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# ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED DERRYNADARRAGH WIND FARM, CO. KILDARE, OFFALY & LAOIS

## Volume II – Main EIAR

## Chapter 8 – Noise and Vibration

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# 8. NOISE AND VIBRATION

## 8.1 Introduction

This chapter contains an assessment of the likely significant direct and indirect noise and vibration effects of the Proposed Development

The assessment including undertaking of background noise surveys has been carried out by Fehily Timoney and Company (FT), in accordance with current guidance and best practice relating to wind farm noise and vibration. Descriptions of the proposed development are provided in Chapter 2 – Volume II of the EIAR.

Potential construction noise and vibration impacts have been determined with reference to British Standard 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Part 1 - Noise and Part 2 - Vibration.

Potential operational noise impacts associated with the proposed development have been determined with reference to the UK Institute of Acoustics', A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013). It must be noted that a draft replacement document to ETSU-R-97 was published for consultation in July 2025, but is unlikely to be formally issued before the submission date of this EIAR. At the time of writing this EIAR, the draft Assessment and Rating of Wind Turbine Noise document is undergoing a consultation process and does not represent a final position for the UK Government. It is therefore not currently considered best practice to rely on the draft update. Operational noise associated with the proposed development includes noise from the proposed wind turbines and on-site substation. The wind turbine operational noise is compared with noise limits derived in accordance with the Wind Energy Development Guidelines 2006 (DEHLG 2006) currently in force and in accordance with current industry best practice. The substation operational noise has been assessed in accordance with BS4142:2014+A1:2019 Methods for rating industrial and commercial sound.

Decommissioning noise and vibration impacts have been assessed in accordance with the same standards used to determine the construction noise and vibration impacts.

The turbine which forms the basis of the operational noise assessment for the proposed development is the Vestas V162 7.2MW model with a 105m hub height.

## 8.2 Statement of Authority

John Cullen, Fehily Timoney and Company (FT) is an Environmental and Acoustic Engineer with a degree in Agri-Environmental Science from University College Dublin, a Post Graduate Diploma in Environmental Engineering from Trinity College Dublin and a Diploma in Acoustics and Noise Control from the Institute of Acoustics. John is a member of the Institute of Engineers Ireland (MIEI), the Institute of Environmental Sciences (MIEnvSc) and the Institute of Acoustics (MIOA). John has over eight years' experience in the assessment of environmental noise and vibration, and has worked with renewable energy and wind farm projects for over three years. He has undertaken baseline noise surveys for wind farms, developed computational noise models, assessed construction and operational noise impacts for wind farm projects and provided input to Requests for Further Information (RFIs) and the legal response for Judicial Reviews. John undertook the baseline noise survey and data analysis, completed the operational and construction noise predictions, noise impact assessment and compiled the Noise and Vibration Chapter for the Proposed Development.

Maureen Marsden, Fehily Timoney and Company (FT) is an Acoustic Engineer with a Master of Engineering degree in Acoustics and Vibration and over 20 years' experience, in noise and vibration, in particular in industrial noise, including wind farm and solar farm projects. Maureen is a member of the Institute of Acoustics and the Institute of Engineers Ireland. Maureen has worked with wind farm and renewable energy projects for over six years. She has undertaken baseline noise surveys for wind farms, assessed construction and operational noise for wind farm projects and developed noise curtailment strategies where required. In addition to writing Environmental Impact Assessment Report Chapters, she has responded to Requests for Information (RFI's) post EIAR submission and provided input to the legal response for Judicial Reviews. Maureen Marsden undertook the technical review of the Noise and Vibration Chapter and all technical inputs, including review of baseline noise data, noise predictions, and impact assessment.

## 8.3 Noise and Vibration Criteria

### 8.3.1 Construction Noise and Vibration

Noise is generated from the construction of the turbine foundations, the erection of the turbines, the excavation of trenches for cables, and the construction of associated hardstandings and access tracks, and construction of the substations.

Noise from vehicles on local roads and access tracks is also generated from the delivery of the turbine components and construction materials, notably aggregates, concrete and steel reinforcement.

Vibration is generated by construction activities such as rock breaking and passing heavy goods vehicles. The threshold of human perception of vibration in terms of Peak Particle Velocity (PPV) in mm/s is in the range of 0.14mm/s to 0.3mm/s, described as "might just be perceptible" in BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites-Vibration.

The guideline values for damage to buildings from vibration are 15mm/s at 4Hz increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above, as summarised in BS 5228-2 and BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (1993).

There is no piling or blasting associated with the proposed construction of Derrynadarragh Wind Farm. The likely vibration levels generated from the construction activities proposed at the Derrynadarragh Wind Farm are calculated as:

- Tracked excavators and disc cutters from cable trenching (0.8 mm/s at 4m)
- Pneumatic breakers for cable trenching (0.7 mm/s at 10 m)
- Excavation of turbine foundations (0.06 mm/s at 100 m)
- HGV traffic on normal road surfaces (0.01 to 0.5 mm/s) at footings of buildings located 20 m from roadway.

The nearest vibration sensitive locations are sufficiently distant from the construction works (c. 350m), and less than the values above, such that vibration will not be perceivable by residents at their dwellings and building damage will not occur from construction incurred vibration. As such, construction vibration will not be considered further in this chapter as no potential impacts arise.

### 8.3.2 Operational Noise and Vibration

Noise is generated by wind turbines as they rotate to generate power. This only occurs above the 'cut-in' wind speed and below the 'cut-out' wind speed. Below the cut-in wind speed there is insufficient strength in the wind to generate electricity efficiently and above the cut-out wind speed the turbine is automatically shut down to prevent any malfunctions from occurring. The cut-in wind speed at the turbine hub-height is approximately 3 m/s and the cut-out wind speed is approximately 25 m/s.

The principal sources of noise are from the blades rotating in the air (aerodynamic noise) and from internal machinery, normally the gearbox and, to a lesser extent, the generator (mechanical noise).

The blades are carefully designed to minimize noise whilst optimising power transfer from the wind. See Oerlemans et al. (2007) 'Location and quantification of noise sources on a wind turbine' for further details on the principal sources of noise from a wind turbine.

Noise may also be generated from ancillary equipment such as transformers at on-site substations. However, these generally have low source noise levels compared to wind turbines themselves and, provided they are not located within the immediate vicinity of a residential dwelling, are unlikely to cause disturbance in the context of the other noise sources. Noise from the proposed substation has been considered as part of this assessment and is discussed further in section 8.6.3.2

#### *8.3.2.1 Amplitude Modulation of Aerodynamic Noise (Blade Swish)*

This is the periodic variation in noise level associated with turbine operation, at the rate of the blade passing frequency (rotational speed multiplied by number of blades). It is often referred to as blade swish or amplitude modulation (AM). This effect is discussed in ETSU-R-97, 'The Assessment and Rating of Noise from Wind Farms' (1996), which states that *'… modulation of blade noise may result in variation of the overall A-Weighted noise level by as much as 3 dB(A) (peak to trough) when measured close to a wind turbine... '* and that at distances further from the turbine where there are *'… more than two hard, reflective surfaces, then the increase in modulation depth may be as much as 6 dB(A) (peak to trough)*'. It concludes that *'the noise levels (i.e. limits) recommended in this report take into account the character of noise described ... as blade swish'*.

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

In some cases amplitude modulation 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. This is known as '*Other AM'* , '*OAM*', or '*Excess AM*'.

It was proposed in the RenewableUK 2013 study that the fundamental cause of OAM 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 University of Salford carried out a study on behalf the Department for Business, Enterprise and Regulatory Reform (BERR, 2007) to investigate the prevalence of amplitude modulation of aerodynamic noise on UK wind farm sites. The study concluded that OAM occurred at 4 out of 133 wind farms in the UK. A further investigation of the four sites by the Local Authority showed that the conditions associated with OAM might occur between 7% and 15% of the time.

RenewableUK conducted research into AM and this was summarised in:, 'Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect' (December 2013). This research focused on the less understood 'Other AM' or 'OAM', where reported incidents are relatively limited and infrequent but is a recognised phenomenon. However, the occurrence and intensity of Other AM is specific to a location and its likelihood of occurrence cannot be reliably predicted.

Section 6 of the 'Summary of Research into Amplitude Modulation of Aerodynamic Noise from Wind Turbines - Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect' states that '*At present there is no way of predicting OAM at any particular location before turbines begin operation due to the general features of a site or the known attributes of a particular turbine*.'

However, the Guidance Note on Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (EPA, 2011) states…

'*features which are thought to enhance this effect are:*

- *close spacing of turbines in linear rows;*
- *tower height to rotor diameter ratio less than approximately 0.75;*
- *stable atmospheric conditions;*
- *topography leading to different wind directions being seen by the blades at different points in their rotation'.*

The RenewableUK study 'has found that by minimising the onset of blade stall, the occurrence of OAM is also likely to be minimised.' It goes on to discuss 'the future involvement of turbine manufacturers in developing methods of avoiding or minimising the partial stall mechanism identified as a primary cause of OAM; and suggests that in future changes to blade design and the way in which the blade pitch (the angle of attack of the blade to the incoming air flow) is controlled are likely to have a role to play in achieving better management of the phenomenon.' Ultimately, further work is required to identify the exact on-blade conditions required for OAM to occur and thus aid in the development of mitigation measures for OAM. If OAM occurs from the Proposed Development, the wind turbine(s) will be operated in a manner to address this through software controls, by way of implementation of blade pitch regulation, vortex generators or temporary turbine shut downs.

At present there is no method for predicting OAM at any particular location before turbines begin operation based on the general features of a site or the known attributes of a particular turbine. Therefore, it is not possible to predict an occurrence of OAM at the planning stage. It should also be noted that it is a rare event associated with a limited number of wind farms. While it can occur, it is the exception rather than the rule. The RenewableUK study states that *"even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent."*, and *"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."*

Assessment of AM Research and Guidance is ongoing, with publications being issued by the Institute of Acoustics (IOA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG): *"A Method for Rating Amplitude Modulation in Wind Turbine Noise"* (2016). 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 to use existing research to develop a Reference Methodology for the measurement and rating of AM. The definition of any limits of acceptability for AM, or consideration of how such limits might be incorporated into a wind farm planning condition, is outside the scope of the AMWG's work. There has been no adoption of endorsement of an AM 'penalty' scheme by any government. The IOA GPG states "*The evidence in relation to "Excess" or "Other" Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM."*

The current best practice relating to OAM is outlined in the more recent document prepared by WSP Consultants on behalf of the UK Department for Business, Energy & Industrial Strategy (BEIS): *"A review of noise guidance for onshore wind turbines (ref 70081416-001-03-05)"*, 2023.

The WSP report identifies controls for AM in wind turbine sound as a priority area for current AM guidance. It notes that the IOA Reference Method for AM measurement (outlined above) has been shown to be a robust and practical approach to quantifying AM once the wind farm is operational. The report considers that of the measurement methods available, the IOA methodology offers the best balance between reliability and practicality.

The WSP report states that there is limited scientific evidence available concerning the impact of AM, as experienced by wind farm neighbours in their homes. The WSP report recommends a study to determine most effective way of controlling the impact of AM.

Where it occurs, AM is typically an intermittent occurrence, therefore assessment may involve long-term measurements. As described in the WSP report, the 'Reference Method' for measuring AM outlined in the IOA AMWG (2016) document will provide a robust and reliable indicator of any associated AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions to be implemented to avoid the occurrence. Furthermore, Wind Energy Ireland (WEI) published the *"WEI Position Paper on Amplitude Modulation Planning Conditions"* in October 2025. The paper concludes that "No AM" conditions are *"not realistic, not evidence based and are unsupported by science"*. The paper supports a complaints based monitoring system, in line with UK good practice (IOA guidance).

#### *8.3.2.2 Infrasound and Low Frequency Noise*

The definition of low frequency noise can vary, but it is generally accepted that low frequency noise is noise that occurs within the frequency range of 10 Hz to 160 Hz as defined in NANR45: "*Procedure for assessment of low frequency noise, Salford University Report"*.

Infrasound is noise occurring at frequencies below that at which sound is normally audible, that is, less than about 20 Hz, owning to the significantly reduced sensitivity of the ear at such frequencies. In this frequency range, for sound to be perceptible, it must be at very high amplitude, and it is generally considered that when such sounds are perceptible then they can cause considerable annoyance. However, wind turbines do not produce infrasound at amplitudes capable of causing annoyance as outlined in the following paragraphs.

The UK Department of Trade and Industry study, 'The Measurement of Low Frequency Noise at Three UK Windfarms', concluded that:

*"infrasound noise emissions from wind turbines are significantly below the recognised threshold of perception for acoustic energy within this frequency range. Even assuming that the most sensitive members of the population have a hearing threshold which is 12 dB lower than the median hearing threshold, measured infrasound levels are well below this criterion."*

It goes on to state that, based on information from the World Health Organisation, '*there is no reliable evidence that infrasound below the hearing threshold produce physiological or psychological effects*' and that '*it may therefore be concluded that infrasound associated with modern wind turbines is not a source which may be injurious to the health of a wind farm neighbour*'.

The study reports that low frequency noise is measurable but below the UK DEFRA low frequency noise criterion. The study also assessed low frequency measurements against the Danish criterion of LpA,LF = 20 dB. It was found that internal levels do not exceed 20dB when measurements are undertaken within rooms with the windows closed. However, the study acknowledges that wind turbine noise (low frequency) may result in an internal noise level that is just above the threshold of audibility as defined in ISO 226. The study goes on to say… '*However, at all the measurement sites, low frequency noise associated with traffic movement along local roads has been found to be greater than that from the neighbouring wind farm*.'

Bowdler et al. (2009) concludes 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*'.

In January 2013, the Environmental Protection Authority of South Australia published the results of a study into infrasound levels near wind farms. Measurements were undertaken at seven locations in urban areas and four locations in rural areas including two residences approximately 1.5 km from the wind turbines. The study concluded 'that the level of infrasound at houses near the wind turbines … *is no greater than that experienced in other urban and rural environments and is also significantly below the human perception threshold*.'

In 2016, the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in Germany published a report entitled '*Low-frequency noise incl. infrasound from wind turbines and other sources.*' It assessed infrasound and low frequency sound from wind turbines and other sources. It found that for '*the measurements carried out even at close range, the infrasound levels in the vicinity of wind turbines – at distances between 150 and 300 m – were well below the threshold of what humans can perceive in accordance with DIN 45680 (2013).*'

This is further supported by a report undertaken by WSP on behalf of the Department for Business, Energy & Industrial Strategy (2022), "A review of noise guidance for onshore wind turbines", report reference 70081416 001 03 03] which concludes that *"the findings from the existing evidence base indicate that infrasound from wind turbines at typical exposure levels has no direct adverse effects on physical or mental health".*

It is concluded that infrasound noise emissions from wind turbines are significantly below the recognised threshold of perception for acoustic energy within this frequency range and there is no evidence of health effects arising from low frequency noise generated by wind turbines. Therefore, infrasound is not a source which may be injurious to the health of a wind farm neighbour and an assessment of infrasound and low frequency noise from the proposed wind farm has been scoped out of this assessment.

#### *8.3.2.3 Tonal Noise*

Relevant industry Guidance, "The Assessment and Rating of Noise from Wind Farms" ETSU-R-97 describes tonal noise as '*noise containing a discrete frequency component most often of mechanical origin*'. Wind turbine sound can be tonal in some cases, for example if there is a defect in a turbine blade or a fault in the mechanical equipment such as the gearbox. Tonality from wind turbines is generally caused by structural resonances in the mechanical parts of the turbine and thus is highly specific not only to the turbine model but the specific components used, including tower height. However, a correctly operating modern wind turbine is not considered to have tonal sound emissions. Therefore, in EIA terms, the occurrence of tonal noise is not considered likely.

The WSP Consultants report "A review of noise guidance for onshore wind turbines" (BEIS, 2023) notes there are several methods for evaluating tonal characteristics. Also, tonality characteristics in sound emissions from turbines have been effectively addressed with improved technology from turbine manufacturers.

The source data provided for the turbine which forms the basis of this assessment (Vestas V162 7.2MW) does not indicate a tonal component. In the event of tonal noise being present and following establishment of the likely cause, this can be addressed by turbine manufacturers and/or operator as and when it occurs through software controls and repairs/replacements of turbine components. There are no potential impacts from tonal noise anticipated from the proposed development. In accordance with best practice guidance, the assessment of wind turbine noise in this EIAR chapter assumes that there are no tonal sound emissions associated with the proposed turbines and there is no correction therefore required for tonal noise, i.e., the tonal penalty is 0 dB.

#### *8.3.2.4 Substation Noise*

Noise from the proposed substation has been assessed using the methodology described in British Standard, BS4142:2014+A1:2019 *Methods for rating industrial and commercial sound*. BS4142 describes a method for rating and assessing sound of an industrial and/or commercial nature, and is considered best practice guidance for the assessment of substation noise emissions. The method described in BS 4142 uses outdoor sound levels to assess the likely effects of sound on people inside or outside a dwelling or premises used for residential purposes upon which sound is incident. The BS4142 methodology and assessment is described further in Section 8.4.3.3.

#### *8.3.2.5 Vibration*

Vibration from operational wind turbines is low and will not result in perceptible levels at nearby sensitive receptors, nor will the levels of vibration result in any structural damage. Research undertaken in "*Low frequency noise and vibrations measurements at a modern wind farm"* (D J Snow, 1997), found that levels of ground-borne vibration 100 m from the nearest wind turbine were significantly below criteria for 'critical working areas' given by British Standard BS 6472:1992 Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz) and were lower than limits specified for residential premises by an even greater margin. Hence, the level of vibration produced by wind turbines at this distance is low and does not pose a risk to human health.

More recently, a research project titled "*Low-frequency noise incl. infrasound from wind turbines and other sources*" (Federal State of Baden-Württemberg, 2016) simultaneously measured vibration at several locations, ranging from directly at the wind turbine tower to up to 285m distance from an operational Nordex N117 – 2.4 MW wind turbine with a hub height of 140.6m. The report concluded that at less than 300m from the turbine, the vibration levels had reduced such that they could no longer be differentiated from the background vibration levels.

Considering the curtilage of the nearest sensitive receptor is over 730m from the nearest turbine, the level of vibration from the turbine (Vestas V162 7.2MW with a 105m hub height) is significantly below any thresholds of perceptibility. Vibration from the turbines is too low to be perceived at neighbouring residential dwellings.

Vibration levels will also be significantly below levels that would result in damage to the nearest buildings (including farm buildings). Therefore, operational vibration associated with the Proposed Development has been scoped out of this assessment as no potential impacts arise.

##### *8.3.2.6 Decommissioning Noise and Vibration*

Decommissioning of the site will be comparable to the construction phase. The current best practice guidance for construction noise and vibration assessment described above also applies to the decommissioning phase of the wind farm at the end of the service life of the proposed wind farm site.

## 8.4 Methodology

The methodology adopted for this noise and vibration assessment is as follows:

- Review of appropriate best-practice guidance and specification of suitable construction and operational noise / vibration criteria
- Characterisation of the receiving noise environment/baseline
- Prediction of the noise impact associated with the proposed development
- Evaluation of noise impacts and assessment of resulting likely direct and indirect significant effects
- Propose mitigation
- Assess residual impacts.

### 8.4.1 Relevant Guidance

A list of relevant guidance documents is provided below. These have been referred to where referenced or applied in the relevant sections hereafter.

EIA Guidance:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports, Environmental Protection Agency, May 2022

Guidance on the Preparation of the Environmental Impact Assessment Report (European Commission, 2017).
Noise Modelling Standards and Technical Advice:

- International Standard ISO 9613-2: 2024 *Attenuation of sound during propagation outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors*;
- UK Institute of Acoustics', *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment at Rating of Wind Turbine Noise (2013) and supplementary notes*;
- British Standard BS 5228 Part 1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites Part 1: Noise*;
- Irish Wind Energy Association, *Best Practice Guidelines for the Irish Wind Energy Industry (2012)*;
- UK Department of Trade and Industry (DTI), ETSU-R-97, *The Assessment and Rating of Noise from Wind Farms (1996)*;
- British Standard 4142:2014+A1:2019, *Methods for rating and assessing industrial and commercial sound.*
- Environmental Protection Agency 2011, *Guidance Note on Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3).*

Guideline Noise Levels:

- Wind Energy Development Planning Guidelines, Department of the Environment, Heritage and Local Government (2006);
- Draft Revised Wind Energy Development Guidelines (December 2019), Department of Housing, Planning and Local Government, 2019;
- Offaly County Development Plan 2021-2027;
- Offaly Wind Energy Strategy 2021-2027;
- Kildare County Development Plan 2023-2029;
- Kildare Wind Energy Strategy 2023-2029;
- Laois County Development Plan 2021-2027;
- Laois Wind Energy Strategy 2021-2027.

### 8.4.2 Study Area

Construction and decommissioning noise have been assessed by comparing predicted construction activities against best practice construction noise criteria outlined in Standard BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Noise at the nearest noise sensitive receptors to the construction activities. As such, if the construction noise meets the relevant noise limits at the nearest locations, it will also be below the relevant noise limits at more distant residential locations.

The operational noise study area includes all noise sensitive locations with a predicted noise level greater than 35 dB $L_{A90}$ (which is the lowest limit in the 2006 Department of the Environment, Heritage, and Local Government, Wind Energy Development Guidelines). The study area is also in accordance with the UK Institute of Acoustics', A Good Practice Guide to the Application of ETSU-R-97 for the Assessment at Rating of Wind Turbine Noise (2013) whereby the guidance document defines the study area as "*the area within which noise levels from the proposed, consented and existing wind turbine(s) may exceed 35 dB $L_{A90}$ at up to 10 m/s wind speed.*"

The hub height and the choice of turbine are the main elements that influence the operational noise impact of the development. Any influence of blade length is accounted from by the turbine manufacturer in their sound power data which is used for the purpose of modelling the proposed turbine layout using the representative turbine.

As discussed in Chapter 2, Volume II of this EIAR, for the purpose of the noise assessment, the turbine model for Derrynadarragh Wind Farm is the Vestas V162 7.2 MW wind turbine, with a hub height of 105 m. This is the turbine model and hub height used in the assessment, along with the 9-turbine layout shown on the planning drawings. Turbines T1, T4, T5, T8 and T9 will be placed on a 1m concrete plinth, as described in Chapter 2, Volume II of the EIAR, resulting in a hub height of 106m for these turbines. In accordance with best industry practice, these turbine heights have been accounted for in the noise modelling, however there is no appreciable change in sound power of a 105m and 106m hub height turbine, when standardised to 10m. Therefore, the 105m standardised data is presented in this Chapter.

The IOA guidance (2013) also states… "*During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary.*"

Other existing and proposed developments located within 20km of the proposed Derrynadarragh Wind Farm are detailed in Appendix 1.3 of Volume III of this EIAR. On review of these developments, it was concluded that the proposed Derrynadarragh Wind Farm produces noise levels within 10 dB of Cushina Wind Farm (pre-application stage) at the same receptor locations, and a cumulative assessment is therefore required, in accordance with best practice guidance. The proposed Derrynadarragh Wind Farm is sufficiently distant from other existing and consented windfarms in the locality, such that the proposed wind farm will not produce noise levels within 10 dB of any other existing wind farm/s at the same receptor location.

A cumulative noise impact assessment has therefore been carried out for the Proposed Development, including cumulative noise emissions from Cushina Wind Farm.

The operational study area is presented in Figure 8.1. The study area includes 259 noise sensitive locations, including 240 residential dwellings, 18 mixed use buildings and one commercial building (Community Hall) which is considered noise sensitive.

As construction and operational vibration have been scoped out (see Section 8.3) there is no requirement to set study areas for each.

### 8.4.3 Evaluation Criteria

#### *8.4.3.1 Construction Noise Criteria*

There is no statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. In the absence of specific noise limits, appropriate emission criteria relating to permissible construction noise levels at the noise sensitive receptors outlined in Section 8.4.2 for a project of this scale may be found in the British Standard BS 5228-1:2009+A1:2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Noise*.

BS5228-1 describes noise-sensitive premises/receivers as: *"any occupied premises outside a site used as a dwelling (including gardens), place of worship, educational establishment, hospital or similar institution, or any other property likely to be adversely affected by an increase in noise level".*

BS 5228-1:2009+A1:2014 contains several methods for the assessment of the potential significance of noise effects at sensitive receivers. The ABC Method was used to derive appropriate noise limits for the proposed development. The threshold limit to be applied (as defined in Table 8-1) is dependent on the existing ambient noise levels (rounded to the nearest 5dB).

**Table 8-1: Threshold of Potential Significant Noise Effect during Construction and Decommissioning**

| Threshold value period ($L_{Aeq}$) | Threshold Value, in decibels (dB) | | |
|---|---|---|---|
| | Category A | Category B | Category C |
| Night-time (23:00 - 07:00hrs) | 45 | 50 | 55 |
| Evenings (19:00 – 23:00 hrs) and weekends (13:00 – 22:00 Saturdays) and (07:00 – 19:00 hrs Sundays) | 55 | 60 | 65 |
| Daytime (07:00 – 19:00) and Saturdays (08:00 – 16:30) | 65 | 70 | 75 |
| Note<br>Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.<br>Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.<br>Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values. | | | |

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. For the appropriate period (e.g. daytime), the ambient noise level is determined and rounded to the nearest 5dB.

The baseline noise survey results ambient (free-field) noise levels were analysed. The ambient façade noise level when rounded to the nearest 5dB varies, but is less than the Category A $L_{Aeq}$ values for all periods. The nearest residential dwellings to the proposed development are afforded Category A designation (65 dB $L_{Aeq,1hr}$ during daytime periods).

Section 8.6.2 provides the detailed assessment of construction activity in relation to this site.

If the modelled construction noise level exceeds the appropriate category value (e.g. 65 dB $L_{Aeq,1hr}$ during daytime periods) then a potential significant effect is predicted and mitigation measures may be required to reduce the noise levels below the $L_{Aeq,1hr}$ daytime noise limit.

### *8.4.3.2 Windfarm Operational Noise Criteria*

#### 8.4.3.2.1 Overview of Guidance

The Wind Energy Development Guidelines (WEDGs) (2006) published by The Department of the Environment, Heritage and Local Government offer advice to planning authorities on planning for wind energy through the development plan process and in determining applications for planning permission. These guidelines contain recommended noise limits to control operational noise from wind farms and state...

*In general, a lower fixed limit of 45 dB(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. 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 30 dB(A), it is recommended that the daytime level of the LA90,10min of the wind energy development noise be limited to an absolute level within the range of 35-40 dB(A).*

*Separate noise limits should apply for day-time and for night-time. During the night, the protection of external amenity becomes less important and the emphasis should be on preventing sleep disturbance. A fixed limit of 43dB(A) will protect sleep inside properties during the night.*

The 2006 WEDGs do not provide further details and there is no standard approach in relation to the identification of low noise environments "*where background noise is less than 30dB(A)*". There are no details on the application of "*an absolute level within the range of 35-40 dB(A)*" or the specific periods which are represented by daytime and night-time hours.

The 2006 WEDGs define Noise Sensitive Locations: *"In the case of wind energy development, this includes any occupied dwelling house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational amenity importance".*

Draft Revised Wind Energy Development Guidelines were published by the Department of Housing, Planning and Local Government in December 2019. This draft document is the most recent publication from the Department of Housing, Planning and Local Government, however, the guidelines have a number of technical errors, ambiguities and inconsistencies and require further detailed review and amendment. This is a fact supported by several acoustic consultants from Ireland and the UK as per joint submission to consultation by a group acousticians available on https://hayesmckenzie.co.uk/acoustic-publications/noise-guidance.

The review and amendment by the Department remains ongoing at the time of writing this EIAR. In assessing the draft Guidelines, the World Health Organization (WHO, 2018) 45 dB $L_{den}$ noise criterion was considered. The WHO document is based on a very limited data set, which only estimated the $L_{den}$ for the sites studied, rather than assessing it directly from wind statistics. Furthermore, the WHO recommendation is "conditional".

The guidelines also state… "*it may be concluded that the acoustical description of wind turbine noise by means of Lden or Lnight may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes.*"

A conditional recommendation, before it becomes folded into any legislative context, would require substantial debate of stakeholders (such as, but not limited to the Public, government bodies, wind farm developers and operators as well as turbine manufacturers). A conditional recommendation is based on low quality evidence that this chosen noise level is effective. Therefore, it would be premature to adopt the WHO recommendations without further careful and detailed consideration and therefore this has not been adopted.

ETSU-R-97[1], The Assessment and Rating of Noise from Wind Farms (1996) published by the Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) and Institute of Acoustics' A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, (2013) are considered best practice guidance in the assessment of wind turbine noise and can be used to supplement the guidance contained within the 2006 'Wind Energy Development Guidelines' (WEDGs), where necessary.

ETSU-R-97 states:

"*The actual value chosen for the day-time lower limit, within the range of 35-40dB(A), should depend upon a number of factors:*

- *Number of dwellings in the neighbourhood of the wind farm.*
- *The effect of noise limits on the number of kWh generated.*
- *Duration and level of exposure*."

ETSU-R-97 defines daytime and night time assessment hours:

| | |
|---|---|
| Amenity/Quiet Daytime Hours: | 18:00 – 23:00 Monday to Friday |
| | 13:00 – 18:00 Saturday |
| | 07:00 – 18:00 Sunday |
| Night-time hours: | 23:00 – 07:00 |

The "Code of Practice for Wind Energy Development in Ireland - Guidelines for Community Engagement" (Department of Environment, Climate and Communications, 2016) does not provide guidance on appropriate noise limits but provides guidelines for community engagement. The guidelines aim to build strong and effective relationships with communities and individuals as an integral part of any infrastructure project. The document sets out a Code of Practice to enhance engagement and transparency between wind farm promoters and communities and does not purport to be of a legal form. The guidelines set out a number of practical steps that wind farm promoters should comply with in engaging with communities, which reduce the effects of noise including advice on contact and visibility, arrangements for making contact, engagement, compliance with statutory/regulatory obligations, community benefit, impact mitigation, independent advisory and information bodies, expert professional advice ancillary development and reports.

[1] See Page 65 of *The Assessment and rating of noise from wind farms (ETSU-R-97)*: ETSU (Energy Technology Support Unit) for more details.

#### 8.4.3.2.2 Kildare County Development Plan

Kildare County Council published a County Development Plan (CDP) 2023-2029, which came into effect on 28 January 2023. The CDP includes a number of policies and objectives relating to wind energy development, including Policy EC P4, which is to:

*"Have regard to the Department of the Environment, Heritage and Local Government's 'Guidelines for Planning Authorities on Wind Energy Development' (or any subsequent updates) and the Kildare County Council Wind Energy Strategy when assessing planning applications for wind farms."*

The CDP is supported by a Wind Energy Strategy. The Strategy provides the background work for the formulation of policies and objectives within the county and sets a target of 107MW wind energy for Kildare to the end of the plan period, which will contribute towards realising overall national targets on renewable energy and climate change mitigation.

The Strategy designates areas across the county where wind energy developments are "*acceptable in principle"*, "*open for consideration"* and *"not normally permissible*". The Strategy states that the area identified as acceptable in principle (which includes the Proposed Development site) is "*the preferred area for wind energy development characterised by a robust landscape, a low housing density, adequate windspeeds and proximity to the existing electricity transmission and distribution grid, while having no significant conflicts with natural heritage designations.".*

Section 6.10 of the Kildare Wind Energy Strategy also includes a number of noise considerations for planning applications, which are specified below:

- *An acoustic report carried out by an appropriately qualified and competent person shall be prepared for all noise sensitive properties within a distance of ten times the rotor diameter of any proposed wind turbine location.*
- *A separate acoustic report shall be prepared where there are other existing or permitted wind farm developments within 2km of the proposed development.*
- *Relative related noise levels (LA rated, 10min) resulting from wind development and taking into account the cumulative impact of noise levels from existing and proposed wind energy developments shall not exceed:*
    1) *Background noise levels by more than 5 dB(A) within the range 35-43 dB(A), or*
    2) *43 dB(A), Both measured as LA90, 10min outdoors at specified noise sensitive locations*
- *In lower noise environments where the background noise is less than 30 dB(A), the daytime level of the LA90, 10min of the wind energy noise shall be limited within the range of 35-40 dB(A).*
- *Noise shall be measured in accordance with the most up-to-date ISO standards for noise measurement or other best practice standards, as appropriate.*

The Strategy also specifies acoustic criteria for the commissioning of permitted wind farms:

- *Once commissioned, the development will be required to be monitored at the expense of the developer/operator. A noise monitoring report shall be submitted to the Planning Authority one year prior to commission and/or at the request of the Planning Authority. In the event that the monitoring report shows that any turbines is exceeding its projected noise levels and is having a detrimental noise impact, the wind turbines shall be turned off until compliance with noise limits is proven to the satisfaction of the Planning Authority. The Planning Authority reserves the right to commission an independent noise monitoring report to ensure compliance with noise limits are achieved, the costs of which shall be borne by the developer/operator.*

*The submitted acoustic report shall include the following:*

1. *A proposed noise monitoring and control procedure for the construction phase*
2. *A clear statement that the wind energy development shall not exceed the predicted LA rated levels per the acoustic report*
3. *A proposed detailed methodology for a post compliance noise survey in accordance with IOA GPG Supplementary Guidance Note 5: Post Completion Measurements for each turbine to be commenced within four weeks of commissioning of any turbine or group of turbines.*
4. *A map showing the noise monitoring locations for the ongoing phase of the wind energy development along with a detailed proposed noise monitoring and reporting procedure.*
5. *A proposal for a documented complaint handling procedure.*

#### 8.4.3.2.3 Offaly County Development Plan

Offaly County Council published a County Development Plan (CDP) 2021-2027, which came into effect on 22 October 2021. Regarding wind energy, the CDP states:

*"Site suitability is an important factor in determining the suitability of wind farms having regard to possible adverse impacts associated with, for example, residential amenities, landscape, including views or prospects, wildlife, habitats, designated sites, protected structures or bird migration paths and compatibility with adjoining land uses."*

Policy CAEP-38 of the CDP states:

*"It is Council policy that in assessing planning applications for wind farms, the Council shall:*

a) *have regard to the provisions of the Wind Energy Development Guidelines 2006, the Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change 2017 and the Draft revised Wind Energy Guidelines 2019 which are expected to be finalised in the near future;*
b) *have regard to 'Areas Open for Consideration for Wind Energy Developments' in the Wind Energy Strategy Designations Map from the County Wind Energy Strategy;*
c) *the impact of the proposed wind farm development on proposed Wilderness Corridors as detailed in Objective BLO-28 of Chapter 4;*
d) *have regard to Development Management Standard 109 on wind farms contained in Chapter 13 of this Plan; and*
e) *have regard to existing and future international, European, national and regional policy, directives and legislation."*

The CDP sets a wind energy target of 466.3 MW by the end of Plan period and is accompanied by a Wind Energy Strategy. The Strategy does not include specific acoustic criteria for wind farms but sets out areas 'open for consideration' for wind energy developments and considerations for the evaluation of wind energy planning applications and policy context. The Proposed Development lies within an area '*open for consideration*' for wind energy developments. The area is therefore considered to "*be characterised by low housing densities*", does "*not conflict with European or National designated sites*" and has "*the ability by virtue of their landscape characteristics to absorb wind farm developments*".

#### 8.4.3.2.4 Laois County Development Plan 2021-2027

The proposed wind turbines are not located within County Laois. Furthermore, the 35 dB noise study area does not intersect with any noise sensitive locations within County Laois. However, the assessment has had regard to the Laois County Development Plan, as the proposed grid connection route includes areas within County Laois.

Laois County Council published a County Development Plan (CDP) 2021-2027, which came into effect on 8 March 2022. The CDP includes a number of policies and objectives relating to wind energy development, including Objective CM RE 2, which is to:

*"Promote and encourage the development of energy from renewable sources such as hydro, bio-energy, wind, solar, geothermal and landfill gas subject to compliance with normal planning and environmental criteria in co-operation with statutory and other energy providers"*

Objective CM RE 5 of the CDP is to:

*"Promote and facilitate wind energy development in accordance with the Guidelines for Planning Authorities on Wind Energy Development (Department of Housing, Planning and Local Government) and any update thereof and the Appendix 5 Wind Energy Strategy of this Plan, the Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change, and subject to compliance with normal planning and environmental criteria".*

The CDP specifies Development Management Standards for Renewable Energy Installations, including DM RE 2 for Wind Energy Development. This standard states that

*"When assessing planning applications for wind energy developments the council will have regard to:*

*a) The wind energy development guidelines for planning authorities;*

*b) The wind energy strategy designations map for Laois showing areas (a) Area open for consideration and (b) Areas not deemed suitable*

*In addition to the above, the following considerations will also be taken into account:*

*i. Impact on visual amenity;*

*ii. Impact on residential amenities;*

*iii. Scale and layout of the project and the cumulative effects due to other projects and the extent to which the impacts are visible across the local landscape;*

*iv. Visual impact of the proposal on the protected views and aspects;*

*v. Impact on nature conservation, ecology, soil, hydrology;*

*vi. Impact on ground conditions and geology;*

*vii. Impact on the road network;*

*viii. Impact on human health in relation to noise disturbance."*

The CDP is accompanied by a Wind Energy Strategy. The Strategy sets out areas 'open for consideration' for wind energy developments and acknowledges that the Wind Energy Development Guidelines, DoEHLG, 2006 are currently under review. Regarding wind farm noise, the Strategy states the following:

*"Permitted maximum noise levels at noise sensitive residences shall be in compliance with noise specifications of the DoEHLG "Wind Energy Guidelines". Once commissioned the development will be monitored. In the event that the monitoring shows that any turbine is exceeding its projected noise levels and is having a detrimental noise impact, mitigating measures shall be agreed with the Local Authority."*

#### 8.4.3.2.5 Best Practice Approach

Given the technical errors, ambiguities and inconsistencies contained in the Draft Revised Wind Energy Development Guidelines, published by the Department of Housing, Planning and Local Government 2019 discussed above, the operational noise assessment summarised in the following sections has been based on guidance in relation to acceptable levels of noise from wind farms as contained in the current Wind Energy Development Guidelines (WEDGs) published by the Department of the Environment, Heritage and Local Government (2006).

The noise criteria used to assess operational noise from the proposed development is based on a Best Practice Approach, which is considered current best practice and currently used by the acoustics industry. This best practice approach is based on:

- Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006);
- ETSU-R-97, The Assessment and Rating of Noise from Wind Farms (1996);
- Institute of Acoustics' A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, (2013).

The best practice guidance contained in ETSU-R-97 together with the detailed guidance contained in the Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2013) and its six supplementary guidance notes have been considered and applied in the absence of detailed guidance from the Wind Energy Development Guidelines 2006, where necessary, to ensure a robust and best practice approach to the assessment. Where background noise is less than 30 dB(A), an absolute level within the range of 35-40 dB(A) is applicable, according to the WEDGs 2006. However, there is no standard approach in relation to the identification of low noise environments "*where background noise is less than 30dB(A)*" nor are there details on the application of "*an absolute level within the range of 35-40 dB(A)*". In the absence of detailed guidance from the Wind Energy Development Guidelines 2006, on what range of 35-40 dB to use, this impact assessment has referred to industry best practice guidance from ETSU-R-97.

The 2006 Wind Energy Development Guidelines do not provide the specific periods which are represented by daytime and night-time hours, therefore the definitions from ETSU-R-97 are taken as 07:00 to 23:00 hrs for daytime and 23:00 to 07:00 hrs for night-time. ETSU-R-97, with amenity hours outlined in section 8.4.3.2.1. Amenity hours were used to derive the background noise levels in this assessment. Substation transformer noise has been assessed according to British Standard BS 4142 as detailed in Section 8.4.3.3.

Having regard to the Kildare Wind Energy Strategy, the best practice approach discussed above will materially contravene the Kildare Wind Energy Strategy, and CDP 2023-2029.

As discussed in Section 8.4.3.2.2 above, Section 6.10 of the Kildare Wind Energy Strategy (WES) includes a number of noise considerations for planning applications. Some of these considerations are not in accordance with best practice guidance and/or are based on the requirements outlined in the Draft Revised Wind Energy Development Guidelines, published by the Department of Housing, Planning and Local Government in 2019. Given the best practice approach outlined in the above sections and the technical errors, ambiguities and inconsistencies contained in the 2019 Draft WEDGs discussed in Section 8.4.3.2.1, compliance with the following elements of Section 6.10 of the Kildare WES is not possible and will be contravened:

- *"An acoustic report carried out by an appropriately qualified and competent person shall be prepared for all noise sensitive properties within a distance of ten times the rotor diameter of any proposed wind turbine location."*
  This requirement has not been complied with, as it conflicts with current best practice guidance on defining the noise study area for the proposed development. The study area has been defined using current best practice guidance, as outlined in Section 8.4.2.
- *"Relative related noise levels (LA rated, 10min) resulting from wind development and taking into account the cumulative impact of noise levels from existing and proposed wind energy developments shall not exceed:*
    3) *Background noise levels by more than 5 dB(A) within the range 35-43 dB(A), or*
    4) *43 dB(A), Both measured as LA90, 10min outdoors at specified noise sensitive locations"*

  This has not been complied with, as it is based on the Draft Revised Wind Energy Development Guidelines. Appropriate noise limits for the proposed development have been derived using current best practice guidance on wind farm noise limits. This is discussed in detail in Section 8.4.3.2.

The proposed development will comply with the Kildare WES and CDP in all other respects and will comply with current best practice guidance relating to noise.

Permission can and should be granted for the proposed development for the reasons outlined above. In addition, the Proposed Development will assist the State in achieving its legally binding national and European renewable energy targets. A grant of permission for the Proposed Development is therefore consistent with the obligations under Section 15 of the Climate Action and Low Carbon Development Act 2015, as amended.

The development will comply with the Offaly and Laois CDPs and will assist the Counties in meeting their renewable energy targets.

#### *8.4.3.3 Substation Operational Noise Criteria*

The proposed substation has been assessed using the methodology in BS4142:2014+A1:2019 Methods for rating industrial and commercial sound. This standard has a number of descriptors of the sound summarised below:

**Background sound level**, $L_{A90,\,T}$ This is the 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 with a Fast time weighting.

**Residual sound** This is the ambient sound remaining at the assessment location when the specific sound (i.e the source being assessed), is suppressed to such a degree that it does not contribute to the ambient sound.

**Specific Sound Level**, ($L_S$=$L_{Aeq,Tr}$) This is the equivalent continuous A-weighted sound pressure level of the specific sound source (i.e. the source being assessed) at the assessment location over a given reference time interval Tr. The reference time interval is 1 hour during the day (07:00 to 23:00) or 15 minutes at night (23:00 to 07:00).

**Rating Level** ($L_{ar,Tr}$) This is the specific sound plus any adjustment for the characteristic features of the sound.

The significance of a sound of an industrial or commercial source depends on the difference between the rating level of the specific source and the background noise level and the context under which the sound occurs. Generally, the greater the difference the greater the magnitude of the impact.

- A difference of +10 dB or is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of +5 dB is likely to be an indication of an adverse impact, depending on the context.

BS4142 notes that where the initial estimate of the impact needs to be modified due to the context, the following needs to be considered:

1. The absolute level of the sound. Where the absolute noise levels are low, absolute noise limits may be more relevant, particularly at night.
2. Character and level of residual sound compared to character and level of specific sound.
3. Sensitivity of receptor to sound and whether design measures that improve the acoustic environment can be considered (e.g. façade insulation, ventilation or acoustic screening)

### 8.4.4 Significance of Effects

The criteria for determining the significance of impacts and the effects are set out in the EPAs 'Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, 2022'. The EPA guidelines do not quantify the impacts in decibel terms. In absence of such information, reference is made to the relevant standards and guidance documents noise limits for the construction and operational phases outlined in Section 8.4. 3.1 and 8.4.3.2, respectively. If the predicted impact from the construction or operational phase are below the respective noise limits, it is considered that no significant effect occurs.

The significance of effects in this assessment is described as per the above EPA Guidelines. For this assessment, it has been assumed that dwellings have a medium to high sensitivity. Table 8-2 presents the effect significance criteria from the EPA guidelines and Table 8-3 describes the duration of effects:

**Table 8-2: Significance of Effects Criteria**

| Significance of Effects | Criteria |
|---|---|
| Imperceptible | An effect capable of measurement but without noticeable consequences. |
| Not significant | An effect which causes noticeable changes in the character of environment but without significant consequences. |
| Slight effects | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities. |
| Moderate effects | An effect that alters the character of the environment in a manner that is consistent with existing and emerging trends. |
| Significant effects | An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment. |

| Significance of Effects | Criteria |
|---|---|
| Very Significant | An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment. |
| Profound effects | An effect which obliterates sensitive characteristics. |

**Table 8-3: Duration of Effects**

| Duration of Effects | Criteria |
|---|---|
| Momentary Effects | Effects lasting from seconds to minutes. |
| Brief Effects | Effects lasting less than a day. |
| Temporary Effects | Effects lasting less than a year. |
| Short-term Effects | Effects lasting one to seven years. |
| Medium-term Effects | Effects lasting seven to fifteen years. |
| Long-term Effects | Effects lasting fifteen to sixty years. |
| Permanent Effects | Effects lasting over sixty years. |

### 8.4.5 Consultation

Chapter 5 EIA Scoping and Consultation of Volume II of the EIAR refers to scoping and consultation. Submissions and comments from various consultees are included in Chapter 5 and have informed the project's assessment methodology throughout the EIAR. One Scoping response was received from Offaly County Council which although does not directly refer to noise, directs attention to the Offaly County Council Development Plan 2021-2027 Wind Strategy. This assessment has had regard to the Offaly CDP and Wind Strategy, as detailed in Section 8.4.3.2.3.

## 8.5 Existing Environment

Baseline noise monitoring was undertaken at seven no. noise monitoring locations (NML1-NML7) surrounding the proposed Derrynadarragh Wind Farm to establish the existing background noise levels at noise sensitive locations in the vicinity of the proposed development. These are some of the closest noise sensitive locations to the proposed development as well as representing different noise environments in the vicinity of the proposed development.

The 35 dB $L_{A90}$ study area, as described in Section 8.4.2 and Figure 8.1 were reviewed to determine noise sensitive locations to be considered for noise monitoring. Permission to access the noise measurement locations was arranged by the applicant, with Fehily Timoney & Company setting up the noise monitoring equipment. Baseline noise data was collected at the seven no. locations, shown in Figure 8.2 and details of the noise monitoring locations are presented in Table 8-4. The rationale for the selection of these monitoring locations is described in Appendix 8.1 Volume III of the EIAR, which presents details on the baseline measurements and data analysis.

**Table 8-4: Noise Monitoring Location Details**

| Location ID | ITM Easting | ITM Northing | Description | Photograph* (see Appendix 8.1) |
|---|---|---|---|---|
| NML1 | 660150 | 717666 | Located in agricultural field adjacent to a group of dwellings. | Plate 8.1-1* |
| NML2 | 660857 | 717685 | Located in field/paddock beside dwelling house approximately 20m from dwelling façade. | Plate 8.1-2* |
| NML3 | 661653 | 716620 | Located in agricultural field north of a group of dwellings. | Plate 8.1-3* |
| NML4 | 659813 | 714450 | Located in field northeast of a group of residential dwellings. | Plate 8.1-4* |
| NML5 | 657688 | 716007 | Located adjacent to dwelling and farmyard, approximately 15m from dwelling façade. | Plate 8.1-5* |
| NML6 | 657773 | 717293 | Located in field adjacent to dwelling and farmyard. | Plate 8.1-6* |
| NML7 | 658838 | 717389 | Located in field adjacent to dwelling, approximately 30m from dwelling facade. | Plate 8.1-7* |

*Photographs provided in Appendix 8.1

### 8.5.1 Analysis of Background Noise Data

The raw background $L_{A90}$ noise data was reviewed to determine whether there are any periods of non-consistent noise level owing to equipment malfunction. Any inconsistent data points were removed from the raw noise level data. The raw noise level data was then correlated with the time synchronised 10 m standardised wind speed, based on a hub height of 105 m, and rainfall data. Periods of rainfall, data affected by dawn chorus and atypical data was removed from the analysis. Once the remaining data sets were found to be representative of the noise environment, they were analysed to ensure that sufficient data sets remained to provide sufficient data coverage over the required wind speeds. A “best-fitting polynomial” (not higher than a fourth order) was determined to present the prevailing background noise level at each monitoring location. Appendix 8.1 presents the results of the data analysis.

The prevailing daytime amenity noise levels at each of the seven noise monitoring locations are presented in Table 8-5. The derived prevailing background noise polynomial curve was not extended beyond the range covered by adequate data points. Where a noise limit is required at higher wind speeds; it was restricted to the highest derived point, in accordance with best practice guidance.

**Table 8-5: Summary of Prevailing Background Noise during Daytime Periods**

| Location | Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NML1 | 24.2 | 25.5 | 27.1 | 28.9 | 30.9 | 33.2 | 35.8 | 38.6 | 41.7 | 45.0 | 45.0§ |
| NML2 | 29.5 | 30.8 | 32.2 | 33.7 | 35.4 | 37.2 | 39.1 | 41.1 | 43.2 | 45.5 | 45.5§ |
| NML3 | 20.5 | 24.1 | 27.3 | 30.2 | 32.8 | 35.0 | 36.8 | 38.3 | 39.5 | 40.3 | 40.3§ |
| NML4 | 26.1 | 26.7 | 27.6 | 28.7 | 30.2 | 31.9 | 33.9 | 36.2 | 38.8 | 41.7 | 41.7§ |
| NML5 | 30.1* | 30.0 | 30.4 | 31.4 | 32.9 | 34.9 | 37.4 | 40.5 | 44.2 | 48.3 | 48.3§ |
| NML6 | 25.3 | 26.5 | 27.9 | 29.5 | 31.2 | 33.2 | 35.3 | 37.7 | 40.2 | 42.9 | 42.9§ |
| NML7 | 24.4 | 25.7 | 27.3 | 29.2 | 31.3 | 33.8 | 36.6 | 39.7 | 43.1 | 46.8 | 46.8§ |
| § - noise level restricted to the highest derived point<br>* - noise level restricted to lowest derived point | | | | | | | | | | | |

**Table 8-6: Summary of Prevailing Background Noise during Night-time Periods**

| Location | Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NML1 | 16.8 | 18.6 | 20.7 | 23.1 | 25.7 | 28.7 | 32.0 | 35.5 | 39.3 | 43.5 | 47.9 |
| NML2 | 16.6 | 18.9 | 21.3 | 23.9 | 26.7 | 29.8 | 33.0 | 36.4 | 40.1 | 44.0 | 48.0 |
| NML3 | 13.1 | 17.1 | 21.0 | 24.6 | 28.1 | 31.3 | 34.4 | 37.3 | 39.9 | 42.4 | 44.6 |
| NML4 | 17.8 | 19.1 | 20.8 | 22.7 | 24.9 | 27.4 | 30.3 | 33.4 | 36.8 | 40.6 | 44.6 |
| NML5 | 20.0* | 20.0 | 21.8 | 23.9 | 26.2 | 28.8 | 31.7 | 34.9 | 38.3 | 41.9 | 45.9 |
| NML6 | 14.9 | 17.2 | 19.7 | 22.3 | 25.1 | 28.1 | 31.2 | 34.6 | 38.1 | 41.7 | 45.6 |
| NML7 | 14.5 | 17.3 | 20.1 | 23.1 | 26.2 | 29.4 | 32.8 | 36.3 | 39.9 | 43.7 | 47.6 |
| § - noise level restricted to the highest derived point<br>* - noise level restricted to lowest derived point | | | | | | | | | | | |

### 8.5.2 Derived Windfarm Noise Limits

The standard approach (outlined in the IOA GPG) regarding the derivation of noise limits is to carry out background measurements at several locations representative of different noise environments around the proposed site. As it is not usually possible to carry out measurements at every noise sensitive location (NSL), NSLs near to the measurement location are then assigned the same limits as the measurement location. The operational impact at each of the measurement locations was assessed in accordance with the IOA GPG.

As detailed in previous sections, the noise criteria used to assess operational noise from the Proposed Development is based on a Best Practice Approach, currently used by the acoustics industry, as outlined in Section (8.4.3.2.5).

The 2006 WEDGs state that a fixed limit of 43 dB $L_{A90}$ applies during night-time periods. In this case a limit of 43 dB $L_{A90}$ has been assumed or +5dB above background, whichever is the greater. However, the derivation of the daytime noise limit uses the prevailing daytime amenity background noise data. Where low background noise levels are found, the 2006 guidelines recommend a limit of 35 to 40 dB $L_{A90}$. There is no further guidance on how to choose the noise limit from within this range. For this project for low background noise areas (<30 dB $L_{A90}$) a limit of 40 dB $L_{A90}$ has been adopted, in accordance with best practice guidance, as discussed below.

There is no further detail provided on how to determine how the appropriate noise limit be derived. However, the guidelines state… "*An appropriate balance must be achieved between power generation and noise impact*." Reference has also been made to best practice guidance outlined in ETSU-R-97, which recommends that the following three factors be considered when determining the fixed limit within the range:

1. Number of dwellings in neighbourhood of the wind farm.
2. The effect of noise limits on the kWh.
3. Duration and level of exposure.

However, the IOA GPG (2013) states the following with respect to the ETSU-R-97 criteria… "*It can be argued that assessing these factors do not represent an acoustic consideration but ultimately a planning consideration*."

1. Number of dwellings in neighbourhood of the wind farm: ETSU-R-97 describes this factor as balancing the benefits from a wind energy project with the local environment impact, "*The more dwellings that are in the vicinity of a wind farm the tighter the limits should be as the total environmental impact will be greater. Conversely if only a few dwellings are affected, then the environmental impact is less and noise limits towards the upper end of the range may be appropriate*." The number of noise sensitive locations (based on Eircode information) within the Derrynadarragh site 35dB $L_{A90}$ noise contour is 169 and the noise limits are not exceeded at any noise sensitive location. A noise limit of 40 dB $L_{A90}$ is considered appropriate.
2. The effect of noise limits on the power output of the wind farm: Similarly, to the first factor, this balances the planning merit of the project against the local impact. The proposed development has 9 no. turbines. If the limit is lowered, then, based on the noise modelling results, curtailment would be required. Since this project is considered to assist the State in achieving its legally binding national and European renewable energy targets and is consistent with the obligations under Section 15 of the Climate Action and Low Carbon Development Act 2015, as amended . the upper 40 dB noise limit which will optimise the power output of the wind farm is considered appropriate.
3. Duration and level of exposure: The prevailing background noise levels are described in detail in Section 8.5.1 and Appendix 8.1. In terms of the location of the properties within the study area, these are mainly located north, southeast and west of the Proposed Development. The areas close to the Proposed Development are not densely populated with properties evenly distributed, and set back from the site. The derived noise limits are summarised in Table 8-7, based on the prevailing noise levels detailed in Section 8.5.2. The predicted noise levels are comparable to existing background noise measured and the derived noise limits are based on the quietest background noise levels measured across the site and therefore are considered conservative.

Considering the above criteria, it has been determined that a 40 dB $L_{A90}$ noise limit is appropriate for low background noise areas within the environs of the Proposed Development. This noise limit allows for an appropriate balance to be achieved between power generation and noise impact. The limit will optimise the power output of the wind farm, assist the State in achieving legally binding renewable energy targets and will offer an appropriate level of protection to prevent significant effects at noise sensitive locations.

**Table 8-7: Derived Noise Limits**

| Location | Period | Noise Limit $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| NML1 | Daytime | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Night-time | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| NML2 | Daytime | 40 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| | Night-time | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| NML3 | Daytime | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 | 45 |
| | Night-time | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| NML4 | Daytime | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Night-time | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| NML5 | Daytime | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| | Night-time | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| NML6 | Daytime | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Night-time | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| NML7 | Daytime | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Night-time | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |

## 8.6 Potential Noise Impacts

### 8.6.1 Do Nothing Scenario

Under the Do-Nothing scenario, the proposed development is not constructed or operated. The noise environment remains largely unchanged.

### 8.6.2 Potential Noise Impacts During Construction

Noise predictions were undertaken to determine the likely impact during the construction works. BS 5228-1:2009+A1:2014 sets out sound power levels and $L_{Aeq}$ noise levels of plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations.

Construction noise modelling is based on the details presented in Chapter 2, Volume II of the EIAR. Noise modelling was carried out using guidance and plant noise data from BS 5228:2009+A1:2014. The ground cover in the vicinity of construction works is predominately acoustically soft (G=1). To ensure a conservative assessment, the noise model assumes that the ground cover is a mix between acoustically hard and soft ground, with a ground cover of G=0.75 used to allow for pockets of acoustically hard ground such as roads. Percentage on time for plant is outlined for each of the plant items used during construction.

The construction noise model assessed several tasks with the potential to generate noise. These tasks included: deliveries and/or removal of material to and from site, preparation of access roads, preparation of hardstands and drainage, pouring of foundations, installation of wind turbines and works associated with construction of the on-site substation and grid connection route.

**Site Traffic**

Detailed information on construction traffic is presented in Chapter 14, Volume II of the EIAR. To summarise, additional light goods vehicles travelling to and from the site during the construction phase would be expected to peak during the morning (arrival of contractors at the site) and evening (departure of contractors from the site) and are envisaged not to be a continuous source of noise emissions from the site during a typical working day. Therefore, noise impacts from construction personnel movements to and from the site is expected to be low.

All deliveries of turbine components to the site will only be by way of the proposed turbine delivery route (TDR) outlined in Chapter 14, Volume II of the EIAR. The construction period is expected to take 24 months. The most intensive period of the works programme will be Month 9. The busiest period is when Internal access tracks, hardstanding works, preparation of turbine foundations, turbine installation and substation works will be ongoing in parallel. Site traffic associated with construction is expected to have a slight negative effect and will be short-term in duration. Site traffic movements have been considered in each phase of construction below.

**Tree Felling**

Tree felling will be required in the vicinity of the site entrance and Turbine 2, as outlined in Chapter 2, Volume II of the EIAR. Table 8-8 presents the predicted noise from tree felling at the nearest dwelling, R18. Assuming all plant associated with tree felling is operating, the predicted cumulative noise at noise sensitive location R18 is 49.4 dB $L_{Aeq,1hr}$. Therefore, the predicted noise at the nearest noise sensitive location is below the daytime noise limit of 65 dB $L_{Aeq,1hr}$. The noise associated with the tree felling activity is expected to have a slight negative effect and will be temporary in duration.

**Table 8-8: Tree Felling - Expected Plant and Predicted Noise Levels**

| Plant | BS 5228 Ref. | Activity | Percentage on-time (%) | Predicted Noise Level at R18 ($L_{Aeq,1hr}$) |
|---|---|---|---|---|
| Harvester § | C2.5 | Harvesting trees | 80 | 44.3 |
| Forwarder µ | C4.53 | Moving felled trees | 80 | 44.8 |
| Lorry * | C11.9 | Transporting timber and brash off site | 10 two-way trips per hour | 44.8 |
| Cumulative | | | | 49.4 |
| § - Excavator BS 5228 Ref C2.5<br>µ - Lorry with lifting boom – C4.53<br>* - Drive-by maximum sound pressure level | | | | |

**Preparation of Access Tracks, Hardstands and Drainage**

Table 8-9 presents the expected plant required for the preparation of access tracks, hardstandings and drainage. Also presented are the predicted noise levels at the nearest dwellings, R26 and R13, approximately 400m from this activity to the west of site. Assuming all construction activities required for the preparation of the access tracks occur simultaneously, the worst case predicted noise level from the construction activities is 41.2 dB $L_{Aeq,1hr}$ at R13 and 41.1 dB $L_{Aeq,1hr}$ at R26. The predicted noise levels are below the 65dB $L_{Aeq,1hr}$ noise limit. The preparation of access tracks, hardstands and drainage are expected to have a slight negative effect and will be temporary in duration.

**Table 8-9: Preparation of Access Tracks, Hardstands and Drainage - Expected Plant and Predicted Noise Levels**

| Plant | BS 5228 Ref. | Activity | Percentage on-time (%) | Predicted Noise Level at R13 ($L_{Aeq,1hr}$) | Predicted Noise Level at R26 ($L_{Aeq,1hr}$) |
|---|---|---|---|---|---|
| Tracked excavator 25t | C2.19 | Ground excavations/ earthworks | 80 | 33 | 26.8 |
| Lorry* | C11.9 | Moving Fill | 40 two-way trips per day | 39.2 | 40.7 |
| Articulated dump truck (tipping) 23t | C2.32 | Tipping Fill | 20 | 26.7 | 20.4 |
| Dozer (14t) | C5.12 | Spread Chipping/Fill | 80 | 32.4 | 26.1 |
| Vibratory roller (3t) | C5.27 | Rolling & Compaction | 80 | 22.2 | 15.9 |
| Tracked excavator 21t | C4.65 | Trench for drainage | 80 | 27.7 | 21.5 |
| Cumulative | | | | 41.2 | 41.1 |

**Preparation of Wind Turbine Foundations**

Table 8-10 presents the expected plant required for the preparation of wind turbine foundations. Predicted noise levels at R1 to the north of site and R58 to the South are presented, both approximately 800m from the works. Assuming all construction activities required for the preparation of the turbine foundations occur simultaneously, the worst-case predicted noise levels at R1 and R58 from the construction activities are 45.3 dB $L_{Aeq,1hr}$ and 43.4 dB $L_{Aeq,1hr}$, respectively. The predicted noise levels are below the 65dB $L_{Aeq,1hr}$ noise limit. The construction works associated with the preparation of the turbine foundations are expected to have a slight negative effect and will be temporary in duration.

**Table 8-10: Preparation of Wind Turbine Foundations - Expected Plant and Predicted Noise Levels**

| Plant | BS 5228 Ref. | Activity | Percentage on-time (%) | Predicted Noise Level at R1 (North) ($L_{Aeq,1hr}$) | Predicted Noise Level at R58 (South) ($L_{Aeq,1hr}$) |
|---|---|---|---|---|---|
| Tracked Excavator (25t) | C2.19 | Ground excavation/ earthworks | 80 | 37 | 36 |
| Excavator (23t) | C10.8 | Loading sand / soil | 20 | 39.7 | 38.7 |
| Diesel Pump | C4.88 | Pump water | 100 | 29.3 | 28.3 |
| Mobile telescopic crane | C4.41 | Lifting reinforcing steel | 80 | 30.7 | 29.7 |

| Plant | BS 5228 Ref. | Activity | Percentage on-time (%) | Predicted Noise Level at R1 (North) ($L_{Aeq,1hr}$) | Predicted Noise Level at R58 (South) ($L_{Aeq,1hr}$) |
|---|---|---|---|---|---|
| Concrete mixer truck & concrete pump | C4.32 | Concrete mixer truck + truck mounted concrete pump + boom arm | 100 | 38.3 | 37.3 |
| Lorry* | C11.9 | Delivery and removal of material | 40 two-way trips per day | 40.2 | 35.2 |
| Cumulative | | | | 45.3 | 43.4 |
| * - Drive-by maximum sound level | | | | | |

**Installation of Wind Turbines**

Turbine components will be delivered to site and a mobile telescopic crane will lift the turbine components into place. A worst-case of the two cranes lifting turbine components 80% of the time was assumed in addition to noise associated with the delivery of turbine components. The predicted noise levels are presented in Table 8-11. The predicted cumulative noise level at receptor R26 is 47 dB $L_{Aeq,1hr}$. The predicted noise levels are below the 65 dB $L_{Aeq,1hr}$ noise limit. The construction works associated with the installation of the wind turbines are expected to have a slight negative effect and will be temporary in duration.

**Table 8-11: Installation of Wind Turbines - Expected Plant and Predicted Noise Levels**

| Plant | BS 5228 Ref. | Activity | Percentage on-time (%) | Predicted Noise Level at R26 ($L_{Aeq,1hr}$) |
|---|---|---|---|---|
| Mobile telescopic crane (x2) | C4.41 | Lifting turbine components | 80 | 23.4 |
| Lorry * | C11.9 | Delivery of Turbine Components | 40 two-way trips per day | 47 |
| Cumulative | | | | 47 |
| * - Drive-by maximum sound level | | | | |

**Culvert Installation**

Culvert water crossings are planned within the site which will require the installation of culverts as described in Chapter 2, Volume II of this EIAR. The noise impact associated with the delivery and construction of culverts was assessed. Table 8-12 presents the plant required for the culvert installation and predicted noise levels at the nearest dwelling, R18, approximately 350m from the works. The cumulative predicted noise level at R18, assuming all activity occurs simultaneously is predicted to be 47.2 dB $L_{Aeq,1hr}$. This is below the construction noise limit of 65 dB $L_{Aeq,1hr}$. The works associated with the construction of the culverts is expected to have a slight negative effect and will be temporary in duration.

**Table 8-12: Culvert Installation - Expected Plant and Predicted Noise Levels**

| Plant | BS 5228 Ref. | Activity | Percentage on-time (%) | Predicted Noise Level at R18 ($L_{Aeq,1hr}$) |
|---|---|---|---|---|
| Tracked Excavator (25t) | C2.19 | Ground excavation/ earthworks and backfill | 80 | 44 |
| Mobile telescopic crane | C4.41 | Lifting culverts | 80 | 37.8 |
| Lorry * | C11.9 | Delivery of culverts and materials | 40 two-way trips per day | 43.4 |
| Cumulative | | | | 47.2 |
| * - Drive-by maximum sound level | | | | |

### On-site Clear Span Bridges Construction

Two clear span bridge water crossings are planned for the proposed development which will require the installation of bridges as described in Chapter 2, Volume II of this EIAR. The noise impact associated with the delivery and construction of the bridges was assessed. Table 8-13 presents the typical plant required for such construction. Also presented are predicted noise levels at the nearest dwelling, R13, approximately 500m from the works. The cumulative predicted noise levels at R13, assuming all activity occurs simultaneously, is 46.3 dB $L_{Aeq,1hr}$ which is below the construction noise limit of 65 dB $L_{Aeq,1hr}$. The works associated with the construction of the bridge is expected to have a slight negative effect and will be temporary in duration.

**Table 8-13: On-site Clear Span Bridges Construction- Expected Plant and Predicted Noise Levels**

| Plant | BS 5228 Ref. | Activity | Percentage on-time (%) | Predicted Noise Level at R13 ($L_{Aeq,1hr}$) |
|---|---|---|---|---|
| Tracked Excavator (25t) | C2.19 | Ground excavation/ earthworks | 80 | 39.8 |
| Articulated Dump Truck (23t) | C2.32 | Tipping Fill | 20 | 40.3 |
| Excavator (23t) | C10.8 | Loading sand / soil | 80 | 42.5 |
| Vibratory roller (3t) | C5.27 | Rolling and Compaction | 80 | 28.9 |
| Mobile telescopic crane | C4.41 | Lifting components | 100 | 33.6 |
| Concrete Mixer | C 4.32 | Pouring Concrete | 80 | 40.3 |
| Cumulative | | | | 46.3 |
| * - Drive-by maximum sound level | | | | |

**Substation Construction**

As outlined in Chapter 2, Volume II of this EIAR, it is proposed to construct an onsite electricity substation. The construction of the substation buildings will occur during the construction phase of the proposed development. The works will be progressed in a number of phases:

- Site clearance and Preparation
- Preparation and pouring of foundations and floor areas
- Preparation of hardstanding areas
- Erection of blockwork/ installation concrete slabs
- General Construction including installation of electrical and mechanical plant

Table 8-14 presents the plant required for the different construction phases of the proposed substation buildings to be constructed on site. The nearest occupied dwelling (R13) will be over 600m from the substation. The highest cumulative predicted noise levels for substation works is predicted to be 43.5 dB $L_{Aeq,1hr}$ at the nearest occupied dwelling during the preparation of hardstanding areas. This is below the construction noise limit of 65 dB $L_{Aeq,1hr}$. The works associated with the construction of the substation are expected to have a slight negative effect and will be temporary in duration.

## Table 8-14: Construction of Substation - Expected Plant and Predicted Levels

| Phase | Plant | BS 5228 Ref. | Activity | Percentage on-time (%) | Predicted Noise Level at R13 ($L_{Aeq,1hr}$) |
|---|---|---|---|---|---|
| Site Clearance and Preparation | Tracked excavator (22t) | C2.3 | Earthworks/site clearance | 80 | 36.9 |
| | Dozer (11t) | C2.12 | Ground excavation/ earthworks | 80 | 39.6 |
| | Loading Lorry | C10.8 | Loading Sand to Lorry | 80 | 39.1 |
| | Cumulative | | | | 43.4 |
| Preparation and pouring of Foundations | Concrete mixer truck + truck mounted concrete pump + boom arm | C4.32 | Concrete pumping | 80 | 36.9 |
| | Tracked excavator 25t | C2.19 | Earthworks | 80 | 36.5 |
| | Lorry* | C11.9 | Delivery of material | 40 two-way trips per day | 41 |
| | Cumulative | | | | 43.4 |
| Preparation of hardstanding areas | Tracked Excavator (25t) | C2.19 | Ground excavation/earthworks | 80 | 36.5 |
| | Articulated Dump Truck (23t) | C2.32 | Tipping Fill | 20 | 30 |
| | Dozer (14t) | C5.12 | Spreading chipping/fill | 80 | 35.7 |
| | Vibratory roller (3t) | C5.27 | Rolling and Compaction | 80 | 25.6 |
| | Lorry* | C11.9 | Delivery of material | 40 two-way trips per day | 41 |
| | Cumulative | | | | 43.5 |
| Erection of blockwork/ installation concrete slabs | Mobile telescopic crane (80t) | C4.39 | Lifting concrete slabs | 80 | 35.8 |
| | Lorry* (32t) | C11.9 | Delivery of material | 40 two-way trips per day | 41.1 |
| | Cumulative | | | | 42.2 |
| General Construction including installation of electrical and mechanical plant | Generator | C4.84 | Power for site cabins | 100 | 33.7 |
| | Telescopic handler | C4.54 | Lifting Plant | 80 | 37.6 |
| | Angle grinder (grinding steel) | C4.93 | Miscellaneous | 80 | 39.7 |
| | Cumulative | | | | 42.4 |

* Drive-by maximum sound level

### Grid Connection Works

As described in Chapter 2 of this EIAR, each turbine will be connected to the on-site electricity substation via underground cables (UGC). The cable route will follow the proposed access tracks between each turbine.

Most of the proposed grid connection route is on public roads, joining the proposed substation to the existing 110KV GIS Bracklone Substation. The grid connection will require 11.4km of underground 110kV electrical cabling as described in Chapter 2, Volume II of the EIAR.

The grid connection works will be carried out over a 4-month period and 'rolling road closures' will be implemented, whereby the site will progress each day along a road, which will have the effect of reducing the impact for residents. The expected plant required during the construction works are presented in Table 8-15.

**Table 8-15: Grid Connection Works – Expected Plant and Predicted Noise Levels**

| Plant | Activity | Percentage on-time (%) | A-Weighted Sound Pressure Level, $L_{Aeq,1hr}$, dB | | | |
|---|---|---|---|---|---|---|
| | | | 10m | 25m | 50m | 100m |
| Road sweeper (C4.90) | Sweeping and dust suppression | 10 | 49.5 | 41.6 | 35.6 | 29.6 |
| Mini excavator with hydraulic breaker (C5.2) | Breaking Road Surface | 25 | 78.9 | 71.4 | 65.5 | 59.5 |
| Vibratory roller (C5.27) | Rolling and Compaction | 50 | 66.3 | 58.6 | 52.6 | 46.6 |
| Wheeled excavator (C5.34) | Trenching | 50 | 69.9 | 62 | 56 | 50 |
| Hand-held circular saw (petrol) (C5.36) | Cutting Concrete Slabs | 10 | 79 | 71.6 | 65.6 | 59.6 |
| Dump truck (tipping fill) (C2.30) | Tipping Fill | 10 | 71.8 | 64.1 | 58.1 | 52.1 |
| Vibratory plate (petrol) (C2.41) | Compaction | 10 | 72.7 | 65.1 | 59.1 | 53.1 |

Table 8-15 also presents predicted noise level for a range of construction activities at distances of 10 m, 25 m, 50 m and 100 m from the works. There are 5 noise sensitive properties within 10m of the grid connection works, 52 residential properties within 25m, 36 residential properties between 25m and 50m and 18 dwellings between 50-100m. The noise levels presented are predicted maximum expected levels and are expected to occur for only short periods of time at a limited number of dwellings.

At receptors within approximately 50m, the maximum predicted noise levels may be above the noise limit of 65 dB $L_{Aeq,1hr}$. However, these elevated noise levels will only occur for short durations at a limited number of dwellings. Given the nature of the grid connection works, construction activities will not occur over an extended period at any one location.

There is potential for temporary elevated noise levels owing to the grid connection works. However, these works will be for a short duration at a particular property (i.e. typically less than 3 days)The grid connection works are expected to have a significant temporary negative effect, in the absence of mitigation measures.

**Turbine Delivery Route (TDR) Construction Activities**

This section assesses noise from temporary accommodation works along the turbine delivery route which have the potential to generate noise. The details of the proposed temporary accommodation works associated with the TDR route are summarised in Chapter 2, Volume II of the EIAR.

Chapter 2 identifies the TDR Node Number and the construction activities proposed along the route. These activities have been assessed under the following headings:

- Installation of load bearing surfaces and construction of a new offline track along the TDR - Nodes 13, 19, 22, 25, 31, 32, 33, 38, 46/47 and 35/36.
- Construction of a new access bridge - Node 29/30.

Node 34 involves trimming of vegetation and trees. These works are minor and have not been considered further in the noise assessment.

Table 8-16 presents predicted noise levels for the activities associated with the installation of load bearing surfaces and construction of a new offline track along the TDR. The closest noise sensitive properties to these works are located at approximately 30m distance. At Receptor R82 at Node 46/47, 30m from the works, if all plant operate simultaneously, the worst case cumulative noise is predicted to exceed the daytime limit by 2.8 dB. The works associated with the installation of load bearing surfaces and construction of a new offline track along the TDR, is therefore expected to have a significant impact that is temporary in duration, if all plant operates simultaneously.

**Table 8-16: Installation of Load Bearing Surfaces and Offline Track along the TDR - Expected Plant and Predicted Noise Levels**

| Plant | BS5228 Ref | Activity | Percentage on-time (%) | Predicted Noise Level $L_{Aeq,1hr}$ at 30m dB(A) |
|---|---|---|---|---|
| Articulated dump truck 23t | C2.33 | Delivering Fill | 5 return trips/ day | 45 |
| Articulated dump truck (tipping) 23t | C2.32 | Tipping Fill | 20 | 57.3 |
| Dozer (14t) | C5.12 | Spread Chipping/Fill | 80 | 66 |
| Vibratory roller (3t) | C5.27 | Rolling & Compaction | 20 | 56 |
| Tracked excavator 21t | C4.65 | Ground excavations/earthworks and Spread Chipping/Fill | 80 | 60.7 |
| Cumulative: | | | | **67.8** |

Table 8-17 presents predicted noise levels for the activities associated with the construction of a new access bridge at Node 29/30 along the TDR. The closest noise sensitive property to this activity is approximately 60 m from the works. If all plant operate simultaneously, the worst case cumulative noise level has the potential to exceed the daytime limit by approximately 3 dB. The works associated with the TDR accommodation works at Node 29/30, if all plant operates simultaneously, is therefore expected to have a significant negative effect that is temporary in duration.

**Table 8-17: Clear Span Bridges Construction along the TDR - Expected Plant and Predicted Noise Levels**

| Plant | BS 5228 Ref. | Activity | Percentage on-time (%) | Predicted Noise Level at R1069 ($L_{Aeq,1hr}$) |
|---|---|---|---|---|
| Tracked Excavator (25t) | C2.19 | Ground excavation/ earthworks | 80 | 61.3 |
| Articulated Dump Truck (23t) | C2.32 | Tipping Fill | 20 | 52.3 |
| Excavator (23t) | C10.8 | Loading sand / soil | 80 | 64.5 |
| Vibratory roller (3t) | C5.27 | Rolling and Compaction | 80 | 51.6 |
| Mobile telescopic crane | C4.41 | Lifting components | 100 | 54.7 |
| Concrete Mixer | C 4.32 | Pouring Concrete | 80 | 62.3 |
| Cumulative | | | | 68.1 |
| * - Drive-by maximum sound level | | | | |

In summary, the general construction works during the construction phase of the Proposed Development are expected to result in slight negative effects at nearby receptors, without mitigation, which will be temporary in duration. The construction works associated with the grid connection works and TDR works (installation of load bearing surfaces and construction of a new offline track and construction of a new access bridge at Node at Node 29/30) are expected to result in a significant negative effect that is temporary in duration at the closest noise sensitive receptors, in the absence of mitigation.

### 8.6.3 Potential Noise Impacts During Operation

Noise predictions have been carried out using DGMR iNoise noise prediction modelling software, v2024.3, based on International Standard ISO 9613-2: 2024, *Acoustics – Attenuation of Sound during Propagation Outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors*..

The propagation model described in ISO 9613-2: 2024 provides for the prediction of sound pressure levels based on either short-term downwind (i.e. worst case) conditions or long-term overall averages.

Only the worst-case downwind condition has been considered in this assessment, i.e., – for wind blowing from the proposed turbines towards the nearby houses. When the wind is blowing in the opposite direction noise levels may be significantly lower, especially where there is any shielding between the turbines and the houses.

The ISO propagation model calculates the predicted sound pressure level by taking the source sound power level for each turbine in separate octave bands and subtracting a number of attenuation factors according to the following:

Predicted Octave Band Noise Level = $L_W + D_c - A_{geo} - A_{atm} - A_{gr} - A_{bar} - A_{misc}$

These factors are discussed further below.

The predicted octave band levels from the turbine are summed together to give the overall 'A' weighted predicted sound level.

**$L_W$ - Source Sound Power Level**

The sound power level of a noise source is normally expressed in dB re:1pW. Sound power level data for the Vestas V162 7.2MW with 105m hub height turbines to be installed as part of the proposed development has been modelled. Further details on the wind turbine are provided later in this section. Sound Power Level data is presented in Tables 8-16 and 8-17, and Appendix 8. 4.

**$D_c$ – Directivity Factor**

The directivity correction describes the extent by which the equivalent continuous sound pressure level from the point source deviates in a specified direction from the level of an omnidirectional point source producing the sound power level **$L_W$** expressed in decibels. In this case the sound power level is measured in a downwind direction, corresponding to the worst-case propagation conditions considered here and needs no further adjustment, and therefore a directivity correction of 0 has been assumed.

**$A_{div}$ – Geometrical Divergence**

The geometrical divergence accounts for spherical spreading in the free-field from a point sound source resulting in attenuation depending on distance according to the following:

$$A_{div} = 20 \text{ x } \log(d/d_o) + 11$$

where, d = distance from the source (turbines) to receivers, in meters

$d_o$ is the reference distance (1m)A wind turbine may be considered as a point source beyond distances corresponding to one rotor diameter.

**$A_{atm}$ - Atmospheric Absorption**

The atmospheric absorption accounts for the frequency dependant linear attenuation with distance of sound power over the frequency spectrum according to:

$$A_{atm} = \alpha_{atm} d/1000$$

where, $\alpha_{atm}$ = the atmospheric absorption coefficient for each octave band and the mid-band frequency expressed in decibels per kilometer.

The $\alpha_{atm}$ shall be calculated with ISO 9613-1:1993, formulae (2) to (6) in connection with ISO 9613-1:1993, B.1 to B3. A temperature of 10$^{o}$C and a relative humidity of 70%, the values specified in the IOA GPG, which give relatively low levels of atmospheric attenuation have been assumed and subsequently conservative noise predictions as given in Table 8-15:

**Table 8-18: Atmospheric Octave Band Attenuation coefficients, dB/m**

| Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|
| 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1 kHz | 2 kHz | 4 kHz | 8 kHz |
| 0.00012 | 0.00041 | 0.00104 | 0.00193 | 0.00366 | 0.00966 | 0.03280 | 0.11700 |

**$A_{gr}$ - Ground Effect**

Ground effect is the interference of sound reflected by the ground surface interfering with the sound propagating directly from source to receiver. The ground attenuation is largely determined by the ground surfaces near the source and near the receiver. The prediction of ground effects is inherently complex and depends on the source height, receiver height, propagation height between the source and receiver and the ground conditions.

The ground conditions are described according to a variable G which varies between 0 for 'hard' ground (includes paving, water, ice, concrete and any sites with low porosity) and 1 for 'soft' ground (includes ground covered by grass, trees or other vegetation). The IOA GPG states that use of G = 0.5 and a receptor height of 4 m should be used to predict the resultant turbine noise level at dwellings neighbouring a proposed development provided that an appropriate allowance for measurement uncertainty is accounted for within the stated source noise levels. Therefore, predictions in this report are based on G = 0.5 with a receptor height of 4 m and, due to the inclusion of the assumed uncertainty (see 'Overview of Input Datasets' for more details) within the source noise levels, these predictions are considered to be worst case.

**$A_{bar}$ - Barrier Attenuation**

The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise. The barrier attenuations predicted by the ISO 9613 model have, however, been shown to be significantly greater than that measured in practice under downwind conditions.

The results of a study of propagation of noise from wind farm sites carried out for ETSU concludes that an attenuation of just 2 dB(A) should be allowed where the direct line of site between the source and receiver is just interrupted by a landform, such as a hill and that 10 dB(A) should be allowed where a barrier lies within 5 m of a receiver and provides a significant interruption to the line of site.

The IOA GPG states that 'Topographic screening effects of the terrain (ISO 9613-2, Equation 2) should be limited to a reduction of no more than 2 dB, and then only if there is no direct line of sight between the highest point on the turbine rotor and the receiver location'. As a conservative approach, barrier attenuation has not been accounted for in the noise model predictions.

**$A_{misc}$ – Miscellaneous Other Effects**

ISO 9613 includes effects of propagation through foliage, industrial plants and built-up regions as additional attenuation effects. The attenuation due to forestry has not been included here and any such effects are unlikely to significantly reduce noise levels below those predicted.

The site topography was also analysed to determine if there is a valley correction (+3 dB) for concave ground profile, or where the ground falls away significantly, between the turbine and the receiver location. The IOA guidelines provide a criterion of application and it was determined that no valley correction is applicable.

**Predicted Noise Levels**

The predicted turbine noise $L_{Aeq}$ has been adjusted by subtracting 2 dB to give the equivalent $L_{A90}$, as suggested in the IOA GPG.

### *8.6.3.1 Overview of Operational Noise Model Input Datasets*

Wind Turbine Noise in order to calculate the noise levels at noise sensitive locations, an accurate representation of the source and receiver positions (See Appendix 8.3 & 8.5 for details) was necessary for the prediction modelling. The proposed turbine locations are presented in Table 2-3 in Section 2.4.1.2 of Chapter 2, Volume II of this EIAR and noise sensitive locations are presented in Appendix 8.3, Volume III. The closest dwelling is 770 m from the nearest turbine.

The assessment has considered the range of turbine design elements. From a noise perspective, when following the guidance contained within the IOA GPG and Supplementary Guidance Notes, the hub height range is the only element of the turbine dimensions that influence the operational noise impact assessment. Any influence from the variation of blade length is accounted for by the turbine manufacturer in their sound power data, which was provided and used for the purpose of modelling the proposed turbine layout.

The turbine model that is the basis of this assessment is the Vestas V162 7.2MW, with a hub height of 105m and trailing edge serrations.

Manufacturer data for the proposed turbine has been provided, standardised to a wind height of 10m, based on data from a 105m turbine height. The sound power level and octave band values for the turbine are based on the noise levels provided by the manufacturers. The sound power levels at standardised 10 m height wind speeds are presented in Table 8-19, calculated as per the guidance in IOA supplementary guidance note 3: Sound Power Level Data, Section 5. Octave band data in dB(A) is presented in Table 8-20. The wind turbine data used as part of the assessment is presented in Appendix 8.4, Volume III of this EIAR. The final choice of turbine will be subject to a competitive procurement process, however the final turbine model selected for the wind farm will have an equal or lower total sound power level than the Vestas V162 7.2MW model used in this assessment and the resultant noise levels at NSLs will not exceed those predicted in this EIAR.

**Table 8-19: Vestas V162 7.2MW Wind Turbine Sound Power Levels, dB $L_{WA}$ (with trailing edge serrations) 105m hub height (Standardised to 10m)**

| Turbine | Standardised 10 m Height Wind Speed (m/s) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 to Cut-out |
| Vestas V162 7.2MW | 94 | 94 | 94.7 | 99.2 | 103.4 | 104.6 | 104.7 | 105.0 | 105.5 |

**Table 8-20: Vestas V162 7.2MW Wind Turbine Octave Band Sound Power Levels, dB $L_{WA}$ (with trailing edge serrations) 105m hub height (Standardised to 10m)**

| Standardised 10 m Height Wind Speed (m/s) | Sound Power Level (dBA) at Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| 2 | 77.5 | 84.2 | 87.4 | 88.8 | 87.7 | 83.6 | 76.6 | 66.5 |
| 3 | 78.0 | 84.5 | 87.5 | 88.8 | 87.6 | 83.4 | 76.3 | 66.4 |
| 4 | 78.6 | 85.5 | 88.5 | 89.4 | 88.1 | 83.8 | 76.5 | 66.2 |
| 5 | 83.0 | 90.3 | 93.3 | 93.9 | 92.4 | 87.9 | 80.4 | 69.8 |
| 6 | 86.9 | 94.6 | 97.7 | 98.0 | 96.3 | 91.7 | 84.1 | 73.4 |
| 7 | 88.2 | 95.9 | 99.0 | 99.2 | 97.5 | 92.9 | 85.3 | 74.6 |
| 8 | 88.4 | 96.0 | 99.1 | 99.3 | 97.7 | 93.1 | 85.6 | 74.9 |
| 9 | 88.6 | 96.2 | 99.4 | 99.6 | 98.0 | 93.5 | 86.0 | 75.4 |
| 10 to cut-out | 88.5 | 96.4 | 99.8 | 100.2 | 98.7 | 94.2 | 86.6 | 75.9 |

The industry accepted IOA GPG (2013) best practice guidance states that a margin of uncertainty should be included within source wind turbine noise data used in noise predictions. A +2 dB correction was added to the sound power levels above to account for a margin of uncertainty.

It is possible to run the proposed turbine model in a noise reduced mode of operation, whereby the noise level is lessened by reducing the rotational speed of the turbines, with a resultant loss of electrical energy production.

### *Substation Noise*

In addition to the noise from wind turbines, noise will be produced by the transformer located in the substation. The noise level is likely to depend on the load on the transformer which is dependent on the wind speed (as the wind turbines producing more energy in high wind speeds).

In addition, noise from the proposed substation has been assessed in line with BS4142. This standard uses a comparison of the background noise with the specific noise from the source to be introduced to assess the likelihood of complaints, as detailed in Section 8.2.6.

The background noise at the nearest noise sensitive location to the proposed substation (R13) has been determined from the long term noise monitoring at location NML6, which is approximately 700m from the proposed transformer location and considered representative of the noise environment at the receptor.

The daytime and night time background noise measurements ($L_{A90,\ 10min}$) have been filtered to exclude data for atypical data, windspeeds above 5m/s and any data during which rainfall occurred, in accordance with BS4142. BS4142 categorises daytime as 07:00-23:00, with night time between 23:00-07:00.

Predictions have been carried out based on an example transformer; the Siemens TLPN7747 40000 / 50000 kVA. The sound power level for the transformer is 93 dB(A). The octave band sound data for the transformer has been sourced from 'An Introduction to Sound Level Data for Mechanical and Electrical Equipment' published by CED Engineering. The A-weighted octave band data is presented in Table 8-21. If an alternative transformer is selected, it will not exceed a sound power level of 93 dB(A).

**Table 8-21: Octave Band Sound Power Level Data**

| Equipment | A-weighted Octave Band Centre Frequency (Hz) | | | | | | | | Overall LWA |
|---|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | |
| Transformer Ω | 87 | 89 | 84 | 84 | 78 | 73 | 68 | 61 | 93 |
| Ω - Manufacturer's datasheet provided information on overall sound power levels. Octave band data was sourced from 'An Introduction to Sound Level Data for Mechanical and Electrical Equipment' CED Engineering | | | | | | | | | |

Noise predictions have been carried out using DGMR iNoise noise prediction modelling software, v2024.3 based ISO 9613-2: 2024 prediction methodology. A worst case scenario with equipment producing their highest noise emissions has been assumed. The on-site substation transformer noise has been predicted in terms of the $L_{Aeq}$.

### *8.6.3.2 Potential Operational Impacts - Predicted Noise Levels*

***Wind Turbine Noise***

Noise predictions were performed for the wind turbine layout using the highest noise levels at each wind speed, for the proposed turbine model for a range of standardised 10m height wind speeds from 2 m/s up to 10 m/s (to cut-out). Receptors included those within the 35 dB $L_{A90}$ noise contour of the turbines were modelled. Predicted noise levels from other on-site noise sources, i.e., the substation, have been assessed in the previous section. Noise from the proposed wind turbines were assessed against the derived noise limits.

Table 8-19 presents predicted daytime and night-time noise levels from the proposed wind turbines at 10 receptor locations that include the highest predicted noise levels and controlling locations close to the proposed windfarm. Table 8-20 also presents the derived noise limits for each period.

The predicted noise levels at all receptor locations within the study area are presented in Appendix 8-5. Note that the noise prediction methodology assumes that noise sensitive receptors are downwind of the proposed wind farm, representing a worst case scenario. In practice, receptor locations will not be downwind of all noise sources simultaneously, and the actual noise levels will be lower than those presented in Table 8-22 and Appendix 8.5.

**Table 8-22: Assessment of Predicted $L_{A90}$ Noise Levels for Derrynadarragh Wind Farm against Noise Limits**

| Receptor ID / Noise Monitoring Location | Description | Predicted $L_{A90}$ Sound Pressure Level at 10m Standardised Wind Speed, dB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 m/s | 3 m/s | 4 m/s | 5 m/s | 6 m/s | 7 m/s | 8 m/s | 9 m/s | 10 m/s to cut-out |
| R97/ NML1 | Predicted Level | 24.6 | 24.7 | 25.5 | 30.1 | 34.3 | 35.6 | 35.7 | 36 | 36.4 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R304/ NML2 | Predicted Level | 21.7 | 21.9 | 22.6 | 27.3 | 31.5 | 32.7 | 32.8 | 33.1 | 33.5 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R440/ NML3 | Predicted Level | 16.6 | 16.8 | 17.6 | 22.3 | 26.5 | 27.7 | 27.9 | 28.1 | 28.5 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R37/ NML4 | Predicted Level | 28.2 | 28.3 | 29 | 33.6 | 37.8 | 39 | 39.1 | 39.4 | 39.9 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |

| Receptor ID / Noise Monitoring Location | Description | Predicted $L_{A90}$ Sound Pressure Level at 10m Standardised Wind Speed, dB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 m/s | 3 m/s | 4 m/s | 5 m/s | 6 m/s | 7 m/s | 8 m/s | 9 m/s | 10 m/s to cut-out |
| R13/ NML5 | Predicted Level | 27.5 | 27.6 | 28.4 | 33 | 37.1 | 38.4 | 38.5 | 38.8 | 39.2 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R57/ NML6 | Predicted Level | 24.1 | 24.2 | 25 | 29.6 | 33.7 | 35 | 35.1 | 35.4 | 35.8 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R1/ NML7 | Predicted Level | 27.8 | 27.9 | 28.6 | 33.2 | 37.4 | 38.6 | 38.8 | 39 | 39.5 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |

The highest predicted noise level from the proposed wind turbines is 39.9 dB $L_{A90}$ at 10 m/s at noise sensitive location R37, south of the Proposed Development. The noise levels at this location are below the daytime and night-time noise limits by 5.1 dB and 3.1 dB, respectively. The predicted noise levels are lower at all other locations, with the daytime and night-time noise criteria met at all locations for all wind speeds.

At NSLs within the study area, a new source of noise will be introduced into the soundscape and it is expected that there will be a long-term, slight to moderate negative effect at the closest dwellings to the proposed wind farm.

***Substation Noise***

Table 8-23 summarises the basis of the BS4142 assessment for the on-site substation.

**Table 8-23: BS4142 Assessment of Substation Noise**

| Results | Daytime | Night time |
|---|---|---|
| Ambient noise level (Measured residual noise level from baseline noise survey plus predicted noise level from transformer at closest receptor (R13)) | (Residual 43 dB + specific 26 dB=) 43 $L_{Aeq,1hr}$ | (Residual 33 dB + specific 26 dB=) 33 $L_{Aeq,15min}$ |
| Residual sound level | 43 dB $L_{Aeq,1hr}$ | 33 dB $L_{Aeq,15min}$ |
| Background sound level (when source not in operation) | 30 dB $L_{A90,1hr}$ | 20 dB $L_{A90,15min}$ |
| Reference period | 1 hour | 15 minutes |
| Specific sound level at closest receptor (R13) | 26 dB $L_{Aeq,1hr}$ | 26 dB $L_{Aeq,15min}$ |
| Acoustic character correction (none applied) | - | - |
| Rating level (no correction applied) | 26 dB $L_{Aeq,1hr}$ | 26 dB $L_{A90,15mins}$ |
| Background sound level | 30 dB $L_{A90,10mins}$ | 20 dB $L_{A90,10mins}$ |
| Excess of rating over background | -4 dB | +6 dB |
| Results | The difference is -4dB. The specific sound level is 4dB below the existing daytime background sound level. Adverse noise impacts are therefore considered unlikely. | The difference is +6 dB. Although the difference is greater than 5 dB above the background noise level, adverse impacts are not considered likely, considering the context. |

| Results | Daytime | Night time |
|---|---|---|
| | | Given the low absolute source level and low background noise level , an absolute noise limit is considered more appropriate for night time, in accordance with BS4142 guidance (see below). |
| Uncertainty of assessment | To reduce the measurement uncertainty, data from a long duration noise survey was used. Data was filtered to exclude periods of high winds (>5m/s), rainfall and atypical data/events.<br>There is some uncertainty or variability in the noise level assumed for the transformer compared with that which will ultimately be installed. As measurements were conducted over 10-minute intervals, the background level may vary slightly.<br>As the difference between background sound level and rating sound level is significant, the uncertainty of the assessment is not likely to influence the outcome of the assessment. | To reduce the measurement uncertainty, data from a long duration noise survey was used. Data was filtered to exclude periods of high winds (>5m/s), rainfall and atypical data/events.<br>There is some uncertainty or variability in the noise level assumed for the transformer compared with that which will ultimately be installed. As measurements were conducted over 10-minute intervals, as opposed to the reference interval of 15 mins the background level may vary slightly.<br>Given the low specific sound level and difference between the proposed noise limit (see below) and specific sound level, the uncertainty is unlikely to influence the outcome of the assessment. |

As detailed in Table 8-23 , during the daytime the rating sound level is 4dB below the background sound level. As the rating sound level is below the existing background sound level, adverse noise impacts are considered unlikely during daytime.

During the night-time, the difference in noise level is +6dB. The difference is greater than +5 dB, however, BS4142 states the initial estimate of the impact needs to be modified due to the context in the case where the absolute noise levels are low, particularly at night. It also states that where noise levels are low, an absolute noise criteria is more appropriate. World Health Organisation Night Noise Guidelines for Europe (WHO, 2009) define a noise limit for $L_{night}$, which is the equivalent outdoor sound pressure associated with a particular type of noise during the night (at least 8 hours) a period of a year, outside. A limit of $L_{night}$, outside of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise. As the noise predicted from the substation is 14 dB below the limit, adverse noise impacts owing to the proposed substation are not considered likely at night-time.

In summary, in accordance with BS4142 guidance, the substation predicted daytime noise levels are below the level that would lead to a significant adverse effect. At night time, absolute noise levels are considered more appropriate and the predicted noise levels are at a level that will not lead to any significant adverse effects.

#### 8.6.4 Potential Noise Impacts During Decommissioning

The impacts associated with decommissioning of the project are comparable to those described for the construction phase. On decommissioning, cranes will disassemble the above ground turbine components which would be removed off site for recycling. All the major component parts are bolted together, so this is a relatively straightforward process. The foundations will be covered over and allowed to re-vegetate naturally.

Grid connection infrastructure including substations and ancillary electrical equipment shall form part of the national grid and will be left in situ.

Decommissioning activities will be undertaken during daytime hours, and noise, which will be of a lesser effect than for construction, will be controlled through the relevant best practice guidance and standards discussed in this chapter and those in place at the time of decommissioning. Similar to the predicted effects of general construction woks, it is expected that the noise limits will be met and effects during decommissioning will be negative, moderate, and temporary in duration.

A detailed decommissioning plan will be agreed in advance of construction with Kildare, Offaly, and Laois County Councils, as appropriate. A decommissioning plan is contained in the Construction Environmental Management Plan (CEMP) in Appendix 2.1.

## 8.7 Mitigation Measures

#### 8.7.1 Mitigation Measures during Construction

The predicted noise levels from on-site activity from the general construction works associated with the proposed development are below the noise criteria in BS 5228-1:2009+A1:2014 and are not expected to result in significant negative effects. Nonetheless, several mitigation measures will be employed, as good practice, to minimise any potential impacts from the proposed development.

The noise impact for construction works traffic will be mitigated by generally restricting movements along access routes to the standard working hours, unless specifically agreed otherwise. For example, during turbine base concrete pours, works will need to start earlier due to the curing process. If deliveries are required at night, it will be ensured that vehicles on local roads do not wait outside residential properties with their engines idling, and that the local residents will be informed of any activities likely to occur outside of normal working hours. Consultation with the local community is important in minimising noise impacts, and therefore any out of hours working would be agreed in advance with the local planning authority. In addition, residents will be informed of construction activities through the Community Liaison Officer.

The construction works on site will be carried out in accordance with the guidance set out in BS 5228:2009+A1:2014, and the noise control measures set out in Appendix 2.1 Construction Environmental Management Plan (CEMP), in Volume III of this EIAR.

- Proper maintenance of plant will be employed to minimise the noise produced by any site operations. All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the project, with particular attention paid to the lubrication of bearings.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Training will be provided by the Site Manager to workers and drivers to ensure smooth machinery operation/driving, and to minimise unnecessary noise generation.
- Local areas of the haul route will be condition monitored and maintained, if necessary.

- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall be restricted to between 07:00hours and 19:00 Monday to Friday, and 08:00 hours and 14:00 hours on Saturday. However, to ensure that optimal use is made of fair-weather windows, or at critical periods within the programme, it could occasionally be necessary to work outside these hours. Any such out of hours working would be agreed in advance with the local planning authority and consultation with the local community.

The on-site construction noise levels will be below the relevant noise limit of 65 dB $L_{Aeq,1hr}$ for operations exceeding one month, and therefore general construction noise effects are expected to be negative, moderate and temporary in duration post-mitigation.

There is potential for temporary elevated noise levels due to the grid connection works that has the potential to exceed the noise limits at up to 93 properties. However, the impact of these works at any particular receptor will be for a short duration (i.e. less than 3 days) and mitigation measures are required. Where the works at elevated noise levels are required over an extended period, greater than 3 days, at a given location, a temporary noise barrier or screen will be used to reduce noise levels below the noise limit, where required. The noise impact will also be minimised by limiting the number of plant items operating simultaneously, where reasonably practicable. The resulting effects during grid connection works are expected to be negative, moderate and temporary in duration, post-mitigation.

The pre-mitigation assessment concluded that the works associated with the installation of load bearing surfaces and offline track and bridge construction along the TDR are expected to result in a significant negative effect, which is temporary in duration. Mitigation measures are therefore required. The impacts of these works at any particular receptor will be for a short duration (i.e. less than 3 days). Where the works at elevated noise levels are required over an extended period, greater than 3 days, at a given location, a temporary barrier or screen will be used to reduce noise levels below the noise limit where required. The noise impact will also be minimised by limiting the number of plant items operating simultaneously, where reasonably practicable. The resulting effects are expected to be negative, moderate and temporary in duration, post-mitigation.

### 8.7.2 Mitigation Measures during Wind Farm Operation

The predicted operational noise emissions from the proposed windfarm are below the derived noise limits and are expected to result in a long-term, slight to moderate negative effect at the closest dwellings to the proposed wind farm, as a new source of noise will be introduced into the soundscape.

Should the project be granted permission, an operational noise survey will be undertaken to ensure the project complies with the noise limits once the windfarm is operational. It has been predicted that the noise limits will be met. However, in the unlikely event of an exceedance, mitigation measures will be implemented to ensure compliance with the noise limits is achieved at all noise sensitive locations. In the event of an exceedance, noise mitigation will be provided by running the relevant turbine(s) in noise reduced modes of operation. The noise emissions can be lessened by reducing the rotational speed of the turbines, with a resultant loss of electrical energy production.

It is not currently possible to predict AM during the planning stage, and this occurs on only a small proportion of windfarms. As discussed in 8.3.2.1, planning conditions imposing AM limits are not currently considered best practice. It is proposed that the wind farm development will implement a complaints-based monitoring procedure for AM.

In the unlikely event that a complaint is received which indicates potential AM associated with wind turbine operation, the operator will employ an independent acoustic consultant to assess the level of AM in accordance with the 'Reference Method' outlined in the Institute of Acoustics IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group Final Report: A Method for Rating Amplitude Modulation in Wind Turbine Noise (2016), or subsequent revisions. This will provide a robust and reliable indicator of AM and if a correction/penalty for AM needs to be applied to the Proposed Development. It is intended that any corrections for AM to be applied will be based on the updated ETSU guidance when finalised, which is currently in draft form. Prior to the commissioning of the wind farm, the developer shall submit and agree in writing with the planning authority a Noise Complaint Monitoring Programme (NCMP). This programme shall detail how noise complaints shall be addressed. If a noise complaint or evidence of an exceedances of the noise limits were to occur, a detailed assessment shall be undertaken following the guidance outlined in the IoOA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be followed, and relevant corrective actions implemented.

This approach to AM will yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions that cause AM and allow for the specification of mitigation measures, which can include turbine software controls, such as operating certain turbines in sound optimised modes, blade pitch regulation, vortex generators or temporary turbine shut downs, as appropriate.

### 8.7.3 Mitigation Measures during Decommissioning

Decommissioning works are expected to result in moderate negative effects and will be temporary in duration. As good practice, the noise control measures outlined in the Appendix 2.1 Construction Environmental Management Plan and in section 8.7.1 will be implemented, in addition to any measures in best practice guidance available at the time of decommissioning.

### 8.7.4 Potential Cumulative Impacts

#### *8.7.4.1 Construction Phase*

Other existing, consented and proposed developments located within 20km of the proposed Derrynadarragh Wind Farm which have been considered as part of this assessment are detailed in Appendix 2.1 of Volume III of this EIAR. These developments have been considered, and it is not expected that there will be cumulative construction noise impacts with any other large or small scale developments in the vicinity of the proposed wind farm, given the distance between the developments and nature of the works proposed as part of these developments.

#### *8.7.4.2 Operational Phase*

Other existing, consented and proposed developments located within 20km of the proposed Derrynadarragh Wind Farm which have been considered as part of this assessment are detailed in Appendix 2.1 of Volume III of this EIAR. As outlined in Section 8.4.2, only Cushina Wind Farm is located close enough to the proposed Derrynadarragh Wind Farm that it has potential to contribute to cumulative noise emissions at noise sensitive locations. It is not expected that there will be cumulative operational noise impacts with any other developments in the vicinity of the proposed wind farm, given the distance between the proposed wind farm and other developments.

The proposed 11 no. turbine windfarm at Cushina, approximately 4.3km northwest of the site has therefore been assessed cumulatively with the Proposed Development.

The proposed Cushina Wind Farm has been modelled using a Vestas V162 7.2MW turbine model with a 119m hub height. Turbine coordinates and sound power levels at standardised 10 m height wind speeds used in the noise model are presented in Appendix 8.4, Volume III of this EIAR, calculated as per the guidance in the IOA supplementary guidance note 3: Sound Power Level Data, Section 5. The industry accepted IOA GPG (2013) best practice guidance states that a margin of uncertainty should be included within source wind turbine noise data used in noise predictions. A +2 dB correction was added to the sound power levels above to account for a margin of uncertainty.

The IOA GPG makes reference to directivity effects from wind turbines in Section 4.4. It states that if a noise source is upwind of another, a noise a reduction of 10 dB can be applied. However, the noise modelling undertaken assumes receptors are downwind of both wind farms simultaneously. Given that the closest noise sensitive locations are between Derrynadarragh and Cushina wind farms, they cannot be downwind of both windfarms at any one time. The cumulative noise predictions are therefore considered conservative, and the cumulative noise levels will be lower than those predicted, in practice.

Cumulative noise predictions are presented in Table 8-24 below and have been compared to the derived daytime and night time noise limits. The predicted cumulative noise levels indicate that the proposed daytime and night-time noise limits have not been exceeded at any location. The effects are expected to be negative, slight to moderate and long term in duration, and there are no changes to the mitigation measures outlined in Section 8.7.2 required.

#### *8.7.4.3 Decommissioning*

No potential cumulative impacts have been identified in respect of noise associated with the decommissioning of the Proposed Development and as a result there are no changes to the proposed mitigation measures outlined in Section 8.7.3.

**Table 8-24: Assessment of Cumulative Predicted $L_{A90}$ Noise Levels for Derrynadarragh Wind Farm and Cushina Wind Farm against Noise Limits**

| Receptor ID / Noise Monitoring Location | Description | Predicted $L_{A90}$ Sound Pressure Level at 10m Standardised Wind Speed, dB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 m/s | 3 m/s | 4 m/s | 5 m/s | 6 m/s | 7 m/s | 8 m/s | 9 m/s | 10 m/s to cut-out |
| R97/ NML1 | Predicted Level | 24.9 | 25 | 25.8 | 30.4 | 34.6 | 35.8 | 35.9 | 36.2 | 36.6 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R304/ NML2 | Predicted Level | 21.8 | 21.9 | 22.7 | 27.3 | 31.5 | 32.8 | 32.9 | 33.2 | 33.6 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R440/ NML3 | Predicted Level | 16.6 | 16.8 | 17.6 | 22.3 | 26.5 | 27.7 | 27.9 | 28.1 | 28.5 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R37/ NML4 | Predicted Level | 28.2 | 28.3 | 29 | 33.6 | 37.8 | 39 | 39.1 | 39.4 | 39.9 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |

| Receptor ID / Noise Monitoring Location | Description | Predicted $L_{A90}$ Sound Pressure Level at 10m Standardised Wind Speed, dB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 m/s | 3 m/s | 4 m/s | 5 m/s | 6 m/s | 7 m/s | 8 m/s | 9 m/s | 10 m/s to cut-out |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R13/ NML5 | Predicted Level | 28 | 28.1 | 28.8 | 33.4 | 37.6 | 38.8 | 39 | 39.2 | 39.7 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R57/ NML6 | Predicted Level | 25.8 | 25.9 | 26.7 | 31.3 | 35.5 | 36.7 | 36.8 | 37.1 | 37.5 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |
| R1/ NML7 | Predicted Level | 28.1 | 28.2 | 29 | 33.5 | 37.7 | 39 | 39.1 | 39.4 | 39.8 |
| | Daytime limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 |
| | Daytime Excess | - | - | - | - | - | - | - | - | - |
| | Night-time limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| | Night-time Excess | - | - | - | - | - | - | - | - | - |

## 8.8 Residual Impacts

Construction and decommissioning on-site activities with a duration longer than one month will be below the construction noise limit of 65 dB $L_{Aeq,1hr}$ at noise sensitive locations. As a result, residual construction and decommissioning impacts range between not significant to moderate, with the duration described as temporary.

There is potential for elevated noise levels due to the grid connection works and TDR accommodation works resulting in a temporary significant impact during the construction stage. However, these works will be for a short duration at any particular property (i.e. typically less than 3 days) and where the works are to occur over an extended period at a given location, a temporary barrier or screen will be used to reduce noise level below the noise limit and reduce any potential impact resulting in a moderate short-term residual impact.

The predicted operational wind farm noise levels meet the daytime and night-time noise limits derived using the Wind Energy Development Guidelines 2006 at all noise sensitive locations. As detailed in the criteria section, this is considered to be a current best practice approach. The predicted noise levels from the proposed substation are below a level that will lead to any significant adverse effects at all noise sensitive locations. For some receptors in the study area, the operational wind farm will result in a new source of noise being introduced into the local soundscape, and it is expected that there will be a slight to moderate long-term impact at dwellings closest to the Proposed Development.

## 8.9 References

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