MWP

Chapter 10 Noise and Vibration

Ballinla Windfarm

Ballinla Wind Farm

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10. Noise and Vibration

10.1 Introduction

This chapter describes the assessment undertaken of the potential noise and vibration impact from the Proposed Development. A full description of the Proposed Development is provided in Chapter 2 (Description of the Proposed Development).

Noise and vibration impact assessments have been prepared for the operational phase, the construction and decommissioning phases of the Proposed Development to the nearest noise sensitive locations (NSLs). To inform this assessment baseline noise levels have been measured at five representative NSLs surrounding the Proposed Development site. Noise predictions to the nearest NSLs have been prepared for both the construction and operational phases.

For a glossary of terms used in this chapter please refer to Appendix 10-1.

10.1.1 Competency of Assessor

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

Dr. Aoife Kelly (Senior Acoustic Consultant) holds a BSc (Hons) in Environmental Health, a Diploma in Acoustics and Noise Control, a PhD in Occupational Noise and is a member of the Institute of Acoustics (MIOA). Aoife has specialised in acoustics since 2014 and won the 2016 Association of Noise Consultants (ANC) best diploma project. She has extensive knowledge in the field of occupational noise risk assessments, environmental noise and vibration effect assessment and inward effect assessments. She has seven years of experience as an acoustic consultant and in that time has gained extensive knowledge and experience in relation to impact assessment of wind farms and associated infrastructure as well as a detailed knowledge of acoustic standards and proprietary noise modelling software packages. She has completed noise impact assessments for numerous wind farm projects within Ireland, including Codling Offshore Wind Park, Castlebanny Wind Farm, Knockroe Wind Farm and Foyle Wind Farm. She also has delivered the environmental noise specialist module on the IOA Diploma in Acoustics and Noise Control.

10.1.2 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 enormous range of pressure levels that can be detected by the ear, it is widely accepted that sound levels are measured and expressed using a decibel scale i.e., 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 SPL is 0dB (for the threshold of hearing) to 120dB (for the threshold of pain). In general, a subjective impression of a doubling of loudness corresponds to a tenfold increase in sound energy, which 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, will increase the SPL by 3dB. This results in the subjective impression of a slight increase in noise level.

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. To rank the SPL of various noise sources, the measured level

must be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 Acoustics. normal equal-loudness level contours has been found to provide the best correlations with human response to perceived loudness. SPLs measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 10-1.

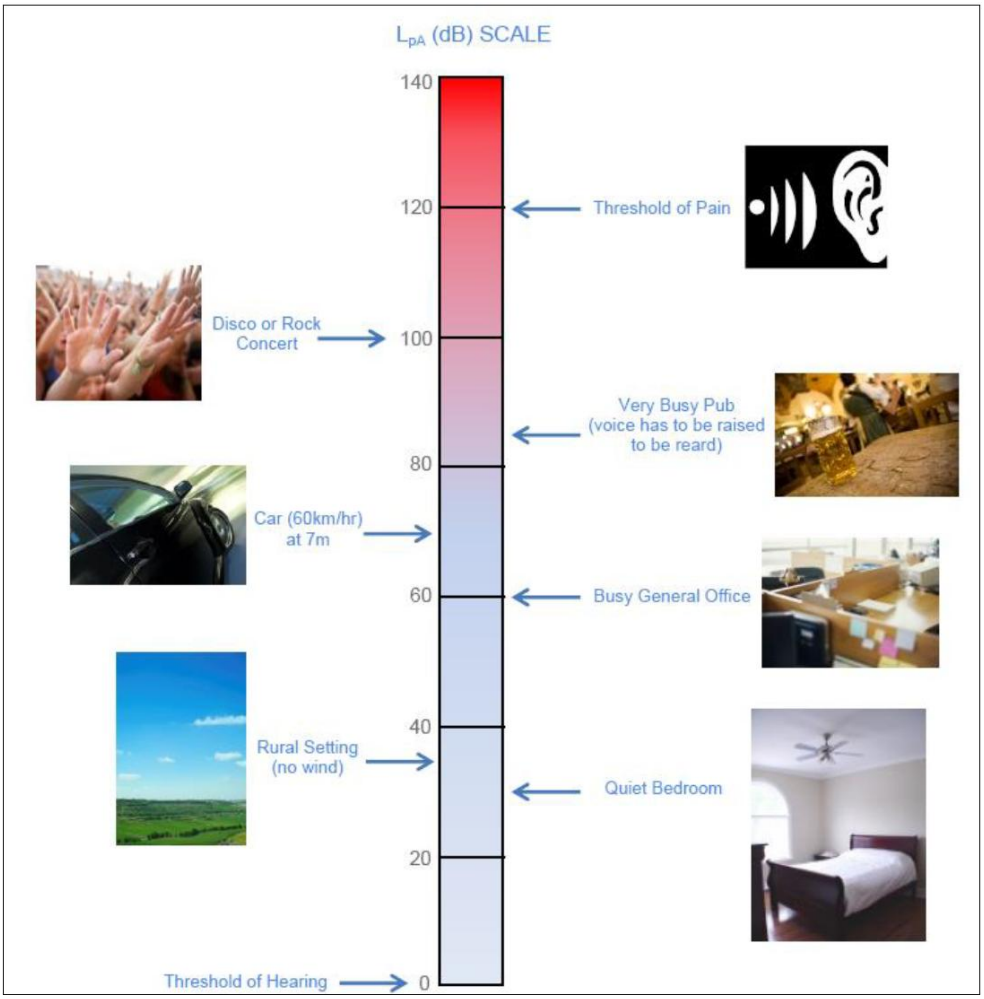

Figure 10-1: dB(A) Scale & Indicative Noise Levels[1]

10.2 Consultation

Consultation was undertaken with local authorities, government department, nongovernmental organisations (NGOs) and stakeholders during the assessment and preparation of the EIAR. The list of consultees is given in Chapter 1 Section 1.5.1 Consultation. In relation to noise impact assessment the responses included the HSE (provided in Appendix 1B - Feedback from Statutory and Non Statutory Consultees) and the preplanning meeting with OCC where it was verbally outlined that cumulative impact from the surrounding wind farms was important and should be addressed. The information from the consultation feedback was taken into account during the wind farm design and assessment process. Section 10.4.5.4 describes the other windfarms included in the operational noise assessment, as presented in Section 10.6.2.1.

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

10.3 Relevant Legislation, Policy and Guidance

The assessment of effects for the Proposed Development has been undertaken with reference to the most relevant guidance documents relating to environmental noise and vibration. The following guidance documents have been consulted when preparing this chapter of the EIAR:

- British Standard Institute (BSI) British Standard (BS) 5228-1:2009 +A1:2014 Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise (hereafter referred to as BS 5228–1) (BSI 2014a).
- BS 5228-2:2009+A:2014 Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration (hereafter referred to as BS 5228–2) (BSI 2014b).
- BS 7385: 1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration (hereafter referred to as BS 7385–2) (BSI 1993).
- Department for Business, Energy & Industrial Strategy Wind Turbine AM Review: Phase 2 Report Project Number: 3514482A Issue: 3 Issued August 2016.
- Department of the Environment, Heritage, and Local Government (DEHLG) Wind Energy Development Guidelines (hereafter referred to as WEDG (DEHLG, 2006),with cognisance of *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (the draft Guidelines).
- Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) ETSU-R-97 The Assessment and Rating of Noise from Wind Farms (hereafter referred to as ETSU-R-97) (ETSU, 1996).
- EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (EPA, 2011).
- EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016).
- Institute of Acoustics (IOA) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (hereafter referred to as IOA GPG) (IOA, 2013).
- TII (previously NRA) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (hereafter referred to as the TII Noise Guidelines 2014) (NRA 2014).
- International Organization for Standardization (ISO) 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation (hereafter referred to as ISO 9613–2) (ISO 2024).
- ISO 1996: 2017: Acoustics – Description, measurement, and assessment of environmental noise.
- United Kingdom (UK) National England (now National Highways (UKHE) Design Manual for Roads and Bridges (DMRB) Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (hereafter referred to as DMRB) (UKHE 2020).
- World Health Organisation (WHO) Environmental Noise Guidelines for the European Region (2018).

In addition to specific noise and vibration guidance documents outlined above, EPA Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2022) was considered and consulted in the preparation of this Chapter.

10.3.1 EPA Description of Effects

The significance of effects of the Proposed Development shall be described in accordance with the EPA guidance document *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EIAR), (2022).

10.3.2 Guidance Documents and Assessment Criteria

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

10.3.2.1 Construction and Decommissioning Phase - Noise

General Construction Noise – Fixed Site

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 development of this scale may be found in the British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise (BS5528-1).

The approach adopted here calls for the designation of an NSL into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. A threshold noise value is applied to each category. Exceedances (construction noise only) of the threshold value, at the facade of a noise-sensitive location (NSL) during construction, indicates a potential significant noise impact associated with the construction activities. The threshold values recommended by BS5228-1 (BSI 2014a) are depicted in Table 10-1. 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.

Table 10-1: Example Threshold Potential Significant Effect at Dwellings

Assessment category and threshold value period (T)	Threshold value, in dB LAeq,T		
	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) and Saturdays (07:00 – 13:00hrs)	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 will be followed:

For each period (i.e. daytime, evening and night time) the ambient noise level is determined and rounded to the nearest 5dB. At some properties, particularly those located close to busy roads, the ambient noise levels are expected to be relatively high. However, given the rural nature of the site in general, reference has been made to the quietest properties near the development which have daytime ambient noise levels typically in the range of 30 to 55dB $L_{Aeq.1hr}$. Therefore, for the purposes of this assessment, as a worst case, all properties will be afforded a Category A designation.

BS 5228-1 states that:

"If the site noise level exceeds the appropriate category value [65dB in this case], 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."

If the specific construction noise level exceeds the category threshold value (e.g., 65dB $L_{Aeq,T}$ during daytime periods) then a significant effect is considered to occur.

Please see 10.6.1 for the detailed assessment in relation to the fixed site construction works of the Proposed Development.

Grid Connection Construction Noise – Linear Works

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

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

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

Paragraph E.2 goes on to state: -

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

70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise.

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

In this assessment, a construction noise limit of 70dB $L_{Aeq,T}$ is adopted for the Proposed Grid Connection underground cabling works. Noise levels above 70dB $L_{Aeq,T}$ would indicate a significant impact.

The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document Guidelines for the Treatment of Noise and Vibration in National Road Schemes (TII, 2014) construction noise limits of 70dB $L_{Aeq,1hr}$ for weekday periods (Monday to Friday 0700 – 1900 hrs) and 65dB $L_{Aeq,1hr}$. on Saturdays (08:00 to 16:30hrs).

10.3.2.2 Interpretation of the Construction Noise Thresholds (CNT)

In order to assist with interpretation of CNTs, Table 10-2 includes guidance as to the likely magnitude of impact associated with construction activities, relative to the CNT. This guidance is derived from Table 3.16 of Design

Manual for Roads and Bridges (DMRB): Noise and Vibration, and adapted to include the relevant significance effects from the EPA Guidelines (EPA 2022).

Table 10-2: Description of the Magnitude of Impacts (Adapted from DMRB Table 3.16)

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

In respect of the fixed site, based on the above the construction noise criterion of 65dB $L_{Aeq,1hr}$ is proposed, for weekdays between 07:00hrs and 19:00hrs and Saturdays between 07:00hrs and 13:00hrs. For weekend construction (Saturdays between 13:00hrs and 16:00hrs) the construction noise criterion of 55dB $L_{Aeq,1hr}$ is proposed.

In respect of the grid connection works the construction noise criterion of 70dB $L_{Aeq,1hr}$ is proposed, also for weekdays between 07:00hrs and 19:00hrs and Saturdays between 07:00hrs and 16:00hrs.

10.3.2.3 Additional Vehicular Activity on Public Roads Construction Phase

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

For the assessment of potential noise impacts from construction related traffic along public roads it is proposed to adopt guidance from Highways England (now National Highways) DMRB Sustainability & Environment Appraisal LA 111 Noise and Vibration (Revision 2) (UKHE, 2020).

Table 10-3 taken from DMRB LA 111 offers guidance as to the likely short-term impact associated with any change in traffic noise level.

Table 10-3: Likely Impacts Associated with Change in Traffic Noise Level (Source DMRB, 2020)

Change in Sound Level (dB L_{A10})	Magnitude of Impact	EPA Significance of Effect
0	No change	Imperceptible
0.1 – 0.9	Negligible	Imperceptible
1 – 2.9	Minor	Not Significant
3 – 4.9	Moderate	Slight, Moderate
5+	Major	Significant

Section 3.19 of DMRB states that construction noise and construction traffic 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.

The DMRB guidance will be used to assess the predicted increases in traffic levels on public roads associated with the Proposed Development 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 traffic in the context of the construction noise threshold values outlined previously in this section.

10.3.2.4 Construction 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 Development, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

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

- BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (BSI, 1993) (BS7385).
- BS 5228-2:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (BSI, 2014) (BS5228-2).

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

BS5228-2 recommends that, for soundly constructed residential properties 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 15Hz and 20 mm/s at frequencies above than 15Hz. Below these vibration magnitudes minor damage is unlikely, although the standard notes that where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) publication Guidelines for the Treatment of Noise and Vibration in National Road Schemes (TII, 2004) also contains information on the permissible construction vibration levels during the construction phase as shown in Table 10-4.

Table 10-4: Allowable Vibration at Sensitive Properties (TII, 2004)

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

Following review of the suggested vibration criteria discussed above from BS7385, BS5228-2 and the TII Guidelines, the values in Table 10-4 from the NRA Guidelines are considered appropriate for this assessment.

10.3.2.5 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 document *Wind Energy Development Guidelines* for Planning Authorities published by the Department of the Environment, Heritage and Local Government in 2006. These guidelines are in turn based on detailed recommendations set out in the Department of Trade and Industry (UK) Energy Technology Support Unit (ETSU) publication *The Assessment and Rating of Noise from Wind Farms* (1996). The

ETSU document has been used to supplement the guidance contained within the *Wind Energy Development Guidelines* publication where necessary.

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

As stated previously the core of the noise guidance contained within the Wind Energy Development Guidelines is based on the ETSU publication ETSU-R-97.

ETSU-R-97 calls for the control of wind turbine noise by the application of noise limits at the nearest noise sensitive properties. ETSU-R-97 considers that absolute noise limits applied at all wind speeds are not suited to wind turbine developments and recommends that noise limits should be set relative to the existing background noise levels at noise sensitive locations. A critical aspect of the noise assessment of wind energy proposals relates to the identification of baseline noise levels through onsite noise surveys.

ETSU-R-97 states on page 58, "*…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…*". The potential for other wind farms to contribute to the NSLs in the study area is assessed in Section 10.6.2.1 and Appendix 10-2.

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

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 A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IOA GPG) including six 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 the treatment of wind shear and the general adaptation to larger wind turbines. The guidance contained within IOA GPG, and its Supplementary Guidance Notes are considered to represent best practice and have been adopted for this assessment.

The IOA GPG states, that at a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e., cut in speeds to wind speed of rated sound power of the proposed turbines). 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 then conducted on the data sets to derive background noise levels at various wind speeds, the resulting background noise curve can be used to establish appropriate turbine noise criteria at each location.

Noise emissions associated with the wind turbines can be predicted in accordance with ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation (2024). This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity, and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

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

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

The IOA GPG states that cumulative noise exceedances should be avoided and where existing or permitted development is at the noise limit, any new turbine noise sources should be designed to be 10dB below the limit value.

Section 5.1 of the relevant IOA GPG states the following:

"5.1.1 ETSU-R-97 states at page 58, "…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…"

5.1.2 The HMP Report states that "If an existing wind farm has permission to generate noise levels up to ETSU-R-97 limits, planning permission noise limits set at any future neighbouring wind farm would have to be at least 10dB lower than the limits set for the existing wind farm to ensure there is no potential for cumulative noise impacts to breach ETSU-R-97 limits (except in such cases where a higher fixed limit could be justified)". Such an approach could prevent any further wind farm development in the locality, and a more detailed analysis can be undertaken on a case by case basis.

5.1.3 As with the assessment of noise for all wind farm developments, sequential steps need to be taken, but such steps require more detailed attention due to the added complexity of cumulative noise impacts. The advice of the EHO could be invaluable to this part of the assessment.

Cumulative impact assessment 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 10dB 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 10dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary."

An appraisal of the study area to determine whether a cumulative turbine noise impact assessment is required is presented Section 10.4.5.4 and Appendix 10-2.

Wind Energy Development Guidelines for Planning Authorities

Section 5.6 of the Wind Energy Development Guidelines for Planning Authorities published by the Department of the Environment, Heritage and Local Government (2006) addresses noise and outlines the appropriate noise criteria in relation to wind farm developments.

The following extracts from this document should be considered:

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

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

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

As can be seen from the calculations presented later in this chapter the various issues identified in this extract have been incorporated into our assessment.

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

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

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

In relation to night time periods the following guidance is given:

> *"A fixed limit of 43dB(A) will protect sleep inside properties during the night."*

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

In summary, the Wind Energy Development Guidelines outlines the following guidance to identify appropriate wind turbine noise criteria curves at noise sensitive locations:

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

While the caveat of an increase of 5dB(A) above background for night-time operation is not explicit within the current guidance it is commonly applied in noise assessments prepared and is detailed in numerous examples of planning conditions issued by planning authorities.

Future Potential Guidance Changes for Wind Turbine Noise

In December 2019, the Draft Revised Wind Energy Development Guidelines (the draft Guidelines) were published for consultation and at the time of writing, updated guidelines have yet to be published. It is important to note that during the related public consultation several concerns relating to the proposed approach of the draft Guidelines were 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.

A statement from the cross party group can be reviewed at https://www.ioa.org.uk/wind-energy-development-guidelines-wedg-consultation-irish-department-housing-planning-community.

The following statement is of note from the response[2]:

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

The following statements was submitted by the Minister for Housing, Local Government and Heritage during a Dail Eireann Debates on 13 June 2023[3]:

> *"My Department is currently undertaking a focused review of the 2006 Wind Energy Development Guidelines. The review is addressing a number of key aspects including noise, setback distance, shadow flicker, community obligation, community dividend and grid connections.*
>
> *Guidance on the noise aspect, which is highly technical in nature, is currently being finalised by my Department in conjunction with the Department of the Environment, Climate and Communications (DECC), which has primary responsibility for environmental noise matters. Both Departments are 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.*
>
> *In this connection, DECC has recently appointed an acoustic expert, who has commenced work to inform any amendments to the noise aspect of the Guidelines. My Department in conjunction with DECC will make any further changes to the draft Guidelines which are deemed necessary or appropriate in the wake of this work, with a view to bringing the review of the Guidelines to a conclusion. My Department will be in a better position to provide an update on the expected publication date of the revised Guidelines once this process has concluded.*
>
> *It should be noted that Action EL/23/4 of the Climate Action Plan 2023 Annex of Actions contains a commitment to having new draft Guidelines prepared by the end of Q4 2023, with revised Guidelines to be published in 2024.*
>
> *When finalised, the revised Guidelines will be issued under section 28 of the Planning and Development Act 2000, as amended. Planning authorities and, where applicable, ACP (formerly ABP), must have regard to guidelines issued under section 28 in the performance of their functions generally under the Planning Acts. In the meantime, the current 2006 Wind Energy Development Guidelines remain in force."*

Based on the above, the assessment of wind turbine noise presented in this EIAR is based on the guidance outlined in the Guidelines and has been supplemented with best practice guidance from ESTU-R-97 and the IOA GPG.

If updated Wind Energy Development Guidelines are published during the application process for the Proposed Wind Farm 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.

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

[3] https://www.oireachtas.ie/en/debates/question/2023-06-13/780/

Planning Conditions for Operational Noise on Existing Wind Energy Developments in the Area

The planning permission conditions from ACP (formerly ABP) related to operational noise for the Cloncreen, Mount Lucas and Yellow River are presented below.

Cloncreen Wind Farm

The relevant granted planning condition (Condition No.8) relating to noise emissions from the Cloncreen site by ABP, Ref. PL 19.PA0047, is presented below and states:

"Planning Condition (No 8)

(a) Noise levels emanating from the Proposed Development following commissioning, by itself or in combination with other existing or permitted wind energy development in the vicinity, when measured externally at third party noise-sensitive locations, shall not exceed the greater of 43dB(A) L90,10min or 5dB(A) above background levels…"

It is understood that this 43dB(A) $L_{90,10min}$ or 5dB(A) above background levels condition relates to all periods, day and night.

Mount Lucas Wind Farm

The ABP planning permission in relation to the nearby Mount Lucas wind farm development (Ref: PL19.237263) states the following planning condition in relation to noise:

"10. (a) At critical wind speed (that is, the speed at which the noise of the turbines and blades is most in excess of ambient noise levels), the noise from the Proposed Development shall not, when measured externally at the nearest occupied house, exceed 45dB(A)L_{eq} daytime limit and 43dB(A)L_{eq} night time limit when measured over any five minute period unless written agreement of the Planning Authority has been obtained to exceed these noise limits where it can be determined that this will not impact negatively on residential amenity.' During the operational period, noise levels resulting from the operation of the wind turbines and the fixed anemometry mast, when measured at the nearest inhabited house, shall not exceed 43dBA (15 minutes Leq). All sound measurement shall be carried out in accordance with ISO Recommendation R 1996 "Assessment of Noise with respect of Community Response" as amended by ISO Recommendations R 1996 1."

The stated limit of 43dB $L_{Aeq,15min}$ in the relevant planning condition is equivalent to a level of 41dB $L_{A90,10min}$. Therefore, the proposed lower threshold for Ballinla of 40dB $L_{A90,10min}$ at wind speeds at or below 6 m/s is considered robust in terms of conditions placed on other developments in the area.

Yellow River Wind Farm

The relevant granted planning condition (Condition No.10) relating to noise emissions from the Yellow River site by ABP, Ref. PL 19.PA0032, is presented below and states:

"10. (a) Noise levels emanating from the Proposed Development following commissioning, when measured externally at third party noise -sensitive locations, shall not exceed the greater of 43dB (A) L90, 10 min or 5dB (A) above background levels."

It is understood that this 43dB(A) $L_{90,10min}$ or 5dB(A) above background levels condition relates to all periods, day and night.

Special Characteristics

Infrasound/Low Frequency Noise

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

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

> *"Infrasound is the term generally used to describe sound at frequencies below 20Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.*
>
> *Sounds at frequencies from about 20Hz to 200Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view."*

The article concludes that:

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

A report released in January 2013 by the South Australian Environment Protection Authority namely, *Infrasound levels near windfarms and in other environments* (EPA, 2013)[4] found that the level of infrasound from wind turbines is insignificant and no different to any other source of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people.

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

> *"The contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment."*

In conclusion, low frequency noise and infrasound associated with wind turbines is expected to be below perceptibility thresholds and are not likely to result in any significant effects at NSLs. The are no criteria proposed to assess low frequency noise or infrasound as part of the EIAR.

[4] EPA South Australia, 2013, Wind farms https://www.epa.sa.gov.au/files/477912_infrasound.pdf

Amplitude Modulation

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

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

It is now generally accepted that there are two mechanisms which can cause amplitude modulation; 'normal' AM and 'other' AM (sometimes referred to 'excessive' AM).

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

'Normal' AM

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

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

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

'Other' AM

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

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

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

Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances, primarily downwind of the rotor blade.

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

Frequency of Occurrence of AM

Research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report 'Research into Aerodynamic Modulation of Wind Turbine Noise' (2007). The conclusions of this report were that aerodynamic modulation was only considered to be an issue at four, and a

possible issue at a further eight, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the four sites where AM was confirmed as an issue, it was considered that conditions associated with AM might occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system.

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

RenewableUK Research Document states the following in relation to matter:

Page 68 Module F *"even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent."*

Page 6 Module F *"It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months."*

Page 61 Module F *"There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."*

Concluding Comments on AM

It is critical to this discussion to recognise that AM is an inherent characteristic of wind turbine noise. A distinction must be made between 'Normal' AM, which is a regular fluctuation in noise levels, and 'Other' or 'Excessive' AM, which can be more pronounced and potentially disruptive. Normal AM is typically expected and accounted for in noise assessments, whereas Excessive AM should it occur may require additional mitigation measures due to its potential impact on nearby residents.

Research and Guidance in the field of wind turbine noise AM is ongoing with recent publications being issued by the Institute of Acoustics (IOA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, A Method for Rating Amplitude Modulation in Wind Turbine Noise (August 2016) (The Reference Method). The document proposes an objective method for measuring and rating AM. The AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of amplitude modulation.

A 2016 report commissioned by the UK government Wind turbine AM review: Phase 2 report. 3514482A Issue 3. Department for Business, Energy & Industrial Strategy 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. The report included the following caveat "Any condition developed using the elements proposed in this study should be subject to a period of testing and review. The period should cover a number of sites where the condition has been implemented and would be typically in the order of 2-5 years from planning approval being granted."

To date there is no clear industry consensus on how AM should be regulated or managed at the planning stage. Consequently there is no methodology that can be applied to predict the likelihood of AM at a particular wind farm site. Any site specific assessment would need to be undertaken at post commissioning stage. The assessment of AM at post commissioning stage is discussed in Section 10.7.1.2.

10.3.2.7 Operational Phase Noise – Fixed Plant Items

For the proposed Substation (fixed mechanical and electrical plant), it is proposed to set fixed noise limits in accordance with the following best practice guidance.

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

Determining Appropriate Noise Criteria

Table 10-5 outlines the noise emission limit criteria detailed in the NG4 document.

Table 10-5: 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 BS 4142:2014: Methods for rating and assessing industrial and commercial sound that can be used to assess the likelihood of complaints from specific plant noise sources.

BS 4142

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

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

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

"ambient sound level, $L_{Aeq,T}$	*equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at any given time, usually from many sources near and far, at the assessment location over a given time interval, T.*
residual sound level, $L_{Aeq,T}$	*equivalent continuous A-weighted sound pressure level of the residual sound (i.e. ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound) at the assessment location over a given time interval, T.*
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, Tr.*
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 +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c. A difference of around +5dB 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 contains the following pertinent factor that must be considered with respect to the context of the sound, which is relevant to this assessment as the background noise levels are typically low at NSLs during periods of low wind speeds:

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

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

In light of the above guidance from EPA's NG4 and BS4142, is it considered that the proposed absolute criterion of 35dB $L_{Aeq,T}$ at the NSL for noise from the substation is robust to prevent adverse impacts at NSLs. The plant should not give rise to tonal or impulsive noise characteristics at noise-sensitive locations.

10.3.2.8 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 in the Proposed Development to the nearest NSL is approximately 590 m (approximate distance from turbine WTG-01 to NSL ref. H248). At that distance, the level of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria have not been specified for the operational phase of the Proposed Development.

10.3.2.9 Decommissioning Noise and Vibration

The guidance for construction noise and vibration assessment described above also applies to the decommissioning phase of the project at the end of the service life of the Proposed Development.

10.4 Assessment Methodology

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

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

10.4.1 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 Development during the construction/decommissioning and operational phases.

10.4.1.1 Construction and Decommissioning

During the construction and decommissioning phases, noise could occur at any location within the Site redline boundary and along public roads where there are increases in traffic associated with the Proposed Development. There is also a potential for noise impacts from HGVs along Turbine Delivery Route (TDR) during the construction and decommissioning phases of the Proposed Development.

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 Development. 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 works.

10.4.1.2 Operational Phase Noise

For the operational phase the study area should cover, at a minimum, the area predicted to exceed 35dB L_{A90} from all existing, permitted and proposed wind turbines. An appraisal of the list of wind farm developments in Chapter 2 identified that the nearest other wind turbine developments (existing, permitted or proposed) are Cloncreen Wind Farm located approximately 2.2km (21 turbines), Mount Lucas Wind Farm located approximately 4.1km (28 turbines) and Yellow River Windfarm located approximately 4.2km (29 turbines) from the Proposed Wind Farm. These 78 turbines have been included in the cumulative assessment presented in this Chapter.

Due to the potential for cumulative effects with other existing wind farm developments, the study area for the operational phase of the Proposed Development covered the area predicted to exceed 25dB L_{A90} at the maximum predicted noise emission level. Refer to Appendix 10-2 which show the relevant noise contours maps which identify this area. Therefore other wind farms within a 15km distance (namely Cushaling, Drehid and Moanvane) were not included in the cumulative assessment.

10.4.2 Background Noise Survey

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 five representative locations in the surrounding area.

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

10.4.2.1 Choice of Measurement Noise Locations

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

The co-ordinates for selected locations for the noise monitoring locations are outlined in Table 10-6 and identified on a map in

Figure 10-2.

Table 10-6: Coordinates of Noise Monitoring Equipment

Location	Coordinates (ITM)	
	Easting	Northing
A (H150)	656,082	733,110
B (H330)	657,668	732,084
C (H014)	657,623	729,003
D (H083)	655,690	727,308
E (H248)	655,783	730,959

Figure 10-2: Map of Noise Monitoring Locations

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

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

Noise from the operation of existing turbines located at Mount Lucas and Cloncreen wind farms were not noted to be audible at any of the locations during site visits. It should be noted that the level of wind turbine noise is variable, it is dependent on the operational condition of the turbine, wind speed and direction, distance from the turbines, and the levels of background noise at the location.

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

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

Plate 10-1 to Plate 10-5 illustrate the installed noise monitoring kits at each location.

Location A

The sound meter at Location A was installed in the garden to the front of the property to avoid noise from a heat recovery unit to the rear of the property. The meter was installed at a distance of 15m from the dwelling and 18m from the local road. There were no significant or atypical noise sources noted at this location. An observation of intermittent local road traffic noise was noted at this location.

Plate 10-1: NML-A

Location B

The sound meter at Location B was installed in the garden to the side garden of the property. The meter was installed in line with the rear façade of the dwelling and 15m from the local road. There were no significant or atypical noise sources noted at this location. An observation of distant road traffic noise and birdsong was noted at this location.

Plate 10-2: NML-B

Location C

The sound meter at Location C was installed in the garden to the rear of the property. The meter was installed at a distance of 20m from the dwelling and no direct line of sight to the road. There were no significant or atypical noise sources noted at this location. Cloncreen wind turbines to the south east were visible the installation location but no audible wind turbine noise was noted.

Plate 10-3: NML-C

Location D

The sound meter at Location D was installed in the rear garden of the property. The meter was installed in line with the rear façade of the neighbouring dwelling and 36m from the local road. There were no significant or atypical noise sources noted at this location. Road traffic noise was the dominant noise source at this location.

Plate 10-4: NML-D

Location E

The sound meter at Location E was installed in the greenfield opposite the property. The meter was installed in line with the rear façade of the dwelling and 23m from the local road. There were no significant or atypical noise sources noted at this location as the farmyard was sufficiently set back from the meter. An observation of intermitted local road traffic was noted at this location along with cows lowing in the distance. Cloncreen wind turbines to the south east were visible the installation location but no audible wind turbine noise was noted .

Plate 10-5: NML-E

10.4.2.2 Survey Periods

The survey duration was typically 4 weeks, or until such time that enough data points were captured at each survey locations. Section 2.9.1 of the IOA GPG states:

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

An review of the survey data was conducted at regular intervals to establish when adequate data had been captured. Noise measurements were undertaken at relevant monitoring locations over the periods outlined in Table 10-7.

Table 10-7: Measurement periods of Noise Monitoring Equipment

Location	Start Date	End Date
A	18 January 2024	29 February 2024
B	18 January 2024	29 February 2024
C	18 January 2024	29 February 2024
D	18 January 2024	29 February 2024
E	02 February 2024	29 February 2024

A variety of wind speed and weather conditions were encountered over the survey periods in question. Figure 10-3 shows the distribution of wind speed and direction recorded at the met masts for all periods of day and night between 18 January 2024 and 29 February 2024. The wind speed data presented below relates to a turbine hub height of 104m.

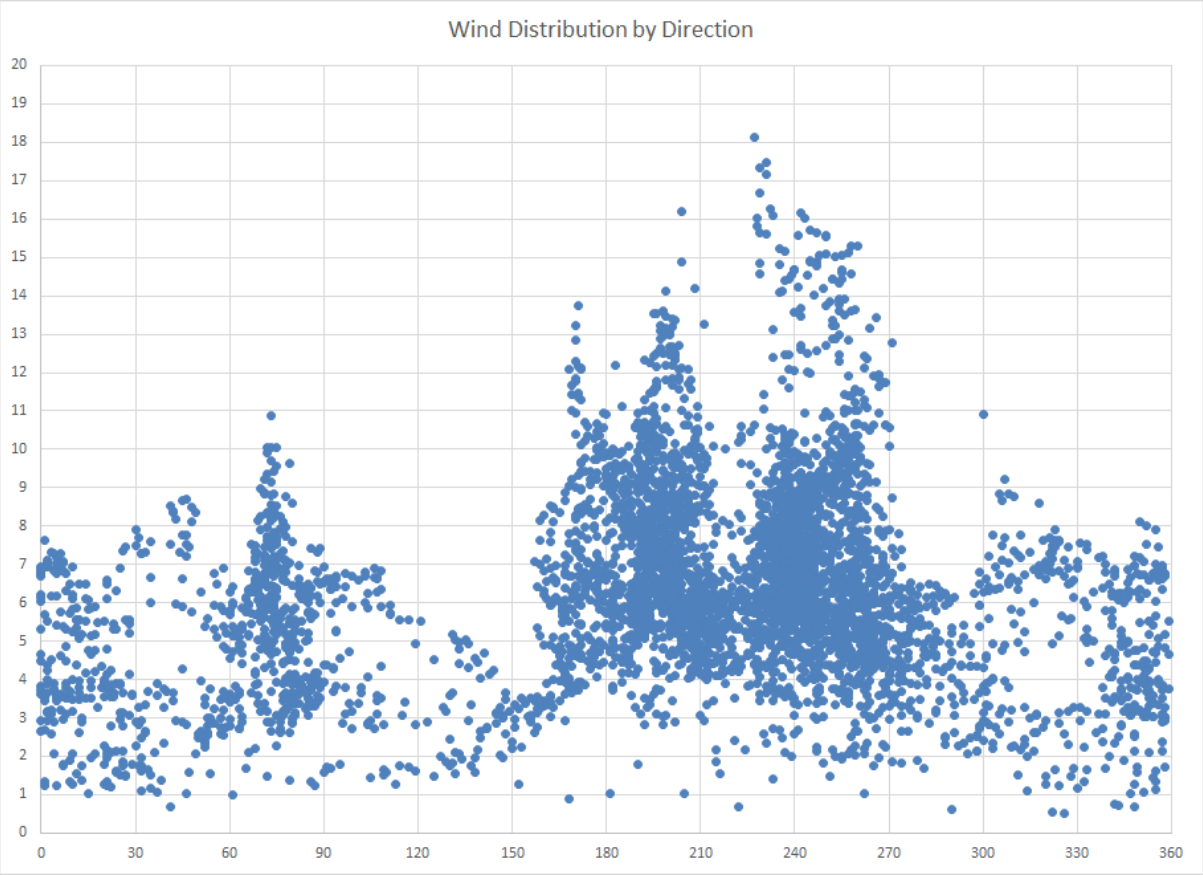

Figure 10-3: Distribution of Wind Speeds and Direction at Met Mast during Survey Period

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

10.4.2.3 Instrumentation

Table 10-8 confirms the details of the instrumentation installed at each location.

Table 10-8: Details of Noise Measurement Instrumentation

Location Ref.	Equipment Make and Model	Serial Number	Calibration Date
A	Rion NL-52	564809	13 January 2023
B	Rion NL-52	186668	13 June 2023
C	Rion NL-52	998409	01 February 2022
		575782	04 September 2023
D	Rion NL-52	186667	13 June 2023
E	Rion NL-52	998413	16 March 2022

Before, after and during each survey period, the measurement instrument was checked and calibrated using a Brüel & Kjær type 4231 Sound Level Calibrator. All calibration drifts were less than +/- 0.2dB. Copies of the relevant calibration certificates are included in Appendix 10-3.

Rainfall was logged and recorded using rain gauges installed at Location B and Location D. The rainfall data allows for the identification of periods of rainfall so that they can be removed from the noise monitoring data sets, in line with best practice, when calculating the prevailing background noise levels at the various locations.

Wind speed measurements were obtained from an onsite met mast with anemometers situated at 80m and 50m. The location of the met mast is provided in Table 10-9.

Table 10-9: Coordinates of Meteorological Mast

Item	Coordinates (ITM)	
	Easting	Northing
Ballinla Mast	657,304	732,129

10.4.3 Analysis of Survey Data

10.4.3.1 Measurement Procedure

Measurements were conducted at all locations over the survey periods outlined in Table 10-7. Data samples for all measurements (noise, rainfall, and wind) were logged continuously at 10-minute interval periods for the duration of the survey. The $L_{Aeq,10min}$ and $L_{A90,10min}$ noise parameters were measured in this instance and the results were saved to the instrument memory for later analysis.

Survey personnel noted potential primary noise sources contributing to noise build-up during the installation and removal of the sound level meters from site. Description of the observed noise environment at each of the monitoring locations is presented in Section 10.4.2.1.

10.4.3.2 Atypical Noise Data

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

10.4.3.3 Assessment Periods

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

Daytime Amenity hours are:

- All evenings from 18:00 to 23:00hrs.
- Saturday afternoons from 13:00 to 18:00hrs.
- All day Sunday from 07:00 to 18:00hrs.

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

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

10.4.3.4 Noise from Existing Turbines

An appraisal of the wider study area identified the operational Cloncreen and Mount Lucas wind farms which are located approximately 2.2km southeast and 4.1km southwest of the proposed wind farm site, respectively. Yellow River wind farm was not operational during the survey period and therefore not generating wind turbine noise which could affect the baseline noise measurements.

10.4.3.5 Consideration of Wind Shear

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

Equation A this uses the following equation:

Shear Exponent Profile:

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

Where:

U	calculated wind speed.
U_{ref}	measured wind speed.
H	height at which the wind speed will be calculated.
H_{ref}	height at which the wind speed is measured.
m	shear exponent.

Equation B this uses the following equation:

Roughness Length[5] Shear Profile:

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

Where:

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

The derived background noise level at integer wind speeds (standardised 10 m height) is dependent on the specific hub height. an assessment hub height of 104m has been used in this assessment. Any reference to wind speed in the following sections of this chapter should be understood to be the standardised 10m height wind speed reference unless otherwise stated.

[5] 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.

10.4.4 Construction Noise Calculations

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

Due to the nature of construction activities, it is difficult to calculate the actual magnitude of emissions to the local environment in the absence of a detailed construction programme. The standard best practice approach is to predict typical noise levels at the NSLs using guidance set out in BS5228-1 (BSI 2014a). Construction noise predictions have been carried out using guidance set out in the same guidance.

The methodology adopted for the assessment of construction noise is to analyse the various elements of the construction phase in isolation. For each element, the typical construction noise sources are assessed along with typical sound pressure levels and spectra from BS5228-1 (BSI 2014a) at various distances from these works.

10.4.5 Operational Noise Calculations

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

10.4.5.1 Noise Modelling software

The selected software, DGMR iNoise Enterprise (Version 2024.2.1) calculates noise levels in accordance with ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation, (ISO, 2024).

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

- The magnitude of the noise source in terms of A-weighted sound power levels (L_{WA}).
- The distance between the source and receiver.
- The presence of obstacles such as screens or barriers in the propagation path.
- The presence of reflecting surfaces.
- The hardness of the ground between the source and receiver.
- Attenuation due to atmospheric absorption.
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impacts at distances greater than approximately 400 m).

10.4.5.2 Noise Prediction Model - Input Data and Assumptions

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

10.4.5.3 Proposed Turbine Details

Table 2.1 in Chapter 2 details the co-ordinates of the seven turbines of the Proposed Development.

The turbine noise assessment has been undertaken for a turbine hub height of 104m, a rotor diameter of 162m and a tip height of 185m over the top of foundation level. The following section presents details of the sound power level data for the turbine unit that has been used for the operational turbine noise prediction modelling assessment.

The turbine noise levels have been predicted at NSLs for a range of operational wind speeds based on the source of noise at a hub height of 104m and noise emission data for the Vestas V162-7.2MW turbine[6]. The turbine unit is considered representative of the type of turbine that would be installed on the site taking into consideration the proposed dimensions and the nominal generation capacity.

While the noise profile of the Vestas V162 wind turbine has been used for the purposes of this assessment, the exact make and model of the turbine installed on the site will be dictated by a competitive procurement process but will adhere to the specifications and parameters set out above.

As the procurement process will be carried out several years post-consent, the wind turbine eventually selected for installation onsite will be selected so as not give rise to noise levels of greater significance than that used for the purposes of this assessment, to ensure the findings of this assessment remain valid i.e. the Vestas V162 7.2MW candidate wind turbine is within the range proposed for the Proposed Development, which may be selected by the developer subject to availability and the above-mentioned procurement process at that time.

Any references to the V162 turbines in this assessment must be considered in the context of the above statements and should not be interpreted as meaning it is the only make or model of wind turbine that could be installed on the site.

Table 10-10 details the turbine noise data used in the noise predictions models for the Proposed Development, the noise data is for turbines with serrated trailing edge (STE) blades.

Table 10-10: LWA Levels for – V162-7.2MW with 104 m Hub Height

Wind Speed (m/s at 10m Standardised Height)	Sound Power Level, dB L_{WA}
3	94.0
4	94.8
5	99.0
6	103.2
7	104.6
8	104.8
9	105.0
10	105.4
11	105.5

The manufacturer's turbine sound power levels outlined in Table 10-10 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 +2dB is applied in modelling to all turbine sound power levels presented in Table 10-10. The sound power frequency octave band noise levels used for the Vestas V162 are presented in Appendix 10-4.

As explained in Section 10.3.2.5, 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 2dB". A 2dB

[6] EnVestas V162-7.2MW 50/60Hz Document no. 0116-1715_03

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 2dB is applied in the noise prediction modelling.

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

10.4.5.4 Other Wind Farms Included in Cumulative Assessment

As mentioned in Section 10.3.2.5 a correct assessment of wind turbine noise should take into account the cumulative effects. Sound power levels for each turbine type in the three screened in windfarms (as outlined in Section 10.4.1.2) are presented in Table 10-10 to Table 10-13. The sound power frequency octave band noise levels used for the other turbines are presented in Appendix 10-4.

Table 10-11: Sound Power Levels for the V136 turbine at 102m hub height (Cloncreen Wind Farm)

Wind Speed (m/s at 10m Standardised Height)	dB L_{WA}
3	93.1
4	96.7
5	101.1
6	104.7
≥7	105.5

Table 10-12: Sound Power Levels for the S101 3MW turbine at 99.5m hub height (Mount Lucas Wind Farm7)

Wind Speed (m/s at 10m Standardised Height)	dB L_{WA}
4	99.0
5	103.9
6	105.8
≥7	107.0

Table 10-13: Sound Power Levels for the V126 turbine at 106m hub height (Yellow River Wind Farm)

Wind Speed (m/s at 10m Standardised Height)	dB L_{WA}
3	94.0
4	96.4
5	101.9
6	104.5
≥7	105.0

[7] Siemens Technical Report – Standard Acoustic Emission, SWT-3.0-101 (107dB), Hub Height 99.5 m Document ID: E W EN OEN DES TLS-10-0000-0300-00 HST, KOE/2012.03.28. This manufacturer's data has been used, including details of noise spectra. The detailed noise spectra are not presented here due for commercial reasons and associated non-disclosure agreements with the manufacturer.

10.4.5.5 Noise-Sensitive Locations

Appendix 10-6 details the coordinates of the NSLs used in this assessment. Noise predictions were prepared in respect of the various operational turbine wind speeds at these locations.

The IOA GPG states that the study area should at least include the predicted 35dB L_{A90} noise contour. In this instance the study area extends to 3km from the boundary of the Proposed Development. Appendix 10-7 presents the noise contours for the Proposed Development at 11m/s standardised wind speed. The set of 523 noise-sensitive locations included in this noise assessment extends well beyond the 35dB L_{A90} noise contour.

10.4.5.6 Modelling Calculation Parameters

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

The following Appendices provide comprehensive details of turbine sound power emissions (Appendix 10-4), noise prediction calculation settings (Appendix 10-5), the NSL (Appendix 10-6) and the turbine co-ordinates (Section 10.4.5).

10.5 Baseline Environment

This section of the chapter documents the typical background noise levels measured in the vicinity of the NSLs in closest proximity to the proposed wind farm site.

10.5.1 Derived Background Noise Level Survey

The following section presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and night time periods. These levels have been derived using regression analysis carried out on the data sets measured in line with best practice guidance Section 10.4.3.

10.5.1.1 Location A- H150

Figure 10-4 and Figure 10-5 shows the derived daytime and night-time background noise level for Location A.

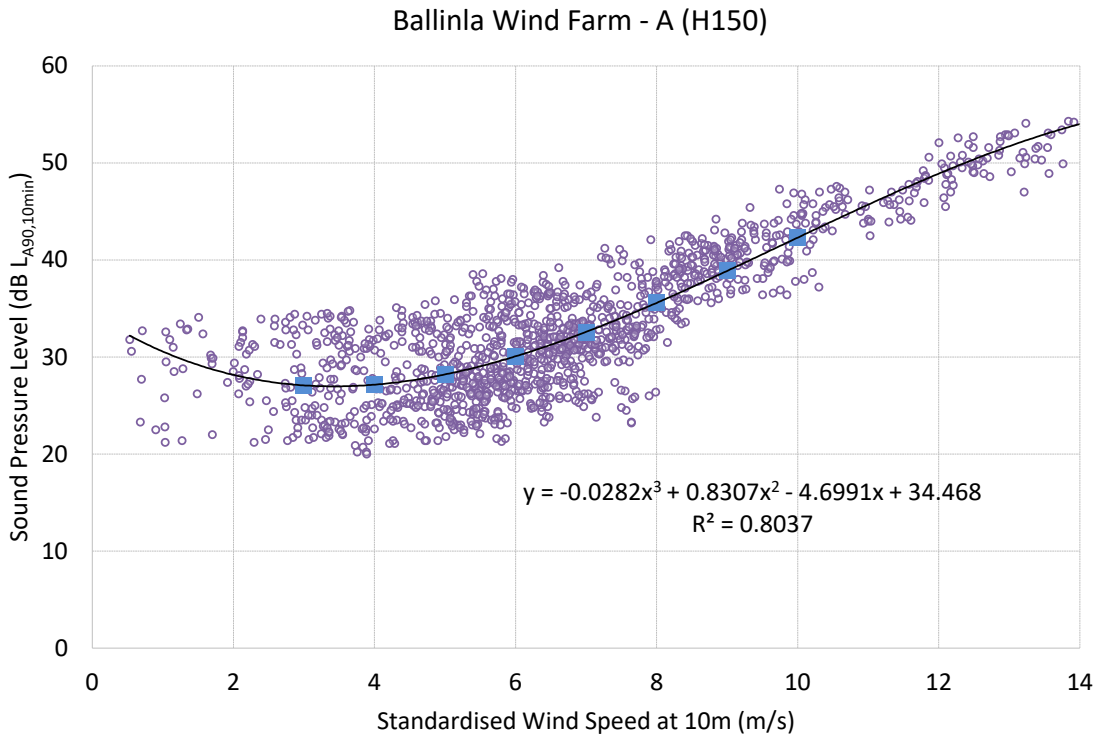

Figure 10-4: Background Noise Levels at H150 – Daytime – 104m Hub Height

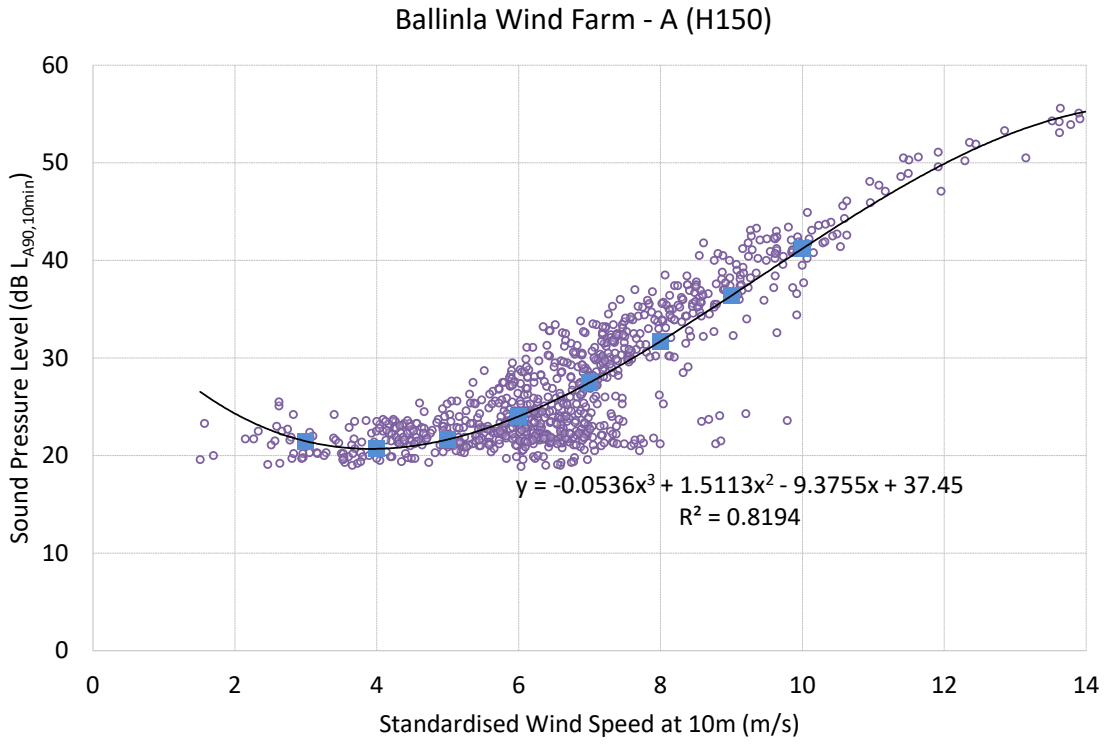

Figure 10-5: Background Noise Levels at H150 – Night-time– 104m Hub Height

10.5.1.2 Location B – H330

Figure 10-6 and Figure 10-7 shows the derived daytime and night-time background noise level for Location B.

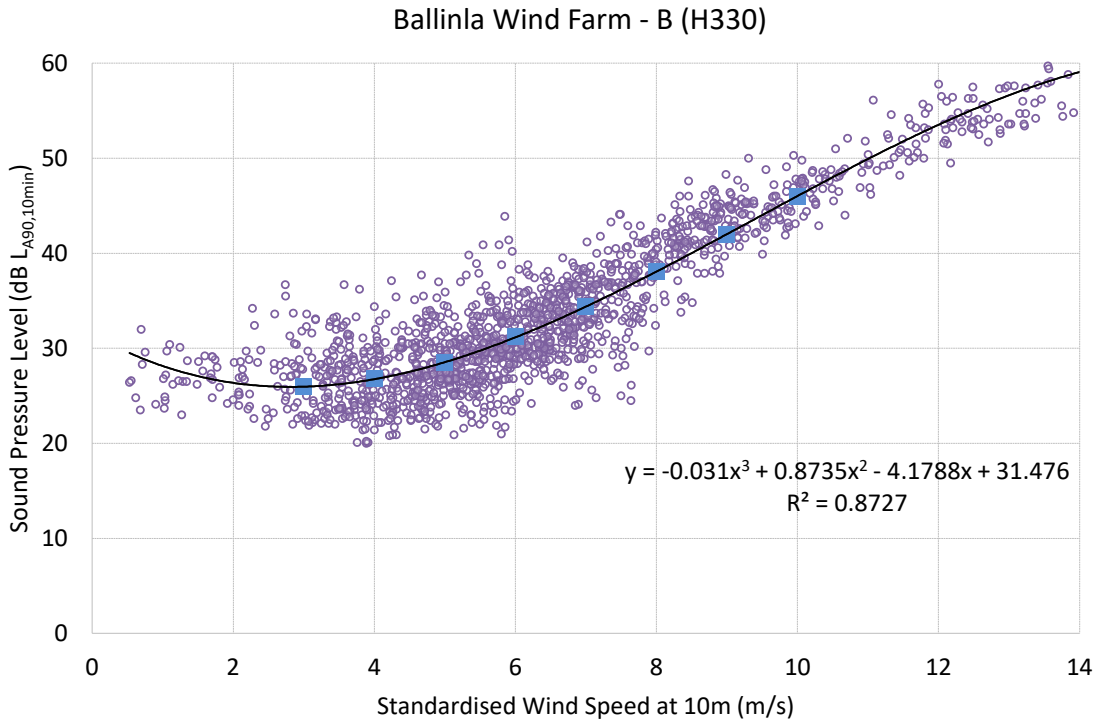

Figure 10-6: Background Noise Levels at H330 - Daytime– 104m Hub Height

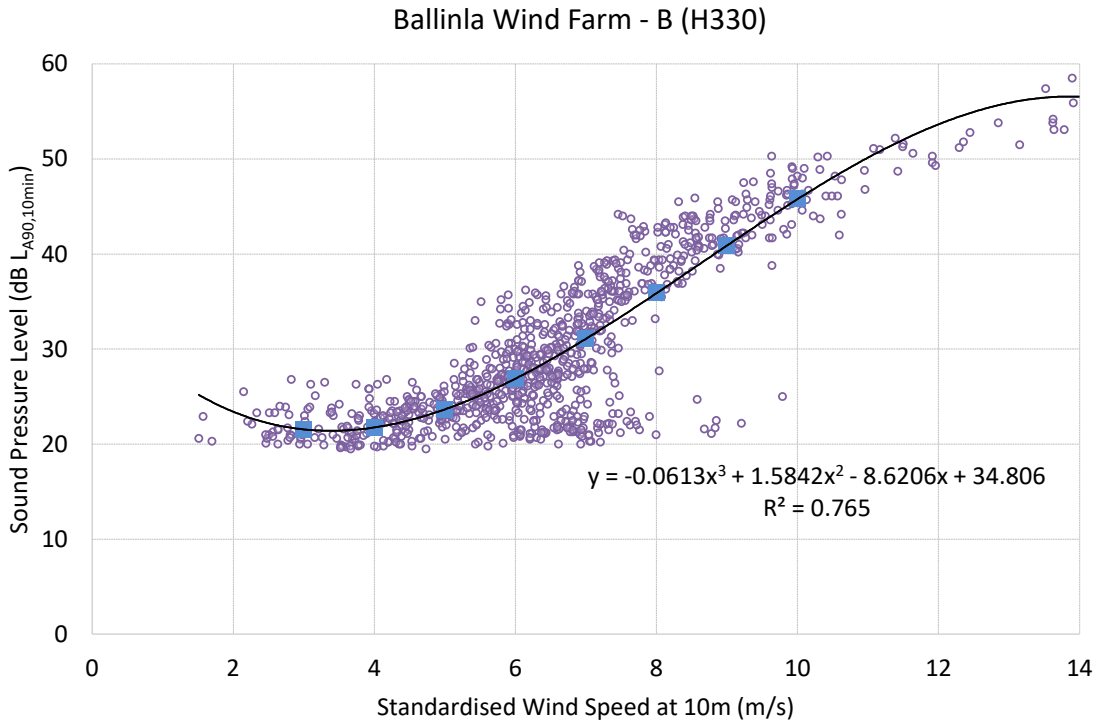

Figure 10-7: Background Noise Levels at H330 – Night-time– 104m Hub Height

10.5.1.3 Location C – H014

Figure 10-8 and Figure 10-9 shows the derived daytime and night-time background noise level for Location C, due to the potential contribution of noise from the existing and operational Cloncreen Windfarm, any noise data from the south and southeast directions have been removed from the regression analysis.

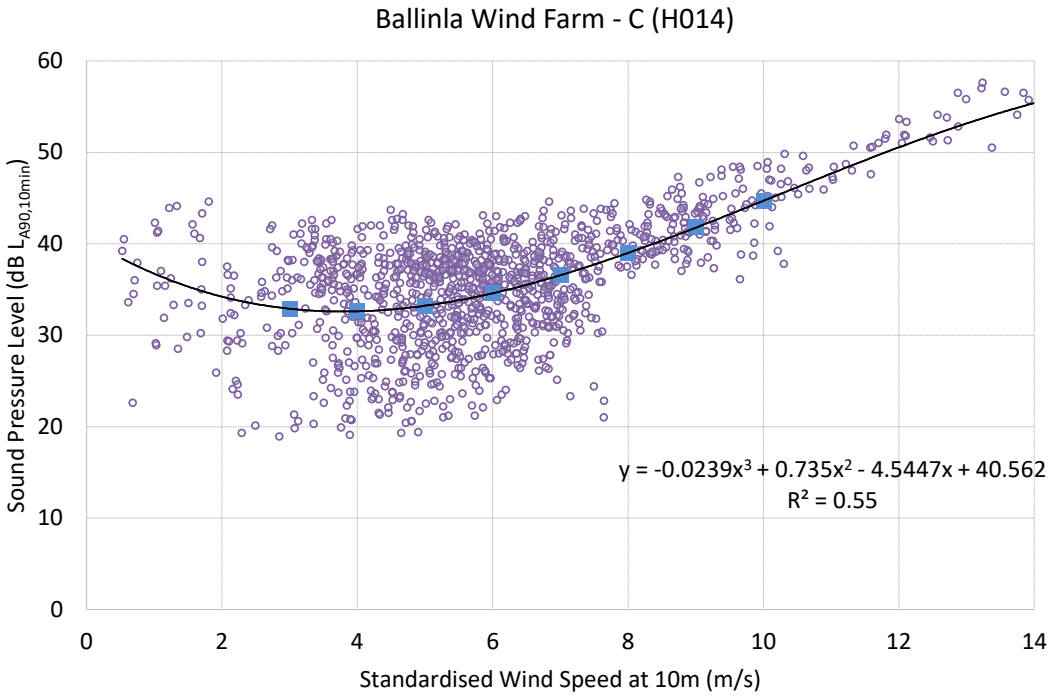

Figure 10-8: Background Noise Levels at H014 - Daytime– 104m Hub Height

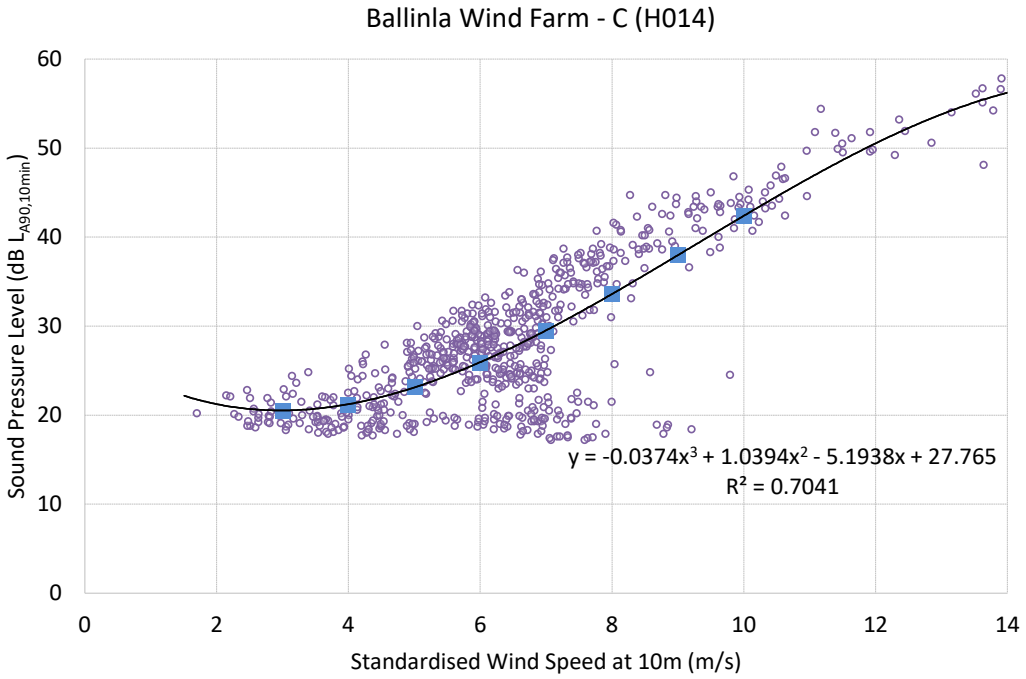

Figure 10-9: Background Noise Levels at H014 – Night-time– 104m Hub Height

10.5.1.4 Location D – H083

Figure 10-10 and Figure 10-11 shows the derived daytime and night-time background noise level for Location D, due to the potential contribution of noise from the existing and operational Mount Lucas and Cloncreen Windfarms, any noise data from the east, south, southeast and southwest directions have been removed from the regression analysis.

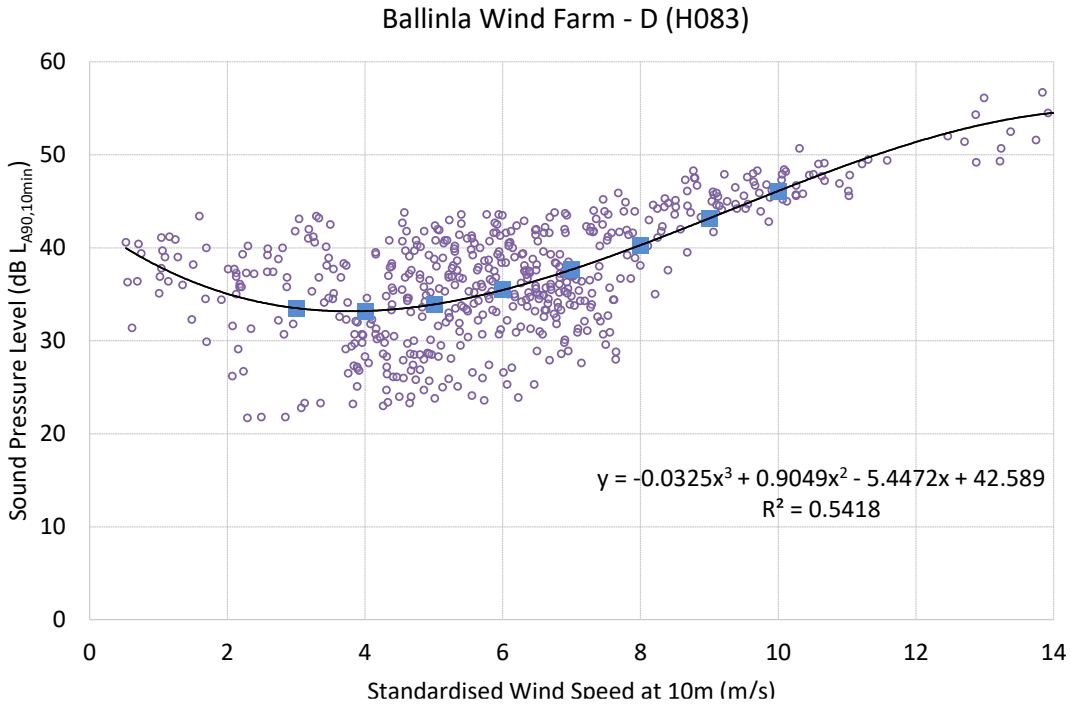

Figure 10-10: Background Noise Levels at H083 - Daytime– 104m Hub Height

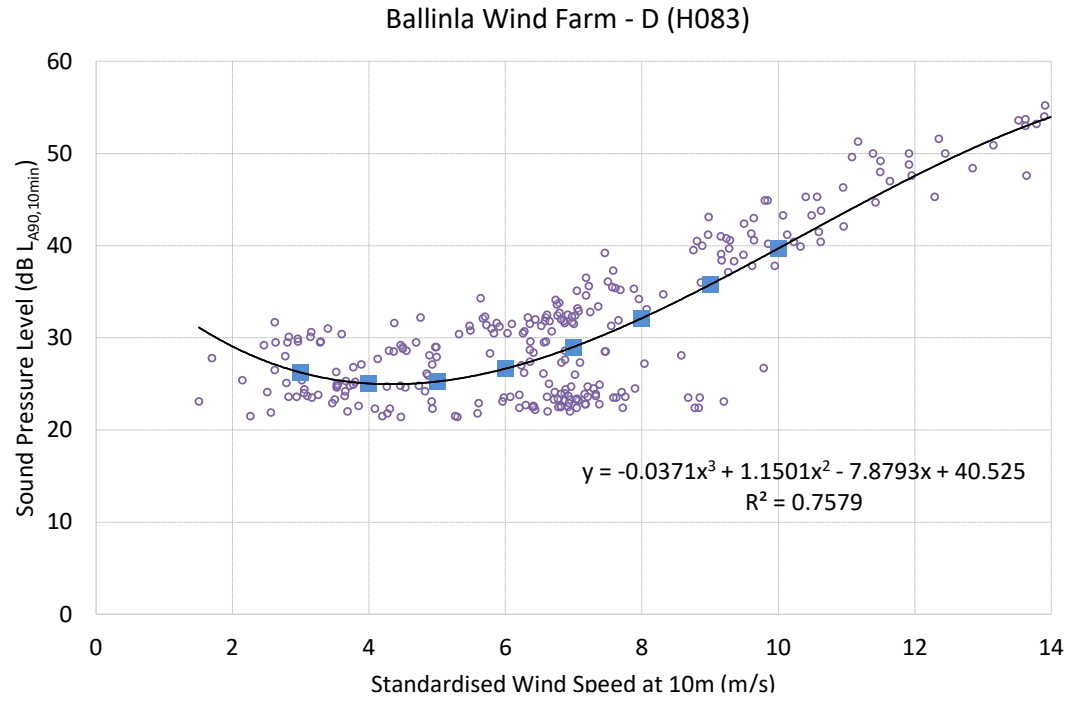

Figure 10-11: Background Noise Levels at H083 – Night-time– 104m Hub Height

10.5.1.5 Location E – H248

Figure 10-12 and Figure 10-13 shows the derived daytime and night-time background noise level for Location E.

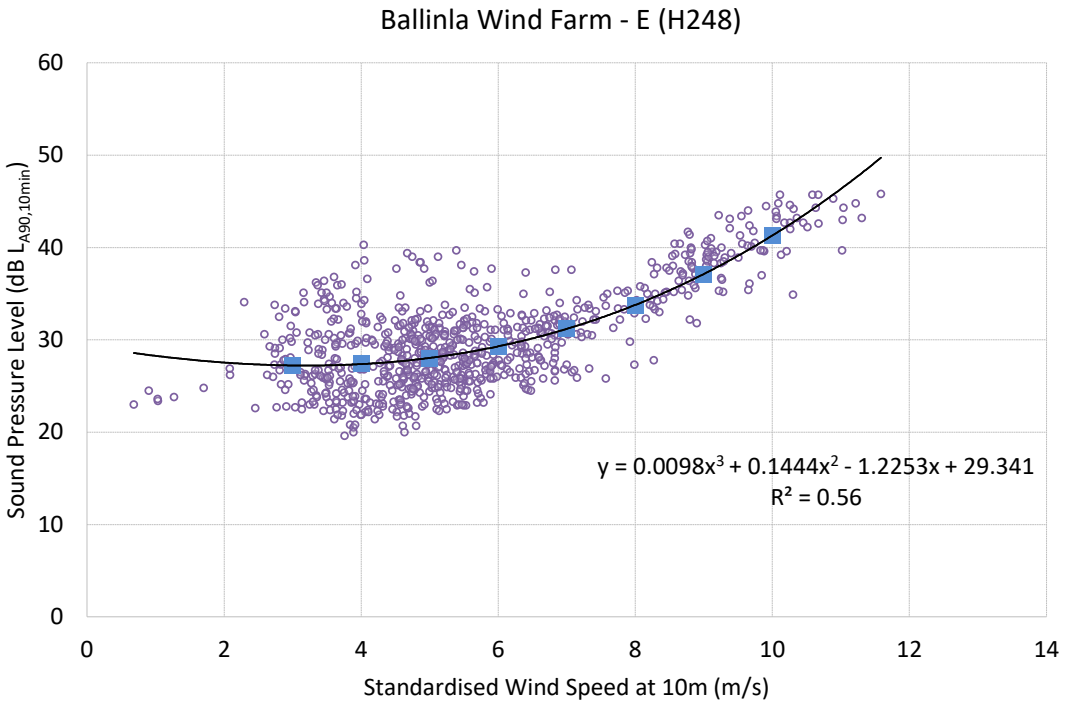

Figure 10-12: Background Noise Levels at H248 - Daytime– 104m Hub Height

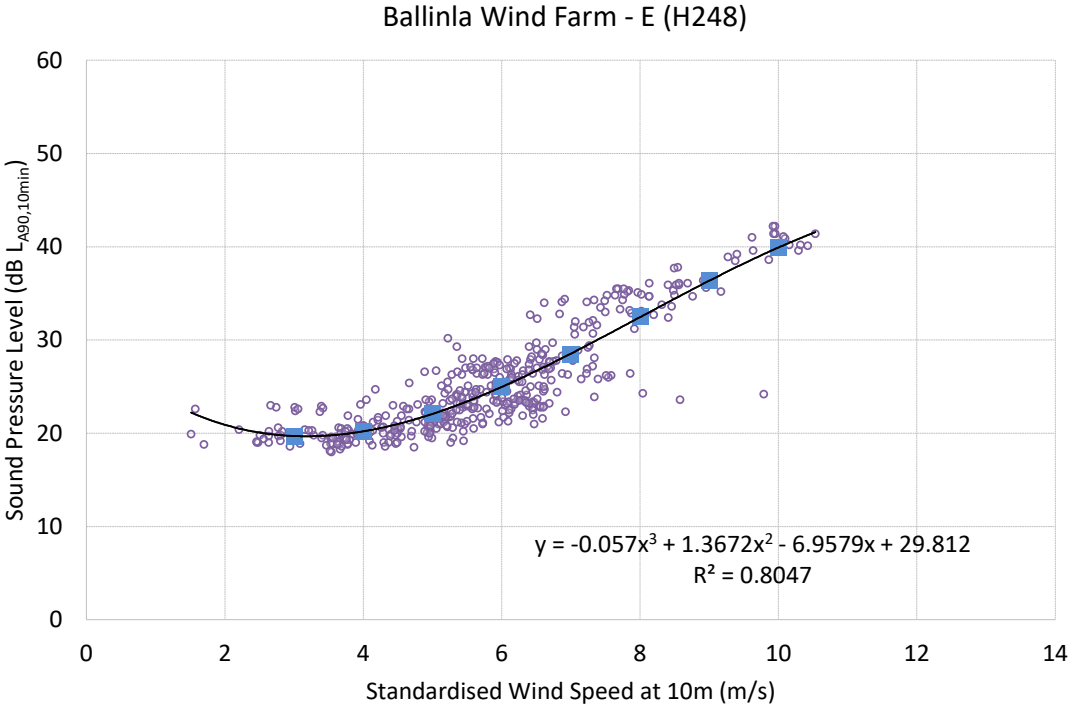

Figure 10-13: Background Noise Levels at H248 – Night-time– 104m Hub Height

10.5.1.6 Summary of Derived Background Noise Levels

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

Table 10-14: Derived Levels of $LA_{90,10\text{-}min}$ for Various Wind Speeds

Loc Ref	House	Period	Derived L_{A90}, 10-min Levels (dB) at Various Standardised 10m Height Wind Speeds									
			3	4	5	6	7	8	9	10	11	12
A	H150	Day	27.1	27.2	28.2	30.1	32.6	35.6	38.9	42.3	45.7	48.9
		Night	21.5	20.7	21.7	24.0	27.5	31.7	36.4	41.2	45.8	49.9
B	H330	Day	26.0	26.8	28.5	31.2	34.4	38.1	42.0	46.0	49.9	53.5
		Night	21.5	21.8	23.7	26.9	31.1	35.9	40.9	45.8	50.1	53.6
C	H014	Day	32.9	32.6	33.2	34.6	36.6	39.0	41.8	44.7	47.7	50.5
		Night	20.5	21.2	23.1	25.9	29.5	33.6	38.0	42.4	46.7	50.5
D	H083	Day	33.5	33.2	33.9	35.5	37.7	40.3	43.2	46.1	48.9	51.4
		Night	26.2	25.0	25.3	26.7	29.0	32.1	35.8	39.7	43.7	47.6
E	H248	Day	27.2	27.4	28.0	29.3	31.2	33.8	37.1	41.3	46.3	52.3
		Night	19.7	20.2	22.1	25.0	28.5	32.5	36.4	39.9	42.8	44.6
	Envelope	Day	26.0	26.8	28.0	29.3	31.2	33.8	37.1	41.3	45.7	48.9
		Night	19.7	20.2	21.7	24.0	27.5	31.7	35.8	39.7	42.8	44.6

A conservative envelope based on the lowest derived background levels at the various wind speeds for both day and night-time is presented in Table 10-14.

10.5.2 Wind Turbine Noise Limits

With respect to the relevant guidance documents outlined in Section 10.3.2.5, noise criteria curves have been established for the Proposed Development. The criteria curves have been derived following a detailed review of the background noise data conducted at representative NSLs described in Section 10.4.2.1.

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

- The EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)' proposes a daytime noise criterion of 45dB(A) in 'areas of low background noise'. Turbine noise limits are detailed in terms of the L_{A90} parameter while the NG4 daytime limit is detailed in terms of the L_{Aeq}. The accepted difference between the L_{Aeq} and L_{A90} for wind turbine noise assessments is 2dB, i.e., 45dB L_{Aeq} equates to 43dB L_{A90}. This approach infers a 3dB difference when accounting for difference parameters between the NG4 limits and the WEDG06 limits (40dB L_{A90}). The proposed lower threshold daytime criterion for wind turbine noise here is 3dB more stringent than the equivalent daytime noise limit for areas of low background noise outlined in NG4.

- The planning conditions issued by ACP (formerly ABP) for the Cloncreen Wind Farm (Planning Ref PL 19.PA0047) and Yellow River Wind Farm (Planning Ref. PL 19.PA0032) developments imposed an effective lower threshold of 43dB $L_{A90,T}$. The proposed lower threshold here is 3dB more stringent than these permitted windfarm levels.
- The planning conditions issued by ABP for the Mount Lucas wind farm (Planning Ref PL19.237263) development imposed an effective lower threshold of 41dB $L_{A90,T}$. The proposed lower threshold here is 1dB more stringent than this permitted windfarm level.
- A lower threshold of 40 or 43dB is commonly adopted in planning conditions for similar developments that have been granted planning permission by ABP and local planning authorities in recent years for example, Derrinlough Wind Farm (ABP Ref: 306706-20). Coole Wind Farm (ABP Ref: PL25M.300686), Borrisbeg (ABP-318704-23) and Ballivor (ABP-316212-23).

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

In summary, the operational noise limits proposed for the wind farm are:

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

Day and night time noise criteria curves have been determined from review of the derived background noise levels at five NSLs surrounding the Proposed Development and are presented in the relevant sections of this chapter.

10.5.2.1 Assigning Turbine Noise Limits

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

To rationalise the assessment, a conservative 'envelope review' will be applied to all non-surveyed locations. The envelope review is a conservative approach that adopts the lowest noise criteria derived from the measured background noise levels and applies it to all non-surveyed locations for the purpose of the assessment.

Table 10-15 outlines the operational noise criteria that will apply to this assessment. The derived criteria at 11m/s have been applied to higher wind speeds for the purpose of this assessment. It should be noted that as wind speed increases so too will the background noise levels, this approach to the assessment is therefore conservative.

Table 10-15: Proposed Noise Criteria Curves

Loc Ref	House	Period	Derived L_{A90}, 10-min Levels (dB) at Various Standardised 10m Height Wind Speeds								
			3	4	5	6	7	8	9	10	≥11
A	H150	Day	40.0	40.0	40.0	45.0	45.0	45.0	45.0	47.3	50.7
		Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.8
B	H330	Day	40.0	40.0	40.0	45.0	45.0	45.0	47.0	51.0	54.9
		Night	43.0	43.0	43.0	43.0	43.0	43.0	45.9	50.8	55.1
C	H014	Day	45.0	45.0	45.0	45.0	45.0	45.0	46.8	49.7	52.7
		Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	47.4	51.7
D	H083	Day	45.0	45.0	45.0	45.0	45.0	45.3	48.2	51.1	53.9
		Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.7	48.7
E	H248	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.3	51.3
		Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.8
Envelope		Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.3	50.7
		Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.7	47.8

10.5.3 Noise Limits for Fixed Plant

Based on a review of the measured noise from the background noise survey (Section 10.4.2), the NSLs in the vicinity of the site are defined as areas of low background noise as per the NG4 guidance. As the proposed substation will operate on a 24-hour basis, the potential impact during night-time periods governs the assessment. A night time criterion of 35dB $L_{Aeq,T}$ is considered appropriate for the operation of the substation. The substation design will ensure that the noise emissions do not contain audible tones or impulsive characteristics at the nearest NSLs. 35dB $L_{Aeq,T}$ is considered a low level of noise.

With respect to the guidance from the BS4142 standard, discussed in Section 10.3.2.6, it is considered that the proposed absolute criterion of 35dB $L_{Aeq,T}$ for noise from the substation is robust and should prevent adverse impacts at NSLs.

10.6 Assessment of Impacts and Effects

10.6.1 Construction Phase

Construction noise prediction calculations have been conducted using the assessment methodology outlined in Section 10.3.2.1. The noise levels referred to in this section are indicative only and are intended to demonstrate that it will be possible for the contractor to comply with current best practice guidance.

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

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

- Site preparation and earthworks.

- Construction of internal site access tracks.
- Construction of turbines (including foundations, component delivery and erection) and hardstand areas.
- Construction of substation.
- Cabling and grid connections.
- Temporary accommodation works.

Chapter 2 (Description of the Proposed Development) and Chapter 3 (Civil Engineering) has detailed information on each of these elements.

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

Construction activities will be carried out during normal daytime working hours (i.e., weekdays 0700 – 1900hrs and Saturdays 0800 – 1600hrs). However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (e.g., concrete pours) or to accommodate delivery of large turbine components along public routes it could be necessary on occasion to work outside of these hours. Any such out of hours working will be agreed in advance with the Local Authority.

10.6.1.1 Upgrade of Existing and Construction of New Internal Access Tracks

It is proposed to construct new internal access tracks to access the various parts of the Proposed Development. Review of the track layout has identified that the nearest NSL to any point along the proposed track is approximately 105m to H010 (ITM Ref: 655,967 Easting, 730,834 Northing) and H163 (ITM Ref: 656,267 Easting, 730,763 Northing). All other locations are at greater distances with the majority at significantly greater distances. The full description of the access tracks is outlined in Chapter 2 (Description of the Proposed Development).

Noise

Table 10-16 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 10-16: Indicative Noise Levels from Access Track Construction

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[8]	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) at 105m
HGV (C.2.30)	79	53
Excavator Mounted Rock Breaker (C9.12)	85	59
Vibration Rollers (D.8.29)	77	51
Cumulative Total	--	60

The table shows that at 105m distance from edge of works, noise levels are within the construction noise thresholds in Table 10-1 and therefore the impact is not significant. As these works will progress along the road the worst-case predicted impacts will reduce. Works will therefore be in proximity to the closest NSLs for limited

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

period. There are no items of plant or construction activities that are likely to give rise to noise levels that would be considered out of the ordinary or in exceedance of the thresholds outlined in Table 10-2. No specific mitigation measures are required.

Temporary works for the TDR are at 40 to 50m (ITM Ref: 656,895 Easting, 730,502 Northing) for the southern entrance and the TDR node in Ballyfore little (ITM Ref: 659,037, 730,194 Northing). At these closest NSLs the predicted construction noise level is 68dB, assuming all plant items operate simultaneously along the closest boundary to the NSLs. These works are temporary in nature and unlikely to be at the worst-case predicted effects for more than a few days. On this basis that the duration of the noise effect is brief, mitigation measures are not required. No specific mitigation measures are required.

Vibration

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

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 update of existing and construction of new internal access tracks are described below.

Table 10-17: Predicted Access Track Construction Noise Effects

Quality	Significance	Duration
Negative	Slight to Moderate	Brief to 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.

10.6.1.2 General Construction of Turbines and Hardstand Areas

Noise

Several noise sources that would be expected on a construction site of this nature have been identified and predictions of the potential noise emissions have been calculated at the closest sensitive receptor. In this instance the closest noise sensitive receptor is Location H248 (ITM Ref: 655,783 Easting, 730,959 Northing) which is situated approximately 590m from the proposed turbine WTG-01.

Table 10-18 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 10-18: Typical Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[9]	Predicted Noise Level (dB $L_{Aeq,T}$) at 590m distance
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials.	79	36
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	77	34

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

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[9]	Predicted Noise Level (dB $L_{Aeq,T}$) at 590m distance
Excavator Mounted Rock Breaker (C9.12)	Rock Breaking.	85	42
Piling Operations (C.12.14)	Piling Foundations (if required).	89	46
General Construction (Various)	All general activities plus deliveries of materials and plant	78	35
Dewatering Pumps (D.7.70)	If required.	80	37
JCB (D.8.13)	For services, drainage and landscaping.	82	39
Vibrating Rollers (D.8.29)	Road surfacing.	77	34
Cumulative Total		--	49

At 590m from the works the predicted noise levels from construction activities are in the range of 34 to 46dB $L_{Aeq,T}$ with a total 'worst-case' cumulative construction level of the order of 49dB $L_{Aeq,T}$. In all instances the predicted noise levels at the nearest NSLs are below the adopted significance threshold outlined in Table 10-1 (Category A – 65dB $L_{Aeq,T}$ 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 10-2 and this finding is valid should all items of plant operate simultaneously. No specific mitigation measures are required.

Vibration

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

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 worst-case associated effects at the nearest noise sensitive locations associated with construction of turbines and hardstanding areas are described as follows:

Table 10-19: Predicted Access Turbine Construction Noise Effects

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.

10.6.1.3 Substation Construction

Noise

The nearest NSL to the proposed substation is H248 (ITM Ref: 655,783 Easting, 730,959 Northing), which is approximately 375m to the closest point of the substation. As a worst-case example assuming the same construction activities as outlined in Table 10-18, it is predicted that the likely worst-case potential noise levels

from construction activities associated with the substation will be in the order of 54dB $L_{Aeq,T}$ at the nearest NSL. This level of noise is more than 10dB below the significance threshold of 65dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

Vibration

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

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 substation are described below.

Table 10-20: Predicted Access Substation Construction Noise Effects

Quality	Significance	Duration
Negative	Slight	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.

10.6.1.4 Proposed Grid Connection and Underground Cabling Construction

A network of underground cables serving each turbine will be installed along the internal access tracks connecting the turbines to the sub-station compound. There will be no overhead power lines constructed on the site. In addition a 110kV underground cable grid connection will be trenched into the road or the verge of the public road. The Proposed Grid Connection route is 8km long on local roads. The full description of the cable route is outlined in Chapter 2 of the EIAR, Description of the Proposed Development.

Noise

Table 10-21 outlines the typical construction noise levels associated with the proposed works for this element of the construction. Calculations have assumed an on-time of 50% for each item of plant i.e., that the item is operational simultaneously for 6 hours over a 12-hour assessment period. Note the plant items and activities are indicative and based on conservative assumption to be representative of a reasonable worst case.

Table 10-21: Indicative Noise Levels for Typical Construction Plant at Various Distances from the Grid Connection Works

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$)	Highest Predicted Plant Noise Level (dB $L_{Aeq,T}$)			
		15m	25m	50m	100m
Tracked Excavator (C.2.7)	70	63	57	50	43
Vibratory Plate (C.2.41)	80	73	67	60	53
Dumper Truck (C.4.4)	76	69	63	56	49
Cumulative Total	--	75	69	62	55

It is important to note that the works for the construction of the underground electrical cabling will vary and will not be continuous in nature. The associated construction works will occur for short durations (rolling construction method, approx. 100m to 200 m per day) at varying distances from NSLs. Works will therefore be in closest proximity to the nearest NSLs for limited amount of time, i.e. less than one day.

Review of the underground electrical cabling route has identified that there are 25 NSLs within 25m of route.

The predicted noise levels at the closest NSLs, at distances of within 25m from works have the potential to exceed the construction noise criterion of 70dB $L_{Aeq,1hr}$ set out in Section 10.3.2.1, if the works generate high noise level in proximity to the NSLs. As these works will progress along the route the worst-case predicted effects will reduce. However, on this basis that the duration of the noise effect is brief, mitigation measures are not required. No specific mitigation measures are required.

Vibration

Due to the distance of the proposed works from sensitive locations vibration effects from the construction of the Proposed Grid Connection are not likely at any NSL.

Another source of vibration is horizontal directional drilling (HDD) during the construction of the Proposed Grid Connection. Due to the distance of 70m from HDD works to the nearest receptor, vibration impacts from the HDD are not considered likely.

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 grid connection and underground cabling are described below.

Table 10-22: Predicted Access Grid Connection and Cabling Construction Noise Effects

Quality	Significance	Duration
Negative	Not Significant to Moderate	Brief

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.

10.6.1.5 Temporary Construction Compounds

Noise

The temporary construction compound is located adjacent to the substation compound at 670m south of T02.

The closest house to either compound is H010 (ITM Ref: 655,967 Easting, 730,834 Northing) at 220m distance. Assuming the same set of construction plant as for access roads outlined in Table 10-16, the predicted noise levels are 53dB $L_{Aeq,T}$ at H010. This level of noise is within the construction noise criterion of 65dB L_{Aeq}, outlined in Table 10-1. therefore it is concluded that there will be no significant noise impact associated with the construction of the temporary construction compounds.

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 the construction compound are described below.

Table 10-23: Predicted Access Grid Temporary Construction Compound Noise Effects

Quality	Significance	Duration
Negative	Not Significant to Slight	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.

10.6.1.6 Other Proposed Construction Works

Noise

Other elements of the proposed construction work include spoil management areas, landscaping and areas of tree felling. These works will be temporary in duration and similar to general agricultural works which take place regularly in the local area. Taking this into account, and considering the distances from these elements of the construction works to NSLs, no significant noise effects are expected.

Description of Effects

With respect to the EPA's criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with spoil management areas, landscaping and areas of tree felling are described are described below.

Table 10-24: Predicted Access Spoil Deposition Area, Landscaping and Felling Noise Effects

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.

10.6.1.7 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 Chapter 15 (Traffic and Transportation) has been used to inform the assessment presented here. Changes in the traffic noise levels associated with the construction traffic for peak construction year 2027, based on the Annual Average Daily Traffic have been calculated on based on information in Chapter 15. The results are presented in Table 10-25.

Table 10-25: Increase in Noise Level Due to Construction Traffic

Road	Do Nothing		Do Something		Change in Traffic Noise Level dB(A)	Significance of Effect
	Total Veh (AADT)	%HGV	Total Veh (AADT	%HGV		
L5010 @ WF site	162	4.9%	232	16.4%	+5.8	Significant see paragraph below
L5006, north of R402	680	3.8%	750	7.5%	+2.5	Not Significant
L5006, south of R402	748	3.5%	766	4.6%	+0.9	Imperceptible
R401, south of L5006	2,727	14.2%	2,745	14.4%	+0.1	Imperceptible

Road	Do Nothing		Do Something		Change in Traffic Noise Level dB(A)	Significance of Effect
	Total Veh (AADT)	%HGV	Total Veh (AADT	%HGV		
R400, north of R402	1,631	2.9%	1,701	4.6%	+1.5	Not Significant
R402 @ L5006 (Ballyfore)	3,940	4.9%	4,010	5.6%	+0.5	Imperceptible
R402 @ R400 (Mount Lucas)	4,231	4.9%	4,301	5.5%	+0.4	Imperceptible
R402 @ Edenderry	6,953	2.4%	7,023	2.8%	+0.4	Imperceptible
R420 between N52 and R402	8,370	5.7%	8,440	6.0%	+0.2	Imperceptible

In the majority of cases, the predicted increases in traffic noise levels during each of the construction stages are less than 3dB, with reference to the DMRB magnitude of impact set out in Section 10.3.2.3, the potential impacts are classified as 'negligible' to 'minor'.

Along the L5010, the change in noise levels correspond to potential 'major' impacts, however the predicted traffic noise level at 5m from the road edge is 55dB $L_{Aeq,\ 12hr}$. Also considering the highest peak hour along the L5010 (Table 15.12 Chapter 15) has 18 HGVs and 16 LGVs, the predicted traffic noise level at 5m from the road edge is 65dB $L_{Aeq,\ 1hr.}$ Both peak scenarios are within the criteria in Section 10.3.2.1 of 65dB $L_{Aeq,T}$, and therefore the effect is considered 'not significant'.

It is concluded that there will be no significant noise effects associated with the additional traffic generated during the construction phase.

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 potential associated effects at the nearest NSLs associated with additional traffic generated during the construction phase are described below.

Table 10-26: Predicted Construction Traffic Noise Effects

Quality	Significance	Duration
Negative	Imperceptible to 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.

10.6.2 Operational Phase

10.6.2.1 Assessment of Wind Turbine Noise

Using the assessment methodology described in Section 10.4.5 the predicted cumulative turbine noise levels have been calculated at all NSLs within the study area of the Proposed Development. A worst-case omni-directional cumulative 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 'worst-case' conditions favourable to noise propagation, i.e., downwind propagation from source to receiver and/or downward refraction under temperature inversions.

The results of the cumulative noise prediction models have been compared against the turbine noise limits that have been assigned to each of the NSL's as presented in Section 10.5.2.1 which in turn have been derived in accordance with the criteria set out in Section 10.3.2.5.

At all NSLs the worst cumulative omni-directional cumulative turbine noise levels are below the noise criterion curves, and at rated power at 11 m/s the highest predicted noise level is 41.9dB L_{A90}, which is more than 1dB below the minimum 43dB night-time threshold, regardless of background noise levels.

Appendix 10-8 presents the predicted cumulative omni-directional turbine results at all NSLs in tabulated form. Table 10-27 presents the result of the turbine noise predictions and assessment review at 13 no. locations with the highest levels of wind turbine noise predicted, at all other locations the maximum turbine noise levels are predicted to be <40dB L_{A90}. Noise contours for the omni-directional rated power wind speed (i.e., highest noise emission) are presented in Appendix 10-7.

Table 10-27: Review of Predicted Turbine Noise Levels against Relevant Criteria

NSL ID	Details	Noise Level,dB LA90 at Standardised Wind Speed, m/s								
	Parameter	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
H010	Predicted	29.9	30.8	35.0	39.2	40.6	40.8	41.0	41.3	41.4
	Daytime Criterion	40	40	40	40	45	45	45	46.3	50.7
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	44.7	47.8
	Night-time Excess	--	--	--	--	--	--	--	--	--
H019	Predicted	29.9	30.8	35.0	39.2	40.6	40.8	41.0	41.3	41.4
	Daytime Criterion	40	40	40	40	45	45	45	46.3	50.7
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	44.7	47.8
	Night-time Excess	--	--	--	--	--	--	--	--	--
H030	Predicted	29.8	30.7	35.0	39.2	40.6	40.7	40.9	41.3	41.4
	Daytime Criterion	40	40	40	40	45	45	45	46.3	50.7
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	44.7	47.8
	Night-time Excess	--	--	--	--	--	--	--	--	--
H089	Predicted	29.5	30.4	34.6	38.9	40.2	40.4	40.6	41.0	41.1
	Daytime Criterion	40	40	40	40	45	45	45	46.3	50.7
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	44.7	47.8
	Night-time Excess	--	--	--	--	--	--	--	--	--
H163	Predicted	29.8	30.7	35.0	39.2	40.6	40.8	40.9	41.3	41.4
	Daytime Criterion	40	40	40	40	45	45	45	46.3	50.7
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	44.7	47.8
	Night-time Excess	--	--	--	--	--	--	--	--	--
H210	Predicted	28.7	31.7	36.0	39.5	40.3	40.4	40.4	40.4	40.4

NSL ID	Details	Noise Level,dB LA90 at Standardised Wind Speed, m/s								
	Parameter	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	Daytime Criterion	40	40	40	40	45	45	45	46.3	50.7
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	44.7	47.8
	Night-time Excess	--	--	--	--	--	--	--	--	--
H248	Predicted	30.4	31.2	35.5	39.7	41.1	41.3	41.5	41.8	41.9
	Daytime Criterion	45	45	45	45	45	45	45	45	45
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	43	43
	Night-time Excess	--	--	--	--	--	--	--	--	--
H320	Predicted	28.7	31.7	36.0	39.5	40.4	40.4	40.4	40.4	40.4
	Daytime Criterion	40	40	40	40	45	45	45	46.3	50.7
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	44.7	47.8
	Night-time Excess	--	--	--	--	--	--	--	--	--
H447	Predicted	29.9	30.9	35.1	39.3	40.7	40.9	41.0	41.4	41.5
	Daytime Criterion	40	40	40	40	45	45	45	46.3	50.7
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	44.7	47.8
	Night-time Excess	--	--	--	--	--	--	--	--	--
H461	Predicted	28.7	29.7	33.9	38.1	39.5	39.7	39.8	40.2	40.3
	Daytime Criterion	40	40	40	40	45	45	45	46.3	50.7
	Daytime Excess	--	--	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43	44.7	47.8
	Night-time Excess	--	--	--	--	--	--	--	--	--

Description of Effects

The predicted cumulative noise levels associated with the Proposed Development are within best practice noise criteria recommended in the Irish guidance '*Wind Energy Development Guidelines for Planning Authorities*' (2006), therefore it is not considered that a significant effect is associated with turbine noise from the Proposed Development.

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

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the most impacted noise sensitive locations associated with operation of the wind turbine of the Proposed Development are described as follows:

Table 10-28: Predicted Operational Turbine Noise Effects

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.

10.6.2.2 Fixed Plant Noise

Substation

Details of the proposed 110kV substation are described in Chapter 2 (Description of the Proposed Development). The substation is likely to be operating continuously , and the noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with the operation of the substation at the nearest NSL.

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

Noise prediction model calculations for the operation of the substation have been undertaken in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation (2024)*. The predicted noise level from the operation of the substation at the nearest NSL (H163 - ITM Ref. 656,267 Easting, 730,763 Northing) at approximately 360 m) is 30dB $L_{Aeq,T}$. This level of noise is low, and it is concluded that there will be no significant noise emissions from the operation of the substation at any NSL. Furthermore, the predicted noise level is well below the criterion for fixed mechanical plant outlined in Section 10.3.2.6 and will not result in any adverse impacts at nearby NSLs. At the detailed design stage, substation plant will be selected to ensure that there are no tonal or impulsive characteristics form the plant audible at any NSLs during night time periods.

Description of Effects

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest NSLs associated with the operation of the fixed mechanical and electrical plant at the proposed substation is described below.

Table 10-29: Predicted Operational Fixed Plant Noise Effects

Quality	Significance	Duration
Negative	Not Significant	Long Term

10.6.3 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 Development can be considered to be comparable to those outlined in relation to the construction phase (as per Section 10.6.1) albeit less works will be required as only above ground structures will be removed. Turbine and mast foundations would remain underground and cable ducting will remain in situ. The underground cabling and onsite substation will remain in place. Refer to Chapter 2 (Description of Proposed Development) for full details. The predicted noise levels are expected to be below the appropriate Category A value (i.e. 65dB $L_{Aeq,T}$) at all NSLs for the decommissioning phase, the impact is not significant.

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 as **negative, not significant**, and **short-term**.

10.6.4 Do-Nothing

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

10.6.5 Cumulative Impacts and Effects

10.6.5.1 Construction and Decommissioning

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

The predicted noise levels from construction activity would need to be in well in excess of 55dB $L_{Aeq,T}$ at an NSL in order for a potential cumulative construction noise increase to exceed the noise thresholds. The assessment in Section 10.6.1 and 10.6.3 confirms that the predicted noise levels from activities at any NSL at ≥55dB $L_{Aeq,T}$ and 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.

10.6.5.2 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. A review of existing, proposed and permitted wind turbine developments in the wider study has been undertaken in accordance with the guidance contained in the IOA GPG, as outlined in Section 10.4.5.4. A cumulative wind turbine assessment has been scoped in for Cloncreen Wind Farm and Mount Lucas Wind Farm as the contributions from these wind farms and the results have been presented in Section 10.6.2.1. All other wind farm turbines at distances greater than 5km from the Proposed Development are more than 10dB below the lowest turbine noise limit and therefore have not been included in the cumulative assessment.

10.6.5.3 Proposed Grid Connection

It is not considered that any significant cumulative operational noise or vibration effects are likely in relation to the Proposed Grid Connection infrastructure. The underground cabling route will not generate any noise during the operational phase, and the predicted operational noise levels at the nearest NSL from the operation of the onsite substation are well below the noise criteria. Furthermore, the distance to any other developments will ensure that any contribution to cumulative noise will not be significant.

10.7 Mitigation and Monitoring Measures

The assessment of potential effects has demonstrated that the Proposed Development is expected to comply with the identified criteria for the construction, operational and decommissioning phases of the project and therefore no specific mitigation measures are required. However, to ameliorate any potential noise effects that may present during the Proposed Development, a schedule of noise control measures has been formulated.

10.7.1 Mitigation Measures

10.7.1.1 Construction and Decommissioning Phases

Notwithstanding the noise impacts being assessed as not significant, the following best practice measures will be implemented during construction of the Proposed Development:

- Fixed and semi-fixed ancillary plant such as generators, compressors etc. to be positioned to cause minimum noise disturbance. If necessary, acoustic barriers or enclosures to be provided for specific items of fixed plant.
- All plant used onsite will comply with the EC Directive on Noise Emissions for Outdoor Equipment (2000/14/EC), where applicable.
- Operation of plant in accordance with the manufacturer's instructions.
- All major compressors to be 'sound reduced' models fitted with properly lined and sealed acoustic covers which are kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools to be fitted with mufflers or silencers of the type recommended by the manufacturers.
- All plant used onsite will be regularly maintained.
- Machines in intermittent use to be shut down in the intervening periods between work or throttled down to a minimum.
- Drop heights of materials from lorries and other plant will be kept to a minimum.
- Adherence to the codes of practice for construction working given in BS 5228-1: 2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise and the guidance given therein for minimising noise emissions from the site.
- Adherence to the codes of practice for construction working given in Noise and BS 5228-2: 2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration and the guidance given therein for minimising vibration emissions from the site.
- Compliance with normal construction working hours of 07:00 to 19:00 Monday to Friday, 08:00 to 14:00 on Saturdays. This excludes public holidays, emergency work provisions and other working periods which would be agreed in writing with the Planning Authority.
- Periodically check that mitigation measures are being implemented and are fit for purpose during the works with corrective action mechanisms in place.
- Local residents will be kept informed and provision of a contact name and number for any queries or complaints.
- All complaints of an environmental nature related to the operation of the activity will be recorded. Each such record shall give details of the date and time of the complaint, the name of the complainant (if

provided), and give details of the nature of the complaint. A record shall also be kept of the response made in the case of each complaint.

Notwithstanding the vibration impacts being assessed as not significant, the following best practice measures will be implemented during construction of the Proposed Development:

- A clear communication programme will be established to inform closest building occupants in advance of any potential intrusive works which may give rise to vibration levels likely to exceed perceptible levels. The nature and duration of the works will be clearly set out in all communication circulars.
- Alternative less intensive working methods and/or plant items shall be employed, where feasible.
- Appropriate vibration isolation shall be applied to plant, where feasible.

A schedule of noise and vibration control measures has been formulated in accordance with best practice guidance and are outlined in the CEMP (Appendix 2-1) .

10.7.1.2 Operational Phase

Wind Turbine Noise

An assessment of the operational turbine noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 10.3.2.5 of this Chapter. A review of other wind turbine developments in accordance with the IOA GPG guidance has confirmed that the cumulative contribution of turbine noise from other sites, namely Cloncreen Wind Farm and Mount Lucas Wind Farm could be scoped in to the cumulative assessment, but all other windfarms at a distance greater than 5km could be scoped out as they are not significant.

The findings of the cumulative assessment confirmed that the predicted operational noise levels from the Proposed Development will be within the relevant best practice noise criteria. Therefore, no specific mitigation measures are required.

If alternative turbine models within the proposed specifications are considered for the Proposed Development, an updated noise assessment will be prepared to confirm that the noise emissions will comply with the noise criteria as per best practice guidance outlined in Section 10.3.2.5 and/or the relevant operational criteria associated with the grant of planning for Proposed Development.

Amplitude Modulation

In the event of a complaint which indicates potential AM associated with turbine operation, the operator will employ a qualified acoustic consultant to assess the level of AM in accordance with the methods outlined in the IOA Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, Institute of Acoustics IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group Final Report: A Method for Rating Amplitude Modulation in Wind Turbine Noise (9 August 2016) or subsequent revisions.

The measurement method outlined in the IOA AMWG document, known as the 'Reference Method', will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

These mitigation measures, if required, will consist of the implementation of operational controls for the relevant turbine type, which will include curtailment of turbines under specific operational conditions.

In the absence of widely accepted and robust planning conditions to control amplitude modulation (AM) from wind turbines, the commitments outlined in this EIAR are considered best practice. The proposed approach will

ensure that any negative impacts arising from AM associated with the operation of the Proposed Development will be effectively addressed by the operator.

Fixed Plant

The assessment of noise from the operation of fixed plant at the substation is predicted to comply with the proposed criteria in Section 10.3.2.6 . Therefore, no specific mitigation measures are required. However at the detailed design stage the following measures will be employed to ensure the noise levels at NSL are within the proposed criterion and the potential for noise disturbance is minimised:

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

10.7.2 Monitoring Measures

Commissioning noise surveys will be undertaken to ensure compliance with any noise conditions applied to the Proposed Development. It is common practice to commence surveys within six months of a proposed development being commissioned.

10.7.2.1 Wind Turbine Noise

If an exceedance of the noise criteria is identified as part of the commissioning assessment, the guidance outlined in the IOA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be followed, and relevant corrective actions taken. The commissioning survey will include a review for the presence of audible tones associated with the operation of the wind turbine farm in accordance with Annex C of ISO 1996-2:2017 Acoustics — Description, measurement and assessment of environmental noise Part 2: Determination of sound pressure levels.

For example, implementation of noise reduced operational modes resulting in curtailment of turbine operation can be implemented for specific turbines in specific wind conditions to ensure turbine noise levels are within the relevant noise criterion curves/planning conditions limits. Such curtailment can be applied using the wind farm SCADA system without undue effect on the wind turbine performance. Following implementation of these measures, noise surveys will be repeated to confirm compliance with the noise criteria.

10.8 Residual Effects

During the construction phase of the project there will be some effect on nearby NSLs due to noise emissions from site traffic and other construction activities. However, given the distances between the main construction works and nearby noise sensitive properties and the fact that the construction phase of the Proposed Development is temporary in nature, it is expected that the various noise sources will not be excessively intrusive. Furthermore, the application of binding noise limits and hours of operation, along with implementation of

appropriate noise and vibration control measures, will ensure that noise and vibration effect is kept within the guidance limits.

The predicted noise levels associated with the Proposed Development will be within best practice noise criteria curves recommended in Irish guidance 'Wind Energy Development Guidelines for Planning Authorities' therefore, it is not considered that a significant effect is associated with the Proposed Development.

During the decommissioning phase of the Proposed Development, there will be some effect on nearby noise sensitive properties 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 Development.

A summary of residual impacts is presented in Table 10-30.

Table 10-30: Residual Effects

Stage	Potential Effect	Pre-Mitigation Impact	Pre-Mitigation Significance of Effect	Mitigation Measures	Post-Mitigation Impact	Residual Effect
Construction	Construction Noise	Negative, negligible to minor and short-term	Not Significant to Moderate	Refer to Section 10.7.1.1	Negative, negligible to minor and short-term	Not Significant
Construction	Construction Vibration	Neutral, imperceptible and short-term	Not Significant	N/A	Neutral, imperceptible and short-term	Not Significant
Construction	Construction Traffic	Negative, negligible to major and short-term	Not Significant	N/A	Negative, not significant and short-term	Not Significant
Operational	Wind Turbine Noise	Negative, not significant and long-term	Not Significant	Refer to Section 10.7.1.2	Negative, not significant and long-term	Not Significant
Operational	Fixed Plant Noise	Negative, not significant and long-term	Not Significant	Refer to Section 10.7.1.2	Negative, not significant and long-term	Not Significant

10.9 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)

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

DMRB, 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)

DEHLG Wind Energy Development Guidelines 2006 (WEDGs)

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)

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 (2019 draft WEDGs)

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.