8 NOISE

8.1 INTRODUCTION

This chapter of the EIAR describes the potential noise and vibration impact from the proposed Kilcumber Bridge 110kV substation. A detailed description of the proposed development is provided in **Chapter 2** of this EIAR.

8.1.1 Substations and Noise Emissions

The main noise source from a high voltage substation is from the transformer(s). The noise is generally recognisable as a steady hum which arises from electric and magnetic forces within the transformer. Infrequent noise may also arise from voltage changes (tap changer) and cooling fans under high loads.

There will be no transformers in this substation compound. The transformers will be in the already assessed and permitted adjacent Cushaling electrical infrastructure compound.

Other noise sources from electrical infrastructure include Aeolian noise (wind through power lines), Corona noise (hiss or crackling from high voltage power lines) and potentially noise from faulty equipment. These are described in more detail in **Section 8.3.2**.

Construction noise will occur during excavation and earth moving, laying of roads and hard standings, and transportation of materials. The construction phase will be phased and temporary.

Noise assessments were undertaken for the operational and the construction phases of the proposed development. The cumulative impact with other projects was also considered.

8.1.2 Fundamentals of Noise

Fundamentally, noise is vibrations of the air which are detectable by the ear. Sound waves radiate out spherically from a sound source in three dimensions.

The human ear can detect a very wide range of pressure variations. To cope with this wide range, a logarithmic scale (decibel (dB) scale) is used to translate pressure values into manageable numbers from 0dB to 140 dB. 0 dB is the threshold of hearing and 120 dB is the threshold of pain.

Measuring in decibels means that a 3 dB increase is equivalent to a doubling of the sound energy and a 10 dB increase in a tenfold increase in energy. For broadband sounds which are very similar in all but magnitude, a change or difference in noise level of 1 dB is just perceptible under laboratory conditions, 3 dB is perceptible under most normal conditions and a 10 dB increase generally appears twice as loud.

A healthy human ear is also sensitive to a large range of frequencies (approximately 20 Hz to 20,000 Hz) and varies in sensitivity depending on the frequency.

The human ear is not equally sensitive to sound at all frequencies and is less sensitive to sound at low frequencies and high frequencies. A -weighting (dB A) is the main way of adjusting measured sound pressure levels (noise) to take account of the uneven human response to frequencies.

Figure 8.1 illustrates some everyday sounds on the dB(A) scale. A quiet bedroom is around 35 dB(A), a busy office around 60dB(A) and a rock concert around 100 dB(A). The illustration is extracted from draft Wind Energy Development Guidelines 2019.

Figure 8-1 The Level of Typical Common Sounds on the dB(A) Scale

8.1.3 Scope of assessment

The scope of the assessment has been defined by industry standard best practice and guidance **(section 8.1.4.1**) used in Ireland. In general, this includes:

- Establishing the existing or baseline noise conditions at representative noise sensitive receptors in this case, habited residential dwellings.
- Establishing noise limits criteria.
- Identifying the significant sources or noise and vibration (if any).
- Using computer software or by calculation, predict the noise emissions at the noise sensitive receptors.
- Comparing the predicted noise emissions (as a standalone development and cumulatively with other permitted or existing developments) against the noise limit criteria and existing noise levels.
- Design and describe mitigation measures, if necessary, to ensure residual impacts are acceptable.

There will be no significant sources of vibration either during construction or once operational, therefore, vibration has been scoped out from further assessment.

8.1.4 Methodology

The methodology and planning guidance framework are described in the following sections.

8.1.4.1 Policy and Guidance

The primary guidance documents used in the preparation of this chapter represent best practice in assessing noise and are outlined as follows:

- *BS 5228-1&2:2009+A1:2014,* Code of Practice for Noise and Vibration Control on construction and open sites.
- *Guidelines for Environmental Noise Impact Assessment*, Institute of Environmental Management and Assessment (IEMA), 2014.
- *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*, Environmental Protection Agency (EPA), 2016.

8.1.4.1.1 Criteria for Evaluating Operational Phase Noise Impact

There are no noise limit criteria specific to substations and electricity infrastructure. When considering the appropriate assessment criteria, the EPA's *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), 2016* was consulted. Typical limit values for noise from licenced sites are outline in **Table 8-1**:

Table 8-1 Operational Noise Emission Criteria

Daytime (07:00-19:00) dB(A) $L_{Ar\ T}$	Evening-time (19:00 – 23:00) dB(A) $L_{Ar\ T}$	Night-time (23:00 – 07:00) dB(A) $L_{Ar\ T}$
55	50	45

During daytime and evening periods rigorous efforts should be made to avoid clearly audible tones and impulsive noise at all sensitive locations. A penalty of 5dB for tonal and/or impulsive elements is to be applied to the daytime and evening measured LAeq,T values to determine the appropriate rating level (LAr,T).

During the night-time period no tonal or impulsive noise from the facility should be clearly audible or measurable at any noise sensitive location (NSL).

8.1.4.1.2 Significance of Effect Descriptors

Table 8.2 describes effect descriptors and corresponding changes in noise levels. They have been sourced from the Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Noise Impact Assessment, 2014. The corresponding terminology as published in the EPAs Guidelines on the Information to be contained in Environmental Impact Assessment Reports, 2017 are also included.

Table 8-2 Significance of Effect Descriptors and Thresholds

IEMA Terminology	EPA Terminology	Description
Very Substantial	Very Significant to Profound	Greater than 10 dB L_{Aeq} change in sound level perceived at a receptor of great sensitivity to noise.
Substantial	Significant	Greater than 5 dB L_{Aeq} change in sound level at a noise sensitive receptor, or a 5 to 9.9 dB L_{Aeq} change in sound level at a receptor or great sensitivity to noise.
Moderate	Moderate	A 3 to 4.9 L_{Aeq} change in sound level at a sensitive or highly sensitive receptor, or a greater than 5 dB L_{Aeq} change in sound level at a receptor of some sensitivity.
Slight	Slight	A 3 to 4.9 dB L_{Aeq} change in sound level at a receptor of some sensitivity.
None/ Not Significant	Not Significant	Less than 2.9 dB L_{Aeq} change in sound level and/or all receptors are of negligible sensitive to noise or marginal to the zone of influence of the proposals.

The proposed substation compound will share the same NSL's (noise sensitive receptors) as the operational Edenderry Power Station, and the permitted Cushaling Wind farm, Battery Energy Storage System and Substation and the Cloncreen wind farm which is under construction.

Due to the logarithmic addition of decibels, if an additional noise source is 10 dB lower (or has no significant noise emissions at all) than an existing noise source then the new noise source will have a negligible impact upon the total noise levels, i.e., no cumulative impact.

8.1.4.2 Criteria for Evaluating Cumulative Impact

The potential cumulative impact has been assessed against the noise limit values for each of the permitted developments assessed in the cumulative impacts. These include:

8.1.4.2.1 Edenderry Power Station

The noise limit criteria contained the EPA publication also apply to the existing operational Bord na Mona Edenderry Power Station IPC licence (P0482-04) are as follows:

Noise from the installation shall not give rise to sound pressure levels (L_{eq}, 30 mins dB(A)) measured at the NSLs of the installation which exceed the limit values.

- *Daytime: L_{Aeq} (30 min) - 55 dB(A)*
- *Night-time: L_{Aeq} (30 min) - 45 dB(A).*

In addition to this, *Section B4* of the licence states that *there shall be no clearly audible tonal component or impulsive component in the noise emissions from the activity at any noise sensitive location.*

8.1.4.2.2 Cushaling Wind Farm

a) Between the hours of 07:00 and 23:00
   (i) The greater of 5 dB(A) L90 10 min above background noise levels, or 45 dB(A) L90, 10min, at wind speeds of 4m/s or greater
   (ii) 40dB(A) L90, 10 min, at all other wind speeds
b) 43 dB(A) L90, 10min, at all other times

8.1.4.2.3 Cloncreen Wind Farm

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

8.1.4.3 Criteria for Evaluating Construction Noise Effects

There is no statutory guidance in Ireland relating to the maximum noise levels permitted during construction works, and in the absence of statutory guidance or other specific limits prescribed by local authorities, the thresholds outlined in the *British Standard 5228-12009+A1:2009, Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise* has been adopted in this assessment. The noise levels, which are reproduced in **Table 8-3** below, are typically deemed acceptable.

Table 8-3: Construction Stage Noise Level Thresholds

Assessment category and threshold value period (T)	Threshold values, L_{AeqT} dB		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evening and Weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 -13:00hrs)	65	70	75

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

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

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

Note D: 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays. Given the rural nature of the site, all properties will be afforded a Category A designation. Therefore, if the predicted construction noise exceeds 65dB $L_{Aeq(T)}$ then this is assessed as a significant impact.

8.1.5 Statement on Limitations and Difficulties Encountered

No limitations or difficulties were encountered in completing this chapter.

8.1.6 Competency of Assessor

This report was written by Peter Barry (BSc MSc). Peter is an environmental scientist and environmental impact assessment practitioner.

Peter has 20 years' experience in the measurement, assessment, prediction, and control of environmental noise. Peter is a member of the Institute of Acoustics (IOA) and has successfully completed the IOA Diploma in Acoustics and Noise Control. Peter is also a member of the Institute of Environmental Science and the Environmental Law Association.

Peter has prepared numerous noise impact assessment reports for various developments including major infrastructural developments, mixed use developments and wind energy development projects.

Peter has presented evidence as expert witness on noise at oral hearings and in court.

8.2 EXISTING RECEIVING ENVIRONMENT

This section describes the existing environment in terms of existing noise sources and the existing noise levels.

The land uses in the area are mainly agricultural and bog land harvested for peat production. Once operational the permitted Cushaling and Cloncreen wind farms and associated electrical infrastructure will generate noise.

Currently the main sources of noise in the area include traffic on the local and regional road network, machinery involved in working peat and agricultural land, Edenderry Power Station, a local gravel pit and construction of the Cloncreen wind farm.

The noise sensitive receptors (NSR's) are dwellings in typical ribbon style development along the local road network.

The following sections describe how the existing pre-development noise environment was measured and characterised.

8.2.1 Noise Sensitive Receptors (NSR's)

The EPA's Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (2016), defines a noise sensitive location as *any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.*

The nearest noise sensitive receptors (NSRs) are numbered NSR 1 and NSR 2 as shown on **Figure 8-2**. They are approximately 400 m and 240 m respectively from the proposed substation area.

NSR 1 is a habitable dwelling and is currently the nearest noise sensitive receptor. If noise level criteria can be met here, they can be met at receptors further afield.

NSR 2 is owned by Bord na Mona (it is not used as a residence). It is excluded as a noise sensitive receptor from their annual noise compliance monitoring. It is therefore not considered a noise sensitive receptor for this assessment as existing noise limit criteria do not apply at this location. Noise levels at this location are excessive due to the influence of the BNM operations.

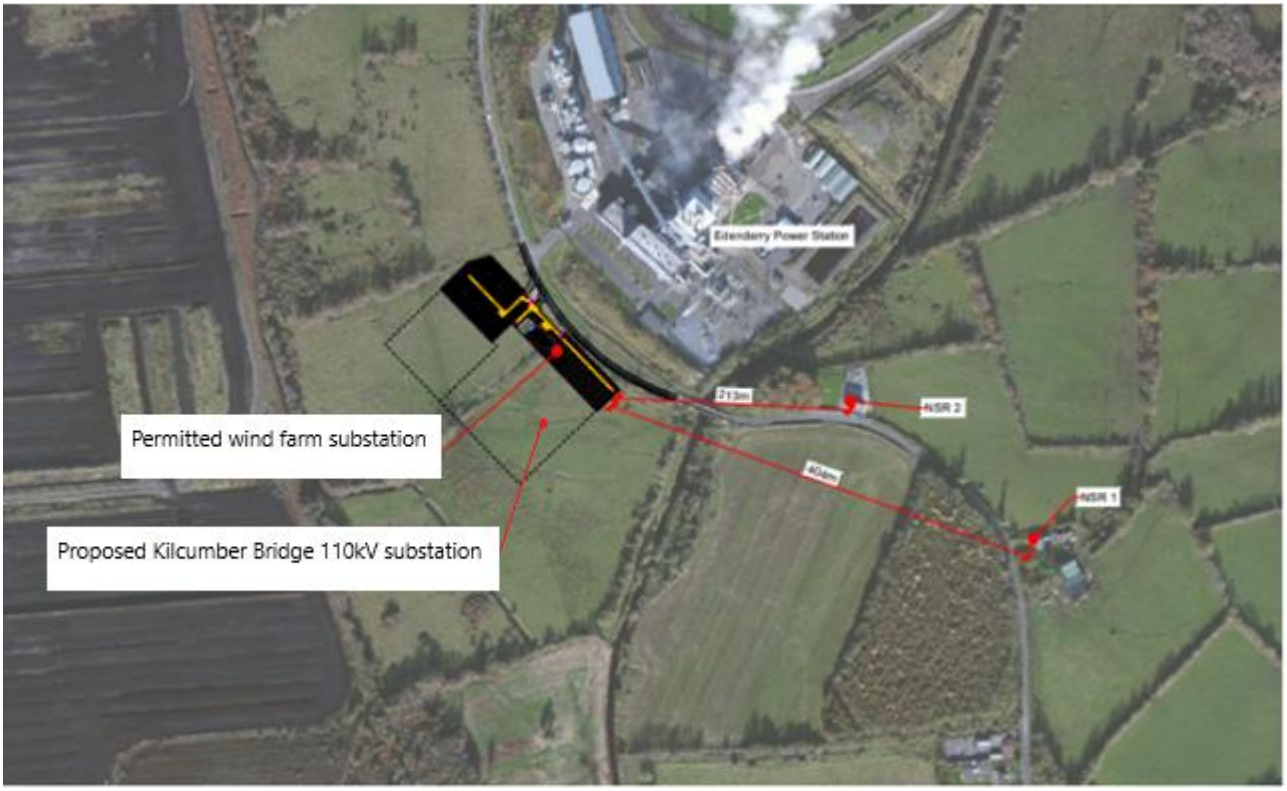

Figure 8-2 Nearest Noise Sensitive Receptors

8.2.2 Background Noise Monitoring

Background noise monitoring was undertaken at NSR 1 over a four-week period (20th June 2019 to 23rd July 2019) to inform the Cushaling Wind Farm Noise Impact Assessment (which was also undertaken by the author of this report). The results of that monitoring are representative of existing background noise levels at the nearest noise sensitive receptor (NSR 1) and are used to inform this report.

The average day and night-time noise levels measured over one 24-hour period are presented in **Table 8-4** below.

Table 8-4 Average Baseline Noise Levels Measured over a 24 hr. period

Date	Period	$L_{Aeq\ 10\ min}$ dB	$L_{AF10\ 10\ min}$ dB	$L_{AF90\ 10\ min}$ dB	$L_{AF\ max\ 10\ min}$ dB	$L_{AFmin\ 10\ min}$ dB
22nd June 2019	Night-time 23:00 to 7:00	39	41	33	57	31
	Daytime 7:00 to 23:00	41	44	36	56	32

8.2.3 Do-Nothing Scenario

Should the proposed development not proceed, noise levels may increase in the vicinity of the zone of influence of the Cloncreen and Cushaling Wind Farms following their construction depending on meteorological conditions.

8.3 LIKELY SIGNIFICANT EFFECTS

The following sections describe the potential noise impact from the proposed development.

8.3.1 Construction Phase

The construction phase entails the building of the electrical infrastructure. The main noise sources include heavy machinery and support equipment used to construct the various elements. This typically means heavy earth moving machinery, generators, and material transport trucks.

8.3.1.1 Substation Construction

Table 8-5 is a typical list of plant and machinery involved in substation construction activities. Noise levels from the equipment identified above have been sourced from *BS5228 Noise Database for Noise and Vibration Control on Construction and Open Site 1& 2: 2014+A1*.

Table 8-5 Typical Construction Plant and Machinery

Plant and Machinery	Sound Pressure Level @10m dB(A)	Predicted Sound Pressure Level @ 400 m L_{eq} dB(A)
Telescopic Handler	71	**54**
Mobile Crane	70	
30-50T Excavator	79	
15-30T Excavator	78	
12T Roller	80	
Dump truck	78	
Tractor & Trailer	79	
15-20T Rubber Tired Excavator	68	
3-10T mini digger	69	
Diesel Generator	61	
Total	**86**	

The construction works will be sequenced and all the noise sources in **Table 8-5** above will not be in operation continuously or simultaneously for the duration of the construction. The resultant theoretical worst-case noise emission level at the nearest receptor is 54 dB(A). This is below the construction noise threshold.

The construction phase will be temporary and of short duration, estimated to be 12 months. The significance of impact of the construction of the substation compound is predicted to be a temporary slight adverse impact.

8.3.1.2 110 kV Overhead Line (OHL) Construction

8.3.1.2.1 110kV Overhead Line Grid Connection

The construction equipment required for the construction of a 110 kV overhead line will be of small scale comprising of a dumper, tracked excavator, small tools and 1 or 2 light commercial vehicles.

Given the very short time frame, the temporary and minor nature of the works and machinery, and the distance to the nearest noise sensitive receptor, the potential impact will not be significant.

8.3.1.3 Construction Traffic

The proposed development will have the most impact during the construction phase when materials are being delivered and the substation is being constructed. Traffic volumes will be only a fraction of the existing traffic levels on the local road network. In general, a 100% increase in traffic levels will increase traffic noise as a line source by 3 dB which is barely noticeable. Construction traffic will not be a significant source of noise at the nearest noise sensitive receptors. Any increase in noise levels will be temporary and of short duration.

8.3.1.4 Cumulative Impact - Construction Phase

Given the minor scale of the construction works (comparable to the erection of agricultural buildings) and the distance to the nearest receptor, approximately 400m away, there will be no significant cumulative impact during construction.

Should the works proceed at the same time as the Cushaling substation, the works will likely be indistinguishable. The same plant and machinery will be used, i.e., shared, and both will be completed within the same timeframe.

8.3.2 Operational Phase

The substation is a 110kV Air Insulated Switchgear (AIS) loop substation. The components of which are listed below:

- control building,
- over & underground ducting/ cables,
- electrical pylons,
- fencing,
- electrical equipment including busbars, disconnects, breakers, sealing ends, lightning, and lighting masts.

The grid connection consists of a 400m 110kV overhead line (OHL) going south east from the substation and connecting into the adjacent existing Cushaling – Mount Lucas 110kV OHL. The OHL would consist of a combination of steel lattice pylons and wooden pylons with a height of 12m.

There are several ways in which noise can be generated from electricity infrastructure. Continuously radiated noise is the most noticeable to neighbours and this is associated primarily with transformers. This is acknowledged in the 2016 EirGrid research report (*EirGrid Evidence Based Environmental Studies Study 8: Noise. Literature review and evidence based filed study on the noise effects of high voltage transmission development)* on noise from electrical infrastructure which states:

there is strong evidence that the only relevant noise sources are the power transformers and associated cooling systems.

Switching operations can cause impulsive audible noise but these are infrequent events and are masked by transformer noise.

Generally, there are four categories of noise within a substation. Of these four, only one (substation transformers noise) will be a potential source of significant noise. All four are outlined in the following paragraphs.

1) Corona Noise – audible noise from high voltage transmission lines, generally described as crackling or hissing. An evidence based environmental noise study commissioned by EirGrid and published in 2016 found that significant Corona Noise impacts are not likely for 110 kV and 220 kV transmission lines and that the potential for significant impacts only relate to 400 kV lines (EirGrid 2008). This was concluded based on a literature review and actual noise measurements.

The results from the 110 kV and 220 kV overhead line noise surveys and described in the report (EirGrid, 2016) presented strong evidence that these lines are not likely to result in a significant noise impacts in their vicinity and concluded that, the planning of 110 kV and 220 kV lines should not be significantly constrained based on potential noise issues.

Therefore, corona noise is unlikely to be significant from the 110kV overhead line grid connection.

2) Faulty insulators - Audible noise associated with dirty, damaged, or cracked insulators. A proper maintenance programme will ensure that these do not become a significant noise source.

It is very unlikely there will be any noise from faulty equipment as it will be well maintained.

3) Aeolian noise – Audible noise from wind blowing through electricity infrastructure.
The conditions required to generate Aeolian noise are very specific, requiring high wind speeds at very specific angles of incidence. The conditions that give rise to Aeolian noise, (i.e. high wind speeds) will in most instances also mask the Aeolian noise. The EirGrid report finds that there is little evidence to suggest Aeolian noise is a significant noise impact at sensitive receptors. Further there is no standard or practical method for measuring and analysing Aeolian noise from existing infrastructure.

It is very unlikely that there will be any significant noise at the nearest receptors from Aeolian noise.

4) Substation equipment – Transformers, boosters, and capacitors. Transformers typically generate a low frequency humming noise, the extent of which depends on the transformer type and the level of nose attenuation at the substation.

An Air Insulated Switchgear (AIS) substation is where the electrical equipment infrastructure is primarily installed outdoors, with the use of natural air as an insulation between circuits.

Transformer hum is the predominant noise generated at electricity substations and is associated with magnetic and electrical forces within the core of an electrical transformer. These forces generate vibrations in the core laminations within the transformer which generates noise. Typically, the noise level does not vary with transformer load.

Generally, modern transformers are manufactured with a specified and guaranteed emission level. Improvements in the manufacture of transformers have reduced the associated level of noise emission and hence modern transformers are typically quieter than equivalent capacity older transformers.

There will be no transformers in the Kilcumber Bridge 110kV substation.

It is concluded that there are no significant sources of operational noise from the proposed development as a standalone entity and therefore there can be no significant impact. The proposed development will have no significant effect on noise levels at the nearest noise sensitive receptors.

8.3.3 Cumulative Impact

As there will be no significant noise emissions from the proposed development there can be no cumulative impacts with other existing or permitted projects including the Edenderry Power Plant, the under construction Cloncreen Wind Farm and the permitted but not yet constructed Cushaling wind farm, substation, and battery energy storage system.

The noise emissions from the aforementioned existing or permitted developments have already been assessed and found to be acceptable.

8.4 MITIGATION

8.4.1 Operational Phase

As there are no significant noise sources within the proposed electrical infrastructure, no specific mitigation measures are required.

8.4.2 Construction Phase

Best practice in the form of BS5228 –1&2:2009 + A1 2014, *Code of Practice for the Control of Noise and Vibration on Construction and Open Sites* will be adopted during the construction phase to minimise the noise generated by construction activities and nuisance to neighbours.

8.5 MONITORING

8.5.1.1 Construction Phase Monitoring

Construction phase noise and vibration monitoring is not required.

8.5.1.2 Operational Phase

As there are no significant noise sources, operational phase monitoring for the proposed development is not required.

8.6 RESIDUAL IMPACTS

Once operation there will be no significant noise from the proposed development either standalone or cumulatively.

8.7 CONCLUSION

There will be construction noise, but it will be temporary and of the short duration. The plant and machinery to be used will be relatively minor in scale, similar to that used in the construction of agricultural buildings. The guideline criteria for construction noise will not be exceeded. There will be no significant cumulative construction noise impacts.

There will be no significant source of noise emissions once operational. The primary source of noise within a substation is the steady hum from transformers of which there will be none.

Research has shown that noise from switch gear and alarms are not considered a significant source of noise primarily because of the infrequent use and short duration.

Corona noise can occur at conductors and from overhead lines hardware. Corona noise at nuisance levels from 110 kV lines is rare and is typically associated with 400 kV lines.

Wind borne Aeolian noise is rare and evidence-based research has shown it not to be a significant source of noise (EirGrid 2016).

As there are no significant operational noise emissions from the proposed development, there will be no cumulative impacts.

Noise emissions from the proposed development either standalone or cumulatively will not increase noise levels at the nearest noise sensitive receptors.

REFERENCES

BS 5228-1&2:2009+A1:2014, Code of Practice for Noise and Vibration Control on construction and open sites.

EirGrid Evidence Based Environmental Studies Study 8: Noise. Literature review and evidence based filed study on the noise effects of high voltage transmission development, EirGrid, May 2016.

Guidelines for Environmental Noise Impact Assessment, Institute of Environmental Management and Assessment (IEMA), 2014.

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