessment. In this instance, Dereenacreenig West wind farm is proposed to use an Enerco E-82 with a hub height of 78.3 m, Shehy More wind farm operates a Nordex N100 at a hub height of 75 m, Gortloughra is proposed to use a Vestas V150 at 105m hub height and Curraglass is proposed to operate a Nordex 133 at a hub height of 90 m.

Sound power levels for the Enercon E-82 referenced to wind speeds at standardised 10 m height are presented in .

Table 12-11 Octave Band Spectrum of Enerco E82 E4 at 8m/s wind speed

Octave Band Centre Frequency (Hz)							
63	125	250	500	1000	2000	4000	8000
83.7	89.5	93.7	97.6	96.5	92.8	84.8	70.7

Table 12-12 Noise Emission Data, Enercon E82 at Standardised 10m height wind speed and 78.3m Hub Height

Maximum Sound Power ( $L_{WA}$ dB) at Standardised 10m Height wind Speed						
4	5	6	7	8	9	10
91.6	95.8	99.7	101.8	102.0	102.0	102.0

Sound power levels for the Nordex N100 referenced to wind speeds at standardised 10 m height are presented in Table 12-13.

Table 12-13 Sound Power Level Spectra for Nordex N100 with a hub height of 75 m

Wind Speed (m/s)	Octave Band Centre Frequency (Hz)								dB $L_{WA}$
	63	125	250	500	1000	2000	4000	8000	
3	71.1	76.7	82.8	86	87.2	87.8	83.2	69.9	93
4	73.1	78.7	84.8	88	89.2	89.8	85.2	71.9	95
5	74.9	79.2	86.4	91.4	93	92.6	87.5	73.6	98
6	80.9	85	90.4	94.7	97.2	96.4	92.4	78.8	102
7	81.5	87.5	91.9	96.2	98.5	97.4	92.5	79.2	103.2
8	82.6	88.9	92.6	96.7	99.4	98.3	93.3	79.7	104
9	82.6	89.3	91.9	96	100.1	99.5	93.7	79.1	104.5

Sound power levels for the Nordex N133 referenced to wind speeds at standardised 10 m height are presented in Table 12-14.

Table 12-14 Sound Power Level Spectra for Nordex N133 with a hub height of 90 m

Wind Speed (m/s)	Octave Band Centre Frequency (Hz)								dB $L_{WA}$
	63	125	250	500	1000	2000	4000	8000	
3	76.5	83.5	88.0	89.3	89.1	86.6	80.9	69.8	95.0
4	77.8	84.8	89.3	90.6	90.4	87.9	82.2	71.1	96.3
5	81.3	88.4	93.2	95.6	96.2	93.7	86.2	73.9	101.3
6	85.5	92.6	97.4	99.8	100.4	97.9	90.4	78.1	105.5
7	87.3	94.4	99.2	101.6	102.2	99.7	92.2	79.9	107.3
8	89.0	94.8	98.0	100.4	102.3	101.4	96.0	82.2	107.5
9	89.0	94.8	98.0	100.4	102.3	101.4	96.0	82.2	107.5

Sound power levels and spectral data for the Gortloughra wind farm proposed Vestas V150 turbines referenced to wind speeds at standardised 10 m height are presented in Table 12-15 and Table 12-16.

Table 12-15 Octave Band Spectrum of Vestas V150-6.0MW, STE at Maximum Sound Power ( $L_{WA}$  dB) at 12m/s wind speed

Octave Band Centre Frequency (Hz)								dB $L_{WA}$
63	125	250	500	1000	2000	4000	8000	
85.5	93.3	98.2	100.1	99.0	94.8	87.7	77.6	104.9

Table 12-16 Noise Emission Data, Vestas V150-6.0MW, STE at Maximum Sound Power ( $L_{WA}$  dB) at Standardised 10m Height wind Speed

Maximum Sound Power ( $L_{WA}$ dB) at Standardised 10m Height wind Speed								
4	5	6	7	8	9	10	11	12
95.4	99.5	103.2	104.7	104.9	104.9	104.9	104.9	104.9

### 12.4.5.5 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 details of noise prediction calculation settings. The previously presented Figure 12-2 presents the turbine locations, study area and receptor locations taken account of for this assessment.

## 12.5 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 site.

### 12.5.1 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 12.4.3.

#### 12.5.1.1 NML1

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

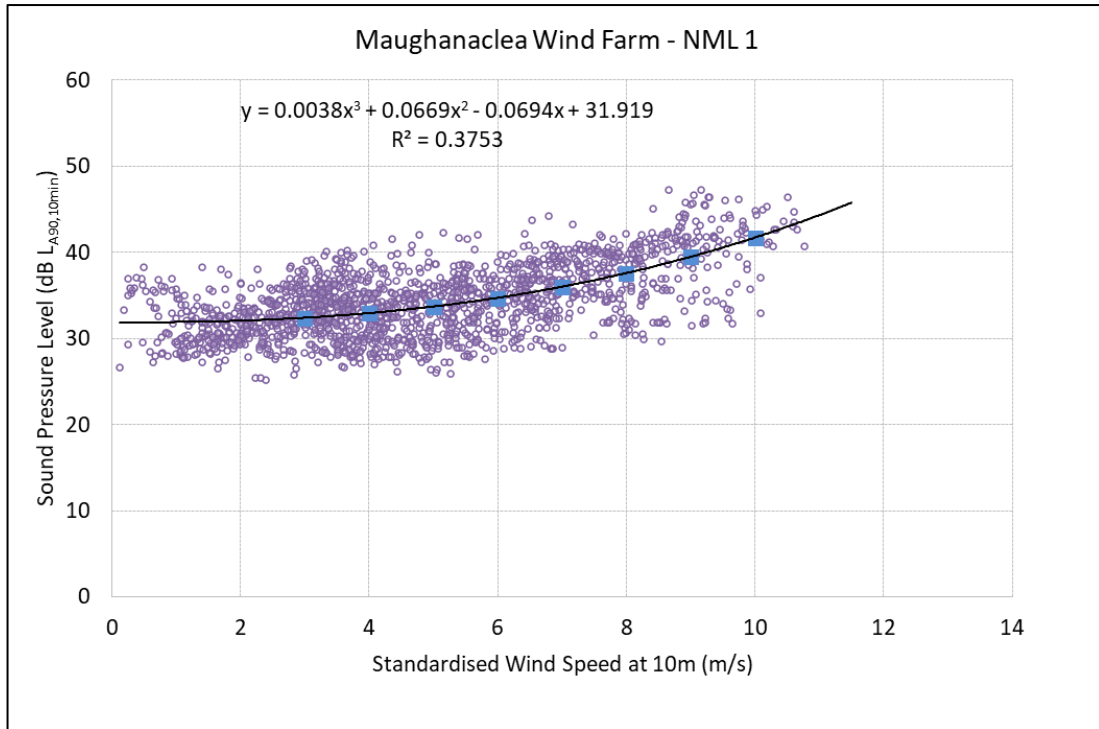


Figure 12-5 NML1 Daytime

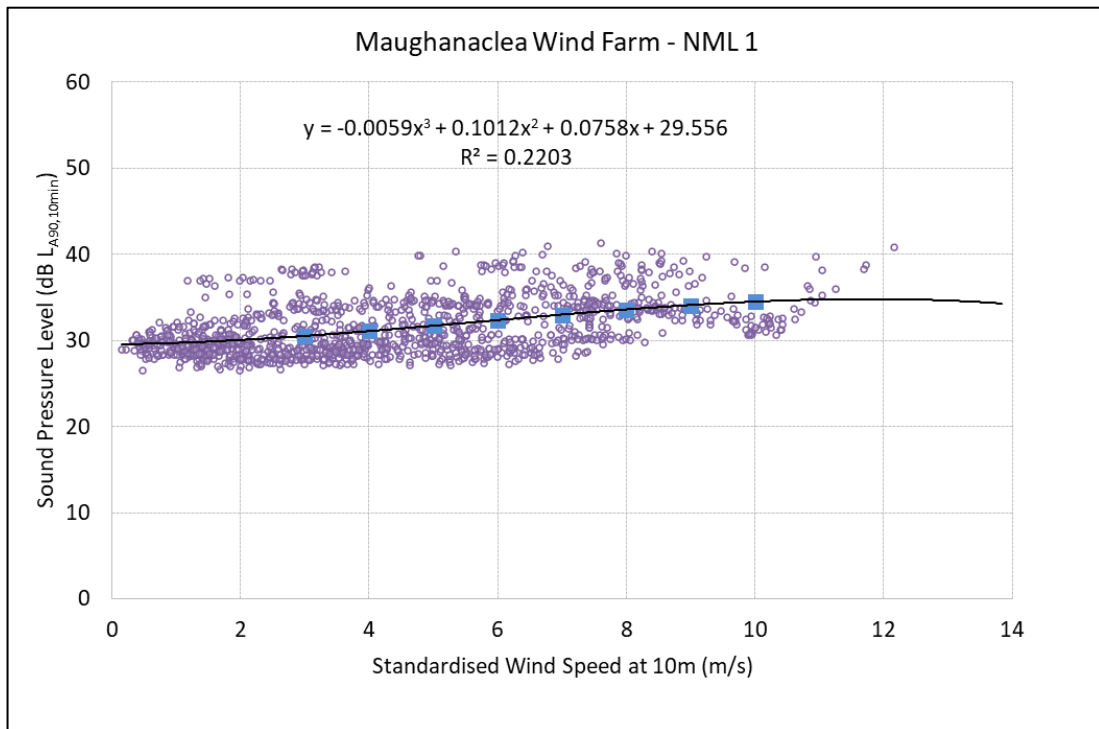


Figure 12-6 NML1 Night

### 12.5.1.2 NML2

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

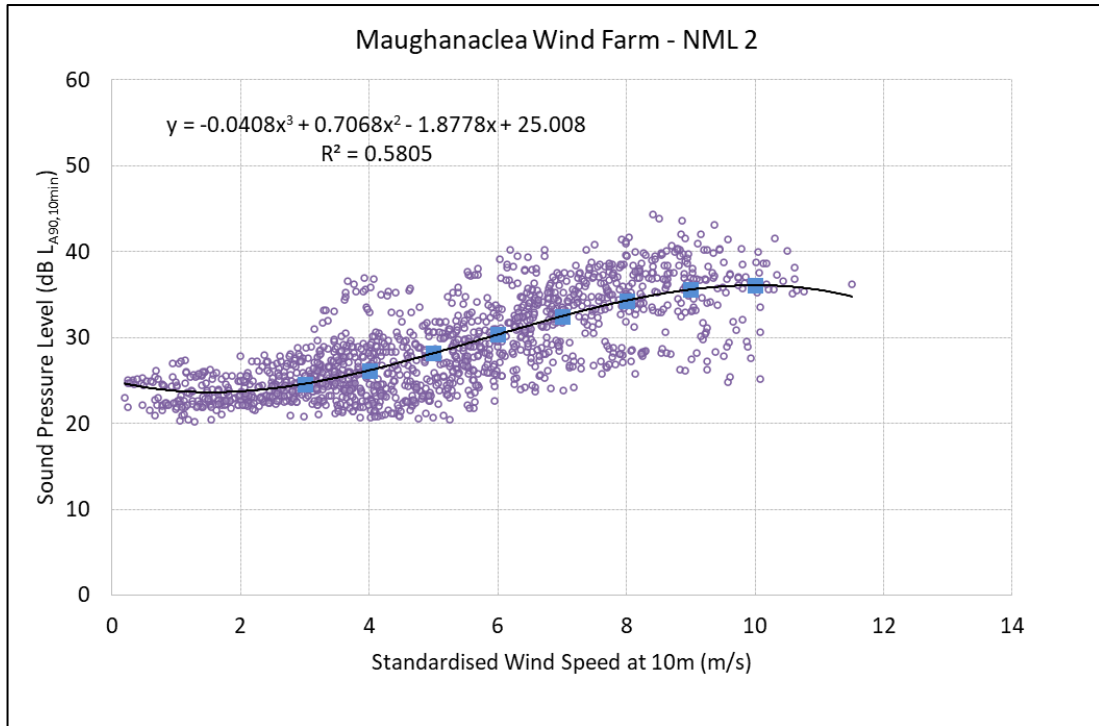


Figure 12-7 NML2 Daytime

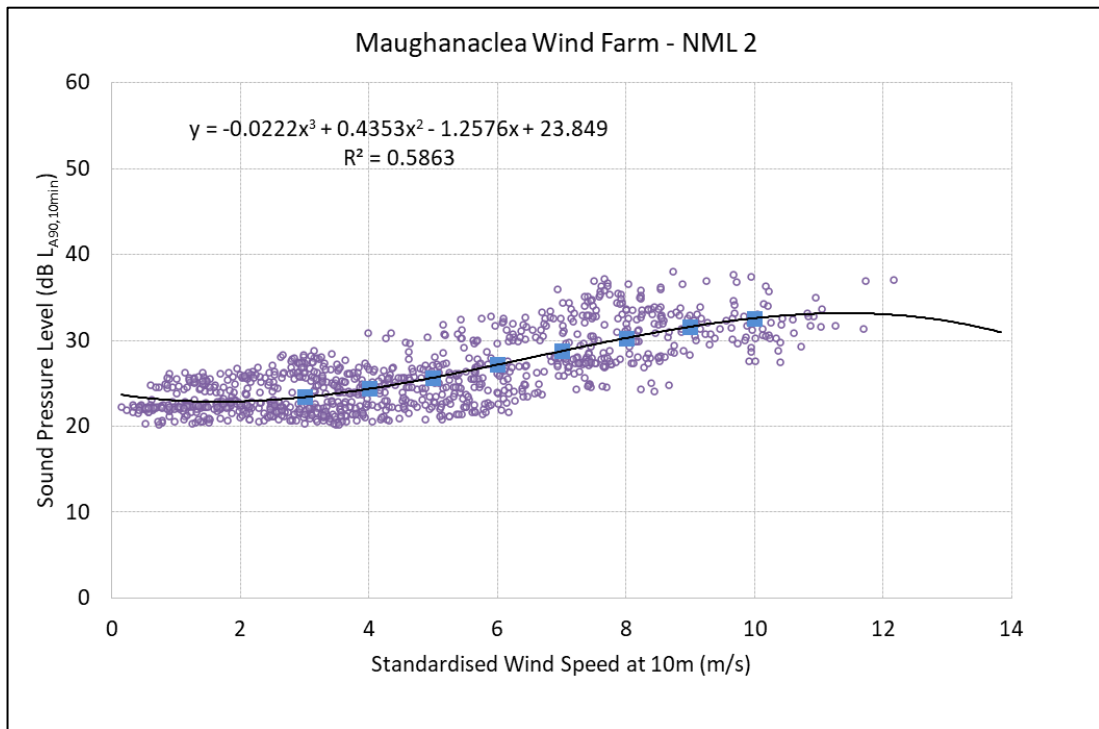


Figure 12-8 NML2 Night

### 12.5.1.3 NML3

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

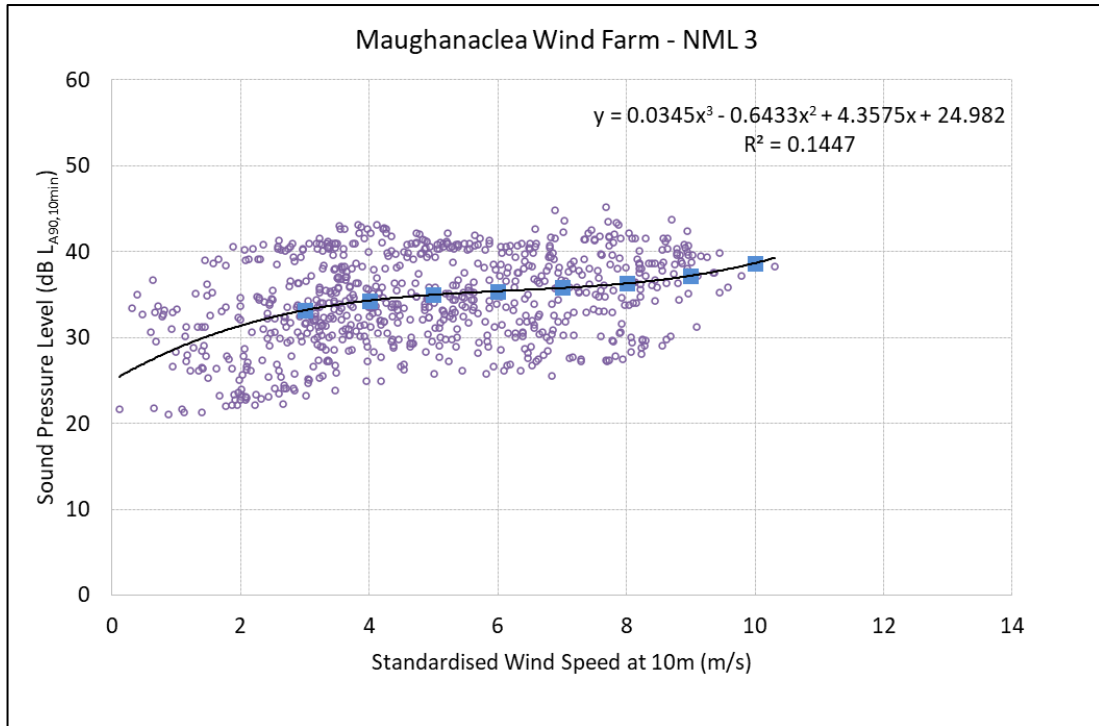


Figure 12-9 NML3 Daytime

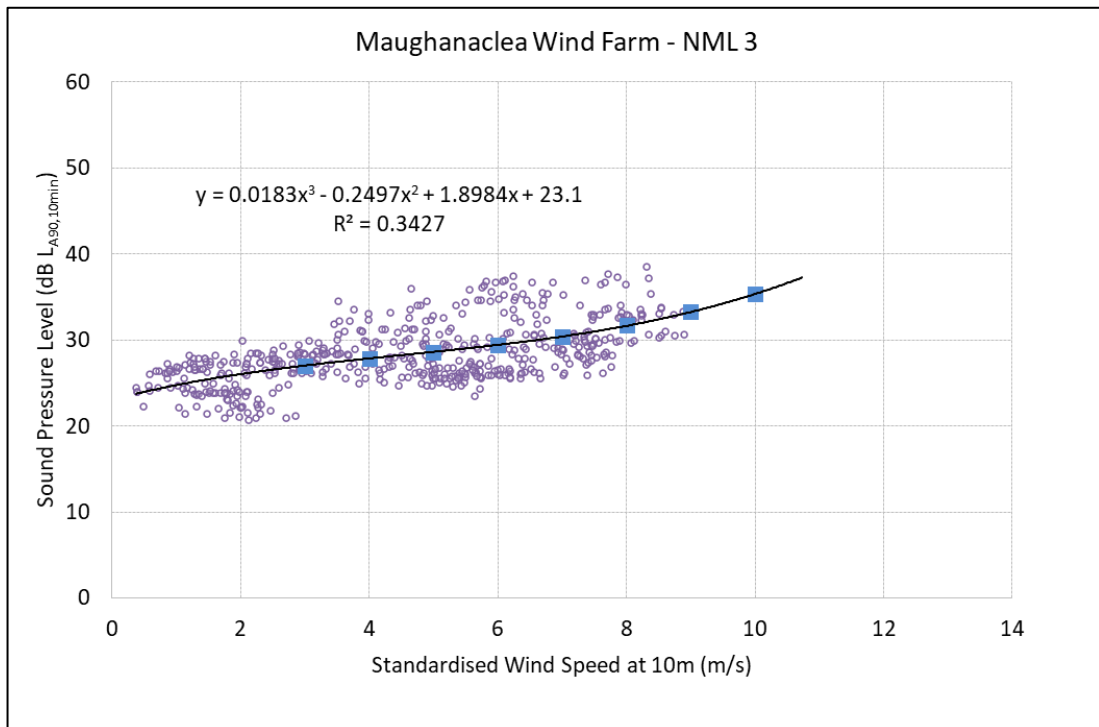


Figure 12-10 NML3 Night

#### 12.5.1.4 NML4

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

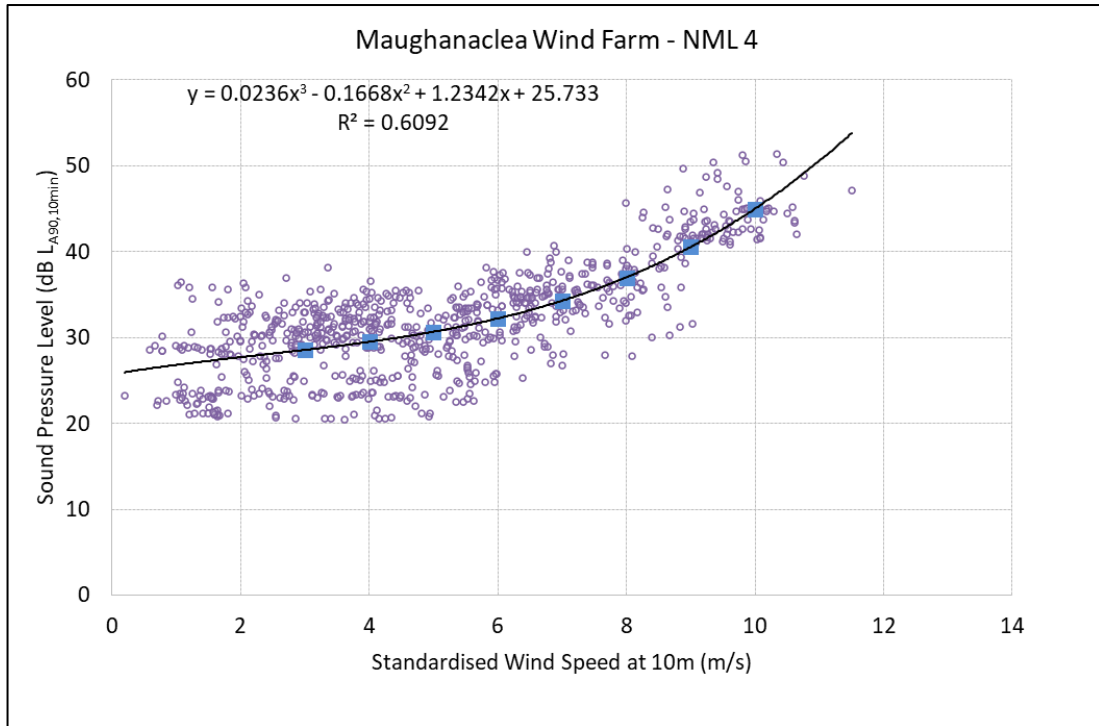


Figure 12-11 NML4 Daytime

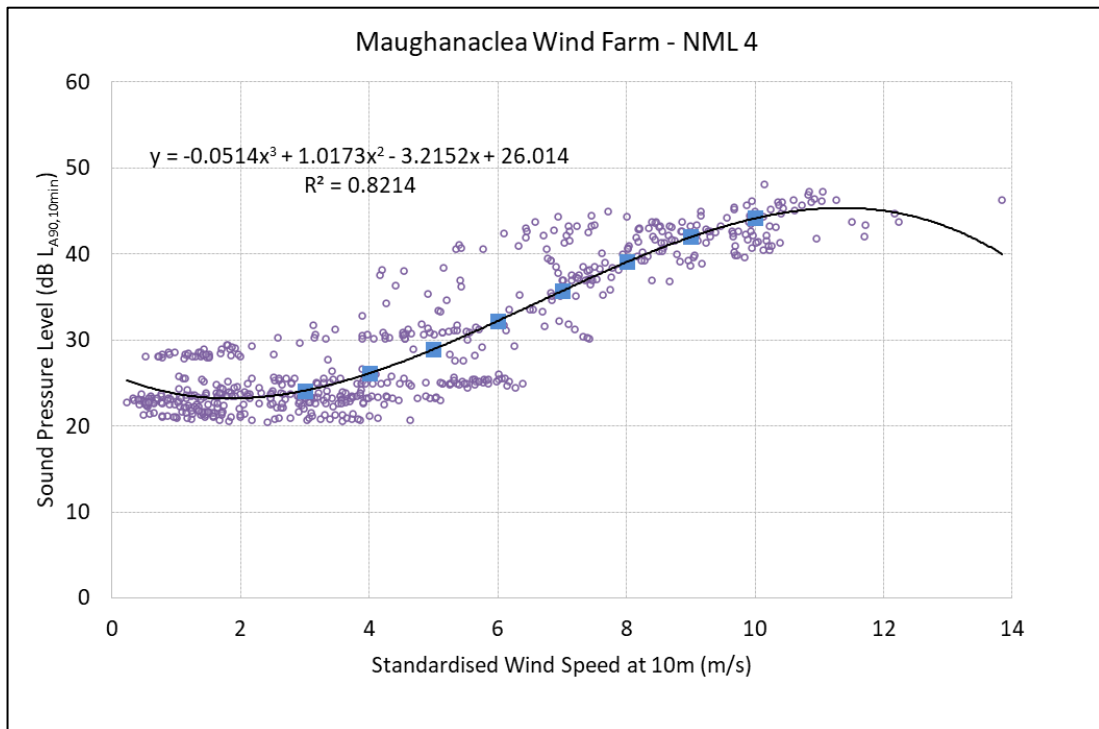


Figure 12-12 NML4 Night

### 12.5.1.5 NML5

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

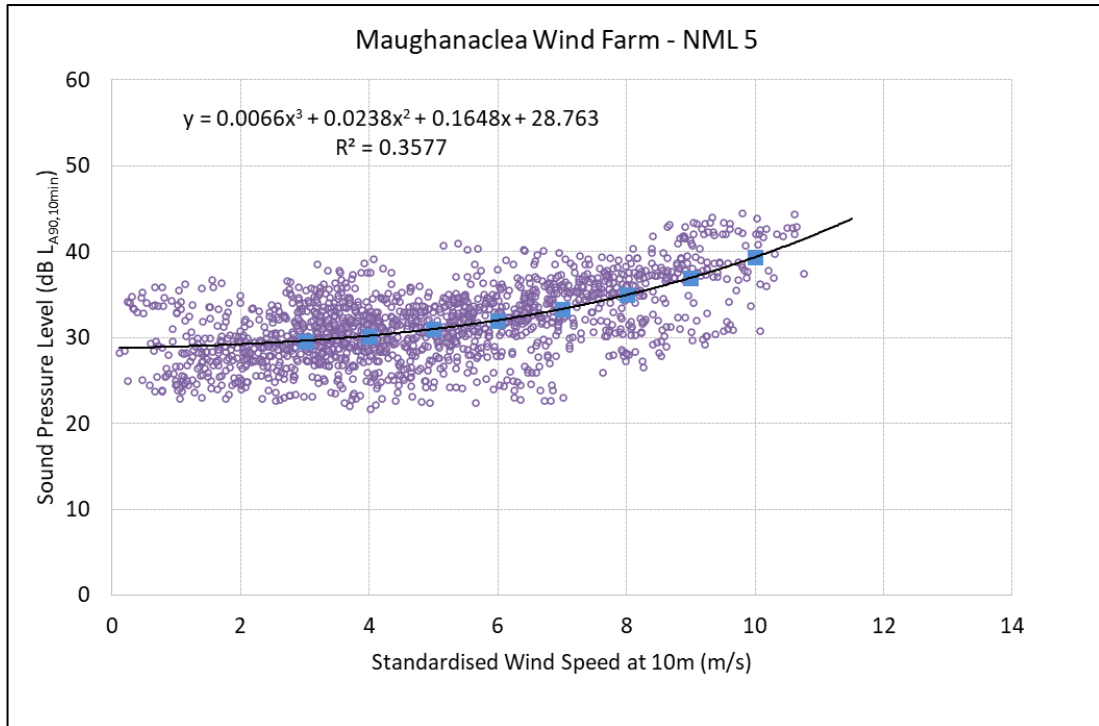


Figure 12-13 NML5 Daytime

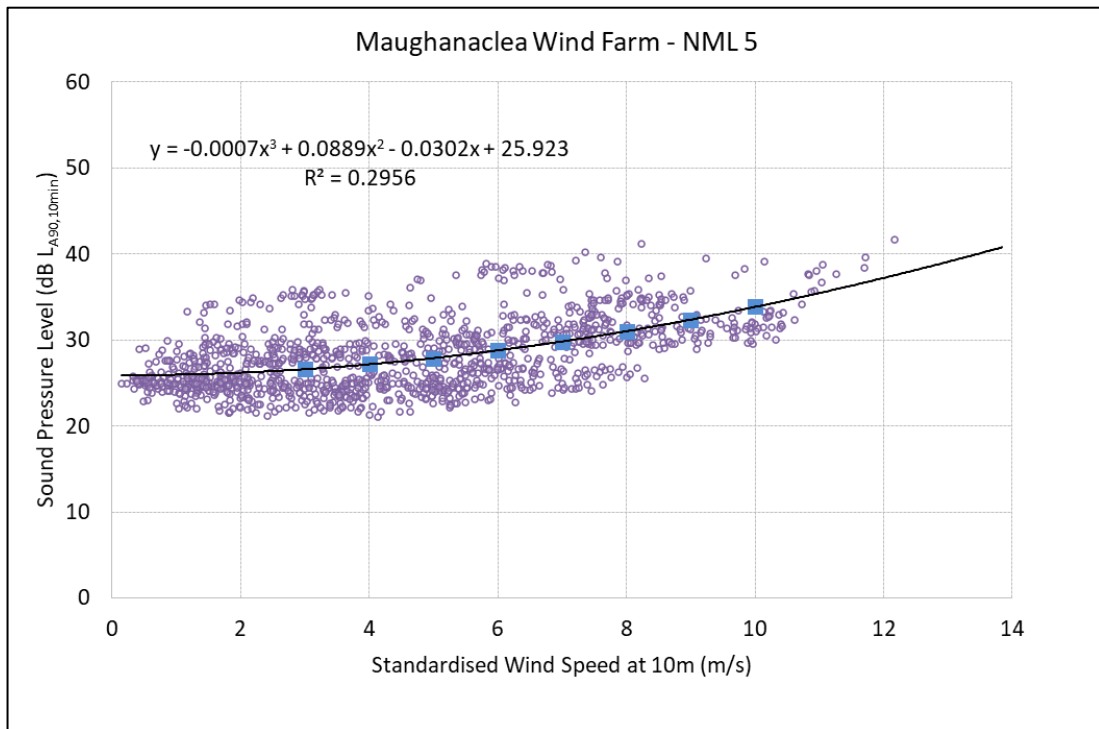


Figure 12-14 NML5 Night

### 12.5.1.6 NML6

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

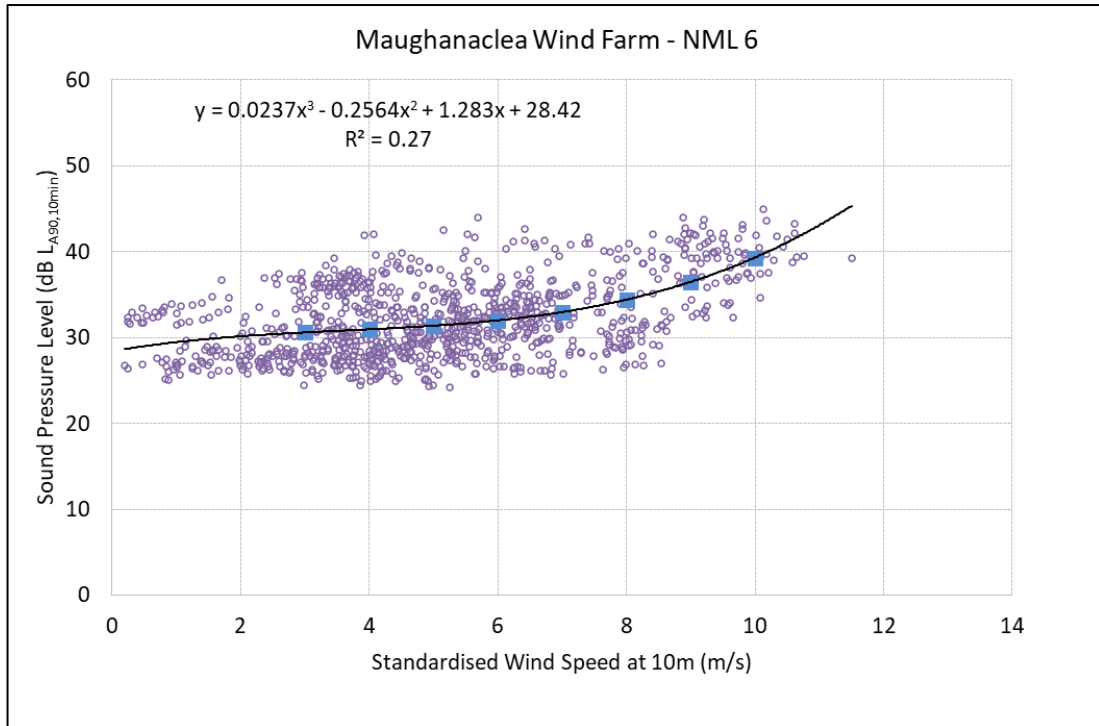


Figure 12-15 NML6 Daytime

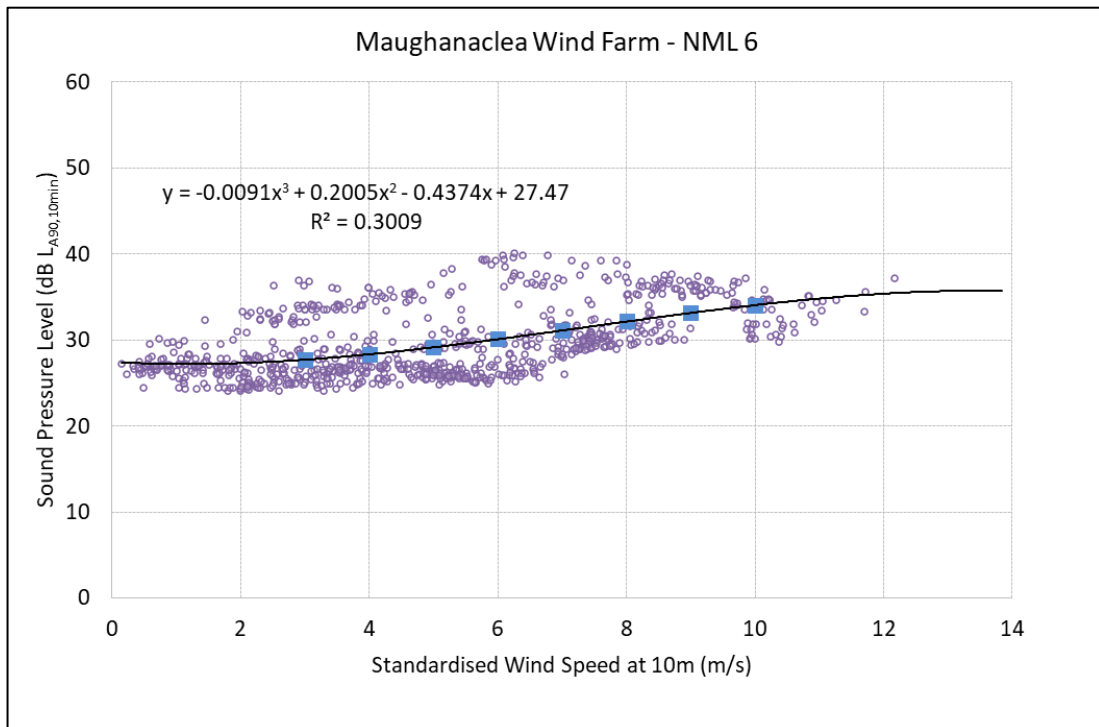


Figure 12-16 NML6 Night

## 12.5.2 Summary of Derived Background Noise Levels

Table 12-17 and Table 12-18 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 data sets measured in line with best practice guidance contained in the IOA GPG and its SGN No. 2 Data Collection.

Table 12-17 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 102.5 m Hub Height							
		3	4	5	6	7	8	9	10
NML1 (H014)	Daytime	32.4	33.0	33.7	34.7	36.0	37.6	39.5	41.7
NML2 (H003)	Daytime	24.6	26.2	28.2	30.4	32.5	34.3	35.6	36.1
NML3 (H015)	Daytime	33.2	34.3	35.0	35.4	35.8	36.3	37.2	38.7
NML4 (H041)	Daytime	28.6	29.5	30.7	32.2	34.3	37.0	40.6	45.0
NML5 (H031)	Daytime	29.6	30.2	31.0	32.0	33.3	35.0	37.0	39.4
NML6 (H018)	Daytime	30.6	31.0	31.4	32.0	33.0	34.4	36.5	39.3

Table 12-18 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 102.5 m Hub Height							
		3	4	5	6	7	8	9	10
NML1 (H014)	Night-time	30.5	31.1	31.7	32.4	33.0	33.6	34.1	34.5
NML2 (H003)	Night-time	23.4	24.4	25.7	27.2	28.8	30.3	31.6	32.6
NML3 (H015)	Night-time	27.0	27.9	28.6	29.4	30.4	31.7	33.3	35.4
NML4 (H041)	Night-time	24.1	26.1	28.9	32.2	35.7	39.1	42.0	44.2
NML5 (H031)	Night-time	26.6	27.2	27.9	28.8	29.8	31.0	32.4	33.9
NML6 (H018)	Night-time	27.7	28.3	29.2	30.1	31.1	32.2	33.2	34.1

### 12.5.3 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 12.5.2.

The turbine noise limits proposed are in line with the applicable the Guidelines (DoEHLG 2006) and noise conditions applied to similar sites previously granted planning permission by An Coimisiún Pleanála.

For the Proposed Project, it is considered that a lower daytime threshold of 40 dB LA90 is appropriate for low noise environments where the background noise is less than 30 dB(A), based on the following considerations:

- The EPA NG4 Guidance proposes a daytime noise criterion of 45 dB(A) in ‘areas of low background noise’. Turbine noise limits are stated in terms of the LA90 parameter while the NG4 daytime limit an LAeq. The accepted difference between LAeq and LA90 in wind turbine noise assessments is 2 dB; for example, 45 dB LAeq corresponds to 43 dB LA90. This approach implies a 3 dB difference when comparing the parameter definitions used in NG4 and the Guidelines (DoEHLG 2006). Accordingly, the proposed lower daytime threshold of 40 dB LA90 is 3 dB more stringent than the equivalent daytime noise limit for low background noise areas as outlined in NG4.
- A lower threshold of 40 dB is commonly adopted in planning conditions for similar developments that have been granted planning permission by ACP in recent years for example, Derrinlough Wind Farm (ACP Ref: 306706-20), Coole Wind Farm (ACP Ref: PL25M.300686) Cloncreen (ACP Ref: PA0047), Borrisbeg (ACP ref: 318704-23), Castlebanny Wind Farm (Planning Ref: 309306-21), Ballivor (ACP-316212-23) and Carrig Renewables Wind Farm (ACP Ref: 318689-23).

Best practice for setting wind turbine noise limits at NSLs is that the limits should relate to the cumulative turbine noise level from all turbines. Therefore, the proposed noise limits shall be cumulative, accounting for all operational wind turbines. When setting appropriate turbine noise limits in accordance with the criteria from the Guidelines (DoEHLG 2006), it is important to bear in mind that where an existing wind turbine development is the dominant source of turbine noise at a given NSL, this must be considered in the context of the planning condition for noise under which that development operates.

Based on the guidance listed above, the proposed operational limits in LA90,10min for the Proposed Project are:

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

- 40 dB LA90,10min for daytime in quiet environments with typical background noise of less than 30 dB LA90,10min.
- 45 dB LA90,10min for daytime in environments with typical background noise greater than or equal to 30 dB LA90,10min or a maximum increase of 5 dB(A) above background noise (whichever is the higher); and
- 43 dB LA90,10min for night-time periods or a maximum increase of 5 dB(A) above background noise (whichever is the higher).

*Prior to the commissioning of the wind farm, the developer shall submit a Noise Compliance Monitoring Programme (NCMP) to the planning authority for written agreement. The NCMP shall include a detailed methodology for all noise measurements, the frequency of monitoring and procedures for recording results. The approved NCMP shall be fully implemented throughout the operational phase of the wind farm.*

Day and nighttime noise criteria curves have been determined from review of the derived background noise levels at 6 no. NSLs surrounding the Proposed Wind Farm and are presented in the relevant sections of this chapter.

### 12.5.3.1 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 12-19 outlines the operational noise criteria for each measurement location. The derived criteria at 9m/s have been applied to higher wind speeds for the purpose of this assessment. It should be noted that as wind speed increases so too will the background noise levels, this approach to the assessment is therefore conservative.

Table 12-19 Proposed Noise Criteria Curves

Location	Period	Turbine Noise Limits LA90, 10min Levels (dB) at Various Standardised 10m Height Wind Speeds)							
		3	4	5	6	7	8	9	10
NML1 (H014)	Day	45	45	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43	43
NML2 (H003)	Day	40	40	40	45	45	45	45	45
	Night	43	43	43	43	43	43	43	43
NML3 (H015)	Day	45	45	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43	43
NML4 (H041)	Day	40	40	45	45	45	45	45.6	45.6
	Night	43	43	43	43	43	44.1	47	47
NML5 (H013)	Day	40	45	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43	43
NML6 (H018)	Day	45	45	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43	43

### 12.5.4 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 Proposed Wind Farm 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 LAeq,T is considered appropriate for the operation of the substation. The substation design will ensure that the noise emissions do not contain audible tones or impulsive characteristics at the nearest NSLs. 35 dB LAeq,T is considered a low level of noise.

In accordance with to the guidance from the BS4142 standard, discussed in Section 12.3.2.5.2, it is considered that the proposed absolute criterion of 35 dB LAeq,T for noise from the substation is robust and should prevent adverse impacts at NSLs.

## 12.6 Likely Significant Effects

### 12.6.1 Do-nothing Scenario

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.

In the absence of the Proposed Project any increases in traffic volumes on the local road network over time would not be expected to result in a significant change to the overall ambient and background noise levels in the receiving environment.

However, if the Proposed Project were not to proceed, the opportunity to capture part of Cork'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.

### 12.6.2 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 site roads;
- Excavation and operation of borrow pits;
- Construction of turbines and hardstand areas;
- Construction of substation;
- 110kV and 33kV underground 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 will be no significant noise, and 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, meteorological mast, security cabins and temporary accommodating works for the TDR.

Construction activities will be carried out during normal daytime working hours (i.e., 07:00hrs – 19:00hrs Monday-Saturday). 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.

## 12.6.2.1 General Construction of Turbines, Hardstand Areas and Met Mast

### 12.6.2.1.1 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 Location H002 and H003 which are situated approximately 682 m respectively from the proposed turbines T03 and T01. The distance from the proposed Met Mast is 832 m from the nearest NSL (H021).

Table 12-20 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.

Table 12-20 Typical Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB L <sub>Aeq,T</sub> ) <sup>1</sup>	Predicted Noise Level (dB L <sub>Aeq,T</sub> ) at distance (682m)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials within the site	79	29
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for turbine foundations	77	27
Excavator Mounted Rock Breaker (C9.12)	Rock Breaking	85	35
General Construction (Various)	All general activities plus deliveries of materials and plant to the site	84	34
Concrete Mixer Truck and Concrete Pump (C.4.27)	Foundations	75	25
Dumper Truck (C.4.4)	Removing peat and spoil and transporting fill and other materials.	76	26
Mobile Telescopic Crane (C.4.39)	Installation of nacelles	77	27

<sup>1</sup> All plant noise levels are derived from BS5228: Part 1

JCB (D.8.13)	Road surfacing.	82	32
Vibrating Rollers (D.8.29)	For services, drainage and landscaping.	77	27
Cumulative Construction Noise Level			40

At 682 m from the works the predicted noise levels from construction activities are in the range of 25 to 35 dB  $L_{Aeq,T}$  with a total theoretical precautionary cumulative construction level of the order of 40 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.

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.

#### 12.6.2.1.2 **Vibration**

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

#### 12.6.2.1.3 **Description of Effects**

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, 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.

#### 12.6.2.2 **Proposed Access Roads and Upgrade of Existing Roads**

It is proposed to construct new internal roads, as well as upgrade existing internal roads for internal access within the Proposed Wind Farm site. Review of the road layout has identified that the nearest NSL to any point of the Proposed Project is approximately 63 m to receptor H016. 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 12-21 Indicative Noise Levels from Construction Plant at Various Distances from Site Roads

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB L <sub>Aeq,T</sub> ) <sup>1</sup>	Predicted Noise Level at Stated Distance from Edge of Works (dB L <sub>Aeq,T</sub> ) at 63 m
Tracked Excavator (C.4.64)	77	59
HGV Movement (C.2.30)	79	61
Vibrating Rollers (D.8.29)	77	58
Dumper Truck (C.4.4)	76	59
Cumulative Total	–	65

The table shows that at 63 m, noise levels do not exceed the construction noise thresholds in Table 12-1, additionally, as these works will progress along the road the worst case impacts predicted will reduce. At 63 m distance or more, the noise levels due to construction of site roads are below the adopted significance threshold outlined in Table 12-1 (Category A – 65 dB L<sub>Aeq,T</sub> during daytime periods).

#### 12.6.2.2.1 **Vibration**

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

#### 12.6.2.2.2 **Description of Effects**

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA, 2022 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	Temporary

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.

### 12.6.2.3 **Borrow Pit Excavation and Reinstatement**

#### 12.6.2.3.1 **Noise**

To inform this aspect of the proposal a comparative noise assessment has been prepared and is outlined in the following paragraphs. Two situations have been considered as follows:

- Scenario A      Blasting operation

<sup>1</sup> All plant noise levels are taken from BS5228: Part 1

➤ Scenario B Rock breaking operation

In terms of these activities please note the following:

- A mobile crusher will operate on site for both options.
- In Scenario B that two rock breakers will be in use on Site during daytime periods for a short period of time.

Table 12-22 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 12-22 Plant Noise Emissions

Location	Plant Noise level at 10m Distance (dB L <sub>Aeq,T</sub> ) <sup>1</sup>								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Crusher	95	98	98	106	103	100	95	86	110
Rock Breaker	93	101	104	114	115	116	113	106	121
HGV Movement	77	88	95	93	93	92	86	76	98
Dump Truck	87	92	99	97	102	99	94	85	105
Semi-mobile screen/stockpiler	69	82	96	99	103	101	99	88	107
Tracked Excavator	77	88	95	93	93	92	86	76	99

A noise 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 a proposed borrow pit location is NSL H008, which lies approximately 300 m to the south of proposed borrow pit BP2. Predicted levels at the closest NSL assuming all plant operates simultaneously is 59 dB L<sub>Aeq</sub> for Scenario A and 48 dB L<sub>Aeq</sub> for Scenario B which are both below the adopted criteria of 65 dB L<sub>Aeq,T</sub>. It is expected that construction works at the borrow pits will only occur during daytime periods.

The blasting proposal results in lower levels of construction noise since the use of the rock breaking plant is not required in this instance. Predicted noise levels are lower at all assessed locations for Scenario A.

It is accepted that the individual blast events will be audible at some locations. Blast events will be designed and controlled such that the best practice noise and vibration limit values outlined in section 12.3 of this chapter are not exceeded.

<sup>1</sup> All plant noise levels are derived from BS5228: Part 1

### 12.6.2.3.2 **Vibration**

With reference to the discussion on vibration presented in Section 12.3.2.3 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.

### 12.6.2.3.3 **Description of Effects**

The predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the potential worst-case associated effects at the nearest NSLs associated with operation of borrow pits are described follows:

Quality	Significance	Duration
Negative	Not Significant	Short Term

### 12.6.2.4 **Peat and Spoil Management Areas**

Areas of peat and spoil management are also proposed as part of the Proposed Wind Farm. The nearest NSL to any of the proposed peat and spoil management areas is H003 at a distance of 605m from the peat and spoil management area located south west of the proposed 110kV onsite substation. The construction machinery to be used in these areas are presented in Table 12-23.

Table 12-23 Typical Construction Noise Emission Levels – Peat and Spoil Management Areas

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L <sub>Aeq,T</sub> ) <sup>1</sup>	Predicted Noise Level at 605 m
Tracked Excavator (C.4.64)	77	39
Dumper Truck (C.4.39)	76	38
<b>Total Construction Noise</b>		<b>42</b>

These levels of noise are within the construction noise criterion outlined in Section 12.3.2.1, (Category A – 65 dB L<sub>Aeq,T</sub> during daytime periods) therefore it is concluded that there will be no significant noise impact associated with the peat and spoil management areas, therefore no specific mitigation measures are required.

### 12.6.2.4.1 **Description of Effects**

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the proposed peat and spoil management areas are described are as described below:

<sup>1</sup> All plant noise levels are derived from BS 5228: Part 1

Quality	Significance	Duration
Negative	Not Significant	Short Term

## 12.6.2.5 Substation and Ancillary Construction Works

### 12.6.2.5.1 Noise

The nearest NSL to the proposed 110kV onsite substation compound is H011, which is at approximately 325 m northeast. Based on a worst case scenario, i.e., assuming the same construction activities as outlined in Table 12-20 above, it is predicted that the likely precautionary noise levels from construction activities associated with the onsite substation and ancillary development works 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.

### 12.6.2.5.2 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.

### 12.6.2.5.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of substation are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

## 12.6.2.6 Proposed Grid Connection

The Proposed Grid Connection includes approximately 20.5 km of 110kV underground cabling from the proposed 110kV onsite substation to the existing 110kV Dunmanway substation. The full description of the Proposed Grid Connection is outlined in Chapter 4 of this EIAR. Review of the drawings has identified that NSLs range in distance to the Proposed Grid Connection, with some receptor locations within 10m of the construction works.

### 12.6.2.6.1 Noise

Table 12-24 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 12-24 Indicative Noise Levels from Construction Plant at Various Distances from Proposed Grid Connection

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L <sub>Aeq,12hr</sub> )	Calculated Construction Noise Level dB L <sub>Aeq,T</sub> at distance from works (m)		
		25 m	50 m	100 m
HGV Movement (C.2.30)	79	67	60	53
Tracked Excavator (C.4.64)	77	65	58	51
Excavator Mounted Rock Breaker (C9.12)	85	73	66	59
General Construction (Various)	84	72	65	58
Concrete Mixer Truck and Concrete Pump (C.4.27)	75	63	56	49
Dumper Truck (C.4.4)	76	64	57	50
Mobile Telescopic Crane (C.4.39)	77	65	58	51
Dewatering Pumps (D.7.70)	80	68	61	54
JCB (D.8.13)	82	70	63	56
Vibrating Rollers (D.8.29)	77	65	58	51
Total Construction Noise	-	79	72	65

The construction activities for the Proposed Grid Connection will vary and will not be continuous in nature. Whilst noise levels are predicted to exceed the noise threshold when works takes place directly outside a receptor location, the noise levels are not expected to exceed the threshold over a significant period, as the works are linear and will continue to move along the grid route at a rate where construction works will not exceed the temporal criteria outside any receptor location 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.

12.6.2.6.2 **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 based 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 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 10 m to 50 m 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 10 m to 50 m 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. Given the range of measurements, it is likely that vibration at 25 m from the activity will be significantly under the assessment threshold set out in Table 12-4 although vibration may be perceptible at times.

12.6.2.6.3 **Description of Effects**

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the potential worst-case associated effects at the nearest NSLs associated with the Proposed Grid Connection are described below.

Quality	Significance	Duration
Negative	Not Significant - Slight	Short Term

12.6.2.7 **Biodiversity Management and Enhancement Plan and Felling Measures**

A Biodiversity Management and Enhancement Plan (BMEP) is proposed as part of the Proposed Project, please refer to Appendix 6-4 of the EIAR for further details. Part of the enhancement proposals includes the felling or removal of existing trees. Tree felling will also be required within and around the Proposed Wind Farm infrastructure footprint to allow for the construction of the proposed turbines and associated bat buffers, access roads, proposed 110kV onsite substation, and the other ancillary infrastructure.

Table 12-25 outlines the likely noise levels associated with felling activity at varying set back distances from the works. The calculations are based on typical sound pressure noise levels derived from BS 5228-1:2009 for the proposed activities and assume an operating time of 50% for each plant item, equivalent to 6 hours within a 12-hour assessment period.

Table 12-25 Typical Noise Levels – Felling

Item (BS 5228-1 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$ ) <sup>1</sup>	Highest Predicted Plant Noise Level (dB $L_{Aeq,T}$ )				
		50m Distance	75m Distance	100m Distance	150m Distance	200m Distance
Wheeled loader (C2.8) x 2	68	49	44	41	37	33
Tracked excavator (C2.2) x 2	77	58	53	50	46	42
Petrol-driven chainsaw (D2.14)	86	64	59	56	52	48
<b>Total Construction Noise</b>		<b>65</b>	<b>60</b>	<b>57</b>	<b>53</b>	<b>49</b>

These predicted levels of noise associated with felling activities are within the construction noise criterion outlined in Section 12.3.2.1, where the works occur at distances of greater than 50 m for the nearest sensitive receptor it is concluded that there will be no significant noise impact associated with these activities and no specific mitigation measures are required. Review of the surrounding area indicates that the closest receptor to the works are H011 and H008, which are located 175 m and 375 m from the works, respectively.

In the unlikely event that the works occur at distance closer than 50 m from the nearest sensitive receptor, the calculations indicate that the noise threshold outlined in Section 12.3.2.1 may be exceeded. However, for a significant effect to occur, the duration of the of any such exceedance would need to be greater than the durations outlined within the criteria. A significant effect is not expected to occur at any Sensitive Receptor as the activity is not likely to occur with 50 m from a sensitive receptor, and specific mitigation measures are therefore not required.

Quality	Significance	Duration
Negative	Not Significant	Short Term

### 12.6.2.8 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:

- > Activity 1: General Construction Works & Proposed Grid Connection
- > Activity 2: Concrete Foundation Delivery
- > Activity 3: General Construction Works & Turbine Delivery - Abnormal Loads
- > Activity 4: General Construction Works & Turbine Delivery - Standard Loads
- > Activity 5: General Construction Works

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.

<sup>1</sup> All plant noise levels are derived from BS 5228: Part 1

Table 12-26 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 12-26 Assumptions for Construction Traffic Noise Assessment

Route	Stage	LGV	HGV
1 – N22 at Castlemore	Existing	15,914	750
	Activity 1	16,000	818
	Activity 2	15,984	964
	Activity 3	15,984	765
	Activity 4	15,959	761
	Activity 5	15,959	759
2 – N585 north of Crookstown	Existing	5,088	245
	Activity 1	5,174	314
	Activity 2	5,158	460
	Activity 3	5,158	261
	Activity 4	5,133	257
	Activity 5	5,133	255
3 – R585 at Gloun	Existing	5,660	279
	Activity 1	5,746	348
	Activity 2	5,730	493
	Activity 3	5,730	294
	Activity 4	5,705	290
	Activity 5	5,705	288

Based on the assumptions presented above changes in noise level based on the existing flows have been estimated and is presented in Table 12-27.

Table 12-27 Estimated Changes in Traffic Noise Levels

Route	Stage	Change in Traffic Noise Level dB(A)	Potential Significance of Effect
1 – N22 at Castlemore	Activity 1	+0.3	Imperceptible
	Activity 2	+0.8	Imperceptible
	Activity 3	+0.1	Imperceptible
	Activity 4	+0.1	Imperceptible
	Activity 5	+0.0	Imperceptible
2 – N585 north of Crookstown	Activity 1	+0.8	Imperceptible
	Activity 2	+2.2	Not Significant
	Activity 3	+0.2	Imperceptible
	Activity 4	+0.2	Imperceptible
	Activity 5	+0.1	Imperceptible
3 – R585 at Gloun	Activity 1	+0.8	Imperceptible
	Activity 2	+2.0	Not Significant
	Activity 3	+0.2	Imperceptible
	Activity 4	+0.1	Imperceptible
	Activity 5	+0.1	Imperceptible

The increase in noise levels due to additional construction traffic on each of the routes is predicted to be less than 2.2 dB or less for all routes and stages. The resultant impact will be negative, imperceptible to not significant and short-term.

Quality	Significance	Duration
Negative	Imperceptible to Not Significant	Short Term

## 12.6.3 Operational Phase

### 12.6.3.1 Assessment of Wind Turbine Noise

Using the assessment methodology described in Section 12.4.5 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 12.5.3, which have been derived in accordance with the criteria set out in Section 12.3.2.4.

At all NSLs the worst omni-directional cumulative turbine noise levels are below the noise criterion curves. Appendix 12-4 presents the predicted omni-directional turbine results at all NSLs in tabulated form.

Table 12-28 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 LA90. Noise contours for the omni-directional rated power wind speed (i.e., highest noise emission) are presented in Appendix 12-5.

Table 12-28 Predicted Noise Levels

NSL Ref	Parameter	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
H002	Predicted	30.6	30.6	35.9	39.6	40.2	40.2	40.2
	Daytime Criterion	45	45	45	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H003	Predicted	30.8	30.8	36	39.7	40.2	40.3	40.3
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H004	Predicted	28.8	28.8	34.1	37.9	38.4	38.4	38.4
	Daytime Criterion	45	45	45	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H006	Predicted	29.2	29.2	34.4	38.2	38.7	38.7	38.8

NSL Ref	Parameter	Predicted Noise Level dB L <sub>A90</sub> at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H008	Predicted	30.6	30.6	35.9	39.7	40.1	40.1	40.1
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H012	Predicted	31	31	36.4	40.2	40.6	40.6	40.6
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H013	Predicted	30.2	30.2	35.6	39.4	39.8	39.8	39.8
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H014	Predicted	29.7	29.7	35	38.8	39.2	39.2	39.2
	Daytime Criterion	45	45	45	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-

NSL Ref	Parameter	Predicted Noise Level dB L <sub>A90</sub> at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
H019	Predicted	29.6	29.6	35	38.8	39.2	39.2	39.2
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H024	Predicted	29	29	34.4	38.2	38.6	38.6	38.6
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H025	Predicted	29.2	29.2	34.6	38.3	38.8	38.8	38.8
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H031	Predicted	29.1	29.1	34.5	38.3	38.7	38.7	38.7
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
H035	Predicted	29	29	33.8	37.5	38.3	38.3	38.5
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43

NSL Ref	Parameter	Predicted Noise Level dB L <sub>A90</sub> at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Night-time Excess	-	-	-	-	-	-	-
H090	Predicted	29.6	29.6	33.5	37.3	38.6	38.8	39
	Daytime Criterion	40	40	40	45	45	45	45
	Daytime Excess	-	-	-	-	-	-	-
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-	-
	H194	Predicted	29.4	29.4	33.3	37	38.4	38.6
Daytime Criterion		40	40	40	45	45	45	45
Daytime Excess		-	-	-	-	-	-	-
Night-time Criterion		43	43	43	43	43	43	43
Night-time Excess		-	-	-	-	-	-	-

### 12.6.3.1.1 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, 2022 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.

### 12.6.3.2 Fixed Plant Noise

#### 12.6.3.2.1 Proposed 110kV Onsite Substation

Details of the proposed 110kV onsite 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 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 110kV onsite 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 110kV onsite substation at the nearest NSL (H011) at approximately 325 m northeast is 27 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 110kV onsite 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. At the detailed design stage, substation plant will be selected to ensure that there are no tonal or impulsive characteristics from the plant audible at any NSLs during nighttime periods.

### 12.6.3.2.2 Cumulative Levels

The operation of the substation is 27 dB  $L_{Aeq,T}$  at the nearest NSL. The predicted noise cumulative noise levels are within the criterion for fixed mechanical 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 no tonal components to the noise are readily evident at any NSLs. At NSLs further from the proposed 110kV onsite substation the noise levels will be lower.

### 12.6.3.2.3 Description of Effects

With respect to the EPA, 2022 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 110kV onsite substation is described below.

Quality	Significance	Duration
Negative	Not Significant	Permanent

## 12.6.4 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 12.4.4) 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. The underground cabling to the proposed 110kV onsite substation will remain in place. Refer to Section 4.12 of Chapter 4 and Appendix 4-6 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.

### 12.6.4.1.1 Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 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

## 12.7 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.

### 12.7.1 Construction Phase Noise

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*'.

The following best practice mitigation measures from these documents will be implemented as required for the duration of the construction and decommissioning phases:

- Limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- Establishing channels of communication between the contractor/developer, Local Authority and residents;
- Monitoring typical levels of noise and vibration during critical periods and at sensitive locations;
- Selection of plant with low inherent potential for generation of noise and/ or vibration where practical;
- Placing of noise generating / vibratory plant as far away from sensitive receptors as practical within the site constraints, and;
- The hours of construction activity will be limited to avoid unsociable hours where possible. Works operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, turbine component deliveries) it could occasionally be necessary to work out of these hours.

And more specifically:

- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.

- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen as appropriate.

Air overpressure from a blast is difficult to control, however, because of its variability much can be done to reduce the effect. A reduction in the amount of primer cord used, together with the adequate burial of any that is above the ground, can give dramatic reduction to air overpressure intensities especially in the audible frequency range. Most complaints are likely to be received from an area downwind of the blast site, and therefore, if air blast complaints are a continual problem, it would be advisable to postpone blasting during unfavourable weather conditions if possible. As air blast intensity is a function of total charge weight, then a reduction in the total amount of explosives used can also reduce the air overpressure value.

Further guidance will be obtained from the recommendations contained within BS 5228: Part 1 and the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988 in relation to blasting operations.

- The methods used to minimise impacts will consist of the following:
- Restriction of hours within which blasting can be conducted (e.g. 09:00 – 18:00hrs).
- The firing of blasts at similar times to reduce the ‘startle’ effect.
- On-going circulars informing people of the progress of the works.
- The implementation of an onsite documented complaints procedure.
- The use of independent monitoring for verification of results.
- Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.

## 12.7.2 Construction Phase Vibration

The assessment presented in Section 12.6.2 has demonstrated that there will be no significant vibration impacts associated with the construction of the Proposed Project and that no specific mitigation measures are required, it is recommended that vibration from construction activities will be limited to the values set out in Section 12.3.2.3.

It should be noted that these limits are not absolute but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage, these limits may need to be reduced by up to 50%.

If blasting is undertaken as part of the Proposed Project, a detailed assessment will be undertaken by a specialist blast design engineer to determine the blast design parameters; all mitigation measures specified by the blast design engineer to keep vibration values within the criteria in 12.3.2.3 will be implemented.

## 12.7.3 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 Section 3.5 of the

Decommissioning Plan (Appendix 4-6 and Section 3.6 of the CEMP (Appendix 4-3) that has been prepared for the Proposed Project.

## 12.7.4 Operational Phase

### 12.7.4.1 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 12.6.3.1 has confirmed that the predicted operational noise levels associated with the Proposed Wind Farm 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 Wind Farm 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 12.5.3 and/or the relevant operational criteria associated with the grant of planning for the Proposed Project.

In the unlikely event that an issue with low frequency noise is associated with the Proposed Project, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in Appendix VI of the EPA document entitled '*Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities*' (NG4) (EPA, 2016). This guidance is based on the threshold values outlined in the Salford University document '*Procedure for the assessment of low frequency noise complaints, Revision 1, December 2011*'.

### 12.7.4.2 Amplitude Modulation and Tonality

In the event that a complaint which indicates potential excessive amplitude modulation (AM) associated with the Proposed Project, the operator will fully investigate the complaint in collaboration with the turbine manufacturer, through review of the meteorological periods and conditions during which the reported AM occurs. If an ongoing issue with excessive AM is identified, a mitigation strategy to reduce the level of AM will be implemented through engineering methods and/or curtailment of specific turbines. The operator may appoint a qualified acoustic consultant to objectively assess the level of AM in accordance with the methods outlined in the IOA AMWG or subsequent revisions.

The measurement method outlined in the IOA AMWG document, known as the 'Reference Method', will 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 to mitigate any excessive AM. These mitigation measures, if required, will consist of the implementation of operational controls for the relevant turbine type, which will include turbine curtailment under specific operational conditions and may in very unlikely circumstance require turning specific turbine off under certain conditions. To minimise adverse impacts from excessive AM associated with the Proposed Project.

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 liaise with the turbine manufacturer to 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 will ensure that any adverse impacts from excessive amplitude modulation (AM) associated with the operation of the Proposed Project are effectively managed by the operator.

### 12.7.4.3 Fixed Plant

The assessment of noise from the operation of fixed plant at the proposed 110kV onsite substation is predicted to comply with the proposed criteria in Section 12.3.2.5. Therefore, no specific mitigation measures are required. However, at the detailed design stage the following measures will be employed to ensure the noise levels at NSL are within the proposed criterion and the potential for noise disturbance is minimised:

- the selection and location of mechanical and electrical plant will be undertaken in order to ensure the noise emission limits set out above are not exceeded.
- all mechanical plant items e.g. fans, pumps etc. shall be regularly maintained to ensure that excessive noise generated any worn or rattling components is minimised.
- any new or replacement mechanical plant items, including plant located inside, shall be designed so that all noise emissions from site do not exceed the noise limits.
- there are no tonal or impulsive characteristics from the plant operation audible at any NSL during night time periods.

## 12.7.5 Monitoring

### 12.7.5.1 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 Plan (NCMP) to the planning authority for written agreement. The NCMP will include a detailed methodology for the noise measurements, procedures for recording results and locations at which noise is to be monitored.

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, relevant corrective actions will be 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.

As an example of this turbine control capability, the following table shows the sound power levels for the Nordex N133 turbine for the various operational modes that can be applied to this turbine. As can be seen at mid to higher wind speeds a reduction in the noise level of the order of 5dB can be achieved dependent on the operational mode set on the specific turbines.

Table 12-29 Sound Power Levels at Reduced Modes

Wind Speed m/s	Sound Power Levels, dB L <sub>WA</sub>				
	Mode 1	Mode 3	Mode 5	Mode 7	Mode 9
3	94.5	94.5	94.5	94.5	94.5
4	96.3	96.3	96.3	96.3	96.3
5	101.9	101.9	101.9	101.7	99.9
6	105.5	104.5	103.5	102.5	100
7	105.5	104.5	103.5	102.5	100
8	105.5	104.5	103.5	102.5	100
9	105.5	104.5	103.5	102.5	100

All modern turbines have the ability to control their power and noise levels in a similar manner, and the suitability of any turbine for the Proposed Wind Farm will be dependent on whether it can operate in an efficient manner while also remaining within any noise limits that may be conditioned in the event of favourable consideration.

### 12.7.5.2 Protocol for Management of Complaints

In the event of a complaint associated with noise, tonality or amplitude modulation from the Proposed Project, the operator will fully investigate the complaint in collaboration with the turbine manufacturer (in accordance with the NCMP documents to be submitted and agreed with the local authority).

A draft protocol for management of complaints addressing AM or tonality is presented in Appendix 12-6. A final version of this protocol will be contained within the NCMP to be agreed the relevant Local Authority and/or Authorities.

### 12.7.5.3 Wind Turbine Noise

If an exceedance of the noise criteria is identified as part of the commissioning assessment, the guidance outlined in the IOA GPG will be followed, 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 curves/planning conditions limits. Following implementation of these measures, noise surveys will be repeated to confirm compliance with the noise criteria.

## 12.8 Residual Effects

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

## 12.8.1 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, 2022 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.

### 12.8.1.1 General Construction of Turbines, Hardstand Areas and Met 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.

### 12.8.1.2 Proposed Access Roads and Upgrade of Existing Roads

Quality	Significance	Duration
Negative	Not Significant	Temporary

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.

### 12.8.1.3 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.

### 12.8.1.4 Peat and Spoil Management Areas

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the proposed peat and spoil management areas are described as described below:

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

### 12.8.1.5 Fixed Plant Noise

<b>Quality</b>	<b>Significance</b>	<b>Duration</b>
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.

### 12.8.1.6 Proposed Grid Connection

<b>Quality</b>	<b>Significance</b>	<b>Duration</b>
Negative	Not Significant - Slight	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.

### 12.8.1.7 Biodiversity and Enhancement Areas

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

Given the distances to receptor locations the noise levels are predicted to be below the adopted criteria.

### 12.8.1.8 Construction Traffic

<b>Quality</b>	<b>Significance</b>	<b>Duration</b>
Negative	Imperceptible to Not Significant	Short Term

The likely predicted noise and vibration effects are below the limits and/or thresholds identified.

## 12.8.2 Operational Phase

### 12.8.2.1 Wind Turbine Noise

The predicted noise levels associated with the Proposed Project will be within best practice noise criteria curves recommended in line with the Guidelines (DoEHLG 2006). 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.

### 12.8.2.2 Substation and Ancillary Works Operation

The residual effects at the nearest NSLs of the proposed 110kV onsite substation and all ancillary infrastructure are described as follows:

Quality	Significance	Duration
Negative	Not Significant	Permanent

## 12.8.3 Decommissioning Phase

During the decommissioning phase of the Proposed Project, 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 Site are considered to be comparable to those outlined in relation to the construction of the Proposed Project.

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

## 12.9 Cumulative Effects

### 12.9.1 Wind Turbine Noise

Existing, permitted and proposed wind farm developments with the potential for cumulative impacts have been considered as part of the turbine noise impact assessment.

As outlined in Section 12.4.5.4, the cumulative turbine noise from the Dereenacreenig West, Shehy More, Gourtoughra and Curraglass Wind Farms have been included in the operational turbine noise assessment.

### 12.9.2 Noise from Fixed Plant Operation

The predicted noise from the operation of the proposed 110kV onsite substation at the nearest NSL is below the adopted criteria, and hence, there remains headroom for other fixed plant operations to operate within the adopted criteria.

### 12.9.3 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 12.6.2.1, 12.6.2.3 and 12.6.2.4 confirms that the predicted noise levels from activities at static construction sites at any NSL are  $\leq 55$  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 is not likely to be exceeded and hence higher cumulative noise levels for those periods would not cause an additional effect.

## 12.10 Difficulties Encountered During the Preparation of this Chapter

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

## 12.11 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 Chapter 6. The traffic flow projections associated with

the Proposed Project provided in Chapter 15 has been utilised in the calculations in Section 0 of this Chapter.

12.12

## 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 below the proposed threshold values. 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 the Guidelines (DoEHLG 2006). Therefore, it is not considered that a significant effect is associated with the Proposed Project.

Operational noise from the proposed 110kV onsite 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 12-30 Impact Assessment Classification Summary

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
<b>Construction Phase</b>				
General Construction of Turbines, Hardstand Areas, and Met Mast	Short-term, Not Significant, Negative	Section 12.7.1 – None Required.	Short-term, Not Significant, Negative	Not Significant
Proposed Access Roads and Upgrade of Existing Roads	Temporary, Not Significant, Negative	Section 12.7.1 – None Required	Temporary, Not Significant, Negative	Not Significant
Borrow Pit Excavation and Reinstatement	Short-Term, Not Significant, Negative	Section 12.7.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Peat and Spoil Management Areas	Short-Term, Not Significant, Negative	Section 12.7.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Substation and Ancillary Construction Works	Short-Term, Not Significant, Negative	Section 12.7.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Proposed Grid Connection	Short-Term, Not Significant -Slight, Negative	Section 12.7.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
Construction Traffic	Short Term, Imperceptible to Not Significant, Negative	Section 12.7.1 – None Required	Short Term, Imperceptible to Not Significant, Negative	Not Significant
Biodiversity Management and Enhancement Areas	Short-Term, Not Significant, Negative	Section 12.7.1 – None Required	Short-Term, Not Significant, Negative	Not Significant
<b>Operational Phase</b>				

Wind Turbine Noise	Long-Term, Not Significant, Negative	Section 12.7.4 Section 12.7.4	Long-Term, Not Significant, Negative	Not Significant
Substation and Ancillary Works	Permanent, Not Significant, Negative	Section 12.7.4	Permanent, Not Significant, Negative	Not Significant
<b>Decommissioning Phase</b>				
Proposed Wind Farm	Short-Term, Not Significant, Negative	Section 12.7.3	Short-Term, Not Significant, Negative	Not Significant