12. NOISE & VIBRATION

12.1 Introduction

This chapter of the EIAR describes the assessment undertaken of the potential noise and vibration effects from the Prospective Development. As detailed in Section 1.1.1 in Chapter 1 of this EIAR, the various development components are described and assessed using the following references: 'Subject Development', 'Existing Development', 'Prospective Development', 'Permitted Development', 'Site', 'Wind Farm Site', 'Grid Connection Site', 'BMEP Site', 'Grid Connection', ' November 2020 Peat Slide', '2017 EIAR' and 'proposed turbines' or 'proposed turbine locations'. A full description of the Prospective Development 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 Prospective Development at noise sensitive locations (NSLs). To inform this assessment, baseline noise levels have been surveyed at two representative NSLs in the vicinity of the Wind Farm Site. Noise predictions for the nearest NSLs have been prepared for all key elements of the Prospective Development that have the potential for noise and vibration 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: Background Noise Levels
- Appendix 12-5: Predicted Noise Contour
- Appendix 12-6: Predicted Noise Levels with Existing Barnesmore Wind Farm
- Appendix 12-7: Lidar Installation Report
- Appendix 12-8: 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 including Dublin Metrolink, Knocknamork Renewable Energy Development, Maughanaclea Renewable Energy Development, Crossrail, and Thames Tideway Tunnel.

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

Some relevant projects Miguel has worked previously are listed below:

- Richfield Wind Farm, Co. Wexford
- Grousemount Wind Farm, Co. Kerry
- Knockraha 220kV Substation Celtic Interconnector, Co. Cork

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). 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.

Some relevant projects Mike has worked previously are listed below:

- Ballivor Wind Farm, Co. Meath
- Brackyn Wind Farm, Co. Westmeath
- Cahermurphy Wind Farm, Co. Claire
- Curraglass Wind Farm, Co. Cork
- Drumlins Park Wind Farm, Co. Monaghan
- Cush Park Wind Farm, Co. Offaly

Dermot Blunnie (Associate Director) 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.

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.

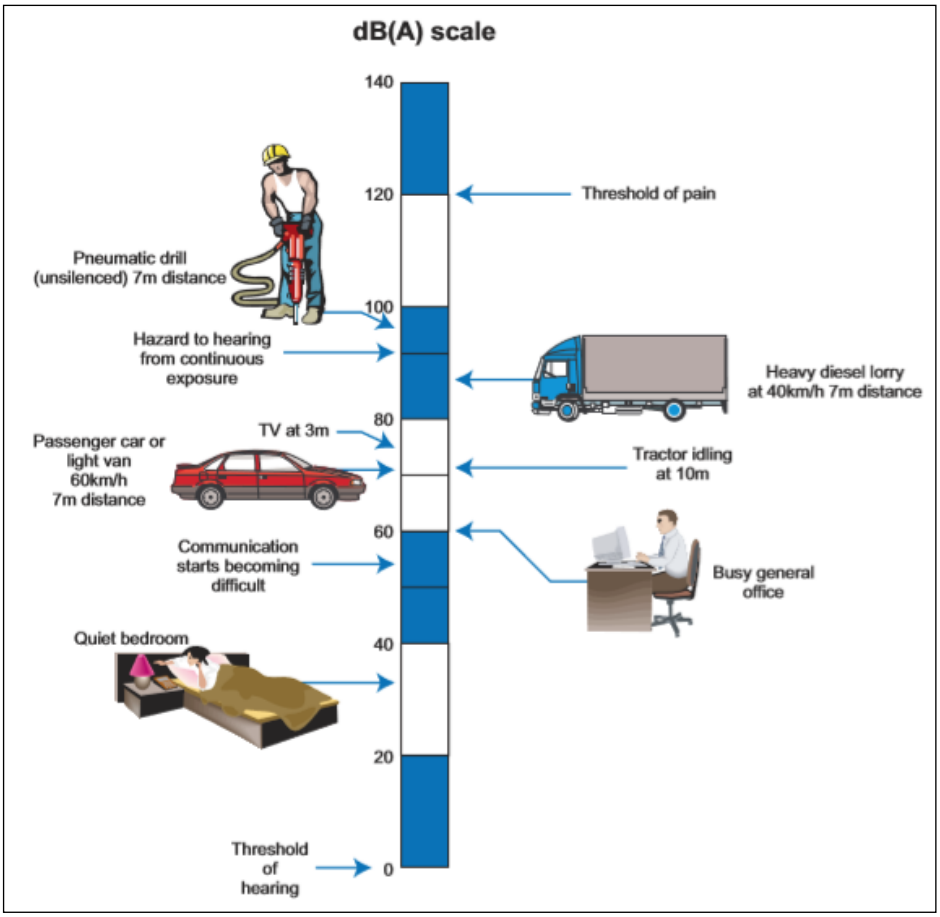

Figure 12.1 The level of typical common sounds on the dB(A) scale (National Roads Authority (NRA) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (NRA, 2014)

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

12.3 Legislation, Policy and Guidance

12.3.1 Environmental Protection Agency (EPA) Description of Effects

The significance of effects of the Prospective Development 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 Prospective Development are described in the relevant sections of this chapter in accordance with the EPA, 2022 as 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) (hereafter referred to as 'the Guidelines (DoEHLG, 2006)') with cognisance of *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (hereafter referred to as 'the Draft Guidelines (DoHPLG, 2019)');
- The Assessment and Rating of Noise from Wind Farms, Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) (1996)[1];
- 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.

[1] *Since the preparation of this chapter, an update to ETSU-R-97, Assessment and Rating of Wind Turbine Noise, was published by the UK Department for Energy Security and Net Zero on 19 June 2026. The updated guidance retains the core methodology of the original ETSU-R-97 for the assessment of noise from wind farm developments. The references to ETSU-R-97 within this chapter remain applicable and consistent with current best practice guidance. Baseline noise data collected in accordance with the IOA GPG are unaffected and remain valid for the purposes of this assessment. The Irish Wind Energy Development Guidelines (the Guidelines (DoEHLG, 2006)) continue to set the noise criteria applicable at receptors for proposed wind farms in Ireland. On this basis, the updated UK guidance has no material impact on the methodology, baseline data, or conclusions of the noise assessment presented in this chapter.*

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 Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs)	65	70	75

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

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

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

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

It should be noted that this assessment method is only proposed for residential properties. The following method is 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 phase of the Prospective Development.

Interpretation of the CNT

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

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

Construction Noise Level	Magnitude of Impact (DMRB)	EPA Significance of Effect	Determination
Below or equal Baseline Noise Level	Negligible	Not Significant	Depending on CNT, Construction noise level and baseline noise level
Above Baseline and below or equal to CNT	Minor	Slight – Moderate	
Above CNT and below or equal to CNT + 5dB	Moderate	Moderate – Significant	
Above CNT + 5dB	Major	Significant – Very Significant	

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

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

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

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 Prospective Development (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.

12.3.2.3 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 Prospective Development, 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 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.

12.3.2.5 Operational Phase Noise – Wind Turbines

The operational phase 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.

12.3.2.5.1 *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 Prospective Development, both as a higher fixed level of 45 dB L_{A90} and/or a higher level above the prevailing background noise level.

12.3.2.5.2 *Institute of Acoustics Good Practice Guide*

The original ETSU-R-97 concepts underwent a thorough standardisation and modernisation in 2013 with the Institute of Acoustics publication of the A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IOA GPG) including 6 Supplementary

Guidance Notes. 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 for this assessment.

The IOA GPG states, that at a minimum continuous background noise monitoring should be carried out for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e., from cut in speeds to the wind speed that generate the highest sound power output from the proposed turbine(s)). Background noise measurements (i.e., $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of 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.

The noise levels associated with the wind turbines are predicted in accordance with ISO 9613-2:1996: *Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation* (Hereafter ISO 9613-2). This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity, and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds, and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

Where noise predictions indicate that reductions in noise emissions are required to satisfy any adopted criteria, consideration can be given to detailed downwind analysis and operating turbines in low noise mode, which is an option on modern wind turbines.

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

12.3.2.5.3 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., $L_{A90,10min}$) 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.

12.3.2.5.4 Noise Prediction Calculations

The noise levels associated with the wind turbines are 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.

12.3.2.5.5 Cumulative Assessment Screening

All existing, permitted and proposed wind turbine developments are considered cumulatively in the noise impact assessment. To determine whether a particular wind farm development can be scoped out of the final assessment, the '10 dB rule' is applied. This rule is grounded in established acoustic principles, whereby if the contribution from an individual source is 10 dB below the total cumulative noise level, it contributes an insignificant amount to the overall noise level. Therefore, in accordance with this methodology, where the predicted contribution from another wind farm is at least 10 dB below the applicable noise limits at the nearest sensitive locations within the study area, it can be scoped out of the final assessment..

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_{A90}.

In some circumstances the cumulative 35 dB L_{A90} 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_{A90}, 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_{A90} 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.

12.3.2.5.6 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.

This following statement from WEDG 2006 represents the widely accepted daytime noise criterion curve in relation to wind farm developments.

> *"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."*

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 WEDGs, 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. This is supported by the guidance in ETSU-R-97 and the IOA GPG and is based on the principle that when background noise levels are sufficiently elevated, the potential impact of wind turbine noise is less significant, provided it does not exceed 5dB above the background level. This approach is also consistent with the daytime criteria in WEDG 2006, which allow the limit to increase by up to 5 dB above background where this exceeds the fixed threshold level.

12.3.2.5.7 Future Potential Guidance Changes

In December 2019, 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"*

In a written answer to Parliamentary Question on 19 June 2025, the Minister for Housing, Local Government and Heritage stated that the review of the 2006 Wind Energy Development Guidelines is ongoing and that, 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 Minister further stated that "*The current 2006 Wind Energy Development Guidelines remain in force, pending the finalisation of the review.*" The full written answer is available from the Houses of the Oireachtas: Wind Energy Guidelines, Dáil Éireann Debate, 19 June 2025[1]

At the time of writing this EIAR chapter, no new draft guidelines have been published, and no confirmed timeframe for their release has been provided. 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 Prospective Development 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.

12.3.2.5.8 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.*

[1] https://www.oireachtas.ie/en/debates/question/2025-06-19/308/

> *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."*

The WHO recommended average noise exposure level (i.e. 45 dB L_{den}) is not an appropriate target noise criterion for an existing or proposed wind turbine development in Ireland. It is not industry best practice to implement an Lden limit for wind turbine noise, as it is considered a poor characterisation of wind turbine noise. The WHO Environmental Noise Guidelines recommendation for average noise exposure of 45 dB Lden is conditional, meaning that the available scientific data for wind turbine noise was not strong enough to justify a strong recommendation.

12.3.2.5.9 Low Frequency Noise and Infrasound

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

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

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.

12.3.2.5.10 Tonality

A tone is the concentration of acoustic energy into a very narrow frequency range, with a noticeable character (such as a "hum" or "whine" for example). The audibility of any tones can be assessed by comparing the narrow band level of such tones with the masking level contained in a band of frequencies around the tone. Several objective methodologies to assess tonal audibility are available, such as the one included in ETSU-R-97 or that of ISO 1996-2 (2017) .

Mechanical noise may emanate from components within the nacelle of a wind turbine. This is a less natural sounding noise which can be characterised in some cases by its tonal content, particularly if resonances in the mechanical noise are not suitably controlled. However, modern turbine designs have evolved to minimise mechanical noise radiation and resonances are normally minimised through design.

Wind farm noise guidelines such as those of ETSU-R-97 assume that the wind turbine noise does not normally contain clearly audible tones. It is not possible to predict the occurrence of tonality on a project reliably at the planning stage. The unlikely occurrence of tonality in the wind turbines of the Prospective Development will be managed through the commitments provided by the Applicant in Section 12.7.3.

12.3.2.5.11 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)."

Previous definitions for AM distinguished between two distinct types:

- '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 inherent characteristic of wind turbine noise, often described as "blade swish." This effect is typically observed relatively close to the turbine and is produced as the trailing edge of the blade rotates toward and then away from the observer.
'Other' AM	A more pronounced form of AM, generally observed at greater distances from the turbine or turbines. It is often perceived as a periodic low-frequency "thumping" or "whoomphing.

While AM is acknowledged as an intrinsic feature of wind turbine noise, the earlier terms Normal AM and Other AM were used to distinguish between the typical (expected AM), and the more pronounced form that may cause disturbance. Normal AM is accounted for in noise impact assessments, whereas Other AM may require additional mitigation if it presents at NSL during turbine operation.

The IOA AMWG now provides a clear, objective definition and rating method for AM, reducing the need for the older terminology.

Frequency of Occurrence of AM

UK 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 essential to recognise that amplitude modulation (AM) is an intrinsic feature of wind turbine noise. A distinction must be made between 'Normal' AM, which is generated by all wind turbines, generally limited in magnitude and reduces with separation distance, and 'Other' or 'Excessive' AM, which can be more pronounced and potentially intrusive. As normal AM is assumed to be part of normal wind

turbine noise, the noise limits set out in applicable guidelines discussed in this section take this into account and are relatively stringent as a result. Excessive AM, should it occur, may lead to additional impacts at sensitive receptors in some cases. The term AM is commonly used without these descriptions; however, where AM is referenced in this chapter, it should be understood to refer to unacceptable or excessive AM with the potential to result in additional adverse impacts, unless otherwise stated.

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

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

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

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

It is noted that the WSP report recommended that excessive AM be controlled specifically during period of complaints. The key point is that while excessive amplitude modulation (AM) may occur during the operation of the wind farm, it may not necessarily result in any adverse impacts. As per the discussion on the research presented previously in this Section, excessive/other AM is considered an atypical phenomenon, and the duration, conditions and specific location or locations at which it presents cannot be predicted in the planning stage. For these reasons, the assessment of AM is typically triggered in response to complaints where the contributing factors aligning to the period of the complaint such as meteorological conditions and turbine operations can be investigated.

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

To date there is no clear industry consensus on how AM should be regulated or managed through the planning stage. In the absence of clear policy in Ireland to control AM from wind turbines, the commitments outlined in the Section 12.7.3.2 are considered to represent best practice and will be adopted in the event that an complaint relating excessive AM is reported.

The assessment and mitigation of AM at post-commissioning stage is discussed in Section 12.7.3.2. AM from the Prospective Development will be managed through the commitments provided by the Applicant in Section 12.7.3.2.

12.3.2.6 Operational Phase Noise – Fixed Plant Items

There is no published statutory Irish guidance relating to the maximum permissible noise level from fixed mechanical and electrical plant. In the absence of specified noise limits, it is proposed to set fixed noise limits the existing 110kV onsite substation in accordance with the following best practice guidance.

12.3.2.6.1 *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 ≤40 dB L_{A90}, and;
- Arithmetic Average of L_{A90} During Evening Period ≤35 dB L_{A90}, and;
- Arithmetic Average of L_{A90} During Night-time Period ≤30 dB L_{A90}.

Table 12-5 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

12.3.2.6.2 *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 is robust to prevent adverse impacts at NSLs. This criterion is intended to apply consistently across every NSL included in the assessment.

12.3.2.7 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 Wind Farm Site to the nearest NSL is in excess of 750m (distance from turbine T17 to NSL ref. H001). 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 Prospective Development.

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 Prospective Development. The assessment of operational phase vibration has therefore been scoped out of this assessment.

12.4 Assessment Methodology

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 Wind Farm Site;
- Undertake predictive calculations to assess the potential effects associated with the construction phase of the Prospective Development;
- Undertake predictive calculations to assess the potential effects associated with the operation of the Prospective Development at NSLs;
- Undertake predictive calculations to assess the potential effects associated with the decommissioning of the Prospective Development at NSLs;

- Specify mitigation measures to reduce, where necessary, the identified potential outward effects relating to noise and vibration from the Prospective Development ; and,
- Describe the significance of the residual noise and vibration effects associated with the Prospective Development.

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 Prospective Development 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 Site and along public roads where there are increases in traffic associated with the Prospective Development. 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 effects from the Prospective Development. Based on a review of typical construction plant noise levels derived from BS 5228-1, including high noise-generating activities such as rock breaking, which at 300 m is more than 10 dB below the lowest noise threshold, a study area of 300 m has been applied for general construction activities. Taking account of the '10 dB rule' described in Section 12.3.2.5.5, it is unlikely that a cumulative impact can occur beyond 300 m.

12.4.1.2 Operational Phase Study Area

As described in Section 12.3.2.5.5 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, application of the '10 dB rule' described in Section 12.3.2.5.5 results in a study area for the operational phase determined as the area predicted to exceed 25 dB L_{A90} at the maximum predicted turbine noise emission level from the Prospective Development in isolation. Refer to Appendix 12-2 which displays the relevant noise contours maps which identify this area.

The Fixed Plant Operational Phase Noise Study Area is greater area between 500 m buffer from the substation or the area where the noise from all proposed fixed plant items is predicted to exceed 25 dB L_{Aeq}.

12.4.2 Background Noise Survey

A summary outlining key information of the of the background survey is presented in this section; full details of the background noise survey methodology instrumentation and results is provided in Appendix 12.4.

A background noise survey was undertaken to establish typical background noise levels at representative NSLs surrounding the Wind Farm Site. The background noise survey was conducted through installing unattended sound level meters at 2 no. representative locations in the surrounding area.

All measurement data collected during the background noise surveys has been carried out in accordance with the IOA GPG and accompanying Supplementary Guidance Note 1: Data Collection (2014) discussed in the following sections.

12.4.2.1 Choice of Measurement Locations

The noise monitoring locations were identified by preparing a preliminary noise model contour at an early stage of the assessment. Any NSLs that fell inside the predicted 35 dB L_{A90} noise contour was considered for noise monitoring in line with current best practice guidance outlined in the IOA GPG. The selection of 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 12.2.

Table 12-6 Noise Measurement Location Coordinates

Location	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
NML1 (H002)	609692	887781
NML2 (H003)	609809	887714

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 and distant traffic noise, birdsongs, dogs barking and local foliage moving with the wind. 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.

No significant sources of vibration were noted at any of the survey locations. Figure 12-2 shows a map of the NMLs.

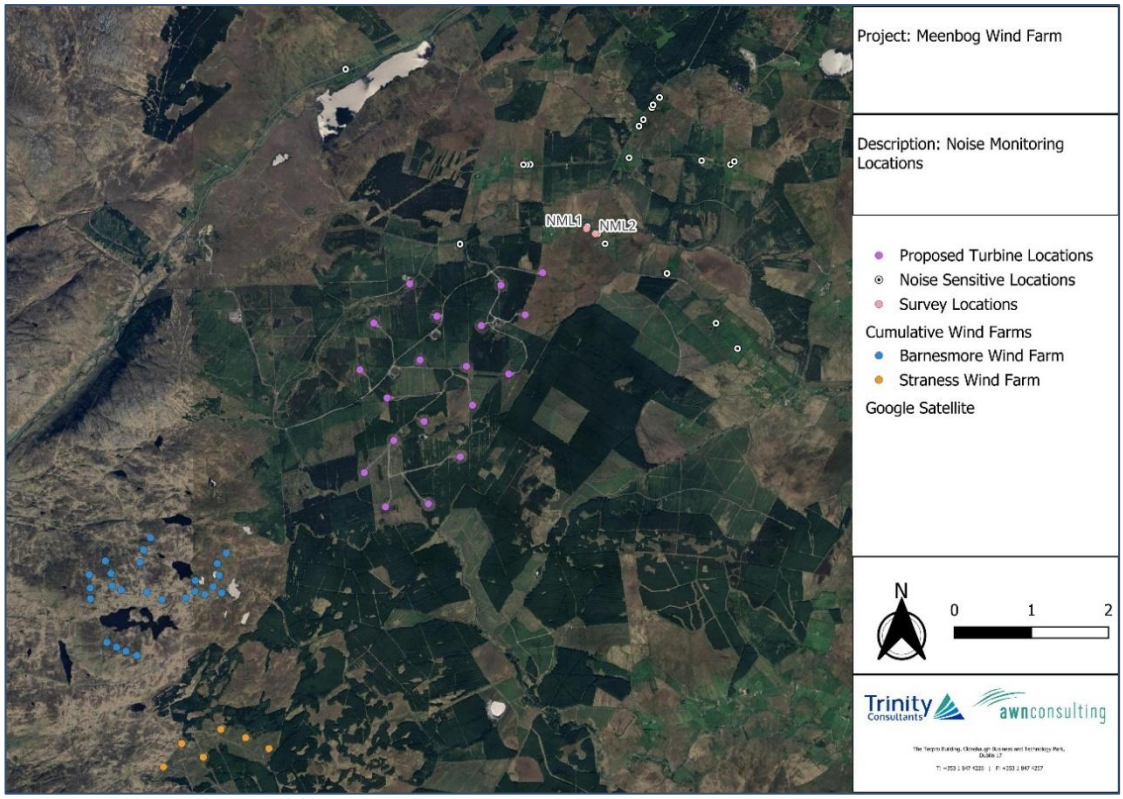

Figure 12.2 Map of Noise Monitoring Locations

12.4.2.2 Wind Data

Wind speed measurements were obtained from an onsite Lidar. A copy of the Lidar installation report is included in Appendix 12.7.

Table 12-7 Coordinates of Lidar

Item	Coordinates (ITM)	
	Easting	Northing
Lidar	609837	887746

12.4.2.3 Analysis of Survey Data

As well as the location-specific filtering, 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 screened from the data sets. The assessment methods outlined above are in line with the guidance contained in the IOA GPG.

The results presented Appendix 12-4 and summarised in the following sections refers to the noise data collated during 'quiet periods' of the day and night as defined in the IOA GPG.

12.4.2.4 Consideration of Wind Shear

Wind shear is defined as the change of wind speed with height above ground. Site specific wind shear is captured in the background noise assessment through simultaneously measurement of deriving wind speeds adjust to hub height using the one of three methods described in the IOA GPG.

To ensure clearly and consistently defined wind speeds it is standard industry practice to convert and reference wind speeds to the 'Standardised Wind Speed'. The Standardised Wind Speed is a wind speed measured at a height different than 10 m (generally measured at the turbine hub height) which is expressed to a reference height of 10 m in accordance with the IEC 61400-11 standard. The standardised equations used to determine the wind speed at standardised 10m above ground is presented in Appendix 12-3.

Any reference to wind speed in this chapter should be understood to be standardised wind speed at a height of 10 m height unless otherwise stated.

12.4.3 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.

12.4.4 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 Prospective Development on the receiving environment. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

12.4.4.1 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*'.

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).

12.4.4.2 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*'. The input data and assumptions made are described in the following sections.

12.4.4.3 Proposed Turbine Details

The proposed turbine is a Nordex N133 at 90 m hub height. This turbine is considered representative of the type of turbine that would be installed on the site taking into consideration the proposed dimensions and the nominal generation capacity.

While the noise 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 site will be dictated by manufacturer availability 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 12-8.

Table 12-8 Sound Power Level Spectra for Nordex N133 with a hub height of 90 m

Wind Speed (m/s)	Sound Power Level, dB(A) at Octave Band Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	74.7	81.7	85.5	86.4	86.9	85.6	81.3	72.1	93.0
4	75.9	83.7	86.7	87.6	88.1	86.8	82.5	73.3	94.2
5	81.4	89.3	92.2	93.1	93.6	92.3	88.0	78.8	99.7
6	85.6	93	96.4	97.3	97.8	96.5	92.2	83.0	103.9
7	86.3	93.3	97.1	98.0	98.4	97.2	92.9	83.7	104.5
8	86.2	93.2	97.0	97.9	98.4	97.1	92.8	83.6	104.5

Table 4-1 in Chapter 4; Description of the Prospective Development details the co-ordinates and elevations of the 19 no. turbines of the Prospective Development.

The manufacturer's turbine sound power levels outlined in Table 12-8 are presented in terms of the L_{Aeq} 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 12-8.

As explained in Section 12.3.2, the criteria are couched in terms of a L_{A90} criterion. Best practice guidance in the IOA GPG states that "L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB". A 2 dB reduction has therefore been applied in the noise model calculation which cancels out the 2 dB added for uncertainty. All predicted noise levels in this chapter are presented in terms of L_{A90} parameter.

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.

12.4.4.4 Cumulative Turbine Details

The following tables outline the sound power levels of the cumulative wind farms included in the assessment. In this instance Barnesmore Repowering wind farm is proposed to use an Enercon E-136 with a hub height of 109 m and the Streaness Wind Farm is proposed to use a Nordex N90 at 70 m hub height. Meenakeeran has been modelled using the worst case data outlined in its respective EIAR.

Predicted noise levels from the existing Barnesmore turbines have been reviewed and confirm that the noise contribution is similar for both the existing Barnesmore scenario and the proposed repowering scenario (see Appendix 12-6) . Accordingly, the proposed repowering wind farm scenario has been adopted for the purposes of this cumulative noise assessment.

Sound power levels for the Enercon E-136 referenced to wind speeds at standardised 10 m height are presented in Table 12-9.

Table 12-9 Sound Power Level Spectra for Enercon E-136 with a hub height of 109 m

Wind Speed (m/s)	Sound Power Level, dB(A) at Octave Band Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	74.1	82.9	90	91.9	90.4	87.9	82.8	75.4	96.7
4	79.5	88.3	95.4	97.3	95.8	93.3	88.2	80.8	102.1
5	81.5	90.3	97.4	99.3	97.8	95.3	90.2	82.8	104.1
6	83.7	92.5	99.6	101.5	100	97.5	92.4	85	106.3
7	83.8	92.6	99.7	101.6	100.1	97.6	92.5	85.1	106.4

Sound power levels for the Nordex N90 referenced to wind speeds at standardised 10 m height are presented in Table 12-10.

Table 12-10 Sound Power Level Spectra for Nordex N90 with a hub height of 70 m

Wind Speed (m/s)	Sound Power Level, dB(A) at Octave Band Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	78.7	82.8	87.2	87.6	86.1	85	81	73.4	93.5
4	82.6	86.7	91.1	91.5	90	88.9	84.9	77.3	97.4
5	85.8	89.9	94.3	94.7	93.2	92.1	88.1	80.5	100.6

Wind Speed (m/s)	Sound Power Level, dB(A) at Octave Band Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
6	89.1	93.2	97.6	98	96.5	95.4	91.4	83.8	103.9
7	90.2	94.3	98.7	99.1	97.6	96.5	92.5	84.9	105
8	90.6	94.7	99.1	99.5	98	96.9	92.9	85.3	105.4
9	90.7	94.8	99.2	99.6	98.1	97	93	85.4	105.5

Sound power levels for the worst case Meenakeeran turbines referenced to wind speeds at standardised 10 m height are presented in Table 12-11, reproduced from its EIAR.

Table 12-11 Sound Power Level for Meenakeeran turbines with a hub height of 84 m

Wind Speed (m/s)	dB L_{WA}
4	98.3
5	102.7
6	105.9
7	108
8	108
9	108

12.4.4.5 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*'.

Appendix 12-3 provides details of noise prediction calculation settings.

12.4.5 Difficulties Encountered During the Preparation of this Chapter

There were no difficulties or limitations encountered when undertaking 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 Wind Farm Site. Appendix 12-4 presents the results of the background noise surveys as analysed in accordance with the methodology in Section 12.3.2.4.3.

12.5.1 Summary of Derived Background Noise Levels

Table 12-12 and Table 12-13 presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations 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.

Values in parenthesis are used where, for higher wind speeds during day and night-time periods, the measurement obtained during the survey did not have sufficient data points at these wind speeds. In accordance with IOA GPG Supplementary Guidance Note 2: Data Processing & Derivation of ETSU-R-97 Background Curves, paragraph 2.9.1: "*Where background noise data has not been collected for higher wind speeds it may be appropriate to cap the background noise curve (and therefore the associated noise limit)*".

Table 12-12 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 90 m Hub Height							
		3	4	5	6	7	8	9	10
NML1 (H002)	Daytime	27.3	29.4	32.1	35	38.1	41.2	44.3	47.2
NML2 (H003)	Daytime	27.2	28.5	30.1	32.1	34.2	36.5	38.8	41.2

Table 12-13 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 90 m Hub Height							
		3	4	5	6	7	8	9	10
NML1 (H002)	Night-time	25	27.4	30.4	33.9	37.6	41.3	44.8	48
NML2 (H003)	Night-time	25.1	26.3	28.2	30.5	33.2	36	38.9	41.6

12.5.2 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 Prospective Development. The criteria curves have been derived following a detailed review of the background noise data conducted at representative NSLs described in Section 12.4.2.

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

For the Prospective Development, it is considered that a lower daytime threshold of 40 dB L_{A90} 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 L_{A90} parameter

while the NG4 daytime limit an L_{Aeq}. The accepted difference between L_{Aeq} and L_{A90} in wind turbine noise assessments is 2 dB; for example, 45 dB L_{Aeq} corresponds to 43 dB L_{A90}. This approach implies a 3 dB difference when comparing the parameter definitions used in NG4 and WEDG06. Accordingly, the proposed lower daytime threshold of 40 dB L_{A90} is 3 dB more stringent than the equivalent daytime noise limit for low background noise areas as outlined in NG4.

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. It is not uncommon for older wind farm developments in Ireland to have conditioned noise limits that conflict with best practice guidance and may often conflict with neighbouring wind farm developments.

The proposed noise limits shall be cumulative, accounting for all operational wind turbines. When setting appropriate turbine noise limits in accordance with the criteria following the applicable WEDG06 guidelines and best practice guidance, 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 other development operate.

The proposed turbine noise criteria should apply to the nearest NSLs where it can be reasonably determined that the noise contribution from the operation of the proposed turbines is the dominant wind turbine source or has a significant contribution to the cumulative turbine noise level at a given NSL. The proposed operational noise limits for the proposed turbines at 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 $L_{A90,10min}$ for daytime in quiet environments with typical background noise of less than 30 dB $L_{A90,10min}$.
- 45 dB $L_{A90,10min}$ for daytime in environments with typical background noise greater than or equal to 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB(A) above background noise (whichever is the higher); and
- 43 dB $L_{A90,10min}$ for night-time periods or a maximum increase of 5 dB(A) above background noise (whichever is the higher).

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, (which is usually monitored within the first 6 months of turbine operation) and procedures for recording results.

12.5.2.1 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, revised background noise levels could alter the derived noise limits detailed below.

Table 12-14 outlines the operational noise criteria for each measurement location.

Table 12-14 Proposed Noise Criteria Curves

Location	Period	Turbine Noise Limits $L_{A90, 10min}$ Levels (dB) at Various Standardised 10m Height Wind Speeds)							
		3	4	5	6	7	8	9	10
NML1 (H002)	Day	40	40	45	45	45	46.3	49.4	52.2
	Night	43	43	43	43	43	46.3	49.8	53
NML2 (H003)	Day	40	40	45	45	45	45	45	46.2
	Night	43	43	43	43	43	43	43.9	46.6

12.5.3 Noise Limits for Fixed Plant

Based on a review of the measured noise from the background noise survey described in Section 12.4.2, in scenarios where the wind speeds are very low, the NSLs in the vicinity of the Wind Farm Site can be defined as areas of low background noise. As the onsite 110kV substation will operate at a consistent noise output on a 24-hour basis, the potential impact during night-time periods is the primary consideration in this assessment. The following criteria is proposed at NSLs:

An absolute threshold of 35 dB LAeq has been applied for fixed plant. Acoustic features such as tonality, impulsivity and intermittency, will be considered in the context of the character assessment framework contained in BS 4142. Where these acoustic features are present, the Rating Level should be controlled to avoid adverse impacts at NSLs in accordance with BS 4142. Where background noise levels are elevated at specific NSLs, i.e. greater than 30 dB L_{A90}, a higher absolute threshold, of up to 5 dB above the background level, may be acceptable.

With respect to the guidance from the BS4142 standard, as discussed in Section 12.3.2.6.2, it is considered that the proposed criteria are robust and are expected to prevent adverse impacts at NSLs.

12.6 Likely Significant Effects

12.6.1 Do-nothing Scenario

If the Prospective Development was not to proceed, the Site will continue to function as it does at present. The likely future receiving environment is anticipated to experience a gradual increase in traffic volumes on the local road network; however, this is not expected to result in a significant change to the overall ambient or background noise levels within the receiving environment.

In this scenario, the Existing Development will remain in-situ as an unauthorised and partially completed wind farm, which is, in effect, the "do nothing" option insofar as it represents the current situation as at the date of the application for Substitute Consent. The impact of this is considered neutral in the context of this EIAR. However, by implementing this 'Do-Nothing' alternative, the opportunity to capture a significant part of the country's renewable energy resource by completing the Meenbog Wind Farm (subject to the appropriate planning consent) would be lost, as would the 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, local authority development contributions, rates and investment in the local area would also be lost.

12.6.2 Construction Phase

Construction noise prediction calculations have been conducted using the assessment methodology outlined and discussed in Section 12.3.2.1. 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 Prospective Development.

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 Prospective Development.

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

- Construction of new roads and completion and upgrade of existing internal site roads;
- Excavation and operation of borrow pits;
- Management of peat and spoil;
- Erection of turbines and completion of hardstand areas;
- Construction of meteorological (met) mast
- 33kV underground electrical cabling connecting the proposed turbines to the existing onsite 110kV substation.
- Temporary and permanent felling of approximately 122 hectares (ha) of coniferous forestry.

Chapter 4 Description of the Prospective Development has detailed information on each of these elements.

In general, the distances between the construction activities associated with the Prospective Development 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.

Construction activities will be carried out during normal daytime working hours (i.e., 07:00hrs – 19:00hrs Monday to 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 notified in advance with the Local Authority.

12.6.2.1 General Construction of Turbines, Hardstand Areas, Met Mast and Temporary Construction Compound

12.6.2.1.1 *Noise*

All foundation works are required at Turbine T07, along with the completion of foundations at the locations of 4 no. other proposed turbines. Hardstanding works are required at all proposed turbines, with the extent of works ranging from minor to more substantial depending on the current level completion. A met mast is proposed as part of the Prospective Development. 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 H001 at approximately 740 m from the proposed turbines works. The distance from the met mast is over 2 km from the nearest NSL (H001).

Table 12-15 outlines the typical construction noise levels associated with the proposed works for this element of the construction. Calculations are based on a reasonable assumption of 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. This accounts for the fact that not all items of plant can be in operation for 100% of the time and that not all items of plant will operate simultaneously.

Table 12-15 Typical Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[1]	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (750m)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials within the site	79	28
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for turbine foundations	75	24
Excavator Mounted Rock Breaker (C9.12)	Rock Breaking	85	34
General Construction (Various)	All general activities plus deliveries of materials and plant to the site	84	33
Concrete Mixer Truck and Concrete Pump (C.4.27)	Foundations	79	28
Dumper Truck (C.4.4)	Removing peat and spoil and transporting fill and other materials.	76	25
Mobile Telescopic Crane (C.4.39)	Installation of nacelles	77	26
JCB (D.8.13)	Road surfacing.	82	31

[1] *All plant noise levels are derived from BS5228: Part 1*

Vibrating Rollers (C.5.26)	For services, drainage and landscaping.	77	26
Steel Cutting (C.4.93)	Foundations	80	29
Cumulative Construction Noise Level			40

At 750 m from the works the predicted noise levels from construction activities are in the range of 24 to 34 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 this finding is valid should all items of plant operate simultaneously. No specific mitigation measures are required.

12.6.2.1.2 Vibration

Rock breaking activity will likely generate the highest levels of vibrations through the ground. Empirical data for this activity is not provided in BS 5228-2, however the likely level of vibration from this activity is expected to be substantially below the vibration criteria for building damage 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. The levels measured at up to 50 m from the activity are significantly below the assessment threshold set out in Table 12-4.

Due to the 750m distance of the proposed works from sensitive locations vibration effects are not likely to occur at any NSL.

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 Construction and Upgrade of Internal Wind Farm Roads

It is proposed that new roads will be constructed, and existing roads will be completed and upgraded as part of the Prospective Development, for internal access within the Wind Farm Site and for the purposes of amenity. Construction works for the proposed stabilisation berm north of T1 will use similar plant items as those used for the construction and upgrade of the internal roads. Review of the roads and amenity track layout has identified that the nearest NSL to any point of the Prospective Development is approximately 66 m to receptor H001. All other locations are at greater distances with the majority at significantly greater distances. The full description of the road upgrade and construction works, stabilisation berm and amenity tracks is outlined in Chapter 4 Description of the Prospective Development.

Table 12-16 Indicative Noise Levels from Construction Plant at Various Distances from Site Roads

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)1	Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) at 66 m
Tracked Excavator (C.4.64)	75	54
HGV Movement (C.2.30)	79	58
Dumper Truck (C.4.4)	76	55
Vibrating Rollers (C.5.26)	77	56
Cumulative Total	–	62

The table shows that at 66 m, noise levels do not exceed the construction adopted significance threshold outlined in Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods).

12.6.2.2.1 *Vibration*

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction of internal site roads and therefore no specific mitigation measures are required.

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 at the nearest NSL associated with construction and upgrade of the internal wind farm roads are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

[1] *All plant noise levels are taken from BS5228: Part 1*

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 Construction of Stabilisation Berm

Construction works for the proposed stabilisation berm north of T1 will use similar plant items as those used for the construction and upgrade of the internal roads. The Berm is located approximately 3 km to receptor H001. All other locations are at greater distances with the majority at significantly greater distances. The full description of the stabilisation berm is outlined in Chapter 4 Description of the Prospective Development.

Table 12-17 Indicative Noise Levels from Construction Plant at Various Distances from Site Roads

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)1	Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) at 3 km
Tracked Excavator (C.4.64)	75	16
HGV Movement (C.2.30)	79	20
Dumper Truck (C.4.4)	76	17
Vibrating Rollers (C.5.26)	77	18
Cumulative Total	–	24

The table shows that at 3 km, noise levels do not exceed the construction adopted significance threshold outlined in Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods).

12.6.2.3.1 *Vibration*

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction of internal site roads and therefore no specific mitigation measures are required.

12.6.2.3.2 *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 at the nearest NSL associated with construction of the stabilisation berm are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

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

[1] *All plant noise levels are taken from BS5228: Part 1*

12.6.2.4 Construction of Amenity Proposal

An amenity track layout has identified that the nearest NSL to any point is approximately 66 m to receptor H001. All other locations are at greater distances with the majority at significantly greater distances. The full description of the amenity tracks is outlined in Chapter 4 Description of the Prospective Development.

Table 12-18 Indicative Noise Levels from Construction Plant at Various Distances from Amenity Track

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)1	Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) at 66 m
Tracked Excavator (C.4.64)	75	54
HGV Movement (C.2.30)	79	58
Dumper Truck (C.4.4)	76	55
Vibrating Rollers (C.5.26)	77	56
Cumulative Total	–	62

The table shows that at 66 m, noise levels do not exceed the construction adopted significance threshold outlined in Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods).

12.6.2.4.1 *Vibration*

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction of internal site roads and therefore no specific mitigation measures are required.

12.6.2.4.2 *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 at the nearest NSL associated with construction of the amenity proposal are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

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

[1] *All plant noise levels are taken from BS5228: Part 1*

12.6.2.5 Construction of 33kV Underground Cabling

Review of the underground cabling layout has identified that the nearest NSL to any point of the Prospective Development is approximately 525 m to receptor H001. All other locations are at greater distances with the majority at significantly greater distances. The full description of the underground cabling construction works is outlined in Chapter 4 Description of the Prospective Development.

Table 12-19 Indicative Noise Levels from Construction Plant at Various Distances from underground cabling

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[1]	Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) at 525 m
Tracked Excavator (C.4.64)	75	33
HGV Movement (C.2.30)	79	37
Dumper Truck (C.4.4)	76	34
Vibrating Rollers / Plates (C.5.26)	77	35
Cumulative Total	–	41

The table shows that at 525 m, noise levels do not exceed the construction adopted significance threshold outlined in Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods).

12.6.2.5.1 *Vibration*

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction of underground cabling and therefore no specific mitigation measures are required.

12.6.2.5.2 *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 underground cabling 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.

[1] *All plant noise levels are taken from BS5228: Part 1*

12.6.2.6 BMEP Site

The BMEP Site, as described in Chapter 4 of this EIAR, comprises the felling of trees and the establishment of hen harrier habitat and peatland habitat, which will be conducted during standard daytime working hours (i.e., weekdays 07:00–19:00 and Saturdays 07:00–13:00). However, to optimise favourable weather conditions, address critical periods in the schedule (e.g., specific equipment usage), or accommodate the transportation, occasional work outside of these hours may be necessary. Any such out-of-hours operations will be communicated in advance to the Local Authority.

Table 12-20 outlines the likely noise levels associated with felling activity and habitat establishment 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 12-20 Typical Noise Levels – Felling

Item (BS 5228-1 Ref.)	Plant Noise Level at 10m Distance (dB LAeq,T) 1	Highest Predicted Plant Noise Level (dB LAeq,T)				
		50m Distance	75m Distance	100m Distance	200m Distance	300m Distance
Wheeled loader (C2.8) x 2	68	46	41	38	30	26
Tracked excavator (or forwarder) (C2.2) x 2	77	55	50	47	39	35
Petrol-driven chainsaw (or tree harvester) (D2.14)	86	64	59	56	48	44
Chipping / Mulching Machine (C9-14)	90	68	63	60	52	48
Total Construction Noise		**70**	**65**	**62**	**54**	**50**

These predicted levels of noise associated with felling activities are within the construction noise criterion outlined in Table 12-1, where the works occur at distances of greater than 100 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 areas indicates that there are no receptors within that distance.

12.6.2.6.1 *Vibration*

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

12.6.2.6.2 *Description of Effects*

[1] *All plant noise levels are derived from BS 5228: Part 1*

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

12.6.2.7 Borrow Pit Excavation and Reinstatement

12.6.2.7.1 *Noise*

To inform this aspect of the proposal, a noise assessment has been undertaken to consider the impacts of rock extraction and land clearing. 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
- 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 12-21 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 12-21 Plant Noise Emissions

Location	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[1]								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

[1] *All plant noise levels are derived from BS5228: Part 1*

Location	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[1]								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Tracked Excavator / Loading Shovel	77	88	95	93	93	92	86	76	99

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

The nearest NSL to any of the 3 no. borrow pit locations is NSL H001, which lies over 1 km to the north of the proposed works at BP3, the closest borrow pit to this NSL. Consequently, the resulting noise levels at the NSL are predicted to be low. The predicted levels at the closest NSL assuming all plant operates simultaneously is 42 dB L_{Aeq} for Scenario A and 31 dB L_{Aeq} for Scenario B. Both scenarios are at least 23 dB below the adopted criteria of 65 dB $L_{Aeq,T}$. It is expected that construction works at the borrow pits will only occur during daytime periods.

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 12.3.2.3 of this chapter are not exceeded.

12.6.2.7.2 *Vibration*

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction of borrow pits and therefore no specific mitigation measures are required.

12.6.2.7.3 *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

12.6.2.8 Peat and Spoil Management

Areas of peat and spoil management are also proposed as part of the Prospective Development. The nearest NSL to any of the proposed peat and spoil management areas is H001 at a distance of approximately 770m from the peat and spoil management area. The construction machinery to be used in these areas presented in Table 12-22.

Table 12-22 Typical Construction Noise Emission Levels – Peat and Spoil Management Areas

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [1]	Predicted Noise Level at 785 m
Tracked Excavator (C.4.64)	75	24
Dumper Truck (C.4.39)	76	25
Total Construction Noise		**28**

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

12.6.2.8.1 *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:

Quality	Significance	Duration
Negative	Not Significant	Short Term

12.6.2.9 Construction Traffic

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

- Activity 1: Concrete Foundation Delivery
- Activity 2: General Construction Works
- Activity 3: General Construction Works & Turbine Delivery – Abnormal Loads
- Activity 4: General Construction Works & Turbine Delivery – Standard Loads

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

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

[1] *All plant noise levels are derived from BS 5228: Part 1*

Table 12-23 Assumptions for Construction Traffic Noise Assessment

Route	Stage	LGV	HGV
1 – N56 between Mountcharles and Drimark	Existing	11,766	784
	Activity 1	11,836	1,120
	Activity 2	11,836	886
	Activity 3	11,811	844
	Activity 4	11,811	803
2 – N56 north of Donegal	Existing	8,394	883
	Activity 1	8,464	1,219
	Activity 2	8,464	985
	Activity 3	8,439	943
	Activity 4	8,439	902
3 – N15 between Donegal and Ballybofey	Existing	8,305	1,182
	Activity 1	8,375	1,518
	Activity 2	8,375	1,284
	Activity 3	8,350	1,242
	Activity 4	8,350	1,201

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

Table 12-24 Estimated Changes in Traffic Noise Levels

Route	Stage	Change in Traffic Noise Level dB(A)	Potenrial Significance of Effect
1 – N56 between Mountcharles and Drimark	Activity 1	+1.1	Not Significant
	Activity 2	+0.4	Imperceptible
	Activity 3	+0.1	Imperceptible
	Activity 4	+0.0	Imperceptible
	Activity 1	+1.1	Not Significant

Route	Stage	Change in Traffic Noise Level dB(A)	Potenrial Significance of Effect
2 – N56 north of Donegal	Activity 2	+0.4	Imperceptible
	Activity 3	+0.1	Imperceptible
	Activity 4	+0.0	Imperceptible
3 – N15 between Donegal and Ballybofey	Activity 1	+0.9	Imperceptible
	Activity 2	+0.3	Imperceptible
	Activity 3	+0.0	Imperceptible
	Activity 4	+0.0	Imperceptible

The increase in noise levels due to additional construction traffic on each of the routes is predicted to be less than 1.1 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 12.4.4, the predicted turbine noise levels have been calculated at all NSLs within the study area of the Prospective Development. A precautionary omni-directional 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 12.5.2, which have been derived in accordance with the criteria set out in Section 12.3.2.4.

At all NSLs, the predicted omni-directional cumulative turbine noise levels are below the noise criterion curves.

Table 12-25 presents the result of the turbine noise predictions and assessment review at all the NSLs within the study area. Noise contours for the omni-directional rated power wind speed (i.e., highest noise emission) are presented in Appendix 12-5.

Further predictions that account for the scenario where the existing Barnesmore Wind Farm remains is accounted for in Appendix 12-6.

Table 12-25 Predicted Noise Levels

NSL Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
H001	Predicted	29.3	30.7	36.2	40.2	40.8	40.8	40.8
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H002	Predicted	25.4	26.7	32.2	36.2	36.8	36.8	36.8
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H003	Predicted	25.1	26.4	31.9	35.9	36.5	36.5	36.5
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H004	Predicted	25.0	26.3	31.8	35.8	36.4	36.4	36.4
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H005	Predicted	24.0	25.4	30.9	34.9	35.5	35.5	35.5
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–

NSL Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H006	Predicted	24.1	25.5	31.0	35.0	35.6	35.6	35.6
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H007	Predicted	24.1	25.5	31.0	35.0	35.6	35.6	35.6
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H008	Predicted	21.3	22.6	27.9	31.9	32.5	32.5	32.5
	Daytime Criterion*	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion*	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H009	Predicted	19.0	20.4	25.9	29.9	30.5	30.5	30.5
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H010	Predicted	19.1	20.4	25.9	29.9	30.5	30.5	30.5

NSL Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H011	Predicted	18.8	19.8	24.9	28.7	29.6	29.5	29.5
	Daytime Criterion*	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion*	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H012	Predicted	19.0	20.4	25.8	29.8	30.4	30.4	30.4
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H013	Predicted	18.9	20.2	25.7	29.7	30.3	30.3	30.3
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H014	Predicted	17.9	19.3	24.8	28.8	29.4	29.4	29.4
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3

NSL Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Night-time Excess	–	–	–	–	–	–	–
H015	Predicted	17.8	19.2	24.6	28.6	29.2	29.2	29.2
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H016	Predicted	19.4	20.0	24.7	28.4	29.6	29.4	29.4
	Daytime Criterion*	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion*	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H017	Predicted	17.9	19.2	24.7	28.7	29.3	29.3	29.3
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H018	Predicted	17.4	18.7	24.2	28.2	28.8	28.8	28.8
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H019	Predicted	17.2	18.5	24.0	28.0	28.6	28.6	28.6
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–

NSL Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–
H020	Predicted	17.8	19.1	24.6	28.6	29.2	29.2	29.2
	Daytime Criterion	40	40	45	45	45	45	45
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43	43	43	43	43	43	44.3
	Night-time Excess	–	–	–	–	–	–	–

* With regards to noise sensitive locations in Northern Ireland, the ETSU-R-97 Guidelines are pertinent as the Guidelines (DoEHLG, 2006) are not applicable in this jurisdiction. The set of NSLs within Northern Ireland (H008, H011 and H016) all have predicted noise levels below 35 dB(A), which is the lowest ETSU noise threshold, therefore the lowest and most conservative ETSU noise criterion is met.

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 Prospective Development.

While noise levels at low wind speeds will increase due to the Prospective Development 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 turbines of the Prospective Development 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 *Onsite 110kV Substation*

Details of the existing onsite 110kV 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 93 dB(A) L_w.

Noise prediction model calculations for the operation of the existing onsite 110kV 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 existing onsite 110kV substation at the nearest NSL (H001) at approximately 3 km northeast is 11 dB $L_{Aeq,T}$. This level of noise is low and inaudible, and it is concluded that there will be no significant noise emissions from the operation of the existing onsite 110kV substation at any NSL.

12.6.3.2.2 Cumulative Levels

The operation of the existing onsite 110kV substation is calculated to be 11 dB $L_{Aeq,T}$ at the nearest NSL which is significantly below the criterion for fixed mechanical plant outlined in Section 12.3.2.6 and therefore cannot result in any adverse impacts at nearby NSLs. The reasoning for this is that if a noise source is 10 dB or more below the assessment criterion, it does not materially affect the cumulative noise level and can reasonably be excluded from further consideration. Given the predicted noise level, any fixed plant from other projects would likely dominate at the NSLs, and the substation would not be able to contribute sufficient energy to increase these noise levels over the criteria. At NSLs further from the existing onsite 110kV 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 onsite 110kV substation is described below.

Quality	Significance	Duration
Negative	Imperceptible	Long Term

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 Subject Development can be considered comparable to those outlined in relation to the construction phase (as per Section 12.4.3) albeit less works will be required as only above ground structures will be removed. Turbine and mast foundations will remain underground, and cable ducting will remain in situ. Foundations for temporary construction compound will be covered or naturally revegetate. The underground cable ducting to the onsite 110kV substation will remain in place. All access roads and hardstanding areas forming part of a site roadway network will be required by the ongoing forestry operations, and the amenity trails and therefore will be left in situ for continued use. Refer to Section 4.12 of Chapter 4 for full details on decommissioning. The predicted noise levels are expected to be below the appropriate Category A value (i.e. 65 dB $L_{Aeq,T}$) at all NSLs for the decommissioning phase, given that the works will be comparable with the construction 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 Prospective Development is expected to comply with the identified criteria for the construction, operational and decommissioning phases of the Prospective Development and therefore no specific mitigation measures are required.

12.7.1 Construction and Decommissioning Phases - Noise

The assessment of potential impacts present in Section 12.5.2 has demonstrated that the Prospective Development is expected to comply with the criteria during the construction phase and therefore no specific mitigation measures are required.

The contract documents will specify that the Contractor undertaking the works will be obliged to take specific noise abatement measures and comply with the recommendations of British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. To ameliorate any potential noise impacts that may present during the construction phase, a schedule of noise control measures has been formulated in accordance with best practice guidance. These are outlined in the Construction and Environmental Management Plan (CEMP) that has been prepared for the Prospective Development and included in Appendix 4-3. The following list of measures will be considered, where necessary, to ensure compliance with the relevant construction noise criteria:

- 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 properties as practical within the site constraints, and;
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction 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.

Where rock breaking is employed in relation to the proposed borrow pit locations or other locations across the Site, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.

- Use a dampened bit to eliminate ringing.

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 and Decommissioning Phases – 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 Prospective Development 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.

As blasting will be undertaken as part of the Prospective Development, 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. Further details on blasting are outlined in Section 4.4.1.4 of Chapter 4 of this EIAR.

12.7.3 Operational Phase

12.7.3.1 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 Prospective Development 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 Prospective Development 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 Prospective Development, an updated noise assessment will be prepared to confirm that the noise emissions will comply with the noise criteria outlined in Section 12.5.2 and/or the relevant operational criteria associated with the grant of planning for the Subject Development.

In the unlikely event that an issue with low frequency noise is associated with the Prospective Development, 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'*.

12.7.3.2 Amplitude Modulation and Tonality

In the event that a complaint which indicates potential excessive amplitude modulation (AM) associated with the Subject Development, 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', provide an objective measurement and rating of AM and can 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 measured turbine level plus any adjustment for tonal penalty is above the limit, then the operator would liaise with the turbine manufacturer to investigate and implement measures to reduce the audible tonal component or the total turbine noise level to ensure that the residual turbine noise does not exceed the limit value. 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 is considered to be current best practice. The proposed approach will ensure that any adverse impacts from excessive amplitude modulation (AM) associated with the operation of the Subject Development are effectively managed by the operator.

12.7.3.3 Fixed Plant

The assessment of noise from the operation of fixed plant at the onsite 110kV substation is predicted to comply with the proposed criteria in Section 12.3.1.6. Therefore, no specific mitigation measures are required.

12.7.4 Monitoring

12.7.4.1 Noise Compliance Monitoring

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

Prior to the commissioning of the proposed turbines, the Applicant will submit a Noise Compliance Monitoring Protocol (NCMP) (see Section 12.3.2.5.11) to the planning authority for written agreement and approval. The NCMP will include detailed methodologies for noise measurements, procedures for recording results, and a protocol for managing complaints in accordance with the most up to date guidance, standards, and industry best practice. It is a standard procedure for this to be agreed under the planning condition compliance framework.

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

Modern wind turbines can be programmed to run in reduced modes of operation (or low noise modes) to achieve the required attenuation in specific wind conditions (i.e., wind speed and direction In the unlikely event that an exceedance of the noise criteria is identified as part of the compliance assessment, the guidance outlined in the IOA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be followed, and relevant corrective actions taken to ensure residual compliance with the turbine noise criteria. 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. Such curtailment can be applied using the wind farm control system with reduction of the wind turbine energy generation.

As an example of this turbine control capability, the following table shows the sound power levels for the Nordex N133 4.8MW turbine for Normal Operation along with the sound power levels 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 between 5 and 8 dB can be achieved dependent on the operational mode set on the specific turbines.

Table 12-26 Sound Power Levels at Reduced Modes

		Wind Speed m/s						
		3	4	5	6	7	8	9
Sound Power Levels, dB LWA	Mode 1	93.5	94.4	99.8	104	105.5	105.5	105.5
	Mode 2	93.5	94.4	99.8	104	105	105	105
	Mode 3	93.5	94.4	99.8	103.9	104.5	104.5	104.5
	Mode 4	93.5	94.4	99.8	103.8	104	104	104
	Mode 5	93.5	94.4	99.8	103.4	103.5	103.5	103.5
	Mode 6	93.5	94.4	99.8	103	103	103	103
	Mode 7	93.5	94.4	99.7	102.5	102.5	102.5	102.5
	Mode 8	93.5	94.4	99.6	100.5	100.5	100.5	100.5
	Mode 9	93.5	94.4	99.6	100	100	100	100
	Mode 10	93.5	94.4	99.5	99.5	99.5	99.5	99.5
	Mode 11	93.5	94.4	99	99	99	99	99
	Mode 12	93.5	94.4	98.5	98.5	98.5	98.5	98.5
	Mode 13	93.5	94.4	98	98	98	98	98

12.7.4.2 Complaints Procedure

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 agreed NCMP).

A draft protocol for management of complaints addressing is presented in Appendix 12-8. A final version of this protocol will be contained within the NCMP to be agreed with the relevant Local Authority.

12.8 Residual Effects

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

12.8.1 Construction Phase

During the construction phase of the Prospective Development, 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, Met Mast and Temporary Construction Compound

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 Construction and Upgrade of Internal Wind Farm 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 Construction of Stabilisation Berm

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 Construction of Amenity Proposal

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.

12.8.1.5 Construction of 33kV Underground Cabling

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.

12.8.1.6 BMEP Site

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.

12.8.1.7 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.

12.8.1.8 Peat and Spoil Management

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:

Quality	*Significance*	*Duration*
Negative	Not significant	Short-term

12.8.1.9 Construction Traffic

With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs are described as described below:

Quality	Significance	Duration
Negative	Imperceptible to Not Significant	Short Term

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.

12.8.2 Operational Phase

12.8.2.1 Wind Turbine Noise

The predicted noise levels associated with the Prospective Development will be within best practice noise criteria curves recommended in line with the Guidelines (DoEHLG, 2006 and ETSU-R-97). It is not considered that a significant noise effect is associated with the Prospective Development.

While noise levels at low wind speeds will increase due to the Prospective Development 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 Onsite 110kV Substation and Ancillary Works Operation

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

Quality	Significance	Duration
Negative	Not Significant	Long Term

12.8.3 Decommissioning Phase

During the decommissioning phase of the Subject Development, 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 are considered to be comparable to those outlined in relation to the construction of the Prospective Development.

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

For the assessment of cumulative effects, any other existing, permitted or proposed projects (wind energy or otherwise) have been considered. The potential cumulative effects of the Prospective Development and other relevant developments has been carried out with the purpose of identifying what influence the Prospective Development will have on the surrounding environment when considered cumulatively.

12.9.1 Cumulative Effects – Prospective Development

12.9.1.1 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 12.4.4.4, the cumulative turbine noise from the Barnesmore Repowering wind farm, Meenakeeran Wind Farm and the Straness Wind Farm have been included in the operational turbine noise assessment. No other wind farms have the potential to contribute to cumulative noise levels. The residual cumulative impacts are considered Not Significant.

12.9.1.2 Noise from Fixed Plant Operation

The operation of the existing onsite 110kV substation is calculated to be 11 dB $L_{Aeq,T}$ at the nearest NSL which is significantly below the criterion for fixed mechanical plant outlined in Section 12.3.2.6 and therefore cannot result in any adverse impacts at nearby NSLs. The reasoning for this is that if a noise source is 10 dB or more below the assessment criterion, it does not materially affect the

cumulative noise level and can reasonably be excluded from further consideration. Given the predicted noise level, any fixed plant from other projects would likely dominate at the NSLs, and the substation would not be able to contribute sufficient energy to increase these noise levels over the criteria. At NSLs further from the existing onsite 110kV substation the noise levels will be lower.

12.9.1.3 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 Prospective Development 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, 12.6.2.7 and 12.6.2.8 confirms that the predicted noise levels from activities at static construction sites at any NSL are ≤55 dB $L_{Aeq,T}$, therefore the potential for any cumulative noise effect 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.

12.9.2 In-Cumulation Effects

This section considers the in-cumulation impact of the combination of the Existing Development and Prospective Development (the Subject Development).

Table 12-27 below details the residual in-cumulation effects of the Subject Development.

Table 12-27 Assessment of potential In-Cumulation Effects of the Subject Development

Description	Prospective Development	Existing Development	Subject Development (In-Cumulation Conclusion)
Noise Sensitive Locations (Construction Noise)	Construction activities associated with the Prospective Development will be temporary and short-term in nature. Predicted construction noise levels at the nearest Noise Sensitive Locations (NSLs) comply with the applicable construction noise criteria adopted in accordance with BS 5228-1. With standard best practice construction noise measures in place, no significant noise effects are predicted at NSLs during the construction phase of	Noise effects associated with the Existing Development primarily arose during the construction phase. These construction noise effects were temporary and ceased once construction activities were completed. No ongoing or residual construction noise effects associated with the Existing Development remain in the receiving environment.	As the construction noise effects of the Existing Development are no longer present and construction noise effects from the Prospective Development are temporary, there is no potential for in-cumulation construction noise effects at NSLs.

Description	Prospective Development	Existing Development	Subject Development (In-Cumulation Conclusion)
	the Prospective Development when assessed in isolation.		
Noise Sensitive Locations (Operational Noise)	Operational noise from the Prospective Development, including wind turbines and associated infrastructure, has been assessed in accordance with ETSU-R-97 and the IOA Good Practice Guide. Predicted cumulative operational noise levels are within the relevant noise limits at all NSLs, and no significant operational noise effects are anticipated.	Operational elements of the Existing Development comprise infrastructure such as the onsite 110kV substation and associated Grid Connection, which operates continuously. Calculated noise levels from this infrastructure are extremely low at the nearest NSLs and are considered imperceptible. No significant operational noise effects associated with the Existing Development have been identified.	The operational noise contribution from the Existing Development is negligible relative to the noise criteria and does not materially influence cumulative noise levels. Operational noise from the Prospective Development, are within the relevant noise limits at all NSLs, and no significant operational noise effects are anticipated Accordingly, no significant adverse in-cumulation operational noise effects are predicted to occur.
Construction Related Vibration	Construction-phase vibration associated with the Prospective Development has been assessed with reference to BS 5228-2 and BS 7385. Due to separation distances between works and receptors, vibration levels are not predicted to approach criteria for cosmetic or structural damage and are unlikely to be perceptible at NSLs.	Construction-phase vibration effects associated with the Existing Development were limited, temporary and ceased upon completion of construction works. No residual vibration sources remain.	As vibration effects associated with the Existing Development no longer occur and predicted vibration levels from the Prospective Development are low and temporary, there is no potential for in-cumulation vibration effects.
Construction Traffic Noise	Construction traffic associated with the Prospective Development will make use of the existing	Construction traffic associated with the Existing Development was temporary and has ceased.	Given the temporary nature of construction traffic noise and the

Description	Prospective Development	Existing Development	Subject Development (In-Cumulation Conclusion)
	road network. Predicted changes in traffic noise levels are low, temporary, and generally imperceptible in accordance with DMRB LA 111 guidance.	No ongoing traffic noise effects attributable to the Existing Development are present.	absence of overlapping or ongoing traffic effects, no significant in-cumulation effects associated with construction traffic noise are anticipated.
Human Receptors – Amenity and Health (Noise and Vibration)	With construction and operational noise and vibration levels predicted to remain within applicable guidance limits, no significant adverse effects on residential amenity or human health are anticipated as a result of the Prospective Development.	No significant residual noise- or vibration-related effects on human health or amenity associated with the Existing Development have been identified.	Therefore, there is no potential for significant adverse in-cumulation effects in respect of human amenity or health arising from noise or vibration.

12.9.3 Cumulative Effects – Subject Development

12.9.3.1 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 12.4.4.4, the cumulative turbine noise from the Barnesmore Repowering wind farm, Meenakeeran Wind Farm and the Straness Wind Farm have been included in the operational turbine noise assessment. The residual cumulative impacts are considered Not Significant.

12.9.3.2 Noise from Fixed Plant Operation

The predicted noise from the operation of the onsite 110kV substation at the nearest NSL is 11 dB which is significantly below the adopted criteria to the point that it cannot contribute to a cumulative impact. The reasoning for this is that if a noise source is 10 dB or more below the assessment criterion, it does not materially affect the cumulative noise level and can reasonably be excluded from further consideration. Given the predicted noise level, any fixed plant from other projects would likely dominate at the NSLs, and the substation would not be able to contribute sufficient energy to increase these noise levels over the criteria. The resultant impact is Not Significant.

12.9.3.3 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 Prospective Development 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, 12.6.2.7 and 12.6.2.8 confirms that the predicted noise levels from activities at static construction sites at any NSL are ≤55 dB $L_{Aeq,T}$, therefore the potential for any cumulative noise effect from all of the proposed activities occurring simultaneously or with construction activities from other developments is unlikely and not significant.

Construction activities that will progress over a defined route are predicted to exceed the construction noise threshold at the closest receptor locations, however, given the duration of the activities outside each individual NSL, the temporal criteria is not likely to be exceeded and hence higher cumulative noise levels for those periods would not cause an additional effect.

12.10 Transboundary Effects

This section considers the potential transboundary impact of the Subject Development.

Potential transboundary effects have been considered with respect to Northern Ireland. The construction methodology, as described in Section 12.3.1.1, applies across the jurisdictional boundary. Construction noise was temporary and not significant, in both Ireland and Northern Ireland.

Operational noise modelling for the substation indicates that predicted noise levels within Northern Ireland are extremely low and remain below all relevant assessment thresholds applicable in either jurisdiction. These levels are considered imperceptible at all locations including receptors in Northern Ireland.

Accordingly, no significant transboundary effects occurred during the construction of the Existing Development, and no transboundary mitigation measures were required.

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

In relation to the Subject Development, the ETSU-R-97 Guidelines are pertinent as the Guidelines (DoEHLG, 2006) are not applicable in Northern Ireland.

The set of NSL within Northern Ireland all have predicted noise levels below 35 dB(A) (See Chapter 12 of the EIAR for details), therefore the lowest and most conservative ETSU noise criteria are met.

As outlined in Section 12.4.4.4 of the EIAR, the cumulative turbine noise from the Barnesmore Repowering wind farm, Meenakeeran Wind Farm and the Straness Wind Farm have been included in the operational turbine noise assessment. Additionally, a scenario has been assessed where the existing Barnesmore Wind Farm continues to operate. The residual cumulative impacts for both scenarios are considered Not Significant.

Furthermore, section 12.9.3.3 of the EIAR details in terms of construction and decommissioning noise, that 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.

It follows that as both the Existing Development and Prospective Development do not have the potential for a transboundary effect that the Subject Development does not have the potential for a significant transboundary effect.

12.11 Summary

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

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

Residual noise associated with the construction and decommissioned phases have been predicted to be 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 Prospective Development will be within the best practice noise limits recommended in WEDG06 Guidelines. Therefore, it is not considered that a significant effect is associated with the Prospective Development.

Operational noise from the existing onsite 110kV 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 Prospective Development.