Planning and Environmental Consultants

Environmental Impact Assessment Report

Slieveacurry Renewable Energy Development, Co. Clare

DOCUMENT DETAILS

Client:	Slieveacurry Ltd
Project Title:	Slieveacurry Renewable Energy Development, Co. Clare
Project Number:	[Category]
Document Title:	Environmental Impact Assessment Report
Document File Name:	Chapter 12 – Noise and Vibration
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12.1 Introduction

12.1.1 Background and Objectives

This chapter of the EIAR describes the assessment undertaken of the potential noise and vibration impacts and likely significant effects associated with the Proposed Project. The Proposed Project will comprise up to 9. no. turbines with a tip height of 175 metres, a full description of the Proposed Project is provided in Chapter 4 of this EIAR.

Noise and vibration impact assessments have been prepared for both the construction and decommissioning, and operational phases of the Proposed Project at identified noise sensitive location (NSL's) in the vicinity. Potential effects on ecological receptors as a result of noise from the Proposed Project have been considered in Chapter 6 Biodiversity. To inform this assessment, background noise levels have been measured at five representative NSL's in the vicinity of the Proposed Wind Farm Site.

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 Meter Calibration Certificates
- Appendix 12-3: Noise Modelling Assumptions and Parameters
- Appendix 12-4: Predicted Noise Contours
- Appendix 12-5: Tabulated Predicted Noise Results
- Appendix 12-6: Lidar Installation Report
- Appendix 12-7: Noise Study Area
- Appendix 12-8: Noise Complaint Management Protocol

12.1.2 Statement of Authority

This chapter has been prepared by Miguel Cartuyvels and Dermot Blunnie of AWN Consulting Ltd:

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

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.

The chapter has been reviewed by Mike Simms of AWN Consulting Ltd:

Mike Simms (Senior Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering and is a member of the Institute of Acoustics and of the Institution of Engineering and Technology. Mike has

worked in the field of acoustics for over 19 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, wind energy, industrial, commercial, and residential.

12.2 Fundamentals of Acoustics

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

The audible range of sounds expressed in terms of Sound Pressure Levels (SPL) is 0dB (for the threshold of hearing) to 120dB (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 is 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. SPL's 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.

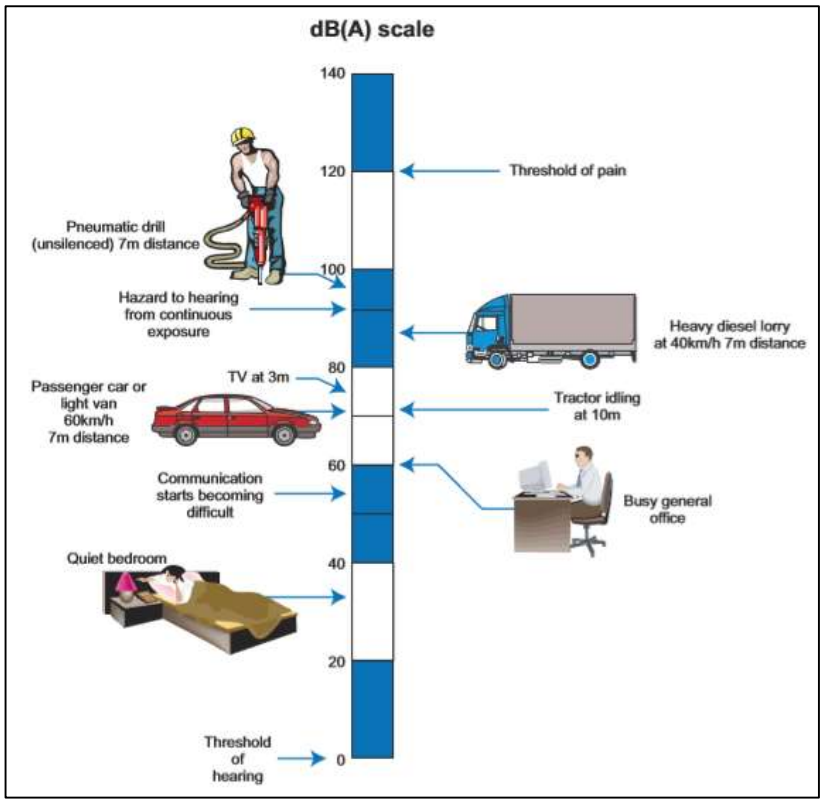

Figure 12-1 The level of typical common sounds on the dB(A) scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

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

12.3 Legislation, Policy and Guidance

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

12.3.1 Environmental Protection Agency (EPA) Description of Effects

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

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

12.3.2 Guidance Documents and Assessment Criteria

The assessment of effects for the proposed project has been undertaken with reference to published standards and guidelines that are applicable to the development and/or considered to represent best practice for the assessment of environmental noise and vibration impacts.

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

- EPA, 2022 as described in 12.3.1;
- Wind Energy Development Guidelines for Planning Authorities, Department of the Environment, Heritage, and Local Government (2006) (the Guidelines (DoEHLG 2006)) with cognisance of *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (Draft Guidelines (DoHLGH 2019));
- The Assessment and Rating of Noise from Wind Farms, Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) (1996)[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;

[1] *A draft update of the guidance 'Assessment and Rating of Wind Turbine Noise' (2025) was published for consultation on 4 July 2025. This draft update to ETSU-R-97 is a UK consultation document and is not applicable to wind energy assessments in Ireland. In line with its draft status, and the advice within the document that it should not be used by planning authorities, the consultation draft has not been considered in this assessment.*

- 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 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO, 1996);
- ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO, 2024);
- EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016);

General context guidance in the following documents has also been considered but not directly applied:

- 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
- EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (EPA, 2011);
- International Electrotechnical Commission (IEC) 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 (Hereafter TS 61400-11-2)

12.3.3 Construction and Decommissioning Phase - Noise

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

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a renewable energy development of this scale may be found in the '*British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites'* – Noise (BS5528-1). This standard is commonly accepted as best practice and used in Ireland.

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.

The following method should be applied:

For each period (e.g., daytime) the ambient noise level is determined and rounded to the nearest 5 dB. At some sensitive properties, especially those situated near busy roads, ambient noise levels are anticipated to be relatively high. However, given the rural nature of the Site and surrounding area, reference has been made to the quietest properties near the development which have daytime ambient noise levels typically in the range of 28 to 45 dB $L_{Aeq,1hr}$. Therefore, for the purposes of this assessment, as a precautionary approach, all properties will be afforded a 'Category A' designation for initial assessing of construction noise impacts.

BS 5228-1 states that:

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

Please see Section 12.6.2 for the detailed assessment in relation to the construction of the Proposed Project.

12.3.3.1 Commercial receptors

BS5228-1:2009+A1 gives several examples of acceptable limits for construction or demolition noise, the most simplistic being based upon the exceedance of fixed noise limits. For example, paragraph E.2 states:

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

Paragraph E.2 goes on to state:

> *"Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:*
>
> *70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;*

75 decibels (dBA) in urban areas near main roads in heavy industrial areas".

For commercial locations it is considered appropriate to adopt the 75 dB(A) criterion during the day. The non-residential properties are only considered to be noise sensitive during office hours.

12.3.3.2 Linear Construction Works

A fixed noise limit is proposed for elements of the construction that are linear and progressive in nature, namely access roads and the proposed 33kV underground cabling. This is deemed appropriate in that noise from associated construction activities is variable and typically occurs for a short period of time only and is at its highest when closest to the NSL. As the works progress, construction noise levels at the NSL will reduce due to the works taking place at greater distances, resulting overall in a shorter duration of exposure to noise impacts.

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

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

Paragraph E.2 goes on to state:

> *"Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:*
>
> - *70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;*
> - *75 decibels (dBA) in urban areas near main roads in heavy industrial areas".*

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

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

12.3.3.3 Interpretation of the Construction Noise Thresholds (CNT)

In order to assist with interpretation of the construction noise thresholds, Table 12-2

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). The DMRB guidance is considered appropriate and best practice as it provides a well-established, internationally recognised framework with objective criteria for assessing construction noise and vibration impacts, which aligns closely with the relevant significance effects from EPA, 2022. Table 3.16 therein has been adapted to include the relevant significance effects from EPA, 2022.

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

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

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

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

In the absence of any national guidelines in Ireland, 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, 2020). The DMRB Guidance is considered appropriate and best practice as it provides a well-established, internationally recognised framework with objective criteria for assessing construction noise and vibration impacts, which aligns closely with the relevant significance effects from EPA 2022.

As traffic from the Proposed Project will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the Proposed Project.

To assist with interpretation of a predicted construction noise level (CNL), relative to the CNT, reference is made to Table 3.16 in DMRB which forms the basis of and been adapted by AWN to include the relevant significance effects from EPA, 2022 to assess the likely magnitude of impact associated with construction activities, as presented in Table 12-3

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	Not Significant
1.0 – 2.9	Barely Perceptible	Minor	
3.0 – 4.9	Perceptible	Moderate	Significant
≥5	Up to a doubling of loudness	Major	

The DMRB Guidance will be used to assess the predicted increases in traffic levels on public roads associated with the Proposed Project (this includes the Turbine Delivery Route (TDR)) and comment on the likely 'short-term' impacts during the construction phase. Where a major or moderate impact is identified due to the change in traffic noise level, reference will be made to the overall predicted noise level from construction/decommissioning traffic in the context of the construction noise threshold values outlined previously in Section 12.3.3.

12.3.3.4.1 Consideration of Duration When Assessing Effects

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

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

12.3.4 Construction and Decommissioning Phase – Vibration

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

In the absence of statutory Irish guidelines for the assessment of construction-related vibration, the following published standards and guidance have been considered in the assessment. These documents provide industry-recognised thresholds and assessment methodologies that align with EIAR requirements:

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

BS7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at 4 Hz rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

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 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

In accordance with the suggested vibration criteria discussed above from BS7385, BS5228-2 and NRA Guidelines, the values in

Table 12-4 from the NRA Guidelines are considered appropriate for this assessment as they provide nationally recognised, conservative PPV thresholds specifically developed for Irish infrastructure and construction works, ensuring a robust assessment in the absence of statutory Irish vibration limits.

12.3.5 Operational Phase Noise – Wind Turbines

The noise assessment documented in this chapter is based on guidance in relation to acceptable levels of noise from wind farms as contained in the Guidelines (DoEHLG 2006). The Guidelines (DoEHLG 2006) are based on detailed recommendations set out in ETSU-R-97. The ETSU-R-97 document has been used to supplement the guidance contained within the Guidelines (DoEHLG 2006), where appropriate and necessary.

12.3.5.1 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 Proposed Project, both as a higher fixed level of 45 dB L_{A90} and/or a higher level above the prevailing background noise level.

12.3.5.2 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.

12.3.5.3 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.

12.3.5.4 Noise Prediction Calculations

The noise levels associated with the wind turbines have been calculated in accordance with ISO 9613-2:1996, incorporating the Institute of Acoustics (IOA) Good Practice Guide (GPG) parameter settings for wind-turbine screening limits and valley correction. A revised edition of ISO 9613 was published in 2024, providing more generalised definitions for these parameters. However, the IOA GPG adopts a more conservative approach to terrain screening and is only applicable when using ISO 9613-2:1996. For this reason, the noise prediction calculations in this assessment have been undertaken using ISO 9613-2:1996 together with the IOA GPG parameters. The IOA is currently reviewing the GPG to clarify the use of the superseded standard in relation to the newer ISO revision.

ISO 9613-2 is a noise prediction standard that accounts for attenuation due to distance, ground absorption, source directivity, and atmospheric absorption, among other factors. The IOA GPG notes that when assessing cumulative noise impacts, the influence of different wind directions on propagation may be considered. Where any directional attenuation factors are applied, these should be clearly reported within the assessment.

Additional details on the noise prediction calculation settings are provided in Appendix 12-3.

12.3.5.5 Cumulative Assessment Screening

All existing, permitted and proposed wind turbine developments must be considered cumulatively in the noise impact assessment. To determine whether a particular wind farm development can be scoped out of the final assessment a '10 dB rule' is applied. The '10 dB rule,' is grounded in scientific principles and supported by best-practice guidance. It states that if the contribution from another noise source is 10 dB below the total noise level, its contribution is insignificant to the total cumulative noise level, therefore, the other source is not significant and can be scoped out of the cumulative 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, permitted 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 criterion applies:

- The study area for operational turbine noise can be defined as the area within which predicted turbine noise levels from the proposed, permitted, 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.

By way of 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. At a minimum, all noise-sensitive receptors within this area will need to be identified and considered in the turbine noise prediction model.

12.3.5.6 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 the Guidelines (DoEHLG 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, he 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 LA90, 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 DoEHLG outlines 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 equal to or greater than 30 dB $L_{A90,10min}$ and;
- 43 dB $L_{A90,10min}$ for night time periods or a maximum increase of 5 dB above background noise (whichever is higher).

While the caveat of an increase of 5 dB 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 5 dB above the background level. This approach is also consistent with the daytime criteria in the Guidelines (DoEHLG 2006), which allow the limit to increase by up to 5 dB above background where this exceeds the fixed threshold level.

12.3.5.7 Future Potential Guidance Changes

In December 2019, the Draft Wind Energy Development Guidelines (DoHLGH 2019) were published for consultation and at the time of writing, no updated guidelines have been published. It is important to note that during the public consultation on the 2019 draft WEDGs, several concerns relating to the proposed approach of the 2019 draft WEDGs 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

Wherein it is stated that:

> *"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"*

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

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

The following statements was submitted by the Minister for Housing, Local Government and Heritage during a Dail Eireann Debates on 19 June 2025[2]

> *"My Department is currently undertaking a focused review of the 2006 Wind Energy Development Guidelines. The review is addressing a number of key aspects of the Guidelines including noise, setback distance, shadow flicker, community obligation, community dividend and grid connections.*
>
> *My Department, in conjunction with the Department of the Climate, Energy and Environment (DCEE) which has primary responsibility for environmental noise matters, has been working to advance guidance on the noise aspect of the Guidelines, which is highly technical in nature. The two Departments have been engaging on proposals regarding the measurement and assessment of noise from wind turbines to ensure they are robust and fit for purpose having regard to, inter alia, the revised 2030 target to generate up to 80% of our electricity from renewable sources.*
>
> *My Department, in conjunction with DCEE, will make any further changes to the draft Guidelines which are deemed necessary or appropriate in the wake of this work to ensure that the finalised Guidelines, once issued, are fit for purpose to provide guidance in line with renewable energy and climate targets, whilst having*

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

appropriate regard to the impacts of wind energy development, including in relation to noise annoyance.

The evolving policy and technical context including the new Planning and Development Act 2024, which was signed by the President on 17 October 2024, and the revision of the National Planning Framework (NPF) reinforces the need to ensure that the finalised Guidelines, once issued, are fit for purpose.

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

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

My Department notes the commitment in the recently published Programme for Government 2025 – Securing Ireland's Future to prioritise the publication of the Wind Energy Development Guidelines, having regard to international best practice and standards. In light of this commitment, my Department is working towards concluding the finalisation of review of the Guidelines as a matter of priority, having regard to the intended public consultation and the finalisation of associated reforms and reviews including the revision of the NPF. When finalised, the revised Guidelines will be issued under section 28 of the Planning and Development Act 2000, as amended or, subject to commencement of the Planning and Development Act 2024, as a National Planning Statement, as appropriate. The current 2006 Wind Energy Development Guidelines remain in force, pending the finalisation of the review."

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

12.3.5.8 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.*
>
> *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 by the WHO to support the recommendation of a 45 dB L_{den} exposure threshold for wind turbine noise is classified within the guidelines as 'low'. The document also acknowledges that no evidence is available to justify implementing the L_{den} parameter as an appropriate noise criterion for wind turbines.

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 L_{den} limit for wind turbine noise, as it is considered a poor characterisation of wind turbine noise. The WHO 2018 recommendation for average noise exposure of 45 dB L_{den} is conditional, meaning that the available scientific data for wind turbine noise was not strong enough to justify a strong recommendation.

12.3.5.9 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."

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published on the IOA website[3] 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

[3] Microsoft Word - IOA Statement Final 18.12.24

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 to assess 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.

12.3.5.10 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 suitable controlled. However, modern turbine designs have evolved to minimise mechanical noise radiation from wind turbines and resonances are normally minimised through design.

Wind farm noise guidelines such as those of ETSU-R-97 assume that the wind turbine noise contains no clearly audible tones. However, it not possible to predict the occurrence of tonality on a project as this would not normally be expected from standard wind turbine designs. The unlikely occurrence of tonality in the wind turbines of the proposed project will be managed through the commitments provided by the Applicant in Section 12.7.4.1.1**Error! Reference source not found.**.

12.3.5.11 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)."

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.

12.3.5.11.1 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."*

12.3.5.11.2 Concluding Comments on AM

It is critical in the discussion of amplitude modulation (AM) to recognise it 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.

Current research and guidance relating to wind turbine noise AM are ongoing. Among the most recent notable contributions is the IOA AMWG's 2016 publication, which outlines an objective measurement and rating approach known as the Reference Method. The IOA AMWG does not propose thresholds for adverse community response or recommend specific limits for AM. The purpose of the group is to consolidate existing research and to establish a consistent methodology for the objective measurement and rating of AM.

A 2016 report commissioned by the UK government BEIS AM Review Phase 2, completed by WSP Parsons Brinckerhoff, 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 and was not adopted by the UK or devolved Governments. 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 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. The WSP report states "*at present it is not possible to predict whether AM will or will not be prevalent on a site*".

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 and Governmental consensus on how AM should be regulated or managed through the planning and operational stage. Planning conditions imposing AM limits are therefore not considered best practice. In the absence of clear policy in Ireland to control AM from wind turbines, the commitments outlined in the Section 12.7.4.1 are considered to represent best practice to control AM and will be adopted in the event that an complaint relating to excessive AM is reported.

12.3.5.12 Factors to Consider when Assessing Wind Turbine Operational Noise Effects

The applicable Guidelines (DoEHLG 2006), along with additional best practice guidance discussed in Section 12.3.5, provide a framework for identifying appropriate noise limits at nearby NSLs. The turbines to be installed will be selected and designed to operate within these limits during the operational phase of the Proposed Project. Where predicted turbine noise levels remain within best practice thresholds, the effect can be considered not significant.

Noise levels at low wind speeds are expected to increase at certain Noise Sensitive Locations (NSLs) with the operation of the Proposed Project. However, although there will be new sources to the existing soundscape, the noise levels will remain below the criteria indicated in the applicable guidelines.

12.3.6 Operational Phase Noise – Fixed Plant Items

The Proposed Project will include the extension of the existing Slieveacallan 110kV substation located within the Slieveacallan Wind Farm.

There is no published statutory Irish guidance relating to the maximum permissible noise level from fixed mechanical and electrical plant that would be associated with the proposed Substation and associated equipment (fixed mechanical and electrical plant). In the absence of specific noise limits,

appropriate criteria relating to fixed mechanical and electrical plant, reference is made to best practice guidance contained in the following published guidelines and standards.

12.3.6.1 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.

12.3.6.2 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."

The guidance discussed above provides a framework in line with national guidelines for identifying appropriate noise limits at nearby NSLs.

Ambient noise levels during night time periods may increase at certain Noise Sensitive Locations (NSLs) with the operation of the Proposed Grid Connection Site. However, the resulting noise will be at a relatively low level due to the distance to the nearest NSL. It is acknowledged that the introduction of the Proposed Project will contribute new sound sources to the existing soundscape.

The proposed criteria have been derived in line with the EPA NG4 guidelines and the BS4142 standard and is set out in Section 12.5.3.

12.3.7 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 Proposed Wind Farm Site to the nearest NSL is in excess of 529 m (distance from turbine T02 to NSL ref. H033). At that distance, the level of vibration will be significantly below any thresholds for perceptibility. Therefore, there are no likely significant effects in terms of vibration from the Proposed Project and vibration criteria are not specified for the operational phase.

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published on the IOA website[4] stated the following in relation to Vibration:

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

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

[4] Microsoft Word - IOA Statement Final 18.12.24

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 noise surveys at various NSLs surrounding the Site;
- Undertake predictive calculations to assess the potential effects associated with the construction, decommissioning and operational phase of the Proposed Project;
- Specify mitigation measures to reduce, where necessary, the identified potential effects relating to noise and vibration from the Proposed Project; and,
- Describe the significance of the residual noise and vibration effects associated with the Proposed Project.

12.4.1 Study Area

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

12.4.1.1 Construction and Decommissioning Study Area

During the construction and decommissioning phases, noise could occur at any location where activities occur as part of the Proposed Wind Farm Site, TDR, Proposed Grid Connection Site (GCS) and along public roads where there are increases in traffic associated with the Proposed Project.

NSLs in proximity to specific construction activities and those situated along haul routes have the most potential to experience noise and vibration from the Proposed Project. Taking account of the works associated with the construction and decommissioning phases, the study area is based on the nearest NSLs to the working areas, these distances are confirmed in the relevant sections and representative of the closest identified NSL, or at defined set back distances from the proposed activities.

12.4.1.2 Operational Phase Study Area

As described in Section 12.3.5.5 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. A review of cumulative wind farm list included in Chapter 2 has been undertaken to determine which turbines meet the threshold for inclusion in the operational study area.

Applying the '10 dB rule' described in Section 12.3.5.5, the proposed Illaunbaun 6-turbine Wind Farm, the operational Slieveacallan 29-turbine Wind Farm have been included in the operational phase assessment.

Refer to Appendix 12.7 – Noise Study Area which displays the relevant noise contours map which identify this area.

The study area for the assessment of operational noise from the proposed fixed plant is a 200 m buffer from the proposed 33kV underground cabling and the proposed extension to the existing 110kV Slievecallan substation. Above this distance, the noise level would be below the threshold that could result in a significant effect. For the substation, the nearest NSL is outside of this buffer, therefore, the noise levels have been assessed at this NSL at a distance of approximately 285 m.

12.4.2 Background Noise Survey

A noise survey was undertaken to determine typical background noise levels at representative NSL's surrounding the development site. The background noise survey was conducted through installing unattended sound level meters at 5 no. representative locations in the surrounding area.

All measurement data collected during the background noise surveys has been carried out in accordance with the Institute to Acoustic's *Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (IoA GPG, 2013) and accompanying, Supplementary Guidance Note 1: Data Collection (2014) discussed in the following Section.

12.4.2.1 Choice of Measurement Locations

The noise monitoring locations were identified by preparing a preliminary cumulative turbine noise model contour at an early stage of the assessment. Any locations that fell inside the predicted 35 dB L_{A90} noise contour were considered for noise monitoring in accordance with the threshold level defined in the IoA GPG. The selection of the noise monitoring locations was informed by site visits and supplemented by reviewing aerial images of the study area and other online sources of information (e.g. Google Earth, Bing Maps, etc.).

The locations selected for the noise monitoring are outlined in the following sections. Coordinates for the noise monitoring locations are detailed in Table 12-6 and illustrated in Figure 12-2.

Table 12-6 Measurement Location Coordinates

Location	NSL ID Ref	Coordinates – Irish Transverse Mercator (ITM)	
		ITM X	ITM Y
A	H001	512,956	681,663
B	H045	512,949	679,147
C	H058	510,989	678,700
D	H061 Proxy	510,742	679,543
E	H006 Proxy	510,817	680,735
Anemometer	n/a	512,924	679,206

The noise monitoring locations were selected to obtain background noise levels representative of the noise environments at noise sensitive locations surrounding the Proposed Wind Farm Site in line with best practice guidance contained in the IOA GPG.

The background noise environments away from any significant sources were typically noted to comprise distant traffic movements, activity in and around the residences and wind generated noise from nearby foliage and other typical anthropogenic sources typically found in such rural settings. Additional descriptions of the noise environments from observations made on site during installation, interim visits and collection are presented below for each monitoring location where relevant.

Site visits by survey personnel were carried out during the morning and afternoon time; during these visits, primary noise sources contributing to noise build-up were noted. In respect of night-time periods, when noise due to traffic on local roads, agricultural activities and other sources tend to reduce, there

was no indication of any significant local night-time sources of noise at any location. Similarly, there was no perceptible source of vibration at any of the noise survey locations. At some locations, noise from the operation of the Slievecallan Wind Turbines was audible to varying degrees depending on the conditions (wind speed and direction) and distance. It is important to note that any noise from the existing wind turbine in the area should not form part of the background noise environment at noise sensitive locations. Steps have been taken to remove any turbine noise from Slievecallan Wind Farm in the analysis of the background noise data, as required by Section 5.2.3 of the IoA GPG. These methods are discussed in detail in Section 12.4.2.5.

Figure 12-2 Noise Monitoring Selection

Plate 12-1 to Plate 12-10 illustrate the installed noise monitoring equipment at each location. Yellow ellipses are added to the photographs to highlight the position of the noise monitoring equipment.

12.4.2.1.1 Location A

The noise meter at Location A was positioned in an open field beside location H001. This location was judged to be representative of the typical background noise at NSL location in the surrounding area, occasional local road traffic noise was noted and turbine noise from Slievecallan Wind Farm was observed to be audible in the background.

Plate 12-1 Location A – Picture 1

Plate 12-2 Location A – Picture 2

12.4.2.1.2 Location B

The noise meter at Location B was positioned in the rear garden of location H045 (derelict dwelling) on the northern side of the property. The main sources of noise at this location were noted to be the Slievecallan Wind Farm turbines located to the South and occasional local traffic. A rain gauge used during the background noise survey was installed at this location.

Plate 12-3 Location B – Picture 1

Plate 12-4 Location B – Picture 2

12.4.2.1.3 Location C

The noise meter at Location C was positioned in an open field adjacent to the dwelling at H058. There was a clear line of site to the existing turbines at Slievecallan Wind Farm, the nearest turbine at Slievecallan is approximately 1.7km to the south east. The turbines were noted to be audible during visits to site.

Plate 12-5 Location C – Picture 1

Plate 12-6 Location C – Picture 2

12.4.2.1.4 Location D

Location D was positioned in a field opposite the dwelling at location H061 the location was noted to be quiet with little road traffic audible; this location is off a quiet road which runs through a narrow valley (glen), which provides screening from distant noise sources. The nearest turbine at Slievecallan Wind Farm is located over 2.5km to the southeast and the turbines were not visible or audible at the measurement location.

Plate 12-7 *Location D – Picture 1*

Plate 12-8 *Location D – Picture 2*

12.4.2.1.5 Location E

Location E was positioned in a field to the rear (south) of H006. The location was noted to be quiet with little distant road traffic audible. The nearest turbine at Slievecallan Wind Farm is located over 3.3km to the southeast and the turbines were not visible or audible at the measurement location. A rain gauge used during the background noise survey was installed at this location.

Plate 12-9 *Location E – Picture 1*

Plate 12-10 Location E – Picture 2

12.4.2.2 Measurement Period

A background noise survey was undertaken to establish typical background noise levels at representative NSLs surrounding the Proposed Wind Farm Site. The background noise survey was conducted through installing unattended sound level meters at 5 no. representative locations in the surrounding area. This noise survey was carried out by AWN in April 2020 in support of a previous application and remains valid as an evaluation of the receiving environment and for determining noise criteria as required by IOA GPG. The period of noise measurements used in the background noise monitoring assessment is outlined in Table 12-7.

It is noted that the baseline noise survey was carried out during a period of restrictions of movement due to the COVID-19 pandemic, and that traffic movements and hence noise levels may have been lower than usual. As the noise criteria are based on the background noise levels, the effect of baseline noise level being lower than normal leads to the noise assessment being slightly conservative. Wind-generated noise in foliage surrounding the measurement equipment and noise-sensitive locations was representative of conditions at the survey locations.

Table 12-7 Measurement Period

Location	Start Date	End Date
All	14 May 2020	12 June 2020

The survey was completed when an adequate number of datasets had been measured as recommended in the IOA GPG to determine a suitable representation of the typical background noise.

12.4.2.3 Personnel and Instrumentation

AWN Consulting installed and removed the noise monitors at all locations. Battery checks and meter calibrations were carried out during the survey periods. The following instrumentation was used at each location.

Table 12-8 Instrumentation Details

Location	Equipment	Serial Number	Maximum Calibration Drift Noted between Checks
A	RION – NL-52	998411	0.0 dB
B	RION – NL-52	998412	0.0 dB
C	RION – NL-52	998410	0.0 dB

D	RION – NL-52	586940	0.2 dB
E	RION – NL-52	998413	0.0 dB

Before and after the survey the measurement apparatus was check calibrated using a Bruell & Kjaer type 4231 Sound Level Calibrator where appropriate. Instruments were calibrated on each interim visit and any drift noted. All calibration drifts were less than ±0.2 dB and within acceptable tolerances outlined in the IOA GPG. Relevant calibration certificates are presented in Appendix 11-2.

Rain fall was monitored and logged using two Texas Instruments TR-525 console data loggers that were installed at Location B & E for the duration of the survey. The logged rainfall data allows for the identification and removal of sample periods affected by rainfall from the data sets during analysis in line with best practice when calculating the prevailing background noise levels.

Wind data was measured using a LIDAR system and the data was supplied to AWN for the analysis. The LIDAR method is one of the preferred methods for measuring wind speed and direction outlined in the IOA GPG. Appendix 12-3 presents a copy of the installation report for the LiDAR system.

12.4.2.4 Procedure

Measurements were conducted at five locations over the survey periods outlined in Table 12-7. Data samples for all measurements (noise, rainfall and wind) were logged continuously over 10-minute intervals for the duration of the survey.

Survey personnel noted potential primary noise sources contributing to noise build-up during the installation and removal of the sound level meters from site. Description of the observed noise environment at each of the monitoring locations is presented below. $L_{Aeq,10min}$ and $L_{A90,10min}$ parameters were measured in this instance.

12.4.2.5 Analysis of Background Noise Data

The data sets have been filtered to remove issues such as the dawn chorus and the influence of other atypical noise sources. An example of atypical sources would be short isolated periods of raised noise levels attributable to local sources, agricultural activity, boiler flues, operation of gardening equipment etc. In addition, sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have also been screened from the data sets. The assessment methods outlined above are in line with the guidance contained in the IoA *GPG*.

Consideration has been given to removing contributing noise from the existing wind turbines from the measured noise data. For guidance, reference has been made to Section 5.2.3 of the IOA GPG which states the following:

> *"5.2.3 In the presence of an existing wind farm, suitable background noise levels can be derived by one of the following methods:*
>
> *switching off the existing wind farm during the background noise level survey (with associated cost implications);*
>
> *accounting for the contribution of the existing wind farm in the measurement data e.g. directional filtering (only including background data when it is not influenced by the existing turbines e.g. upwind of the receptor, but mindful of other extraneous noise sources e.g. motorways) or subtracting a prediction of noise from the existing wind farm from the measured noise levels;*

utilising an agreed proxy location removed from the area acoustically affected by the existing wind farm/s; or utilising background noise level data as presented within the Environmental Statement/s for the original wind farm/s (the suitability of the background noise level data should be established).”

Two methods were adopted in the assessment, directional filtering and subtracting the predicted existing turbine noise levels from the measured data sets. Details of the method applied at each location are discussed in Section 12.5.1 along with the results of the assessment.

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

- Daytime Amenity hours are:
- all evenings from 18:00 to 23:00hrs;
- Saturday afternoons from 13:00 to 18:00hrs, and;
- all day Sunday from 07:00 to 18:00hrs.
- Night-time hours are 23:00 to 07:00hrs.

The background noise levels are derived for each location with reference to the standardised 10m height wind speed relative to the assessment hub height of 100m.

12.4.2.6 Consideration of Wind Shear

Wind shear is defined as the increase of wind speed with height above ground. Site specific wind shear is captured in the background noise assessment through simultaneously measurement of noise and deriving wind speeds adjusted to hub height in accordance with guidance 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.

Wind speed measurements were measured at 100m which is the hub height adopted for the noise assessment. The wind speeds were then corrected to standardised 10 metre height wind speed.

The IoA GPG presents the following equations in relation to the derivation of a standardised wind speed at 10m above ground level:

Roughness Length Shear Profile:

$$U_1 = U_2 \times [(\ln(H_1 \div z))/ (\ln(H_2 \div z))]$$

Where:

H_1	The height of the wind speed to be calculated (10m)
H_2	The height of the measured or calculated HH wind speed.
U_1	The wind speed to be calculated.
U_2	The measured or calculated HH wind speed.
z	The roughness length.

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

Any reference to wind speed in this chapter should be understood to be the standardised 10m height wind speed reference 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.

In the absence of specific details on the plant items and construction methods to be employed, a set of assumptions must be made to predict and assess the likely noise emissions from these activities. The standard best practice approach is to predict typical noise levels at the NSLs using the guidance set out in BS5228-1.

The methodology adopted for the assessment of construction noise involves analysing 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 from BS5228-1 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 Proposed Project on the receiving environment. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

12.4.4.1 Noise Prediction Software

The selected software, DGMR 'iNoise Enterprise (Version 2024.3)' calculates noise levels in accordance with ISO 9613: *'Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation'* (ISO, 1996).

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 Proposed Turbine Details

The candidate turbine used in the noise assessment is a Vestas V150-6MW at 100 m hub height, and 175 m Tip 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 Vestas V150 wind turbine have been used for the purposes of this assessment, the exact make and model of the turbine installed on the site will be dictated by a competitive procurement process but will adhere to the specifications and parameters set out above.

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

- The Hub Height (HH);
- Rotor Diameter (RD); and
- The sound power noise emissions at various wind speeds.

Table 12-9 Sound Power Level Spectra for Vestas V150 with a hub height of 100 m

Wind Speed (m/s)	Octave Band Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	73.6	81.3	86.1	87.9	86.7	82.5	75.3	65.1	92.7
4	76.7	84.6	89.4	91.3	90.1	86.0	78.8	68.6	96.1
5	81.1	88.9	93.7	95.6	94.5	90.3	83.2	73.0	100.4
6	84.4	92.3	97.2	99.1	98.0	93.9	86.8	76.6	103.9
7	85.1	93.1	98.0	100.0	98.9	94.8	87.7	77.5	104.8
8	85.5	93.3	98.2	100.1	99.0	94.8	87.7	77.6	104.9
9	86.3	93.7	98.2	100.0	98.9	94.8	88.0	78.2	104.9

Table 4-1 in Chapter 4: Description of the Proposed Project details the co-ordinates and elevations of the 9 no. Proposed Turbines.

The manufacturer's turbine sound power levels outlined in Table 12-9 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 12-9.

As explained in Section 12.3.5, the criteria are couched in terms of a L_{A90} criterion. Best practice guidance in the IOA GPG states that "*L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB".* A 2 dB reduction has therefore been applied in the noise model calculation. All predicted noise levels in this chapter are presented in terms of L_{A90} parameter, i.e., this reduction of 2 dB is applied in the noise prediction modelling.

Best practice states that should any audible tonal component be present at an NSL from the operation of wind turbines, a penalty shall be added to the measured noise levels. The level of this penalty is described in ETSU-R-97 and relates to the extent by which tonal components exceed the threshold of audibility.

Current good practice recommends that tonal issues at wind farms are best addressed through appropriate planning conditions. A tonal penalty has not been included in the predicted noise levels for this assessment. A warranty will be provided by the manufacturer of the selected turbine to ensure that the noise output, including tonality, is controlled.

12.4.4.3 Cumulative Turbine Details

Cumulative turbine details regarding wind turbine make, sound power and hub height have been obtained through EIAR chapters available to the public.

Table 12-10 below details the noise emission values used for noise modelling of the Slievecallan Wind Farm turbines. The installed turbine model at this site is the Nordex N90/2500[5] with hub height of 80m. The noise emission data has been taken information from AWN's database using data for this turbine type.

Table 12-10 L_{wa} Spectra Used for Prediction Model – Slievecallan Turbine Noise Emissions for Hub Height at 80m

Wind Speed (m/s)	Octave Bank 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	85.0	81.0	73.4	93.5
4	82.7	86.8	91.2	91.6	90.1	89.0	85.0	77.4	97.5
5	86.2	90.3	94.7	95.1	93.6	92.5	88.5	80.9	101.0
6	89.2	93.3	97.7	98.1	96.6	95.5	91.5	83.9	104.0
7	90.2	94.3	98.7	99.1	97.6	96.5	92.5	84.9	105.0
≥8	90.7	94.8	99.2	99.6	98.1	97.0	93.0	85.4	105.5

An uncertainty factor of +1.5 dB has been included for the Nordex N90/2500 turbines in the calculations in line with the manufacturer's data.

Table 12-11below details the noise emission values used for noise modelling of the Illaunbaun Wind Farm turbines. The installed turbine model at this site is the Vestas V117 with hub height of 91.5 m. The noise emission data has been taken from the EIAR chapter[6].

Table 12-11 L_{wa} Spectra Used for Prediction Model – Illaunbaun Turbine Noise Emissions for Hub Height at 91.5m

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
4	76.5	83.7	88.5	90.7	90.6	87.9	82.8	75.1	96.2
5	80.8	88	92.8	95	94.9	92.2	87.1	79.4	100.5
6	84.1	91.3	96.1	98.3	98.2	95.5	90.4	82.7	103.8

[5] *Nordex technical report Ref: F008_144_A04_EN Revision 00 2013-10-07.*
[6] *Illaunbaun Wind Farm - Environmental Impact Assessment Report*

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
7	86	93.2	98	100.2	100.1	97.4	92.3	84.6	105.7
≥8	86.3	93.5	98.3	100.5	100.4	97.7	92.6	84.9	106

An uncertainty factor of +2dB has been applied to the calculation to the noise emissions from Vestas V117.

12.4.4.4 Modelling Calculation Parameters

Prediction calculations for turbine noise have been conducted in accordance with ISO 9613: '*Acoustics – Attenuation of sound propagation outdoors, Part 2: General method of calculation*' (1996).

Appendix 12-3 provides details of noise prediction calculation settings, as well as the turbine and receptor locations.

12.4.4.5 Effects of Propagation from Wind Directions

As discussed in Section 12.3.5.4, when considering noise impacts of wind turbines, the effects of propagation in different wind directions can be considered. The day-to-day operations of the optimised development will not result in a worst-case condition of all noise locations being downwind of all turbines at the same time i.e. omni-directional predictions. Therefore, to address this issue, a review of expected noise levels downwind of the turbines has been prepared for various wind directions in accordance with the IOA GPG.

For any given wind direction, a property can be assigned one of the following classifications in relation to turbine noise propagation:

- Downwind (i.e. 0° ±80°): no reduction in noise levels;
- Crosswind (i.e. 90° ±10° and 270° ±10°): reduction of 2 dB, and;
- Upwind (i.e. 180° ±80°): typically, up to 10 dB reduction depending on distance from turbine

Table 12-12 presents the directivity attenuation factor that has been applied to turbines when considering noise propagation in downwind conditions (full downwind is represented by 0° and full upwind is 180°).

Table 12-12 Turbine Directivity Attenuation with Consideration of Wind Direction

Wind Direction Sector	Degrees (°)	Attenuation (dB)
Downwind	280 – 360 & 0 - 80	0
Crosswind	260 – 280 & 80 - 100	2
Upwind	230 - 250	5
	220	5.5
	210	6

	200	6.5
	190	7
	180	7.5

12.5 Receiving Environment

This stage of the assessment was to determine typical background noise levels in the vicinity of the noise sensitive locations (NSL's) in proximity to the Proposed Wind Farm Site. The methodology for the assessment is outlined in Section 12.4.2 and the results of the assessment are outlined in the following sections.

A variety of wind speed and weather conditions were encountered over the survey period outlined in Section 12.4.2.2. Figure 12-3 illustrates the distributions of wind speed and wind direction standardised to 10 metre height, over the baseline noise survey period detailed in Table 12-7.

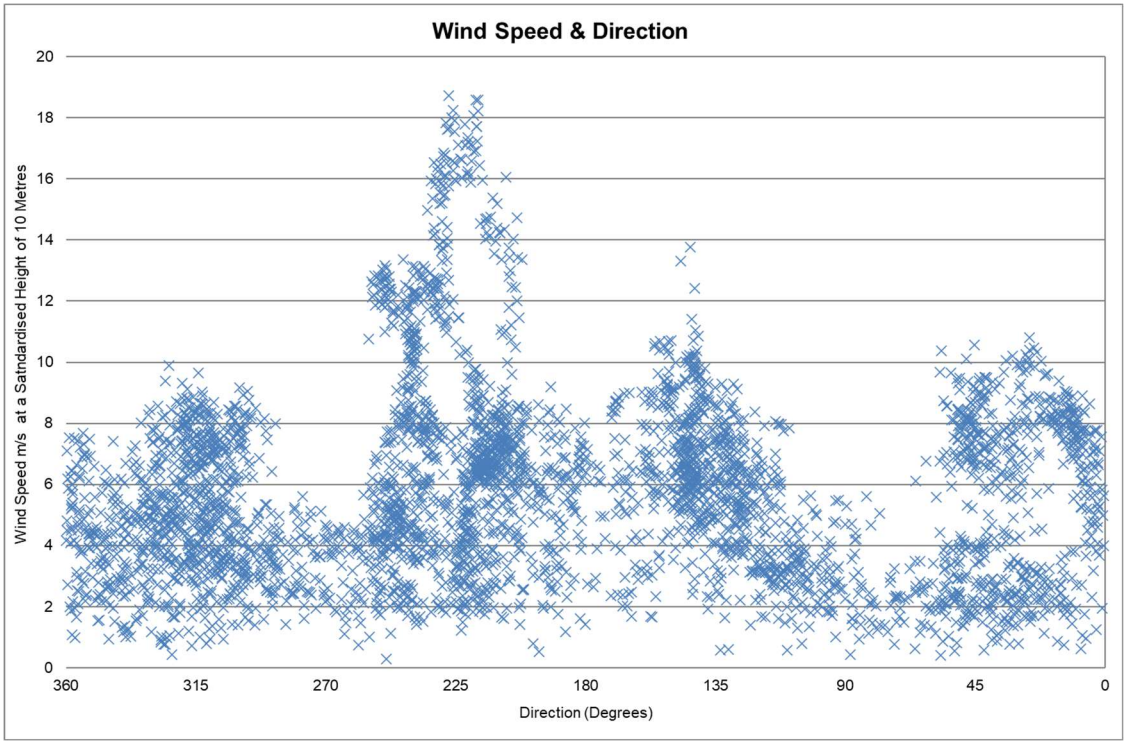

Figure 12-3 Distributions of Wind Speeds and Directions Over the Survey Period

12.5.1 Background Noise Levels

The following sections present an overview and results of the noise monitoring data obtained from the background noise survey in accordance with the methodology set out in Section 12.4.2.5. For each location two graphs are presented: one shows the screened noise datasets used to derive the daytime background noise levels and the other shows the night time datasets.

12.5.1.1 Location A

Location A lies to the north of the Proposed Turbines and is over 3km north from the nearest operational turbines at Slievecallan Wind Farm. Figure 12-4 and Figure 12-5 present the measured background noise levels at Location A. The data has been filtered to include only wind directions between 90 and 270 degrees (east through south, to west), which represents downwind conditions from the Proposed Turbines. These wind directions are also representative of downwind conditions from the operational Slievecallan Wind Farm turbines. Therefore, the measured noise levels at Location A, potentially include a slight contribution from the Slievecallan Wind Farm turbines.

For daytime periods, the predicted turbine noise levels at H001 from the Slievecallan Wind Farm turbines have been subtracted from the measured noise levels to derive the background noise levels in accordance with the guidance discussed in Section 12.4.2.5. This is considered the most conservative approach for the background noise assessment at this location as the predicted levels from Slievecallan Wind Farm are worst-case. The resulting background noise levels are presented in Table 12-13 in Section 12.5.1.6.

For night time periods the measured downwind levels (wind directions between 90 and 270) and the predicted downwind levels due to Slievecallan Wind Farm were effectively equal, in these situations it is not possible to logarithmically subtract the predicted contribution from the Slievecallan Wind Farm turbines from the measured levels. Therefore for night time periods the measured noise levels in upwind conditions i.e. between 270 and 90 degrees (west through north, to east), have been used to determine the night time background noise levels at H001. It was observed in the data that the background levels derived for night time in upwind conditions were approximately 1 dB quieter than the levels derived for downwind conditions. The contribution from the Slievecallan Wind Farm turbines in upwind conditions at location H010 is not significant and it is not required to subtract the predicted contribution from the measured upwind levels when using directional filtering in this instance.

12.5.1.1.1 Daytime Quiet Periods

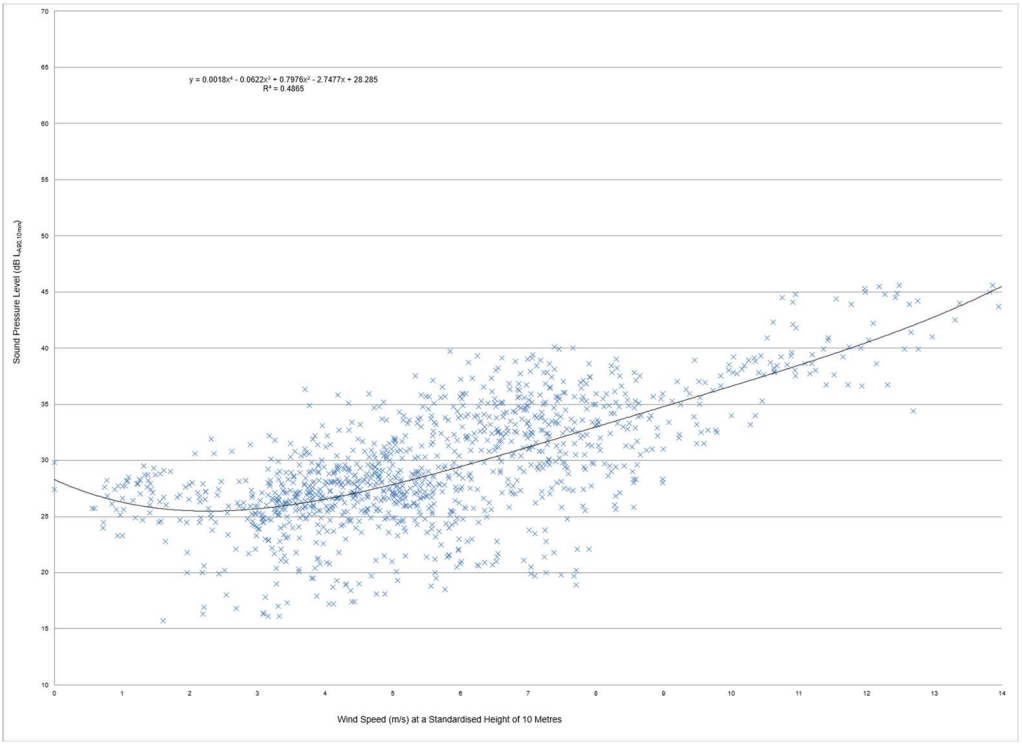

Figure 12-4 Location A - Background Noise Levels dB $L_{A90,\ 10\ min}$ – Daytime wind directions between 90 and 270 Degrees

12.5.1.1.2 Night-time Quiet Periods

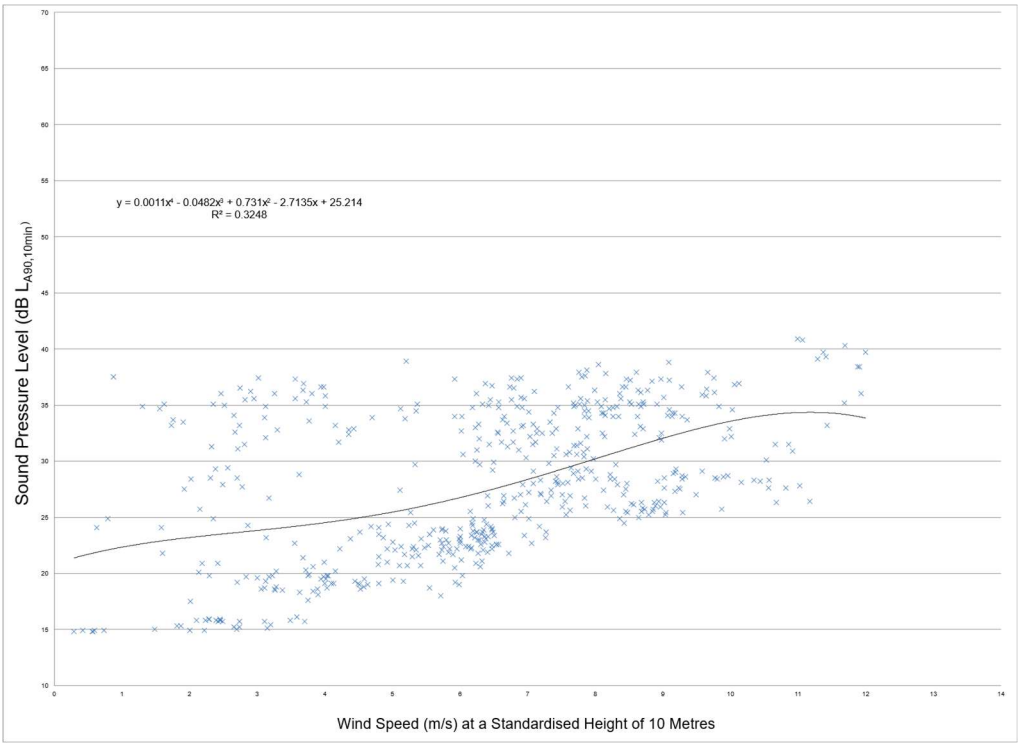

Figure 12-5 Location A - Background Noise Levels dB $L_{A90,\ 10\ min}$ –Nigh-time wind directions between 270 and 90 Degrees

12.5.1.2 Location B

Location B lies to the south of the Proposed Turbines and to the north of the Slievecallan Wind Farm wind turbines therefore, it is located between the two sites. The Slievecallan Wind Farm turbines are closer to Location B than the turbines of the Proposed Project. Figure 12-6 and Figure 12-7 present the measured background noise levels at Location B. For daytime and night time periods, the data has been filtered to include only wind directions between 315 and 45 degrees, which represents downwind conditions from the Proposed Turbines. These wind directions are representative of upwind conditions from the operational Slievecallan Wind Farm turbines. Due to the proximity of Location B to the Slievecallan Wind Farm turbines, the measured upwind noise levels potentially include a contribution from the Slievecallan Wind Farm turbines. The predicted turbine noise levels at H045 from the Slievecallan Wind Farm turbines have been subtracted from the measured noise levels to derive the background noise levels in accordance with the guidance discussed in Section 12.4.2.5. The resulting background noise levels are presented in Table 12-13 in Section 12.5.1.6.

12.5.1.2.1 *Daytime Quiet Periods*

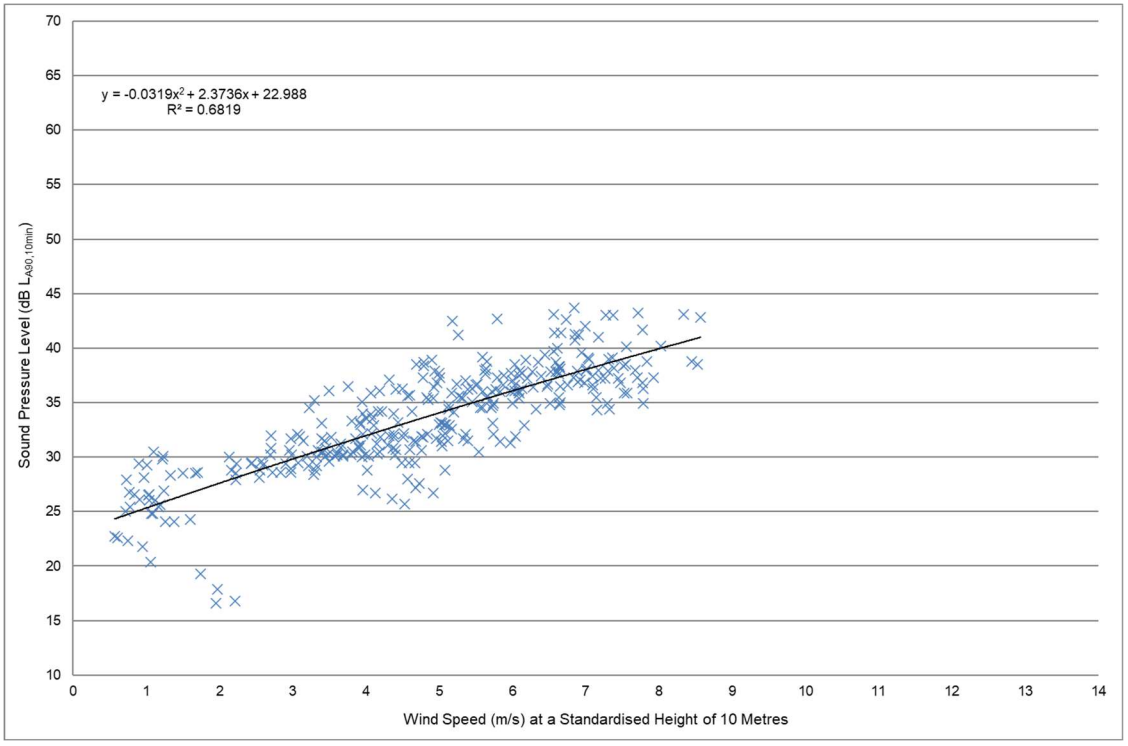

Figure 12-6 Location B - Background Noise Levels dB $L_{A90,\ 10\ min}$– Daytime wind directions between 315 and 45 Degrees

12.5.1.2.2 *Night-time Quiet Periods*

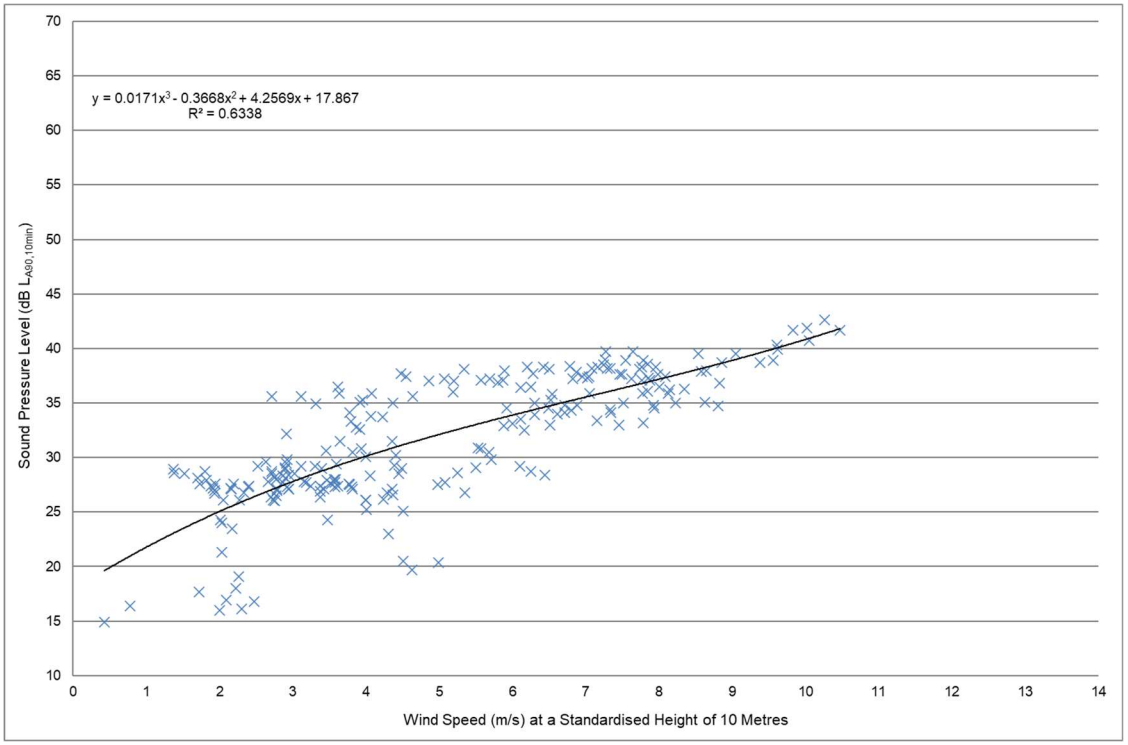

Figure 12-7 Location B - Background Noise Levels dB $L_{A90,\ 10\ min}$ –Night-time wind directions between 315 and 45 Degrees

12.5.1.3 Location C

Location C lies to the southwest of the Proposed Turbines and to the northwest of the Slievecallan Wind Farm wind turbines. The nearest Slievecallan Wind Farm turbine is approximately 1.6km distance from Location C. Figure 12-8 and Figure 12-9 present the measured background noise levels at Location C. For daytime and night time periods, the data has been filtered to include only wind directions between 225 and 45 degrees, which represents downwind conditions from the Proposed Project. These wind directions are representative of upwind conditions from the operational Slievecallan Wind Farm turbines. Due to the proximity of Location C to the Slievecallan Wind Farm turbines the measured upwind noise levels potentially include a contribution from the Slievecallan Wind Farm turbines. The predicted turbine noise levels at H058 from the Slievecallan Wind Farm turbines have been subtracted from the measured noise levels to derive the background noise levels in accordance with the guidance discussed in Section 12.4.2.5. The resulting background noise levels are presented in Table 12-13.

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12.5.1.3.1 Daytime Quiet Periods

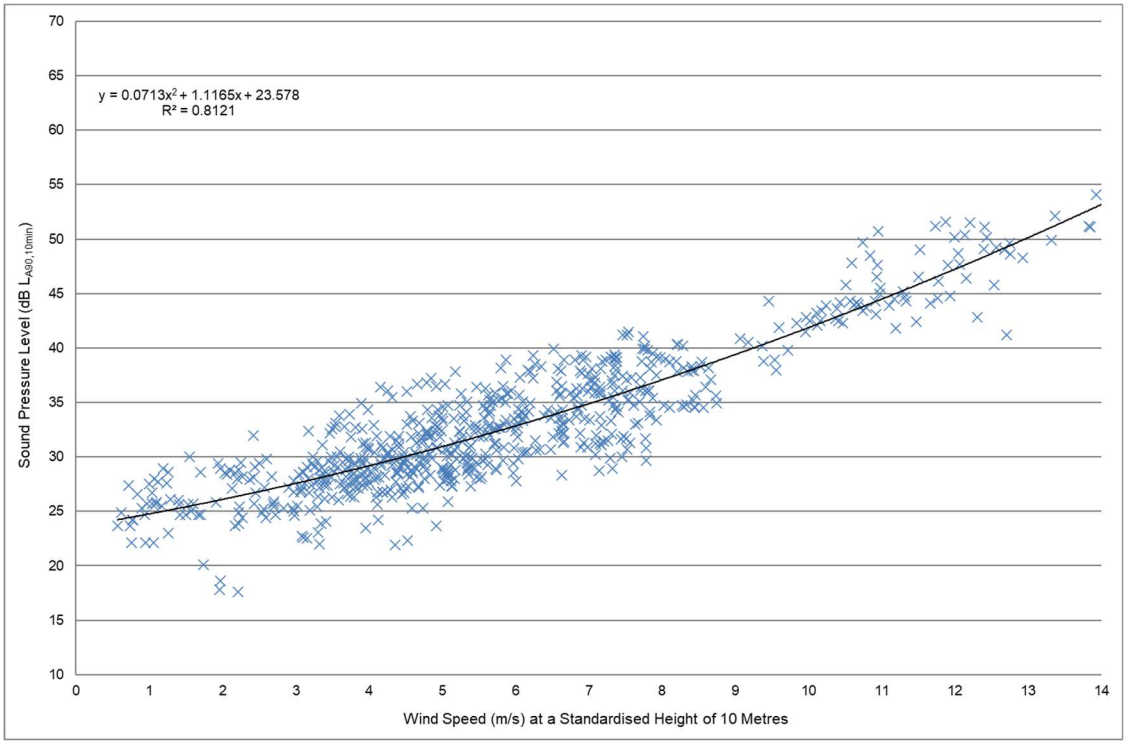

Figure 12-8 Location C - Background Noise Levels dB $L_{A90,\ 10\ min}$–Daytime wind directions between 225 and 45 Degrees

12.5.1.3.2 Night-time Quiet Periods

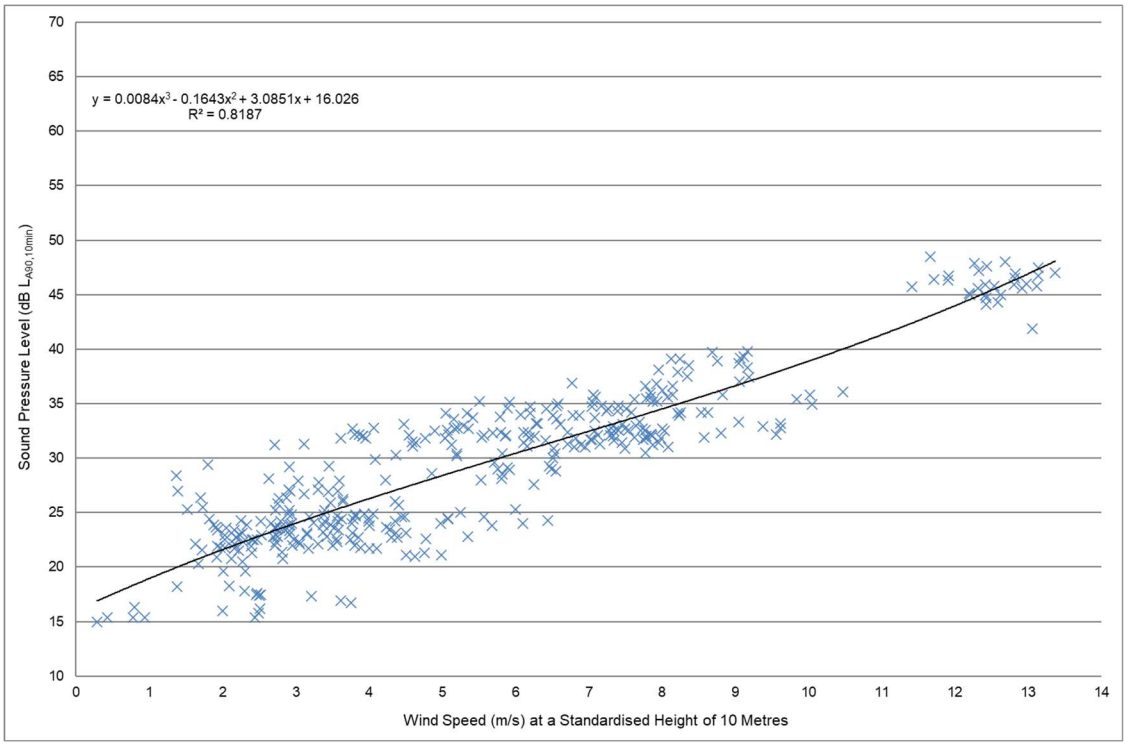

Figure 12-9 Location C - Background Noise Levels dB $L_{A90,\ 10\ min}$– Night-time wind directions between 225 and 45 Degrees

12.5.1.4 Location D

Location D lies to the west of the Proposed Turbines and to the northwest of the Slievecallan Wind Farm wind turbines. The nearest Slievecallan Wind Farm turbine is approximately 2.5km distance from Location D. Figure 12-10 and Figure 12-11 present the measured background noise levels at Location D. For daytime and night-time periods, the data has been filtered to include only wind directions between 0 and 180 degrees, which represents downwind conditions from the Proposed Project. These wind directions are also representative of downwind conditions from the operational Slievecallan Wind Farm turbines. Therefore, the measured noise levels at Location D potentially include a slight contribution from the Slievecallan Wind Farm turbines. The predicted levels from Slievecallan Wind Farm at the measurement location are considered worst-case due to the prediction methodology used in the assessment i.e. favourable conditions for noise propagation and the allowance for uncertainty in the prediction calculations. The predicted turbine noise levels at H061 from the Slievecallan Wind Farm turbines have been subtracted from the measured noise levels to derive the background noise levels in accordance with the guidance discussed in Section 12.4.2.5. The resulting background noise levels are presented in Table 12-13.

12.5.1.4.1 *Daytime Quiet Periods*

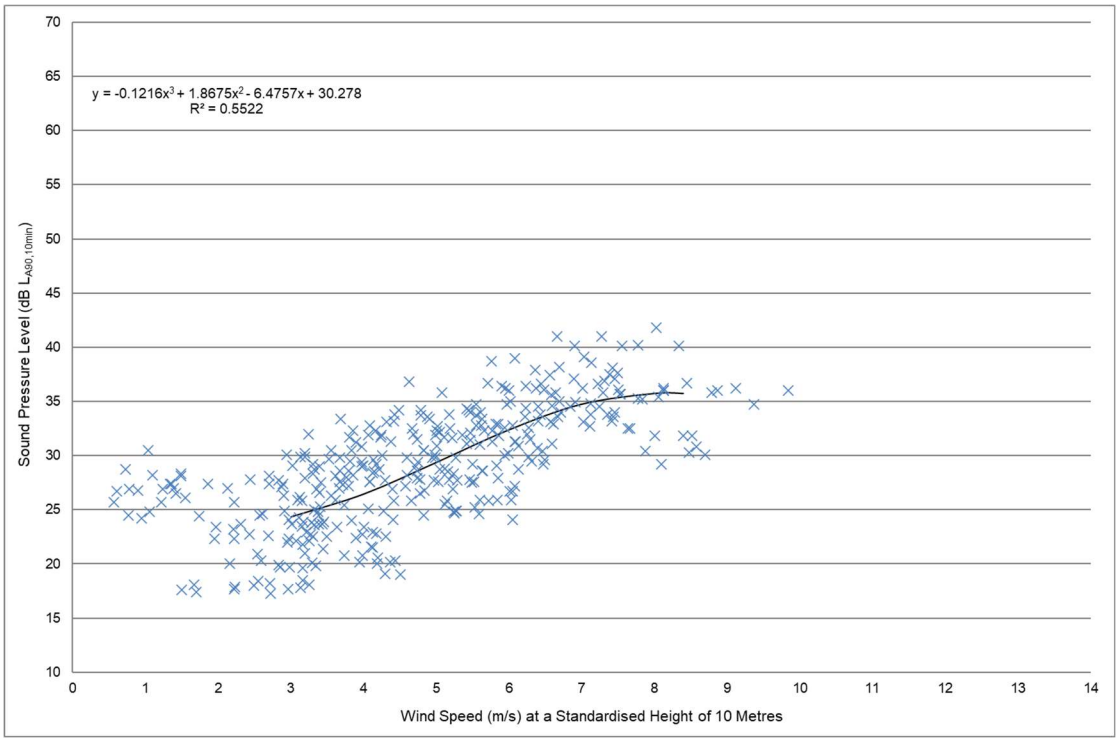

Figure 12-10 Location D - Background Noise Levels dB $L_{A90,\ 10\ min}$– Daytime wind directions between 0 and 180 Degrees

12.5.1.4.2 Night-time Quiet Periods

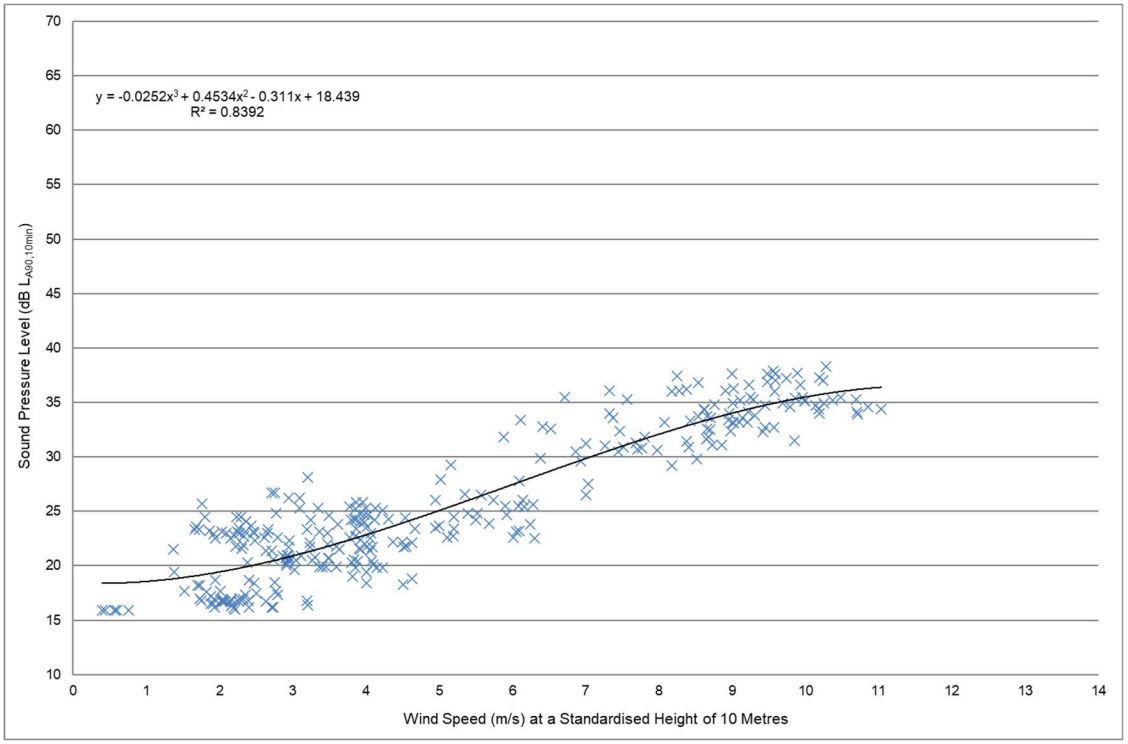

Figure 12-11 Location D - Background Noise Levels dB $L_{A90,\ 10\ min}$– Night-time wind directions between 0 and 180 Degrees

12.5.1.5 Location E

Location E lies to the northwest of the Proposed Turbines, considering the distances to the Slievecallan Wind Farm turbines and the surrounding topography the contribution from the Slievecallan Wind Farm turbines is not considered to be significant at Location E. Figure 12-12 and Figure 12-13 present the measured background noise levels at Location E. For daytime and night-time periods, the data has been filtered to include only wind directions between 60 and 200 degrees, which represents downwind conditions from the Proposed Project. These wind directions are also representative of downwind conditions from the operational Slievecallan Wind Farm turbines. Therefore, the measured noise levels at Location E, potentially include a slight contribution from the Slievecallan Wind Farm turbines. The predicted levels from Slievecallan Wind Farm at the measurement location are considered worst case due to the prediction methodology used in the assessment i.e. favourable conditions for noise propagation and the allowance for uncertainty in the prediction calculations. The predicted turbine noise levels at H006 from the Slievecallan Wind Farm turbines have been subtracted from the measured noise levels to derive the background noise levels in accordance with the guidance discussed in Section 12.4.2.5. The resulting background noise levels are presented in Table 12-13.

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12.5.1.5.1 Daytime Quiet Periods

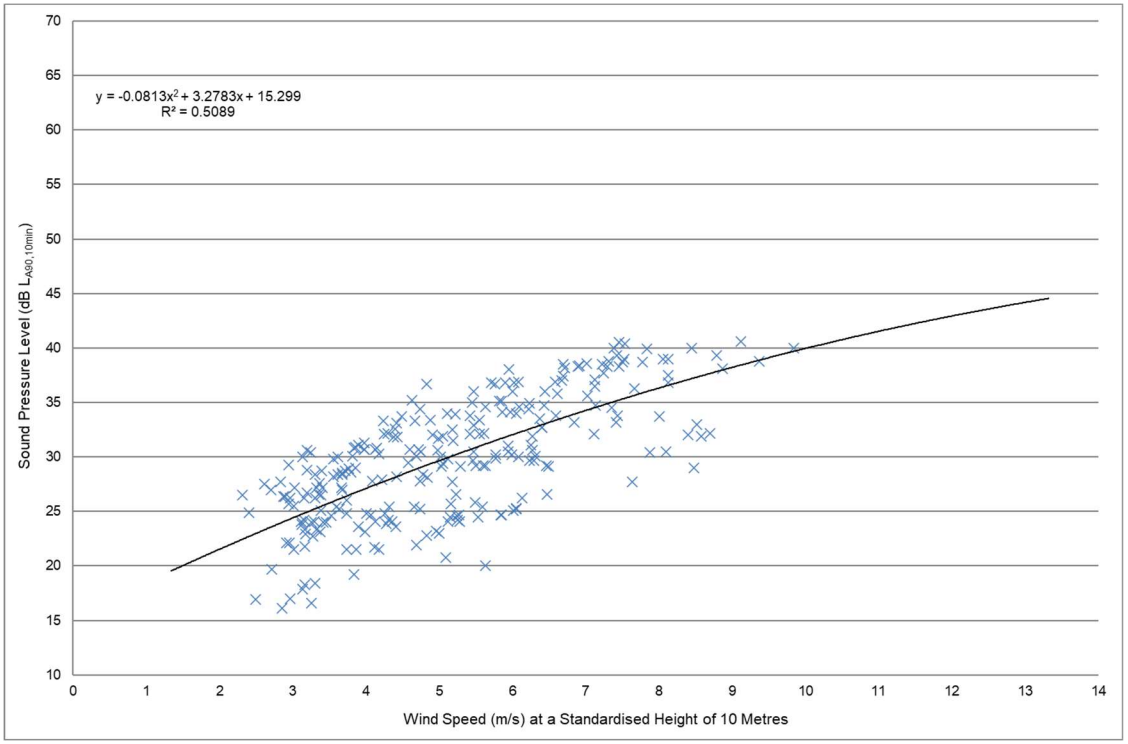


Figure 12-12 Location E - Background Noise Levels dB $L_{A90,\ 10\ min}$– Daytime wind directions between 60 and 200 Degrees

12.5.1.5.2 Night-time Quiet Periods

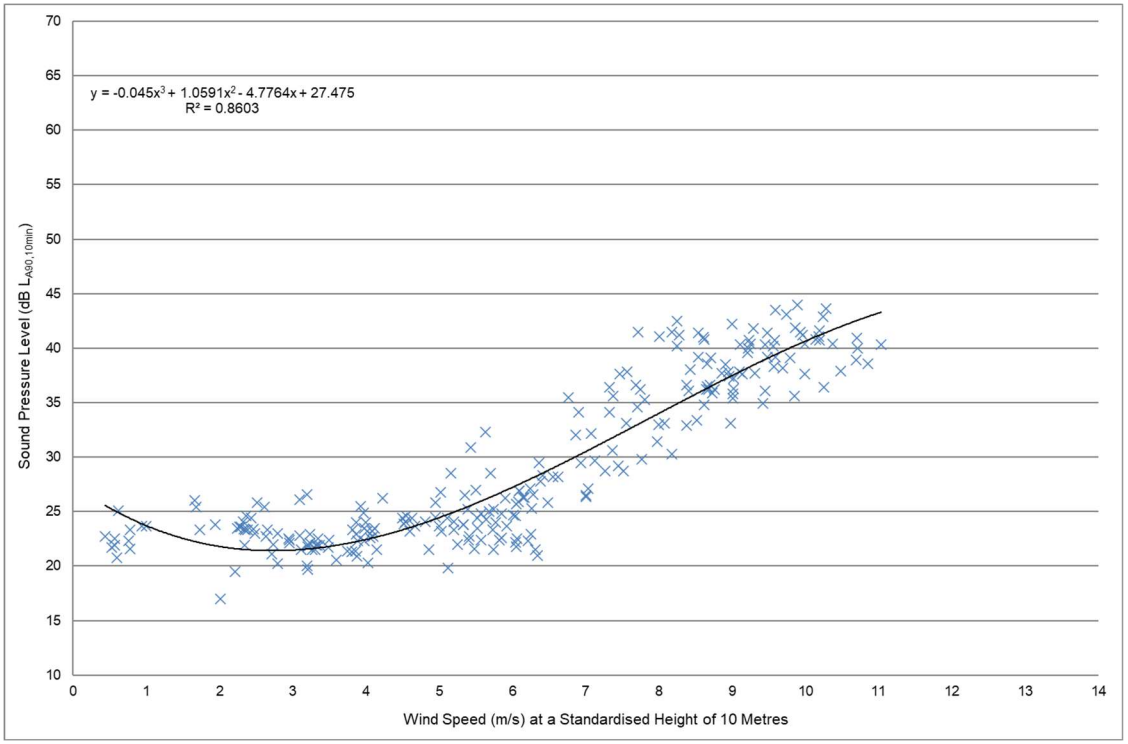


Figure 12-13 Location E - Background Noise Levels dB $L_{A90,\ 10\ min}$– Night -time wind directions between 60 and 200 Degrees

12.5.1.6 Summary of Background Noise Levels

Table 12-13 presents the derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and night-time periods with directional filtering applied and logarithmic subtraction applied as described in the previous sections. These levels have been derived using regression analysis carried out on the data sets in line with guidance contained the IoA GPG and the *Supplementary Guidance Note (SGN) No. 2 Data Processing & Derivation of ETSU-R-97 Background Curves.*

Table 12-13 Derived Background Noise Levels

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standardised 10m Height Wind Speed (m/s)						
		3	4	5	6	7	8	9
A	Day	25.0	25.1	25.0	24.7	27.6	30.5	32.5
	Night	21.4	20.8	19.2	11.9	21.5	26.6	29.2
B	Day	28.0	28.6	27.9	23.0	32.2	36.9	39.1
	Night	28.7	30.5	32.0	33.2	35.9	38.3	39.7
C	Day	27.3	28.7	30.2	31.8	34.1	36.6	39.1
	Night	23.4	25.2	26.7	28.0	30.6	33.2	35.8
D	Day	24.0	25.8	28.6	31.5	34.0	34.8	(34.8)
	Night	19.6	20.6	21.6	23.1	27.4	30.7	33.3
E	Day	24.1	26.8	29.3	31.6	33.9	35.9	37.7
	Night	21.0	21.3	22.7	25.4	29.7	33.8	37.7

Note: Values shown in parentheses correspond to wind speeds for which the number of valid data points was insufficient. In these cases, the background level from the preceding wind speed interval has been applied.

12.5.2 Wind Turbine Noise Criteria

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

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

- The EPA NG4 Guidance proposes a daytime noise criterion of 45 dB(A) in 'areas of low background noise'. Turbine noise limits are stated in terms of the 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 the Guidelines (DoEHLG 2006). 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.

- A lower threshold of 40 dB is commonly adopted in planning conditions for similar developments that have been granted planning permission by ACP in recent years for example, Derrinlough Wind Farm (ACP Ref: 306706-20), Coole Wind Farm (ACP Ref: PL25M.300686) Cloncreen (ACP Ref: PA0047), Meenbog (ACP Ref: PL05E.300460), Borrisbeg (ACP ref: 318704-23), Castlebanny Wind Farm (Planning Ref: 309306-21), Ballivor (ACP-316212-23), Carrig Renewables Wind Farm (ACP Ref: 318689-23) (and which we understand is subject to a judicial review at the time of writing of this chapter), and Cushaling Wind Farm (ABP Ref: PL.19.306924).

Best practice for setting wind turbine noise limits at NSLs is that the limits should relate to the cumulative turbine noise level from all turbines. Therefore, the proposed noise limits shall be cumulative, accounting for all operational wind turbines. When setting appropriate turbine noise limits in accordance with the criteria from the Guidelines (DoEHLG 2006) 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 developments 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 proposed project is the dominant wind turbine source or has a significant contribution to the cumulative turbine noise level at a given NSL. The operational noise limits proposed for the proposed project 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, the frequency of monitoring and procedures for recording results. The approved NCMP shall be fully implemented throughout the operational phase of the wind farm.

In line with ETSU-R-97 guidance (see Section 12.3.5.1), a fixed lower threshold of 45 dB L_{A90} or a maximum increase of 5 dB above background noise (whichever is the higher) is proposed for NSLs identified as being involved in the project.

With respect to the methodology in relevant guidance documents outlined in Section 12.3.5 the noise criteria curves in Table 12-14 have been derived for the NSL's surrounding the Proposed Project. These limit values are determined through applying the criteria to the derived background noise levels in Table 12-13.

Table 12-14 Noise Criteria Curves

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed10m Height Wind Speed (m/s)						
		3	4	5	6	7	8	9
A	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0
B	Day	40.0	45.0	45.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0
C	Day	40.0	40.0	45.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0
D	Day	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0
E	Day	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0

12.5.2.1 Assigning Turbine Noise Limits

The derived background noise levels have been assigned to other NSL's which are deemed to be representative of the measurement locations. Where background noise measurements have been conducted in the vicinity and/or are judged to be typical/indicative of the background noise levels of the area at the measurement location, the background noise levels can be used for deriving turbine noise thresholds at other locations.

Table 12-15 shows where representative background noise levels have been assigned to each of the relevant NSL's for the purpose of setting noise limits for the assessment of turbine noise. They level have been assigned based on professional judgement in line with best practice guidance of representative background noise levels measured as part of the survey. Derelict receptors are not included in the table below.

Table 12-15 Assignment of Representative Background Noise Levels

Representative Background Noise Levels	Noise Sensitive Location (NSL)
A	H009, H015, H016, H017, H018, H019, H020, H024, H025, H029, H066, H067, H068, H070, H071, H073, H075, H076, H077, H078, H120, H125, H126, H127, H128, H129, H130, H135, H138, H139, H164, H165, H166, H167, H168, H169, H170, H171, H172, H173, H174, H175, H176, H179, H184, H185, H193, H194, and H215

B	H036, H037, H038, H039, H040, H041, H079, H131, H132, H133, H134, H151, H153, H154, H157, H158, H159, H200, and H216
C	H032, H054, H055, H056, H057, H058, H059, H060, H080, H085, H086, H088, H089, H090, H091, H092, H093, H096, H097, H098, H099, H148, H149, H150, H196, H204, and H210*
D	H061, H065, H094, H095, H100, H101, H102, H103, H104, H106, H107, H108, H109, H110, H111, H112, H113, H114, H123, H124, H152, H155, H156, H201, H202, H203, H205, and H214
E	H002, H003, H004, H006, H008, H011, H012, H013, H014, H026, H069, H115, H116, H117, H118, H119, H140, H141, H142, H143, H144, H145, H146, H160, H161, H162, H163, H177, H178, H180, H181, H182, H183, H186, H187, H188, H189, H190, H191, H192, H198, and H213
Landowner	H001, H010, H021, H022, H023, H031, H033, H042, H043, H044, H047, H048, H049, H050, H051, H052, H053, H062, H063, H064, H074, H081, H082, H083, H084, H121, H122, and H211

**H210 is considered a Slieveacallan Wind Farm landowner and the lower threshold has been set at 45 dBA. See Section 12.3.5.6.*

12.5.3 Noise Limits for Fixed Plant

Based on a review of the measured noise from the background noise survey described in Section 12.5.1.6, in scenarios where the wind speeds are very low, the NSLs in the vicinity of the site can be defined as areas of low background noise. As the proposed substation extension 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 L_{Aeq} for fixed plant. During the detailed design, acoustic features such as tonality, impulsivity and intermittency, will be considered in the context of the character assessment framework contained in BS 4142. Where these acoustic features are present, the Rating Level should be controlled to avoid adverse impacts at NSLs in accordance with BS 4142. Where background noise levels are elevated at specific NSLs, i.e. greater than 30 dB L_{A90}, a higher absolute threshold, of up to 5 dB above the background level, may be acceptable.

With respect to the guidance from the BS4142 standard, as discussed in Section 12.3.5.12, 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 Proposed Project does not proceed, the opportunity to capture the available renewable energy resource 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 be lost. Furthermore, the opportunity to implement the measures outlined in the Biodiversity Management and Enhancement Plan (BMEP) as outlined in Appendix 6-4 would also be lost.

The existing noise environment is expected to remain unchanged. 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.

12.6.2 Construction Phase

Construction noise prediction calculations have been conducted using the assessment methodology outlined and discussed in Sections 12.3.3 to Section 12.3.4. The source noise levels referred to in this section are indicative of the type of plant items and activities associated with the construction of the Proposed Project.

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

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

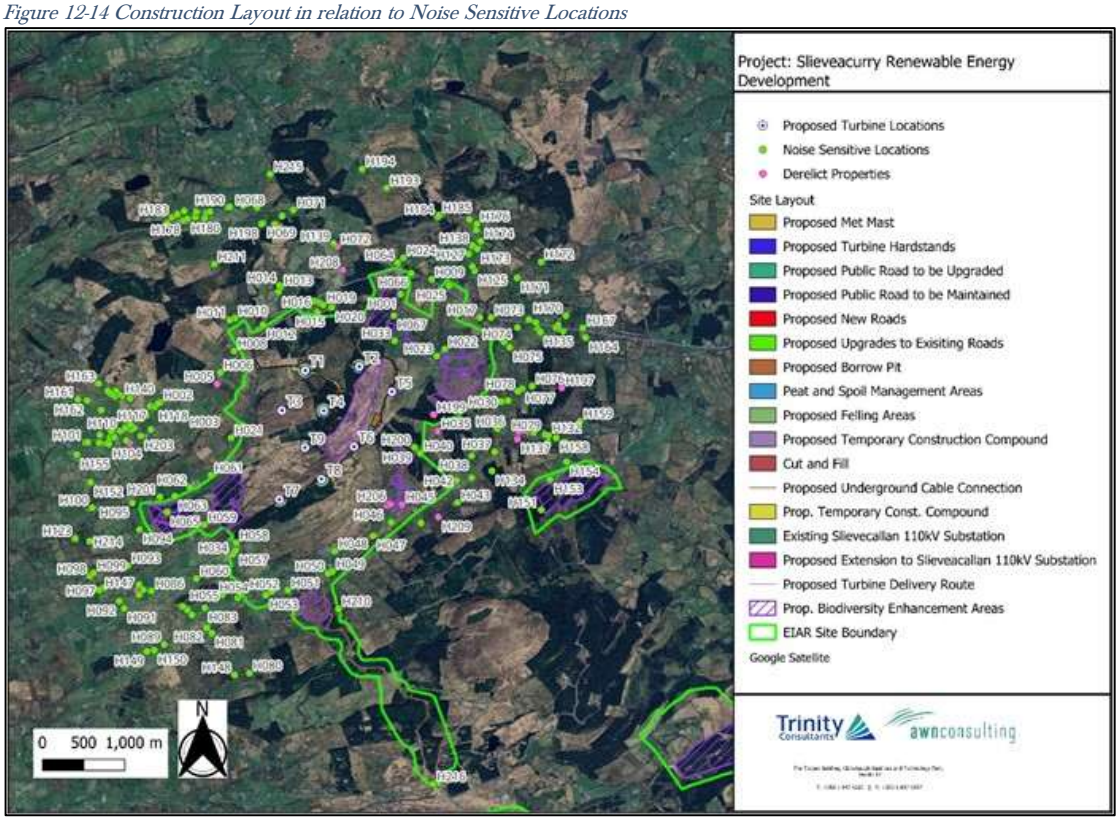
- Construction of new entrance(s) and hardcore existing entrance, construction of internal site roads;
- Excavation and operation of borrow pits;
- Construction of turbines and hardstand areas;
- Construction of substation extension;
- Underground cabling.
- Construction of Meteorological Mast
- Construction of temporary construction compounds.
- Tree felling, vegetation removal and
- Biodiversity Management measures.

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

In general, the distances between the construction activities associated with the Proposed Project and the nearest NSLs are such that there will be no significant noise, and vibration impacts at the NSLs.

Figure 12-14 shows the construction layout in relation to the NSLs. The following sections present an assessment of the main stages of the construction phase that have the potential for associated noise and vibration effects, all other stages and elements are considered unlikely to have any significant noise and vibration effects namely, onsite clear-span bridges, parking, security fencing, onsite cabling and site drainage works.

Figure 12-14 Construction Layout in relation to Noise Sensitive Locations



Construction activities will be carried out during normal daytime working hours (i.e., weekdays 07:00hrs – 19:00hrs and Saturdays 08:00hrs – 13:00hrs). However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (e.g., concrete pours) or to accommodate delivery of large turbine components along public routes it could be necessary on occasion to work outside of these hours. Any such out of hours working will be notified in advance with the Local Authority.

12.6.2.1 General Construction of Turbines, Hardstand Areas and Met Mast

12.6.2.1.1 *Noise*

Foundation and hardstanding construction is required at all Proposed Turbines. 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 H033 at approximately 529 m from turbine T2, and 472 m from the proposed hardstand areas. The distance from the Met Mast is approximately 508 m from the nearest NSL (H200).

Table 12-16 outlines the typical construction noise levels associated with the proposed works for this element of the construction. Calculations have assumed an on-time of 66% for each item of plant i.e., that the item is operational for 8 hours over a 12-hour assessment period.

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

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[7]	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (472 m)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials within the site	79	33
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for turbine foundations	75	29
Excavator Mounted Rock Breaker (C9.12)	Rock Breaking	85	39
General Construction (Various)	All general activities plus deliveries of materials and plant to the site	84	38
Concrete Mixer Truck and Concrete Pump (C.4.27)	Foundations	79	33
Steel cutting (C.4.93)	Grinding steel	80	34
Dumper Truck (C.4.4)	Removing peat and spoil and transporting fill and other materials.	76	30
Mobile Telescopic Crane (C.4.39)	Installation of nacelles	77	31
JCB (D.8.13)	Road surfacing.	82	36
Vibrating Rollers (D.8.29)	For services, drainage and landscaping.	77	31
Cumulative Construction Noise Level			45

At 472 m from the works the predicted noise levels from construction activities are in the range of 29 to 39 dB $L_{Aeq,T}$ with a total conservative cumulative construction level of the order of 45 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

Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods). This assessment is considered representative of worst-case construction noise levels at NSLs.

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

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

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.

Accounting for the distance from proposed works to the nearest NSLs, vibration effects are not likely 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's 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:

Table 12-17 Description of effects for the construction of turbines and hardstanding areas

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. There are no likely significant effects from this element of the proposed construction phase.

12.6.2.2 Construction of Internal Roads and Tracks

It is proposed to construct new internal roads and amenity track, as well as upgrade existing internal roads for internal access within the site and for the purposes of amenity, to access the various parts of the site from public roads. Review of the road and amenity track layout has identified that the nearest NSL to any point of the Proposed Project is the upgrade to existing road to the north of the proposed project and approximately 181 m to receptor H008. All other locations are at greater distances with the majority at significantly greater distances. The full description of the roads is outlined in Chapter 4 Description of the Proposed Project.

Table 12-18 Indicative Noise Levels from Construction Plant at 181 m from Site Roads

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[8]	Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) at 181 m
Tracked Excavator (C.4.64)	75	40
HGV Movement (C.2.30)	79	44
Vibrating Rollers (D.8.29)	76	41
Dumper Truck (C.4.4)	77	42
Cumulative Total	–	48

The table shows that at 181 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's criteria for description of effects, the likely potential effects, under a conservative scenario, at the nearest NSL associated with construction of internal roads are described below.

Table 12-19 Description of effects for the construction of internal roads and tracks

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. There are no likely significant effects from this element of the proposed construction phase.

12.6.2.3 Borrow Pit Excavation and Reinstatement

12.6.2.3.1 *Noise*

To inform this aspect of the proposal, a noise assessment has been undertaken to consider the impacts of rock breaking and land clearing. In this instance, and as a worst case, the scenario will include rock

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

breaking due to higher noise levels of source plant that will be in operation for this activity. The rock breaking activity assessment has been based on the following assumptions:

In terms of these activities please note the following:

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

Table 12-20 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 12-20 Typical Borrow Pit Plant Noise Levels

Item	dB L_w Levels per Octave Band (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Crusher	95	98	98	106	103	100	95	86	110
Rock Breaker	93	101	104	114	115	116	113	106	121
HGV Movement	77	88	95	93	93	92	86	76	98
Dump Truck	87	92	99	97	102	99	94	85	105
Semi-mobile screen/stockpiler	69	82	96	99	103	101	99	88	107
Tracked Excavator	77	88	95	93	93	92	86	76	99

The nearest NSL is H200 which is approximately 530 m from the proposed borrow pit.

A noise model prediction model has been prepared to consider the expected noise emissions from the proposed construction works at the borrow pits as outlined above. A percentage on-time of 66% has been used for the noise calculations. The predicted levels at the ten NSLs with the highest predicted noise levels assuming all borrow pits operate simultaneously are presented in Table 12-21.

Table 12-21 Typical Plant Noise Levels Borrow Pits

Borrow Pit 1			
Loc.	Predicted Construction Noise Level $L_{Aeq,1hr}$ Scenario		Diff. dB(A)
	A (Blasting)	B (Rock breaking)	
H040	37	44	-7
H200	35	43	-8
H039	35	43	-8
H042	32	39	-7
H038	32	39	-7

H033	31	37	-6
H031	31	37	-6
H041	31	37	-6
H043	30	37	-7
H044	30	37	-7

Review of the data contained in

Table 12-21 confirms the following:

- Predicted construction noise levels for both Scenario A and B at the borrow pit are well within the best practice construction noise criteria outlined in Table 12-1. It is assumed that construction works at the borrow pits will only occur during daytime periods only (07:00 to 19:00hrs).
- The blasting proposal results in lower levels of construction noise since the use of the rock breaking plant is not required in this instance. Predicted noise levels are lower at all assessed locations for Scenario A.
- It is accepted that the individual blast events will be audible at some locations. Blast events will be designed and controlled such that the best practice noise and vibration limit values outlined in section 12.3.3 of this chapter are not exceeded.

12.6.2.3.2 *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 the borrow pit and therefore no specific mitigation measures are required.

12.6.2.3.3 *Description of Effects*

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

Table 12-22 Description of effects for the construction of borrow pits

Quality	Significance	Duration
Negative	Not Significant	Short Term

There are no likely significant effects from this element of the proposed construction phase.

12.6.2.4 Enhancement Lands - Tree felling and woodland replanting

Areas of tree felling and woodland replanting are also proposed as part of the Proposed Enhancement Site. The nearest NSL to any of the proposed areas is H067 at a distance of approximately 15m. However, it is considered that this activity is linear in nature and therefore the applicable criteria is defined in Section 12.3.3.2. The construction machinery to be used in these areas presented in Table 12-23.

Table 12-23 Typical Construction Noise Emission Levels – Tree Felling Management Areas

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [9]	Predicted Noise Level at 15 m	Predicted Noise Level at 30 m	Predicted Noise Level at 50 m
Handheld Electrical Saw (D.7. 76)	81	75	65	60
Harvester (C.10.18)	83	77	67	62
Tracked Excavator (C.4.64)	75	69	59	54
Total Construction Noise		**80**	**70**	**65**

NSLs located closer than 30 m to the works may experience construction noise levels slightly above 70 dB $L_{Aeq,1hr.}$ However, due to the progressive nature of the construction methodology, it is anticipated that works will remain in close proximity to the nearest NSLs only for a limited duration. The predicted noise levels shown in Table 12-23 are expected to occur for less than one day in a worst-case scenario.

Where NSLs are located 30 m or more from the proposed activity, it is predicted that the proposed works will remain within the linear construction noise limit of 70 dB $L_{Aeq,1hr}$ as set out in Section 12.3.3.2.

Based on the guidance in Section 12.3.3.3, the likely noise impacts are considered not significant, and no specific mitigation measures are required.

No vibration is expected due to the equipment used and distance from nearest receivers.

12.6.2.4.1 Description of Effects

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

Table 12-24 Description of effects for the construction of Tree felling management areas

Quality	Significance	Duration
Negative	Not Significant	Short Term

There are no likely significant effects from this element of the proposed construction phase.

12.6.2.5 Peat and Spoil Management Areas

Areas of peat and spoil management are also proposed as part of the Proposed Project The nearest NSL to any of the proposed peat and spoil management areas is H033 at a distance of approximately 516m from the nearest peat and spoil management area. The construction machinery to be used in

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

these areas is similar to the ones used for the construction of roads and amenity tracks as in Section 12.6.2.2. Therefore, the predicted noise levels from the construction of peat and spoil management areas will be in the order of 36 dB $L_{Aeq,T}$ at the nearest NSL. This level of noise is well below the significance threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

No vibration is expected due to the equipment used and distance from nearest receivers.

12.6.2.5.1 Description of Effects

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

Table 12-25 Description of effects for the construction of peat and spoil management areas

Quality	Significance	Duration
Negative	Not Significant	Short Term

There are no likely significant effects from the proposed peat and spoil management areas.

12.6.2.6 Construction Traffic

This section has been prepared to review potential noise impacts associated with construction traffic on the local road network. The information presented in Table 15-16 to Table 15-25 in Chapter 15 (Material Assets) has been used to inform the assessment presented in this chapter.

Table 12-26 presents the change in noise level during the different construction phases at the junctions assessed.

Table 12-26 Change of noise level at different junctions during the phases of the construction

Link	Change in Traffic Noise Level (dB) during different phases of construction				
	General construction and grid construction	Concrete foundation deliveries	Turbine Construction (Large components)	Turbine Construction (Small components)	General Construction
1 N85 south of Claureen R'bout	0.2	1.0	0.1	0.0	0.1
2 N85 west of Claureen R'bout	0.2	0.7	0.1	0.0	0.1
3 N85 south of Inagh	0.5	1.9	0.2	0.1	0.2
4 R460 west of Inagh	1.0	3.3	0.3	0.2	0.4
5 L1074	7.3	13.0	2.9	2.4	4.3
Estimate no. days	71	9	24	9	270

Table 12-26 shows that for the large majority of the junction assessed, the change in noise level is below 3 dB which is considered as No Change to Minor, as described in Table 12-3 (DMRB, 2020), therefore the effect is considered Not Significant.

However, at link location 4, during the concrete foundation deliveries, and at link 5, the change of noise level indicates a Moderate to Major impact and therefore the effect is considered Significant.

As outlined in Section 12.3.3.4, 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 Section 12.3.3.

Table 12-27 shows the predicted traffic noise levels for the different phases at a reference distance of 20 m from the road for the links where Moderate to Major impact were found. It is shown that all links and phases noise levels are below the threshold of 65 dB $L_{Aeq,T}$, therefore the significance of effect is considered not significant and no specific mitigation measures are required.

Table 12-27 Predicted Traffic Noise Levels during different phases of construction

Link	Predicted Noise Level during different phases of construction				
	General construction and grid construction	Concrete foundation deliveries	Turbine Construction (Large components)	Turbine Construction (Small components)	General Construction
4 R460 west of Inagh	58	61	54	57	58
5 L1074	52	58	46	47	49

12.6.2.6.1 *Description of Effects*

The likely predicted effects are below the limits and/or thresholds identified for a significant effect to occur. With respect to the EPA's criteria for description of effects, the potential associated effects at the nearest NSLs associated with additional traffic generated during the construction phase are described below.

Table 12-28 Description of effects for the construction of construction traffic

Quality	Significance	Duration
Negative	Not Significant	Short-Term

12.6.2.7 Construction of the Proposed Extension to the Existing 110kV Slievecallan Substation

12.6.2.7.1 *Noise*

As indicated previously and described in Chapter 4 Project Description, the Proposed Project includes an extension to the existing 110kV Slieveacallan substation which is within Slieveacallan Wind Farm. Thus, the nearest receptor is H216 approximately 285 m from the proposed extension to the existing 110kV Slievecallan substation. As a reference, and as a worst-case example assuming the same construction activities as outlined in

Table 12-16, the predicted noise levels from construction activities associated with the proposed extension to the existing 110kV Slievecallan substation have been indicated in Table 12-29.

Based on the same typical construction activities as outlined in Table 12-16 it is predicted that the likely worst-case potential noise level due to construction activities associated with the proposed extension to the existing 110kV Slievecallan substation will be in the order of 51 dB $L_{Aeq,T}$ at a distance of 250m which is well below the significance threshold of 65 dB $L_{Aeq,T}$. outlined in Section 12.3.3 and there are no NSL's located within this distance range from the proposed extension to the existing 110kV Slievecallan substation.

Table 12-29 Proposed extension to the existing 110kV Slievecallan substation Construction Noise Levels

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[10]	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (250 m)	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (500 m)	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (750 m)
HGV Movement (C.2.30)	79	40	33	28
Tracked Excavator (C.4.64)	75	36	29	24
Excavator Mounted Rock Breaker (C9.12)	85	46	39	34
General Construction (Various)	84	45	38	33
Concrete Mixer Truck and Concrete Pump (C.4.27)	79	40	33	28
Dumper Truck (C.4.4)	76	37	30	25
Mobile Telescopic Crane (C.4.39)	77	38	31	26
JCB (D.8.13)	82	43	36	31
Vibrating Rollers (D.8.29)	77	38	31	26
Cumulative Construction Noise Level		51	44	39

Table 12-29 shows that for the proposed extension to the existing 110kV Slievecallan substation, the predicted noise levels at the nearest NSL H216 will be between 51 and 44 dB $L_{Aeq,T}$. This level of noise is well below the significance threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

It is concluded that there will be no significant noise impacts associated with the construction of the proposed extension to the existing 110kV Slievecallan substation and therefore no specific mitigation measures will be required.

12.6.2.7.2 Vibration

Due to the distance of the proposed works from sensitive locations vibration effects are not likely at any NSL. 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 the proposed extension to the existing 110kV Slievecallan substation and therefore no specific mitigation measures are required.

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

12.6.2.7.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of the proposed extension to the existing 110kV Slievecallan substation are described below.

Table 12-30 Description of effects for the construction of the proposed extension to the existing 110kV Slievecallan substation

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 effect. There are no likely significant effects from this element of the proposed construction phase.

12.6.2.8 Proposed Grid Connection Site 33kV underground cabling

The Proposed Grid Connection Site comprises 7.1 km of underground electrical cables linking the Wind Farm Site cabling to the proposed extension to the existing 110kV Slievecallan substation. Further detail is provided in Section 4.4.4 of Chapter 4.

12.6.2.8.1 Noise

The associated construction works will occur for short durations (rolling construction method, approximately 100 – 150 m per day) at varying distances from NSLs. As the Proposed Grid Connection Site underground electrical cable route is approximately 7.1km in length, it will take an estimated 71 days to construct the full length of the route. Review of the Proposed Grid Connection Site has identified that the nearest NSLs to the proposed 33kV underground cabling, are at distances of the order of 10 to 30m.

Table 12-31 presents outline noise calculations, considering the typical anticipated methods of construction, at varying distances from the construction works. The calculations assume that there is no acoustic screening (i.e. barriers) in place between the site works and the NSL and that plant items are operating at nominal on-times noted. Calculations have assumed an on-time of 66% for each item of plant i.e., that the item is operational for 8 hours over a 12-hour assessment period. Note the plant items and activities are indicative and based on assumption to be representative of a reasonable conservative assessment.

The nearest NSL to the proposed 33kV underground cabling is H049 and is located at approximately 10 m.

Table 12-31 Indicative Noise Levels for Typical Construction Plant at nearest distance from the Proposed Grid Connection Site Works

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L_{Aeq})	Calculated Construction Noise Levels dB $L_{Aeq,12hr}$ at given distance from works			
		10 m	15 m	25 m	50 m
Tracked Excavator (C.2.7)	70	68	64	58	51
Vibrating Rollers (C.2.40)	73	71	67	61	54
Wheeled Loader (C.2.8)	68	66	62	56	49

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L_{Aeq})	Calculated Construction Noise Levels dB $L_{Aeq,12hr}$ at given distance from works			
		10 m	15 m	25 m	50 m
Dumper Truck (C.4.4)	76	74	70	64	57
Cumulative Predicted Construction Noise Level (No Rock Breaking)		77	73	67	60
Excavator Mounted Rock Breaker (C9.12)[a]	85	78	74	70	64
Cumulative Predicted Construction Noise Level (with Rock Breaking)[b]		78	74	70	64

A - Assumed 20% on time for rock breaking
B - Only one tracked excavator considered in cumulative calculations. Rock breaking and Vibration rolling will occur simultaneously.

For standard grid connection works, any NSL set back at 20 m or more from the proposed works is predicted to experience noise levels within the linear construction noise limit of 70 dB $L_{Aeq,1hr}$ as set out in Section 12.3.3.2.

NSLs located closer than 20 m to the works may experience construction noise levels slightly above 70 dB $L_{Aeq,1hr}$. However, due to the progressive nature of the construction methodology, it is anticipated that works will remain in close proximity to the nearest NSLs only for a limited duration. The predicted noise levels shown in Table 12-31 are expected to occur for less than one day in a worst-case scenario, with works typically progressing at a rate of 100 to 150 metres per day along the route.

Based on the guidance in Section 12.3.3.3, the likely noise impacts are considered not significant, and no specific mitigation measures are required.

Where rock breaking is required along the route, any NSL set back 25 metres or more from the proposed works is predicted to remain within the linear construction noise limit of 70 dB $L_{Aeq,1hr}$ as set out in Section 12.3.3. Only 4 NSLs were found along the proposed 33kV underground cabling route within 25 m distance. The assessment is assuming that rock breaking activities will be required along the proposed 33kV underground cabling route at the point closest to these NSLs. This assumption is very conservative.

In line with the guidance in Section 12.3.3.4.1 the likely noise impacts are considered not significant, and no specific mitigation measures are required.

12.6.2.8.2 Vibration

Due to the distance of the proposed works from sensitive locations vibration effects are not likely at any NSL. 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 Proposed Grid Connection Site and therefore no specific mitigation measures are required.

12.6.2.8.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of the proposed 33kV underground cabling route are described below.

Table 12-32 Description of effects for the construction of the Proposed Grid Connection Site

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 effect. There are no likely significant effects from this element of the proposed construction phase.

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 Proposed Project. A conservative 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 conservative conditions favourable to noise propagation, i.e., downwind propagation from source to receiver and downward refraction under temperature inversions. On that basis the omnidirectional turbine noise predictions can be considered worst case.

The results of the noise prediction models have been compared against the assigned turbine noise limits that have been presented in Section 12.5.2.1, which have been derived in accordance with the criteria set out in Section 12.3.5.

At most of the NSLs the worst omni-directional cumulative turbine noise levels are below the noise criteria. However, 7 no. NSLs present potential exceedances for the worst-case omni-directional scenario. Therefore, it is necessary to consider wind direction for the noise prediction at these NSLs, the results of which demonstrate turbine noise levels below the noise criteria (see Table 12-32 below).

Table 12-33Table 12-33 presents the result of the turbine noise predictions and assessment review at the 15 no. locations with the highest levels of wind turbine noise predicted. Appendix 12-5 presents the predicted omni-directional turbine results at all NSLs in tabulated form.

Noise contours for the omni-directional rated power wind speed (i.e., highest noise emission) are presented in Appendix 12-4.

Table 12-33 Predicted Noise Levels at top 15 receivers

House	NML Representative Location for Criterion	Parameter	Standardised wind speed m/s						
			3	4	5	6	7	8	9
H006	E	Predicted	32.3	33.7	37.9	41.3	42.7	43	43
		Daytime Criterion	40	40	40	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	43	43	43	43	43	43	43

House	NML Representative Location for Criterion	Parameter	Standardised wind speed m/s						
			3	4	5	6	7	8	9
		Night-time Excess	–	–	–	–	–	–	–
H008	E	Predicted	32.4	33.8	38.0	41.4	42.8	43.1	43.1
		Daytime Criterion	40	40	40	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	43	43	43	43	43	43	43
		Night-time Excess	–	–	–	–	–	0.1	0.1
H011	E	Predicted	33.8	34.8	39.0	42.4	43.9	44.2	44.2
		Daytime Criterion	40	40	40	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	43	43	43	43	43	43	43
		Night-time Excess	–	–	–	–	0.9	1.2	1.2
H015	A	Predicted	29.6	32.5	36.7	40.2	41.2	41.4	41.4
		Daytime Criterion	40	40	40	40	45	45	45
		Daytime Excess	–	–	–	0.2	–	–	–
		Night-time Criterion	43	43	43	43	43	43	43
		Night-time Excess	–	–	–	–	–	–	–
H031	Landowner	Predicted	33.3	37.2	40.8	43.9	44.9	45.3	45.3
		Daytime Criterion	45	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	0.3	0.3
		Night-time Criterion	45	45	45	45	45	45	45

House	NML Representative Location for Criterion	Parameter	Standardised wind speed m/s						
			3	4	5	6	7	8	9
		Night-time Excess	–	–	–	–	–	0.3	0.3
H039	B	Predicted	31.1	34.8	38.7	42	42.9	43.2	43.2
		Daytime Criterion	40	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	43	43	43	43	43	43	43
		Night-time Excess	–	–	–	–	–	0.2	0.2
H043	Landowner	Predicted	31.8	35.6	39.3	42.4	43.4	43.8	43.8
		Daytime Criterion	45	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	45	45	45	45	45	45	45
		Night-time Excess	–	–	–	–	–	–	–
H044	Landowner	Predicted	31.8	35.6	39.3	42.4	43.4	43.8	43.8
		Daytime Criterion	45	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	45	45	45	45	45	45	45
		Night-time Excess	–	–	–	–	–	–	–
H047	Landowner	Predicted	31.5	35.3	39	42.1	43	43.5	43.5
		Daytime Criterion	45	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	45	45	45	45	45	45	45

House	NML Representative Location for Criterion	Parameter	Standardised wind speed m/s						
			3	4	5	6	7	8	9
		Night-time Excess	–	–	–	–	–	–	–
H048	Landowner	Predicted	32.8	36.6	40.2	43.4	44.3	44.8	44.8
		Daytime Criterion	45	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	45	45	45	45	45	45	45
		Night-time Excess	–	–	–	–	–	–	–
H049	Landowner	Predicted	31.1	35	38.6	41.7	42.7	43.1	43.1
		Daytime Criterion	45	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	45	45	45	45	45	45	45
		Night-time Excess	–	–	–	–	–	–	–
H050	Landowner	Predicted	31	34.8	38.4	41.6	42.5	43	43
		Daytime Criterion	45	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	45	45	45	45	45	45	45
		Night-time Excess	–	–	–	–	–	–	–
H151	B	Predicted	31	34.9	38.5	41.5	42.5	43	43
		Daytime Criterion	40	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	43	43	43	43	43	43	43

House	NML Representative Location for Criterion	Parameter	Standardised wind speed m/s						
			3	4	5	6	7	8	9
		Night-time Excess	–	–	–	–	–	–	–
H200	B	Predicted	31.2	34.8	38.7	42	43	43.2	43.2
		Daytime Criterion	40	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	–	–	–
		Night-time Criterion	43	43	43	43	43	43	43
		Night-time Excess	–	–	–	–	–	0.2	0.2
H210	Landowner	Predicted	34.1	38	41.6	44.6	45.6	46.1	46.1
		Daytime Criterion	45	45	45	45	45	45	45
		Daytime Excess	–	–	–	–	0.6	1.1	1.1
		Night-time Criterion	45	45	45	45	45	45	45
		Night-time Excess	–	–	–	–	0.6	1.1	1.1

A review of the worst case omni-directional cumulative exceedances that have been identified at 7 locations in the study area is presented with discussion in Table 12-34.

Table 12-34 Review of potential exceedances in Omni-directional noise predictions

Location Ref.	Highest magnitude of potential exceedance predicted in Omni-directional (Worst Case), dB		Review and Comment
	Day	Night	
H039	–	0.2	The predicted turbine noise level indicated a slight potential exceedance where the Proposed Project is contributing to the overall cumulative noise level (with other wind farms). The next step in the assessment is to consider the effect of directional noise propagation in accordance with methodology described in Section 12.4.4.5 and 12.3.5.5.
H008	–	0.1	
H015	0.2	–	
H200	–	0.2	
H031	0.3	0.3	The predicted turbine noise level is notably dominated by Illaunbaun Wind Farm. The next step in the assessment is to consider the effect of directional noise propagation in accordance with methodology described in Section 12.4.4.5 and 12.3.5.5.
H011	–	1.2	The predicted turbine noise level is notably dominated by Slieveacallan Wind Farm. The next step in the assessment is to consider the effect of direction noise propagation as discussed in Section 12.4.4.5 and 12.3.5.5.
H210	1.1	1.1	

As indicated in Table 12-34, the next stage in the assessment is to consider the effects of wind direction adopting the methodology described in Section 12.4.4.5 to assess the potential exceedances identified. Table 12-35 reviews the predicted noise levels against the noise criteria across the various wind speeds and direction sectors.

Table 12-35 Review of Predicted Turbine Noise Exceedances Considering Wind Direction

NSL	Description	Wind Speed	Predicted Exceedance in L_{A90}, 10-min Levels (dB) in Wind Direction Sector							
			N	NE	E	SE	S	SW	W	NW
H039	Turbine noise criteria Day	≥8	45	45	45	45	45	45	45	45
	Turbine noise criteria Night		43	43	43	43	43	43	43	43
	Predicted Turbine Noise		40.5	40	40.2	40.9	41.7	42.2	42	41.5
	Predicted Exceedance Day		–	–	–	–	–	–	–	–
	Predicted Exceedance Night		–	–	–	–	–	–	–	–
H008	Turbine noise criteria Day	≥8	45	45	45	45	45	45	45	45
	Turbine noise criteria Night		43	43	43	43	43	43	43	43
	Predicted Turbine Noise		41.3	40.5	40.6	40.5	40.9	41.7	41.5	41.3
	Predicted Exceedance Day		–	–	–	–	–	–	–	–
	Predicted Exceedance Night		–	–	–	–	–	–	–	–
H011	Turbine noise criteria Day	7	45	45	45	45	45	45	45	45
	Turbine noise criteria Night		43	43	43	43	43	43	43	43
	Predicted Turbine Noise		41	38.6	38.2	39.2	41.7	42.7	42.4	42.2
	Predicted Exceedance Day		–	–	–	–	–	–	–	–
	Predicted Exceedance Night		–	–	–	–	–			–

NSL	Description	Wind Speed	Predicted Exceedance in L_{A90}, 10-min Levels (dB) in Wind Direction Sector							
			N	NE	E	SE	S	SW	W	NW
	Turbine noise criteria Day	≥8	45	45	45	45	45	45	45	45
	Turbine noise criteria Night		43	43	43	43	43	43	43	43
	Predicted Turbine Noise		41.3	38.9	38.5	39.5	42	43	42.7	42.5
	Predicted Exceedance Day		–	–	–	–	–	–	–	–
	Predicted Exceedance Night		–	–	–	–	–	–	–	–
H015	Turbine noise criteria Day	6	40	40	40	40	40	40	40	40
	Turbine noise criteria Night		43	43	43	43	43	43	43	43
	Predicted Turbine Noise		34.7	36	38.2	39.7	39.9	39.7	38.1	35.8
	Predicted Exceedance Day		–	–	–	–	–	–	–	–
	Predicted Exceedance Night		–	–	–	–	–	–	–	–
H031	Turbine noise criteria Day	≥8	45	45	45	45	45	45	45	45
	Turbine noise criteria Night		45	45	45	45	45	45	45	45
	Predicted Turbine Noise		41.2	42.7	44.2	44.7	44.7	43.9	42.4	40.9
	Predicted Exceedance Day		–	–	–	–	–	–	–	–
	Predicted Exceedance Night		–	–	–	–	–	–	–	–

NSL	Description	Wind Speed	Predicted Exceedance in L_{A90}, 10-min Levels (dB) in Wind Direction Sector							
			N	NE	E	SE	S	SW	W	NW
H200	Turbine noise criteria Day	≥8	45	45	45	45	45	45	45	45
	Turbine noise criteria Night		43	43	43	43	43	43	43	43
	Predicted Turbine Noise		40.6	40.1	40.2	40.9	41.7	42.3	42.1	41.5
	Predicted Exceedance Day		–	–	–	–	–	–	–	–
	Predicted Exceedance Night		–	–	–	–	–	–	–	–
H210	Turbine noise criteria Day	6	45	45	45	45	45	45	45	45
	Turbine noise criteria Night		45	45	45	45	45	45	45	45
	Predicted Turbine Noise		40.4	42.7	43.3	43.8	43.3	41.5	39.7	38.5
	Predicted Exceedance Day		–	–	–	–	–	–	–	–
	Predicted Exceedance Night		–	–	–	–	–	–	–	–
	Turbine noise criteria Day	7	45	45	45	45	45	45	45	45
	Turbine noise criteria Night		45	45	45	45	45	45	45	45
	Predicted Turbine Noise		41.4	43.7	44.3	44.8	44.3	42.5	40.7	39.5
	Predicted Exceedance Day		–	–	–	–	–	–	–	–
	Predicted Exceedance Night		–	–	–	–	–	–	–	–

NSL	Description	Wind Speed	Predicted Exceedance in L_{A90}, 10-min Levels (dB) in Wind Direction Sector							
			N	NE	E	SE	S	SW	W	NW
	Turbine noise criteria Day	≥8	45	45	45	45	45	45	45	45
	Turbine noise criteria Night		45	45	45	45	45	45	45	45
	Predicted Turbine Noise		41.9	44.2	44.8	45.3	44.8	43	41.2	40
	Predicted Exceedance Day		–	–	–	0.3	–	–	–	–
	Predicted Exceedance Night		–	–	–	0.3	–	–	–	–

The assessment of directional cumulative turbine noise at the 7 NSLs that presented a potential exceedance show compliance for all wind directions. The only exception is location H210, which shows a minor exceedance of 0.3 dB during southeast (SE) winds.

As outlined previously in Table 12-34, the proximity of Slieveacallan Wind Farm to this receiver means that the noise level is primarily influenced by Slieveacallan Wind Farm, rather than by the Proposed Project. For SE winds, the Proposed Project contribution at H210 is 26.2 dB L_{A90}, which is more than 10 dB below the applicable noise criterion. Therefore, the contribution from the Proposed Project is not significant as per the assessment methodology and guidance discussed in Section 12.3.5.5.

It is therefore determined that there are no significant effects associated with the operation of the Proposed Project, as the predicted cumulative turbine noise levels are within the turbine noise criteria, or the contribution from the Proposed Project is negligible.

12.6.3.1.1 Description of Effects

The predicted turbine noise levels associated with the Proposed Project are within the applicable noise criteria described in Section 12.5.2, therefore it is not considered that a significant effect is associated with turbine noise from the Proposed Wind Farm Site.

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

With respect to the EPA's criteria for description of effects, the potential effects at the most impacted NSLs associated with noise from the operation of the Proposed Turbines are described as follows:

Table 12-36 Description of effects of the operation of wind turbines

Quality	Significance	Duration
Negative	Not Significant	Long Term

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

12.6.3.2 Fixed Plant Noise

12.6.3.2.1 Proposed extension to the existing 110kV Slievecallan substation

Details of the proposed extension to the existing 110kV Slievecallan substation are described in Chapter 4.

As previously stated, the location of the proposed extension to the existing 110kV Slievecallan substation is shown in the site layout drawings in Appendix 4-1 of this EIAR. The proposed extension to the existing 110kV Slievecallan substation will be operational 24/7 and the noise impact at the nearest NSL (H216)has been assessed to identify the potential greatest impact associated with the operation of the proposed extension to the existing 110kV Slievecallan substation at the nearest NSL.

The following extract from the EirGrid Evidence Based Environmental Studies Study 8: Noise – Literature review and evidence-based field study on the noise effects of high voltage transmission development (May 2016) states the following in relation to noise impacts associated with 110KvA substation installations:

> *"The survey on the 110kV substation at Dunfirth indicated that measured noise levels (L_{Aeq}) were less than 40 dB(A) at 5m from each of the boundaries of the substation. This is below the WHO night-time free-field threshold limit of 42 dB for preventing effects on sleep and well below the WHO daytime threshold limits for serious and moderate annoyance in outdoor living areas (i.e. 55 dB and 50 dB respectively). Spectral analysis of the data recorded at this site demonstrated that there were no distinct tonal elements to the recorded noise level. To avoid any noise impacts from 110kV substations at sensitive receptors, it is recommended that a minimum distance of 5m is maintained between 110kV substations and the land boundary of any noise sensitive property."*

The proposed extension to the existing 110kV Slievecallan substation will have comparable noise emissions to the 110kV unit discussed above. The nearest NSL H216 to the proposed extension to the existing 110kV Slievecallan substation is approximately 285 m. The noise emission level associated with a substation that would support a renewable energy development of this nature is the order of 92 dB(A) L_w.

Noise prediction model calculations for the operation of the proposed extension to the existing 110kV Slievecallan substation have been undertaken in accordance with ISO 9613: '*Acoustics – Attenuation of sound during propagation outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors'* (2024). The predicted noise level from the operation of the proposed extension to the existing 110kV Slievecallan substation at the nearest NSL (H216) at approximately 285 m northwest is 34 dB $L_{Aeq,T}$.

This level of noise is below the criterion for fixed mechanical plant outlined in Section 12.3.6 and will not result in an adverse impact at nearby NSLs. During the detailed design stage of the Proposed Project, careful consideration will be given to the selection of mechanical and electrical plant to ensure that noise emissions comply with the proposed criteria and that any character corrections are appropriately addressed in accordance with the requirements outlined in Section 12.3.6.

It is therefore concluded that noise emissions from the operation of the substation will be Not Significant, the noise from the proposed extension to the existing 110kV Slievecallan substation will be barely audible at the nearest NSL and inaudible at any other NSL, and will have no impact on the operation noise emissions from the Proposed Project.

12.6.3.2.2 Cumulative Levels

There is no known electrical plant in the area that would contribute cumulatively to the proposed extension of the 110kV Slievecallan substation. Therefore, the predicted cumulative noise levels are within the criterion for fixed machinal plant outlined in Section 12.3.5.12 and unlikely to result in any adverse impacts at nearby NSLs. Plant will be selected such that no tonal components are evident at any NSLs. At NSLs further from the proposed extension to the existing 110kV Slievecallan substation the noise levels will be lower.

12.6.3.2.3 Description of Effects

With respect to the EPA's criteria for description of effects, the potential effects, at the nearest NSLs associated with noise from the operation of the fixed mechanical and electrical plant at the proposed extension to the existing 110kV Slievecallan substation is described below.

Table 12-37 Description of effects of the operation of fixed plant

Quality	Significance	Duration
Negative	Not Significant	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 Proposed Wind Farm Site can be considered comparable to those outlined in relation to the construction phase (as per Section 12.6.2) albeit less works will be required as only above ground structures will be removed. Turbine and met mast foundations will remain underground, and cable ducting will remain in situ. The underground cabling to the proposed extension to the existing 110kV Slievecallan substation will be removed from the cable ducts using a mechanical winch. 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, 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's criteria for description of effects, the likely potential associated effects at the nearest noise sensitive locations associated with construction of turbines and hardstanding areas are described below.

Table 12-38 Description of effects of the decommissioning phase

Quality	Significance	Duration
Negative	Not Significant	Short Term

12.7 Mitigation Measures

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

12.7.1 Construction Phase

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

The assessment of potential impacts presented in Section 12.6.2 has demonstrated that the proposed project is expected to comply with the noise and vibration criteria during the construction phase and therefore no specific mitigation measures are required.

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

To ameliorate any potential noise impacts that may present during the construction phase, a schedule of noise control measures has been formulated in accordance with best practice guidance, and the contract documents will require the Contractor to implement these measures. These are outlined in the Construction and Environmental Management Plan that has been prepared for the Proposed Project included in Appendix 4-6.

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 potential temporary exceedances are predicted associated with tree felling at the nearest receivers, the following mitigation measures are proposed to reduce noise impacts during the activities:

- Orientating plant to minimise the noise impact on nearby receptors where practicable,
- Erection of temporary localised mobile noise screens where practicable around activities,
- Phasing of work and reduce percentage on time to lower the noise impact.

Where rock breaking is employed in relation to the proposed borrow pit location 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 Proposed Project and that no specific mitigation measures are required, it is recommended that vibration from construction activities will be limited to the values set out in Section 12.3.2.3.

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

If blasting is required, 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 12.3.4 will be implemented.

12.7.3 Decommissioning Phase

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

To ameliorate any potential noise impacts that may present during the decommissioning phase, a schedule of noise control measures has been formulated in accordance with best practice guidance. These are outlined in the Decommissioning Plan (Appendix 4-6) that has been prepared for the Proposed Project.

12.7.4 Operational Phase

12.7.4.1 Wind Turbine Noise

An assessment of the operational wind turbine noise levels has been undertaken in accordance with best practice guidelines and procedures recommended in line with the Guidelines (DoEHLG 2006) as outlined in Section 12.3.5. The findings of the assessment, presented in Section 12.6.3.1 have confirmed that the predicted operational noise levels associated with the Proposed Wind Farm Site will be within best practice applicable turbine noise criteria at all locations with no significant cumulative impacts or effects.

Therefore, no specific mitigation measures are required.

If alternative turbine models are considered for the Proposed Turbines, 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 Proposed Project.

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

12.7.4.1.1 Amplitude Modulation and Tonality

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

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

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

The commitment outlined to control amplitude modulation (AM) from wind turbines are considered best practice. The proposed approach will ensure that any adverse impacts from excessive amplitude modulation (AM) associated with the operation of the proposed project are effectively managed by the operator.

12.7.4.2 Fixed Plant

The assessment of noise from the operation of fixed plant at the proposed extension to the existing 110kV Slievecallan substation is predicted to comply with the proposed criteria in Section 12.3.5.12. Therefore, no specific mitigation measures are required. However, as the design is progressed the following measures will be considered to ensure the noise levels at NSL are within the proposed criterion and the potential for noise disturbance is minimised:

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

12.7.5 Monitoring

12.7.5.1 Noise Compliance Monitoring Plan

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

Prior to the commissioning of the Proposed Wind Farm Site, the Applicant will submit a Noise Compliance Monitoring Protocol (NCMP) (see Section 12.3.5.11.2) 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.

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

In the event of a complaint associated with noise for example, tonality or amplitude modulation from the proposed project, as discussed in Section 12.7.4.1.1 and in line with the NCMP documents to be submitted and agreed with the local authority), the operator will fully investigate the complaint in collaboration with the turbine manufacturer, through review of the meteorological periods and conditions.

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

As an example of this turbine control capability, the following table shows the sound power levels for the Vestas V150-6.0MW 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 7 dB can be achieved dependent on the operational mode set on the specific turbines.

Table 12-39 Sound Power Levels at Reduced Modes

Wind Speed m/s	Sound Power Levels, dB L_{WA}						
	PO 6000	Mode SO0	Mode SO2	Mode SO3	Mode SO4	Mode SO5	Mode SO6
3	92.7	92.5	92.2	92.2	92.2	92.2	92.2
4	96.1	96.2	96.1	96.1	96.1	96.1	96.1
5	100.4	100.4	100.1	99.9	99.6	98.8	97.8
6	103.9	103.3	102.0	101.0	100.0	99.0	98.0
7	104.8	103.9	102.0	101.0	100.0	99.0	98.0
8	104.9	104.0	102.0	101.0	100.0	99.0	98.0
9	104.9	104.0	102.0	101.0	100.0	99.0	98.0

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

12.7.5.2 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 NCMP documents to be submitted and agreed with the local authority).

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

12.8 Residual Effects

This section summarises the likely residual noise and vibration effects associated with the Proposed Project following the implementation of mitigation/best practice measures. The effects described consider the locations of the greatest potential impact unless otherwise stated.

12.8.1 Construction Phase

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

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

Table 12-40 Construction Residual Effects

Construction Phase	Quality	Significance	Duration
Turbines, Hardstand and Met Mast	Negative	Not Significant	Short Term
Internal Roads and Amenity Tracks	Negative	Not Significant	Temporary
Borrow Pit	Negative	Not Significant	Short Term
Tree Felling and Wood Replanting	Negative	Not Significant	Short Term
Peat and Spoil Management Area	Negative	Not Significant	Short Term
Traffic	Negative	Not Significant	Short-Term
Proposed Extension to the Existing 110kV Slievecallan Substation	Negative	Not Significant	Short Term
Proposed Grid Connection Site 33kV underground cabling	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.

12.8.2 Operational Phase

12.8.2.1 Wind Turbine Noise

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

While noise levels at low wind speeds will increase due to the Proposed Project and specifically the operation of the proposed 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 with respect to EPA (2022) description of effects are summarised as follows at the nearest NSLs.

Table 12-41 Description of effects of the residual operation of wind turbines

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 Fixed Plant Operation

The residual effects at the nearest NSLs of the proposed extension to the existing 110kV Slievecallan substation and all ancillary infrastructure are described as follows with respect to EPA criteria (2022):

Table 12-42 Description of effects of the residual operation of fixed plant

Quality	Significance	Duration
Negative	Not Significant	Long Term

12.8.3 Decommissioning Phase

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

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

Table 12-43 Description of effects of the residual decommissioning phase

Quality	Significance	Duration
Negative	Not Significant	Short-term

12.8.4 Cumulative Effects 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. The noise impact assessment includes the existing Slieveacallan Wind Farm, and the proposed Illaunbaun Wind Farm. The results of the operational phase due to wind turbine noise are detailed in Section 12.6.3.1.

It is noted that the proposed Illaunbaun Wind Farm is subject to 2 separate planning applications (5 no. turbines and 1 no. turbine) as outlined in Chapter 2: 'Background to the Proposed Project', Section 2.9 of the EIAR, but for the purposes of the EIAR the noise assessment outlined in Section 12.6.3.1 the noise considers this a one 6 no. turbine wind farm.

12.8.5 Noise from Fixed Plant Operation

A review of the planning applications submitted in the area in proximity to the Site (as detailed in Chapter 2) has been undertaken and these projects have been considered in the noise and vibration cumulative assessments. Besides Illaunbaun Wind Farm substation, there are no other industrial noise sources of fixed mechanical and electrical plant in the vicinity of the nearest NSLs to the proposed substation that are expected to any cumulative noise impacts at NSLs. Illaunbaun substation is located approximately 6 km away from the existing Slieveacallan substation and the proposed extension for the Proposed Project. Therefore, the potential for any cumulative noise effects is not significant. In conclusion, the predicted noise from the operation of the proposed extension to the existing 110kV Slievecallan substation at the nearest NSL is below the adopted criteria and remains headroom for any other fixed plant operations to operate within the adopted criteria.

12.8.6 Construction and Decommissioning

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

In order for cumulative noise levels to increase, the contribution of noise from the proposed project must be within 10 dB of the other source of noise. 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 and Section 12.6.4 confirms that the predicted noise levels from activities at static construction sites at any NSL are ≤55 dB $L_{Aeq,T}$, therefore the potential for any cumulative noise effect from all of the proposed activities occurring simultaneously or with construction activities from other developments is unlikely and not significant.

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

12.9 Difficulties Encountered During the Preparation of this Chapter

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

12.10 Interactions

The potential interaction between noise and vibration and other specialist chapters in the EIAR is primarily limited to Chapter 5 (Population & Human Health), Chapter 6 (Biodiversity) and Chapter 15 (Material Assets). This chapter has been prepared in consideration of and in conjunction with the relevant elements of these chapters. For example, noise and vibration impacts associated with the Proposed Project have been fully considered within this Chapter of the EIAR. However, commentary on the impact assessment and related noise levels are also summarised specifically with respect to potential human health impacts in Chapter 5 and Chapter 6. The traffic flow projections associated with the Proposed Project provided in Chapter 15 has been utilised in the calculations in Section 12.6.2.6 of this Chapter.

12.11 Summary

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

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

Residual noise associated with the construction and decommissioned phases have been predicted to be below the proposed threshold values. The associated noise and vibration levels are not likely to cause significant effect at any NSL.

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

Operational noise from the proposed extension to the existing 110kV Slievecallan substation has been assessed and found to be within the adopted criteria.

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

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

12.12 EIA Classification Summary

Please see the below table for a summary of all identified impacts for the Proposed Project relating to air quality.

Table 12-44 Impact Assessment Classification Summary

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
Construction Phase				
Noise and Vibration	Negative, Not Significant, Short Term	Section 12.7.1	Negative, Not Significant, Short Term	Not Significant
Operational Phase				
Noise and Vibration	Negative, Not Significant, Long Term	Section 12.7.4	Negative, Not Significant, Long Term	Not Significant
Decommissioning Phase				
Noise and Vibration	Negative, Not Significant, Short Term	Section 12.7.3	Negative, Not Significant, Short Term	Not Significant

13. REFERENCES

Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022)

BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. (BS5228-1)

Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document Guidelines for the Treatment of Noise and Vibration in National Road Schemes (NRA, 2004)

Design Manual for Roads and Bridges, Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (National England (now National Highways) 2020) (DMRB)

BS 7385 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (1993) (BS77385)

BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration. (BS5528-2)

Department of the Environment, Heritage and Local Government Wind Energy Development Guidelines

Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication The Assessment and Rating of Noise from Wind Farms (1996) (ETSU-R-97)

Institute of Acoustics (IOA) document A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013) including six Supplementary Guidance Notes (IOA GPG)

World Health Organisation (WHO) Environmental Noise Guidelines for the European Region (2018)

ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation (2024)

ISO 9613: Acoustics — Attenuation of sound during propagation outdoors, Part 2: General method of calculation (1996)

EPA Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (2011)

EPA Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), 2016 (NG4)

Draft Revised Wind Energy Development Guidelines 2019 Department of Housing, Local Government and Heritage

World Health Organisation (WHO) document Community Noise (WHO, 1995)

South Australian Environment Protection Authority namely, Infrasound levels near windfarms and in other environments (EPA, 2013)

State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg Low Frequency Noise incl. Infrasound from Wind Turbines and Other Sources (2016)

IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016)

RenewableUK AM project (RenewableUK 2013)

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) Research into Aerodynamic Modulation of Wind Turbine Noise (2007)

Wind turbine AM review: Phase 2 report. 3514482A Issue 3. Department for Business, Energy & Industrial Strategy (2016)

ISO 1996: 2017: Acoustics — Description, measurement, and assessment of environmental noise.

International Electrotechnical Commission (IEC) 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 (Hereafter TS 61400-11-2)

14. BIBLIOGRAPHY

APPENDIX 1

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