Chapter 09

Noise

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9 Noise

9.1 Executive Summary

9.1.1 Potential noise effects of the Proposed Development have been evaluated in accordance with appropriate criteria. The assessment has comprised a baseline noise survey, derivation of operational noise limits, consideration of cumulative developments and evaluation of operational noise from turbines and fixed (non-turbine) plant against proposed limits.

9.1.2 Noise effects associated with construction and decommissioning have been scoped out on the basis that these phases will be of relatively short duration and noise from the works can be restricted to meet appropriate limits by implementation of suitable controls, secured by planning conditions.

9.1.3 Following implementation of an outline mitigation strategy, operational noise levels are predicted to meet the derived residual noise limits and noise effects are therefore assessed as not significant. A schedule of mitigation has been applied to the wind turbines for specific wind speeds and directions and predicted noise levels presented in this assessment include this mitigation. The Applicant will also undertake appropriate specification of the final turbine model and transformer plant and development of a Construction Environmental Management Plan (CEMP) to address construction noise.

9.2 Introduction

9.2.1 This chapter provides an assessment of noise effects arising from the operation of the Proposed Development. Aspects of the Proposed Development which will generate noise comprise wind turbines and electrical plant including inverters, transformers and Battery Energy Storage Systems (BESS).

9.2.2 This assessment has assessed the design which considers the Proposed Development layout as described in **Chapter 3**. This assessment has assumed that the Proposed Development turbines will not exceed 230 m to blade tip. The candidate turbine that has been considered as part of this assessment is the Vestas V162 6 MW which has a rotor diameter of 162 m and hub heights of 119 m and 149 m.

Scope of Assessment

9.2.3 The following aspects have been scoped out of assessment:

- Construction and decommissioning noise and vibration – Consideration of construction noise and vibration was scoped in within the original Scoping submission and scoped out within the updated Scoping submission, given the reduced proposal. The consideration of construction noise and vibration, including construction traffic noise, has therefore been scoped out through consultation, on the basis that it is unlikely to be significant and will be controlled by implementation of Best Practicable Means. A Construction Environmental Management Plan (CEMP) will be produced detailing methods by which construction noise will be controlled, which will include a Construction Traffic Management Plan (TMP). These can be found in outline within **Appendix 3.1** and **Appendix 11.3** respectively.
- Excess Amplitude Modulation - Amplitude Modulation (AM) is the noticeable characteristic of wind turbine noise which can result in 'chopping' and 'thumping' noise. Some element of AM will always be present in wind turbine noise, but the Institute of Acoustics (IoA) has produced guidance and tools for evaluating 'excess' AM. AM effects cannot be predicted, however, these can be controlled by planning condition. Where excess AM is identified, mitigation can be put in place.

9.2.4 The scope of this assessment therefore comprises the following:

- scoping consultation with Environmental Health departments of East Ayrshire Council (EAC) and South Lanarkshire Council (SLC);
- evaluation of noise effects associated with the operation of the Proposed Development;
- specification of appropriate mitigation, where necessary; and
- evaluation of residual effects.

9.3 Legislation, Policy and Guidelines

9.3.1 Relevant legislation and guidance documents have been reviewed and taken into account as part of this assessment. Documents of particular relevance are summarised below.

9.3.2 In lieu of any specific legislation, assessing the effect of operation of such a development must draw on information from a variety of sources. This assessment makes reference to a number of British Standards, official planning policy and advice notes and national guidance.

9.3.3 For a development of this nature, there is no specific all-encompassing legislation relating to the standards associated with noise emission/effects. Noise legislation, where it does exist, tends to be either EU-derived and focussed on specific items of noise-emitting plant or on more general nuisance, such as that addressed by the provisions of the Environmental Protection Act 1990 (UK Government, 1990).

Planning Policy

9.3.4 The Planning Statement associated with this Section 36 application sets out the planning policy framework that is relevant to the EIA. This section considers the relevant aspects of National Planning Framework 4 (NPF4), Planning Advice Notes, the South Lanarkshire Local Development Plan (LDP) (2021), and other relevant guidance. Of relevance to the assessment presented within this chapter, regard has been had to the following policies:

NPF4:

- NPF4 - Policy 11:

  "a) Development proposals for all forms of renewable, low-carbon and zero emissions technologies will be supported. These include:

  i. wind farms including repowering, extending, expanding and extending the life of existing wind farms;

  …

  e) In addition, project design and mitigation will demonstrate how the following impacts are addressed:

  i. impacts on communities and individual dwellings, including, residential amenity, visual impact, noise and shadow flicker;"

- NPF4 – Policy 23:

  "Development proposals that are likely to raise unacceptable noise issues will not be supported. The agent of change principle applies to noise sensitive development. A Noise Impact Assessment may be required where the nature of the proposal or its location suggests that significant effects are likely."

Scottish Government Online Planning Advice: Planning Advice Note 1/2011 and Technical Advice Note

9.3.5 Published in March 2011 and last updated in 2014, Planning Advice Note 1/2011 (Scottish Government (2014b)) (PAN 1/2011) provides advice on the role of the planning system in helping to prevent and limit adverse effects of noise. Information and advice on noise assessment methods

are provided in the accompanying Technical Advice Note: Assessment of Noise (Scottish Government (2011b)) (TAN). Included within the PAN document and the accompanying TAN are details of the legislation, technical standards and codes of practice for specific noise issues.

9.3.6 With regard to noise from wind turbines, paragraph 29 of PAN 1/2011 states the following:

> *"There are two sources of noise from wind turbines – the mechanical noise from the turbines and the aerodynamic noise from the blades. Mechanical noise is related to engineering design. Aerodynamic noise varies with rotor design and wind speed and is generally greatest at low speeds. Good acoustical design and siting of turbines is essential to minimise the potential to generate noise. Web based planning advice on renewable technologies for onshore wind turbines provides advice on 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97) published by the former Department of Trade and Industry (DTI) and the findings of the Salford University report into Aerodynamic Modulation of Wind Turbine Noise."*

9.3.7 Regarding appropriate assessment methods, the 'web-based planning advice' referred to in PAN 1/2011 is contained in an online document titled 'Onshore Wind Turbines', published by the Scottish Government (updated 2014). The document is summarised in the corresponding section below, and also refers to the use of ETSU-R-97 The Assessment and Rating of Noise from Wind Farms (The Working Group on Noise from Wind Turbines, 1996) assessment guidance (discussed in **paragraphs 9.3.16** to **9.3.29**).

9.3.8 The IoA has since published 'a Good Practice Guide to the application of ETSU-R-97 for the assessment rating of turbine noise' (IoA, 2013), which is summarised in **paragraphs 9.3.30** to **9.3.43**. The Scottish Government accepts that the guide represents current industry good practice.

9.3.9 Neither PAN 1/2011 nor the associated TAN provide specific guidance on the assessment of noise from fixed plant, but the TAN includes an example assessment scenario for 'New noisy development (including commercial and recreation) affecting a noise sensitive building', which is based on BS4142:1997: 'Method for rating industrial noise affecting mixed residential and industrial areas'. This British Standard (BS) has been superseded by BS4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' (BSi, 2019). The standard is summarised in **paragraphs 9.3.44** to **9.3.51**.

9.3.10 In summary, national planning policy on the assessment of operational noise impacts from wind farms stipulates the use of the ETSU-R-97 assessment method and application of the IoA Good Practice Guide (IoA GPG). These guidance documents, and others relevant to the assessment of possible noise impacts generated by the Proposed Development, are summarised below.

Onshore Wind Policy Statement 2022

9.3.11 Published 21 December 2022 (Scottish Government), the document summarises the Scottish Government policy to onshore wind as follows:

> *'Deployment of onshore wind is mission-critical for meeting our climate targets. As an affordable and reliable source of electricity generation, we must continue to maximise our natural resource and deliver net-zero in a way that is fully aligned with, and continues to protect, our natural heritage and native flora and fauna.'*

9.3.12 Noise is not specifically addressed within the Policy Statement.

Local Planning Policy

9.3.13 SLC's Local Development Plan 2 (LDP2) was adopted in 2021 and notes the following with regard to wind energy developments:

- *Noise to be assessed in accordance with ETSU-R-7 and the IoA GPG.*

9.3.14 EAC's Local Development Plan 2 was adopted in April 2024 and has the following guidance on environmental noise:

- Policy NE12: water, air, light and noise pollution – "*All new development must take full account of any Noise Action Plan and Noise Management Areas that are in operation in the area and*

ensure that significant adverse noise impacts on surrounding properties and uses are avoided. A noise impact assessment may be required in this regard and noise mitigation measures may be required through planning conditions and/or Section 75 Obligations."

- Policy RE1: Renewable energy – Noise included as a criterion in the evaluation of community and economic impacts.

Guidance

9.3.15 Recognisance has been taken of the following best practice guidelines and guidance.

ETSU-R-97: The Assessment and Rating of Noise from Windfarms (ETSU-R-97)

9.3.16 As referenced for use in PAN/2011 and the online planning advice for renewable technologies: Onshore wind turbines, this document was written by a Noise Working Group including developers, noise consultants and environmental health officers, set up in 1995 by the Department of Trade and Industry through ETSU (the Energy Technology Support Unit).

9.3.17 ETSU-R-97 presents a consensus view of the working group and was prepared to present a common approach to the assessment of noise from wind turbines. The document states that noise from wind turbines or wind farms should be assessed against site specific noise limits.

9.3.18 Noise limits are derived based on a series of acceptable lower limits and based on an allowable exceedance above the prevailing background noise level, including consideration of a variety of different prevailing wind speed conditions. The noise limits should be derived for external areas used for relaxation, or areas where a quiet noise environment is highly desirable. Separate limits are required for night-time and daytime periods. Night-time limits are derived drawing upon measured night-time background noise levels, whilst daytime limits are derived drawing upon the background noise levels arising during 'quiet daytime' periods.

9.3.19 Night-time is defined as the period between 23:00 and 07:00 hours, whilst quiet daytime periods are defined as:

- 18:00 to 23:00 hours on all days;
- 13:00 to 18:00 hours on Saturdays and Sundays; and
- 07:00 to 13:00 hours on Sundays.

9.3.20 For daytime, the suggested limits are 5 dB above the prevailing background noise level determined during quiet daytime periods, or 35 to 40 dB(A), whichever is the higher. The absolute criterion between the 35 to 40 dB(A) range is selected taking account of:

- the site environs (e.g. number of local receptors);
- the energy generation capacity (e.g. number of kWh that can be generated) of the Proposed Development; and
- the associated duration and level of exposure.

9.3.21 During night-time, the suggested limits are 5 dB above the prevailing night time background noise level or 43 dB(A), whichever is the higher. The absolute criterion for the night-time is higher than that for the daytime, as the derivation of this limit is based on preventing sleep disturbance within a building whereas for the daytime, limits are based on occupation of external spaces used for relaxation.

9.3.22 The prevailing background noise levels are determined in terms of the $L_{A90,10min}$ noise index for both quiet daytime and night-time periods, for wind conditions ranging from 2 ms^{-1} to 12 ms^{-1}.

9.3.23 The noise limits are calculated by undertaking a regression analysis of the $L_{A90,10min}$ noise levels and the prevailing average wind speed for the same 10-minute period, when measured or determined at 10 m above ground at the location of the proposed turbines. The allowable limit is then defined at +5 dB above the average noise level at each wind speed (as defined by the regression analysis),

or the absolute noise level lower limit, whichever is the higher (assuming no financial involvement within the scheme).

9.3.24 ETSU-R-97 also provides a simplified noise limit of 35 $dBL_{A90,10min}$ which may be applied to avoid the need to measure background noise levels and derive. The 'simplified ETSU limit' typically applies both during the daytime and night time period.

9.3.25 Where a property has a financial involvement in the scheme, the document allows a relaxation of the derived noise limits, stating that "*It is widely accepted that the level of disturbance or annoyance caused by a noise source is not only dependent upon the level and character of noise but also the receiver's attitude towards the noise source in general. If the residents at the noise-sensitive properties were financially involved in the project, then higher noise limits will be appropriate".* The guidance goes on to state that it is "*recommended that both the day and night-time lower fixed limits can be increased to 45 dB(A) and the consideration should be given to increasing the permissible margin above background where the occupier of the property has some financial involvement in the windfarm*". The amount by which the permissible margin above background can be relaxed is not specified, but the allowable relaxation to 45 dB(A) of the lower limits is an increase of (at least) 5 dB during the daytime and 2 dB during the night time, so similar levels of relaxation might also be applied to the background related element of the noise level limits.

9.3.26 The ETSU guidance states that the derived limits should be applied to noise from the proposed wind farm or turbines in terms of the $L_{A90,T}$ index, and that the $L_{A90,T}$ of the wind farm noise is typically 1.5 to 2.5 dB lower than the $L_{Aeq,T}$ measured over the same period.

9.3.27 The derived noise limits are applicable to both the aerodynamic (e.g. 'blade swish') and mechanical (e.g. generator related) components of wind farm noise.

9.3.28 Where noise from the wind farm is tonal, a correction of between 2 and 5 dB is to be applied to the wind farm noise. Guidance is provided on how to determine the level of correction required, but typically, for proposed developments, the need for any applicable correction is confirmed by the independent wind turbine-specific noise tests, following standard test procedures, provided by manufacturers.

9.3.29 It is stated within the ETSU-R-97 guidance that "*The Noise Working Group is of the opinion that absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question. It is clearly unreasonable to suggest that, because a wind farm was constructed in the vicinity in the past which resulted in increased noise levels at some properties, that residents of those properties are now able to tolerate still higher noise levels. The existing wind farm should not be considered as part of the prevailing background noise".* Accordingly, where an existing wind farm contributes to the prevailing background noise levels, it is necessary to either include for the contribution of this wind farm when comparing against the allowable noise limit or correct for this contribution when deriving a limit applicable to the Proposed Development acting alone.

Good Practice Guide to the Application of ETSU-R-97 (IoA GPG)

9.3.30 The IoA GPG presents the report of a 'noise working group' (NWG) assembled in response to a request from the former Department of Energy & Climate Change (DECC). The guide is intended to represent current good practice in applying the ETSU-R-97 method to assessing the noise impact of wind turbine developments with a power rating of over 50 kW.

9.3.31 In addition to detailed consideration of various issues and factors concerned with current 'state of the art' knowledge of UK wind turbine noise assessment, a series of 'summary boxes' (SBs) highlighting key guidance points are included.

9.3.32 The SBs provide clarification and updated guidance on a range of matters relating to ETSU-R-97 noise assessments, including consultation with relevant stakeholders, background noise survey methodology, noise survey data analysis, derivation of noise limits, noise prediction model input data, algorithms and parameters, cumulative impact assessment procedures, assessment reporting, planning conditions and amplitude modulation. A set of supplementary guidance notes (SGNs) also form part of the publication and include further specific detail for different technical areas.

9.3.33 The detail of the IoA GPG has been considered in the preparation of this assessment. Some of the key considerations relevant to this assessment are summarised as follows:

9.3.34 Calculations of predicted wind turbine noise may be carried out using ISO 9613-2: Acoustics – Attenuation of Sound during Propagation Outdoors (International Organization for Standardization, 1996); preferred receptor heights, meteorological and ground absorption input parameters for this calculation procedure are given.

9.3.35 Turbine sound power level source data should include appropriate uncertainty corrections. Guidance is given for determining when such uncertainty corrections have been inherently included in turbine source emission data.

9.3.36 A correction for topographic screening of a maximum -2 dB may be applied where there is no line of sight between the turbine (tip) and the receptor (4 m above ground level).

9.3.37 A correction for constructive reflection within valleys of +3 dB should apply where concave topography is determined to lie between the turbine and the receptor point.

9.3.38 'Excess amplitude modulation' (i.e. where the wind turbine noise has higher variability with momentary time than the 2 – 3 dB(A) considered within ETSU-R-97) is still the subject of research; current practice (at the time of publishing of the IoA GPG) in relation to determining applications for wind turbine developments was to not impose a planning condition specific to this phenomenon.

9.3.39 In addition to the above, the IoA GPG confirms that the ETSU-R-97 noise limits should be applied cumulatively and provides guidance on appropriate assessment methods for a variety of different cumulative scenarios. These scenarios include 'concurrent applications', 'existing wind farm consented with less than total ETSU-R-97 limits', 'existing wind farm/s consented to the total ETSU-R-97 limits currently operating', and 'permitted wind farms consented to total ETSU-R-97 limits but not yet constructed'.

9.3.40 In the section titled 'existing wind farm/s, consented to the total ETSU-R-97 limits, currently operating' it is stated that "*In the first instance, the consented noise limits should be used within the cumulative noise impact calculations unless otherwise agreed with the local authority. Provided the sum of the noise limits derived for the proposed site when added to those already consented for the operational sites does not exceed the limits that would otherwise be within the requirements of ETSU-R-97 for the cumulative impact, then the noise limits derived for the proposed site can be applied directly*".

9.3.41 In practical terms this can be achieved by ensuring that the noise limit for the Proposed Development is set 10 dB or more below that permitted to be generated by the existing development.

9.3.42 It is further discussed that this may not always be necessary, e.g. where there is a 'controlling property', whereby compliance with the noise limit at that controlling property would result in noise levels never realising the noise level limit 'in full' at another property (e.g. because the second property is further removed from the existing development), thereby leaving a proportion of the limits available for use at the second property by the subsequently proposed development. Another reason that is discussed is where there is no realistic prospect of the existing wind farm producing noise levels up to the consented limit, again thereby leaving a proportion of the limit available for the subsequently proposed development.

9.3.43 In the section titled 'concurrent applications' it is stated that where there are no pre-existing wind farms, this scenario permits the apportionment of the ETSU-R-97 limits between the concurrent developments, i.e. each of the developments could be subject to noise limits below the full ETSU-R-97 guidance, such that even if the individual limits applied to each development were utilised 'in full', the combined effect would be that the ETSU-R 97 guidance would not be exceeded cumulatively.

BS4142:2014+A1:2019 – Methods for rating and assessing industrial and commercial sound

9.3.44 BS4142 is applicable for use in the assessment of control building / substation and transformer noise. It sets out a method for rating and assessing sound of an industrial and/or commercial nature,

including "*sound from fixed installations which comprise mechanical and electrical plant and equipment*".

9.3.45 The assessment procedure contained within BS4142 requires that initially the 'rating level' ($L_{Ar,Tr}$) that is (or would be) generated by the source under assessment is determined, externally, at the assessment location. Where this source does not include any acoustic features, such as tonality, impulsivity or intermittency etc., then the rating level equals the specific sound level (L_s), which is the sound pressure level produced at the receptor location by the source, using the $L_{Aeq,T}$ noise index.

9.3.46 Where the source under assessment does include acoustic characteristics, then a series of corrections are added to the specific sound level to determine the rating level. The degree of correction applied to determine the rating level depends upon the results of either subjective or objective appraisals.

9.3.47 The background sound level at the assessment location, measured using the $L_{A90,T}$ index, is then subtracted from the rating level. The result provides an indication of the magnitude of impact, where the greater the difference, the greater the magnitude of impact.

9.3.48 The following guidance is presented with regard to the difference between the rating and background levels:

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact.
- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

9.3.49 It can be seen from the above that the degree of impact is also dependent upon the context in which the sound arises. Factors that are considered with respect to context include: the absolute level of sound, and the character and level of the residual sound (that in absence of the source under assessment) compared to the character and level of the specific sound.

9.3.50 With regard to the absolute level, it is stated, amongst other points, that '*where background sound levels and rating levels are low, absolute levels might be as, or more relevant than the margin by which the rating level exceeds the background. This is especially true at night*'.

9.3.51 Whilst the latest revision of BS 4142 does not provide definition of low or very low background and rating levels, the previous (1997) version considered that background levels of 30 dBA and rating levels of 35 dBA could be considered low. Numerous studies by Moorhouse, Berry, Flindell, *etc*. for the Health Protection Agency and for Defra (referenced within the Further Reading Section of BS 4142) and supported by the recent Association of Noise Consultants (ANC) Working Group report on BS4142 application conclude that impacts at rating levels below 35 dB are unlikely.

9.4 Consultation

9.4.1 A Scoping Report was submitted to the Energy Consents Unit (ECU) in September 2022, with a subsequent update following a redesign of the Proposed Development in February 2024. A summary of the noise scope agreed through the Scoping process, along with subsequent agreements made directly with EAC and SLC Environmental Health Departments, is provided in **Table 9.1**. Records of correspondence undertaken with SLC and EAC are provided in **Appendix 9.1**.

Table 9.1 – Record of Direct EHO Consultation post Scoping Reports

Consultee	Date	Discussed
SLC	15 January 2025	Direct consultation sent by SLR Consulting Limited (SLR), lead technical advisor on noise to the Applicant, to SLC to agree approach to deriving noise limits applicable to wind turbines. Proposed similar approach to that agreed between SLC and applicants for neighbouring cumulative wind developments.
SLC	16 January 2025	Response from SLC committing to providing further comment.
SLC	28 January 2025	Phone call and emails with SLC to agree approach to derivation of noise limits
EAC	14 January 2025	Direct consultation sent by SLR to EAC to agree approach to deriving noise limits. Proposed similar approach to that agreed between SLC and applicants for neighbouring cumulative wind developments.
EAC	15 January 2025	Response from EAC committing to providing further comment, if warranted.

9.5 Assessment Methodology and Significance Criteria

9.5.1 This assessment considers noise from wind turbines and non-turbine fixed plant (electrical plant associated with the BESS and solar aspects and the substation) separately, as these are evaluated using different guidance.

Study Area and Noise Sensitive Receptors (NSRs)

Northern Development Area - Wind Turbines – Study Area

9.5.2 The study area for this assessment has been informed by maps and aerial images of the Proposed Development site and its surroundings, assessments undertaken in support of nearby cumulative developments and a site visit.

9.5.3 The Proposed Development lies within an area of extensive wind energy development, resulting in a complex cumulative scenario comprising existing operational, consented (not built) and proposed developments awaiting determination.

9.5.4 A sample of the closest, and therefore potentially most affected, NSRs to the Proposed Development have been identified and adopted for the evaluation of noise impacts as shown in **Figure 9.1** and **Table 9.2**. These have been selected to represent a geographic spread across the local area of the closest properties in each direction which could potentially be affected by the Proposed Development and cumulative developments. NSRs at which noise limits have been set for cumulative developments have been identified for the evaluation of potential cumulative effects. NSRs identified are either single dwellings or representative of a group or cluster of dwellings.

9.5.5 Determination of the study area for a wind farm typically requires that the 35 dBL_{A90} noise contour is predicted, and NSRs which lie beyond the contour are assumed to meet the most stringent ETSU-R-97 noise limit and are therefore scoped out and discounted from further consideration. NSRs which are identified within the 35 dBL_{A90} noise contour are scoped in, and noise impacts are assessed further.

9.5.6 The complex cumulative situation present in the vicinity of the Proposed Development means that it is unlikely that the Proposed Development would ever operate in isolation, therefore this assessment has necessarily required to take a more robust approach. Where the predicted noise level due to the Proposed Development is below 25 dBL_{A90} and would therefore contribute a negligible amount to any exceedance of the most stringent ETSU-R-97 noise limit (refer to **paragraph 9.3.41**), these NSRs have been scoped out of further evaluation.

9.5.7 The 25 dBL_{A90} and 35 dBL_{A90} operational noise contours for the Proposed Development in isolation (i.e. without cumulative developments) at the wind speed at which the proposed turbines generate

their maximum sound power level, are shown in **Figure 9.1**. This predicted contour does not include any corrections for concave topography or for the visibility of the turbines from receptor locations.

9.5.8 The closest representative NSRs to the Proposed Development which lie within the 25 dBL_{A90} noise contour are listed in **Table 9.2**.

Table 9.2 – Identified Representative NSRs – Wind Turbines

NSR Name	NSR ID	Coordinates (OSGB)		Commentary
		X	Y	
Dungavel Immigration Removal Centre	NSR1	265881	637173	Approximately 1.4 km north of the closest turbine of the Proposed Development. Representative of properties further north.
Templeland	NSR2	265421	636003	Approximately 1.1 km west of the closest turbine of the Proposed Development. Representative of properties further north-west.
Laigh Plewland	NSR3	265423	635255	Approximately 1.3 km south-west of the closest turbine of the Proposed Development. Representative of properties further west.
Glengavel House*	NSR4	266421	635227	Approximately 0.5 km south-west of the closest turbine of the Proposed Development *Financially Involved with the Proposed Development.
High Plewlands Farm	NSR5	265928	634616	Approximately 1.2 km west of the closest turbines of the Proposed Development. Two residential receptors at this location. Representative of properties further west.
Logan Farm	NSR6	273972	635269	Approximately 3 km east of the closest turbine of the Proposed Development. Representative of properties further east.
Dippal Lodge	NSR7	269904	632462	Approximately 1.6 km south of the closest turbine of the Proposed Development. Representative of properties further south. Currently a short-term let property but considered within this chapter as residential.

9.5.9 All identified NSRs are private residential properties, with the exception of NSR1, which is a residential facility and NSR7, which is cabin-style short-term holiday accommodation.

Southern Development Area - Non-Turbine Fixed Plant – Study Area

9.5.10 Two locations are under consideration for the short duration BESS and substation aspect of the Proposed Development; a northern location within the footprint of the proposed wind turbines and a southern location adjacent to the solar array. The northern short duration BESS and substation option has no NSRs within 1.5 km, at which distance noise impacts associated with a BESS and substation of this size will be negligible.

9.5.11 The closest NSR to the BESS and substation location within the northern development area is Glengavel House (NSR4), which lies approximately 1.2 km distant and, as such noise impacts arising will be negligible.

9.5.12 The closest representative NSRs identified for assessment around the southern development area are shown in **Figure 9.2** and listed in **Table 9.3**.

Table 9.3 – Identified Representative NSRs – Non-Turbine Fixed Plant

NSR Name	NSR ID	Coordinates (OSGB)		Commentary
		X	Y	
Linburn Farm*	NSR8	269590	629841	Approximately 600 m north-east from the proposed long duration BESS, 300 m north-east of the short duration BESS and substation, 180 m east of the solar array. Representative of properties further east. *Financially involved with the Proposed Development.
Forkings Lodge	NSR9	268176	629607	Two properties. Closest property lies approximately 200 m from solar array. Approximately 640 m north-west from long duration BESS and 1.1 km north-west from short duration BESS and substation compounds. Two residential receptors at this location.
Middlefield*	NSR10	268197	629396	Approximately 140 m from solar array. Approximately 580 m west from long duration BESS and 1 km west from short duration BESS and substation compounds. *Financially involved with the Proposed Development..
Burnfoot Farm*	NSR11	267275	628531	Approximately 80 m from solar array. Approximately 1.7 km south-west from long duration BESS and 2.2 km south-west from short duration BESS and substation compounds. Two residential receptors at this location. *Financially involved with the Proposed Development..
Netherwood Farm*	NSR12	266116	628334	Approximately 150 m from solar array. Representative of properties further west. Approximately 2.9 km south-west from long duration BESS and 3.3 km south-west from short duration BESS and substation compounds. Two residential receptors at this location. *Financially involved with the Proposed Development.
Laigh Hall	NSR13	267849	628464	Approximately 270 m south of proposed solar array Approximately 1.3 km south-west from long duration BESS and 1.7 km south-west from short duration BESS and substation compounds.

9.5.13 All identified NSRs are private residential properties.

Prediction Method

Prediction Method – Wind Turbines

9.5.14 SLR has undertaken predictive noise modelling of the Proposed Development and for other wind farm developments within the wider study area. The noise model was prepared using the CadnaA® noise prediction software. The model was set to use the ISO 9613 prediction method, which includes prescribed methods for accounting for the effects of geometric divergence, ground absorption, and atmospheric absorption, in accordance with the requirements of ETSU-R-97 and the IoA GPG.

9.5.15 Predictions for the Proposed Development have been undertaken using sound power data provided by Vestas for the V162 6.0 MW candidate turbine, which has a comparable sound power level to the Nordex N163 7.2 MW turbine, which is used as the candidate in other assessments. The maximum sound power level of the V162, including a +2 dB correction for uncertainty, is 106.3 dB, developed at standardised wind speeds of 7 m/s and above. The turbines have been modelled within the prediction software using the 1/3 octave band data for each wind speed, corrected for

uncertainty and standardised to 10 m height wind speed values in accordance with the method provided in the IoA GPG, accounting for the differing hub heights of the turbines of the Proposed Development. The sound power levels are presented in **Table 9.4**.

Table 9.4 – Standardised Sound Power Level of Vestas V162 6.0 MW, Including Uncertainty

Wind speed, ms^{-1}	4	5	6	7	8	9	10	11	12
Sound power level of 119 m hub height standardised to 10 m, dB(A)	98.0	102.2	105.7	106.3	106.3	106.3	106.3	106.3	106.3
Sound power level of 149 m hub height standardised to 10 m, dB(A)	98.3	102.8	106.1	106.3	106.3	106.3	106.3	106.3	106.3

9.5.16 The octave band data for the Vestas V162 is provided in **Table 9.5**.

Table 9.5 – Spectrum of Vestas V162 6.0 MW at 9 ms^{-1} Wind Speed

Wind speed, ms^{-1}	31.5	63	125	250	500	1000	2000	4000	8000
Sound Power Level, dB(A)	74.9	85.4	92.9	97.5	99.2	98.1	94.0	87.1	77.2

9.5.17 The IoA GPG presents methods for the determination of additional corrections to account for propagation directivity, which could be used to account for the effects of wind direction where a receptor is located between two developments. No such corrections been included within this assessment. The predicted operational noise levels can therefore be considered worst-case.

9.5.18 The noise model was configured in compliance with the requirements of the IoA GPG, including the following:

- Ground absorption: G=0.5;
- Receptor Height: 4 m;
- Flat topography;
- Correction from $L_{Aeq,T}$ to $L_{A90,T}$ of -2 dB applied;
- Temperature: 10°C; and
- Humidity: 70%.

9.5.19 SLR determined the requirement to apply valley corrections and topographic screening corrections with reference to the IoA GPG on a turbine-by-turbine basis for all identified NSRs, using a proprietary tool within Geographic Information System (GIS) software. Neither valley correction nor topographic screening apply at any NSRs for any turbines of the Proposed Development or the potentially cumulative developments.

9.5.20 Details of the cumulative turbines considered are provided in **Appendix 9.2**. Cumulative developments have been modelled in the same way as the Proposed Development.

Prediction Method – Non-Turbine Fixed Plant

9.5.21 The actual model of battery and inverter plant installed will depend on the outcome of a tendering process. This assessment therefore considers representative candidate plant, noting that the installed plant will likely be different. Battery and inverter technology is currently developing at a rapid pace and noise is often a primary constraint in the UK market. Technology providers are therefore delivering units with increasingly improved noise performance. It is therefore reasonable to assume that by the time the Proposed Development is ready to build, following planning consent

and an available grid connection, quieter plant than the candidate considered in this assessment will be available.

9.5.22 The exact equipment specification and technology provider for the long and short duration BESS are currently unknown, therefore the assessment has used a candidate model, the CATL EnerOne+ battery unit, and an inverter unit provided by Power Electronics, which is appropriate for use as indicative 'worst-case' items of plant for this assessment. The installed model of battery for the BESS will be the subject of a tendering process and the Applicant expects that the actual plant will be quieter than that considered in this assessment. This assessment also adopts appropriate representative source noise terms for the solar inverters and grid transformers. The representative sound power levels (SWLs) used in the noise model are provided in **Table 9.6**. Spectral data has been normalised to the broad-band SWL within the noise model.

Table 9.6 – Source Noise Terms of Modelled Non-Turbine Fixed Plant

Item	Octave Band Sound Power Level, dB / Octave band centre frequencies									Broad-band A-wt SWL
	31.5	63	125	250	500	1000	2000	4000	8000	
CATL EnerOne+ BESS container	-	85	85	87	82	77	74	68	59	76
Power Electronic Inverter	-	86	93	85	78	75	74	75	75	87
Grid transformer	70	70	86	70	62	58	52	42	32	70

9.5.23 Noise from the solar and BESS elements of the Proposed Development has been modelled using the CadnaA® noise prediction software. The model was set to use the ISO 9613 prediction method (2024 version). The model assumes soft ground conditions, with absorption set to G=1.0 and considers screening provided by local topography in the form of 50 m digital terrain mapping. This assessment has assumed a standard temperature and relative humidity of 10°C and 70% respectively.

9.5.24 The batteries and inverters of the BESS components and inverters of the solar array have been modelled as 3D objects, with their noise emissions coming from area sources and vertical area sources, which represent the top and sides of the units respectively. Noise test reports for the batteries and inverters have been supplied by the manufacturer, and verification modelling has been undertaken in which the test scenario for each item of equipment has been recreated in CadnaA.

9.5.25 In the verification modelling, receivers have been placed at the same locations as the reported microphone positions. The reported 1/3 octave-band sound power levels of the equipment have been entered as source data, and where necessary the sound power levels of the individual area sources/vertical area sources have been adjusted equally in each frequency band so that the predicted sound pressure levels at the receivers match as closely as possible to the reported sound pressure levels during the tests.

9.5.26 Grid transformers have been modelled as point sources. For the source data of the grid transformers, spectral data for a grid transformer has been applied, obtained by SLR during noise monitoring of an operational BESS site.

9.5.27 All NSRs have been modelled at a representative height of 4 m above ground level, representative of a first floor bedroom window.

Characterisation of Baseline Noise Environment

Baseline Characterisation - Wind Turbines

9.5.28 The wind turbines of the Proposed Development lie within an area which is already populated with operational wind turbines, to the extent that characterisation of the baseline noise environment without wind turbine noise would not be achievable by survey. This assessment has therefore determined the baseline noise level at NSRs potentially affected by wind turbine noise by reference

to assessments undertaken for neighbouring developments. This approach has been agreed with the EAC and SLC.

9.5.29 The noise assessments for the adjacent Mill Rig and Bankend Rig III (BRIII) developments rely on baseline data obtained at a proxy location located at Nether Whitehaugh (OSGB coordinates 261575,629107), shown in **Figure 9.3**. The use of this proxy data has been agreed with EAC and SLC.

9.5.30 The dominant noise sources audible during installation and decommissioning of the baseline survey were reported to comprise birdsong and wind-induced rustling of vegetation, along with road traffic and livestock (sheep).

Baseline Characterisation – Non-Turbine Fixed Plant

9.5.31 A baseline noise survey was undertaken at two locations representative of NSRs adjacent to the proposed solar and BESS aspects of the Proposed Development. The survey was designed to meet the requirements of the IoA GPG, as the then-proposed layout of the Proposed Development included wind turbines close to these NSRs. As a result, the data covers a long period and has concurrent measured wind speed data. The data is therefore more than sufficient for the evaluation of noise from non-turbine fixed plant in accordance with BS4142.

9.5.32 The baseline noise monitoring positions (NMPs) are shown in **Figure 9.3** and described in **Table 9.7**. Details of the survey are provided in **Appendix 9.3**.

Table 9.7 – Identified Representative NSRs – Non-Turbine Fixed Plant

NMP Name	NMP ID	Coordinates (OSGB)		Commentary
		X	Y	
Bibblon Lodge	NMP1	265654	628330	SLM installed in the garden of the house, at least 30 m from the boiler flue. Boiler operating at the time of installation and was inaudible at the NMP. Two small wind turbines present to the north of the house. These were audible at the front of the property under very windy conditions, but not audible to the south of the property at the monitoring location.
Blackside	NMP2	270115	629901	SLM installed at the edge of the property; the garden area was unsuitable for monitoring because a polytunnel was rustling in the wind. A small watercourse passes the property; the NMP was positioned further from the watercourse than the property, at a location where the watercourse was inaudible (during installation) or just audible (at decommissioning, following heavy rainfall).

Assessment of Potential Effect Significance

Overall Approach

9.5.33 All NSRs considered in this assessment are residential and are therefore considered to have a high sensitivity to noise. The significance of noise effects has been determined as follows:

- Where predicted noise levels meet the adopted criteria (noise limits), this assessment determines that the resultant significance of effect is 'not significant'.
- Where the predicted noise levels exceed the adopted criteria, this assessment determines that the resultant significance of effect is 'significant' and mitigation will be required.

Operational Phase Wind Turbine Evaluation Criteria (Noise Limits)

9.5.34 Given the cumulative developments, there is little prospect of the Proposed Development operating in isolation. The evaluation criteria will therefore require that the noise limits of cumulative developments are appropriately addressed. SLR has reviewed the decision notices of neighbouring wind farms to identify the noise limits which apply to potentially cumulative proposed, consented and operational developments within the study area.

9.5.35 The wind turbines of the Proposed Development and most of the closest NSRs lie within SLC, and SLC Environmental Health has instructed that the Proposed Development should meet the noise limits set out below.

9.5.36 Overall Noise Limits (ONLs) provided for the proposed BRIII Wind Farm and consented Mill Rig Wind Farm are as follows:

- 35 dBL_{A90} or background +5 dB, whichever is the greater, when considered in standalone operation; and
- 40 dBL_{A90} or background +5 dB, whichever is the greater, when considered with all cumulative developments operating, consented or proposed.

9.5.37 In addition to the ONLs, the noise assessments provided in support of the BRIII and Mill Rig wind farms also propose Residual Noise Limits (RNLs). These set the limit that the specific development must meet such that the ONL would not be exceeded, taking account of consented limits for cumulative developments.

9.5.38 This assessment follows the same approach as that followed in the consented Mill Rig Wind Farm noise assessment and in accordance with agreements made with SLC and EAC EHOs. The process is as set out below:

- For other proposed developments currently within the planning system this assessment has used available information regarding the proposed turbine locations, hub heights and adopted sound power levels for an appropriate scale of turbine and predicted the noise levels.
- At NSRs where the predicted noise level for potentially cumulative developments are either 10 dB below the predicted noise level of the Proposed Development or 10 dB below the cumulative ONL, cumulative effects will be negligible and these developments have been scoped out of further cumulative consideration.
- At NSRs where significant presented headroom (≥5 dB) is determined to exist between the predicted noise level from cumulative developments and the ONL, a cautious prediction (predicted level +2 dB) for cumulative developments has been subtracted from the ONL to determine the RNL.
- Where significant headroom is not present the RNL has been set to the ONL minus 10 dB.
- Where NSRs are financially involved with the Proposed Development, the RNL has been determined by logarithmic subtraction of the ONL from the financially involved noise limit of 45 dB (daytime and night-time) or by subtraction of 10 dB from the financially involved noise limit, whichever gives the higher result.

9.5.39 The applicable cumulative ONL at NSRs within the study area has been set at 40 dB (or background +5 dB, whichever is the higher) by SLC, therefore this assessment derives RNLs accordingly.

9.5.40 The ONLs applicable to NSRs within the study area are presented in **Table 9.8**.

Table 9.8 – Adopted ONLs

Wind speed, ms^{-1}	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
NSR ID	**Noise Limit, $dBL_{A90,10min}$**								
Daytime period (07:00 – 23:00)									
NSR1	40.0	40.0	40.0	40.0	40.0	41.7	43.3	44.4	44.8
NSR2	40.0	40.0	40.0	40.0	40.0	41.7	43.3	44.4	44.8
NSR3	40.0	40.0	40.0	40.0	40.0	41.7	43.3	44.4	44.8
NSR4 (FI)	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

Wind speed, ms^{-1}	4	5	6	7	8	9	10	11	12
NSR ID	**Noise Limit, $dBL_{A90,10min}$**								
NSR5	40.0	40.0	40.0	40.0	40.0	41.7	43.3	44.4	44.8
NSR6	40.0	40.0	40.0	40.0	40.0	41.7	43.3	44.4	44.8
NSR7	40.0	40.0	40.0	40.0	40.0	41.7	43.3	44.4	44.8
Night-time period (23:00 – 07:00)									
NSR1	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR2	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR3	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR4 (FI)	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR5	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR6	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR7	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

9.5.41 The derived RNLs are shown in **Table 9.9**. Limited data was available regarding the sound power level of turbines of cumulative developments at 4 ms^{-1}, therefore the derivation of RNLs and cumulative assessment considers wind speeds of 5 ms^{-1} and above. The process of derivation of the RNLs is shown in **Appendix 9.4**.

Table 9.9 – Derived RNLs

Wind speed, ms^{-1}	4	5	6	7	8	9	10	11	12
NSR ID	**Noise Limit, $dBL_{A90,10min}$**								
Daytime period (07:00 – 23:00)									
NSR1	-	*30.0*	*30.0*	*30.0*	*30.0*	*31.7*	*33.3*	*34.4*	*34.8*
NSR2	-	*30.0*	*30.0*	*30.0*	*30.0*	*31.7*	*33.3*	*34.4*	*34.8*
NSR3	-	*30.0*	*30.0*	*30.0*	*30.0*	*31.7*	*33.3*	*34.4*	*34.8*
NSR4 (FI)	-	*43.5*	*43.3*	*43.3*	*43.3*	*42.3*	*40.1*	*36.1*	*35.0*
NSR5	-	*30.0*	*30.0*	*30.0*	*30.0*	*31.7*	*33.3*	*34.4*	*34.8*
NSR6	-	*30.0*	*30.0*	*30.0*	*30.0*	*31.7*	*33.3*	*34.4*	*34.8*
NSR7	-	*37.0*	*30.0*	*30.0*	*30.0*	*31.7*	*33.3*	*42.0*	*42.7*
Night-time period (23:00 – 07:00)									
NSR1	-	*40.1*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*
NSR2	-	*41.2*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*
NSR3	-	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*
NSR4 (FI)	-	*40.3*	*40.7*	*40.7*	*40.7*	*40.7*	*40.7*	*40.7*	*40.7*
NSR5	-	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*
NSR6	-	*40.4*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*
NSR7	-	*41.7*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*

Operational Phase Non-Turbine Plant Evaluation Criteria (Noise Limits)

9.5.42 Noise from the solar array, BESS compounds and substation has been evaluated against criteria derived from measured baseline data in accordance with the method provided in BS4142, in which

a rating level which exceeds the representative background by less than 5 dB may be considered 'not adverse', depending on the context.

9.5.43 As discussed in **paragraph 9.3.51**, where the representative background level is below 30 $dBL_{A90,T}$, this assessment adopts a fixed criterion whereby the rating level of the non-turbine fixed plant should not exceed 35 $dBL_{Ar,Tr}$.

Receptor Sensitivity

9.5.44 All identified representative NSRs are residential and this assessment therefore considers them to have a high sensitivity to noise.

Requirements for Mitigation

9.5.45 Where predicted noise levels are above the adopted evaluation criteria (noise limits), measures to reduce noise to within the criteria are proposed.

9.5.46 The predicted noise levels for the Proposed Development include the implementation of an outline mitigation strategy. The final noise mitigation strategy to be deployed will depend on the eventual model of turbine installed and which properties are, or are not, financially involved at commencement of operations. The requirement to submit details of the final noise mitigation strategy prior to commencement can be secured by an appropriately worded planning condition.

Assessment of Residual Effect Significance

9.5.47 Where mitigation is proposed, the residual effect significance has been determined following the application of mitigation.

Limitations to Assessment

9.5.48 At the time of this assessment, the proposed BRIII Wind Farm planning application had not been determined. This assessment assumes that, if consented, BRIII will utilise the noise limits proposed in the noise assessment provided in support of its planning application. Should the application not be approved, additional noise budget would be available for the Proposed Development.

9.6 Baseline Conditions

9.6.1 The noise environment within the study area is predominantly influenced by noise from natural sources, such as meteorological phenomena (wind, rain), wind-induced rustling of vegetation, watercourses and bird calls. Anthropogenic noise from existing wind turbines, road traffic, livestock, passing aircraft, and agriculture and estate management (vehicles, machinery) also influence the prevailing noise environment to a greater or lesser extent, depending on proximity to these sources.

9.6.2 The Mill Rig Wind Farm noise assessment notes that audible sounds at Nether Whitehaugh comprised natural sources, including wind induced noise from vegetation and birdsong.

9.6.3 Observations on the ambient noise environment at NMP1 and NMP2, representative of NSRs close to the southern development area are provided in **Appendix 9.3**. This assessment has determined noise limits for the southern development area in accordance with BS4142, considering measured background noise levels at NMP1 and NMP2 at wind speeds below 5 ms^{-1}. The derived representative background and ambient noise levels are provided in **Table 9.10**.

Table 9.10 – Adopted Representative Background Levels – Southern Development Area

NMP Name	NMP ID	Daytime, $dBL_{A90,1hr}$	Night-time, $dBL_{A90,15min}$
Bibblon Lodge	NMP1	25	25
Blackside	NMP2	30	30

9.6.4 The measured background noise levels at standardised wind speeds below 5 ms^{-1} are equal to or below 30 dB at both NMPs.

9.7 Scope of the Assessment

Receptors Requiring Assessment

9.7.1 Potential noise impacts have been assessed at all of the NSRs listed in **Table 9.2** and **Table 9.3**.

Environmental Measures Embedded into the Development Proposals

9.7.2 The proposed mitigation considered within this assessment comprises the production and implementation of a CEMP to control and minimise noise from construction activities. The CEMP will set out the typical construction hours and best practice techniques for limiting noise which will be implemented during the construction phase. An outline CEMP is provided as **Appendix 3.1**.

9.7.3 The Vestas V162 is supplied as standard with serrated trailing edges (STE) to the rotor blades, which reduce aerodynamic noise and noise emissions can be further reduced by the implementation of noise reduced modes operation The sound power level of the turbine assumed in this assessment is that of the turbine with STE. An outline schedule of mitigation utilising low noise mode operation has been considered as embedded mitigation within this assessment, where required to meet the adopted noise limits. The predicted operational noise levels presented in this assessment include the adopted mitigation.

9.7.4 During procurement of non-turbine fixed plant items, the noise generating characteristics (sound power level, tonality, location of noise sources) of the units will be considered and plant specified such that the consented noise limits are met at all NSRs.

9.8 Assessment of Potential Effects

Construction and Decommissioning

9.8.1 As noted in **paragraph 9.2.3**, noise impacts during the construction and decommissioning phases will be controlled through the production and implementation of a CEMP.

9.8.2 Construction noise limits have been derived from measured baseline noise levels, using criteria derived in accordance with the ABC method set out in BS5228. Following the ABC assessment method, the most stringent assessment criterion (Category A), applies during the daytime (07:00 to 19:00 weekdays and 07:00 to 13:00 Saturdays) where the prevailing ambient noise levels are below 65 $dBL_{Aeq,T}$. No evening, weekend or night-time working is proposed with the exception of crane lifting operations for turbine components which may at times need to extend into evening hours relative to weather conditions and safety considerations.

9.8.3 Where Category A applies, the allowable noise level arising from construction noise is 65 dB(A). Measured ambient noise levels during the baseline survey were predominantly below 40 dB(A) at wind speeds not exceeding 5 ms^{-1} during the daytime period, therefore the allowable 'construction only' noise level is 65 $dBL_{Aeq,T}$.

9.8.4 Compliance with the proposed construction phase noise limits will result in noise effects being **not significant** during construction and decommissioning.

Operation – Northern Development Area

9.8.5 Predicted noise levels due to operation of the wind turbines of the Proposed Development, including mitigation across the range 4 m/s – 12 m/s in line with the outline noise mitigation strategy, at all NSRs are provided in **Table 9.11**.

Table 9.11 – Predicted Operational Noise Levels at NSRs – Wind Turbines in Standalone Operation

Wind speed, ms^{-1}	5	6	7	8	9	10	11	12
NSR ID	**Predicted Noise Level, $dBL_{A90,10min}$**							
Daytime Period (07:00 – 23:00)								
NSR1	*24.8*	*24.8*	*24.8*	*24.8*	*24.8*	*24.8*	*24.8*	*24.8*
NSR2	*26.8*	*26.8*	*26.8*	*26.8*	*26.8*	*26.8*	*26.8*	*26.8*
NSR3	*26.8*	*26.8*	*26.8*	*26.8*	*26.8*	*26.8*	*26.8*	*26.8*
NSR4 (FI)	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*	*33.0*
NSR5	*29.1*	*29.1*	*29.1*	*29.1*	*29.1*	*29.1*	*29.1*	*29.1*
NSR6	*19.8*	*19.8*	*19.8*	*19.8*	*19.8*	*19.8*	*19.8*	*19.8*
NSR7	*27.6*	*27.6*	*27.6*	*27.6*	*27.6*	*27.6*	*27.6*	*27.6*
Night-time period (23:00 – 07:00)								
NSR1	*26.1*	*26.1*	*26.1*	*26.1*	*26.1*	*26.1*	*26.1*	*26.1*
NSR2	*28.4*	*28.4*	*28.4*	*28.4*	*28.4*	*28.4*	*28.4*	*28.4*
NSR3	*28.7*	*28.7*	*28.7*	*28.7*	*28.7*	*28.7*	*28.7*	*28.7*
NSR4 (FI)	*36.9*	*36.9*	*36.9*	*36.9*	*36.9*	*36.9*	*36.9*	*36.9*
NSR5	*30.9*	*30.9*	*30.9*	*30.9*	*30.9*	*30.9*	*30.9*	*30.9*
NSR6	*19.9*	*19.9*	*19.9*	*19.9*	*19.9*	*19.9*	*19.9*	*19.9*
NSR7	*27.7*	*27.7*	*27.7*	*27.7*	*27.7*	*27.7*	*27.7*	*27.7*

9.8.6 The predicted mitigated operational noise levels provided in **Table 9.11** show that the Proposed Development in standalone operation meets the standalone daytime noise limit of 35 dBL_{A90} and night-time noise limit of 43 dBL_{A90} at all wind speeds at all NSRs.

9.8.7 The results of a screening assessment to determine worst-case (downwind) noise levels from the operation of cumulative developments at the representative NSRs and therefore the requirement to consider cumulative effects, based on the rationale provided in **paragraph 9.5.38** are provided in **Table 9.12**. Source noise terms are only available for all potentially cumulative developments from 5 – 12 ms^{-1}, therefore 4 ms^{-1} wind speed is excluded from the analysis. Predicted levels due to cumulative developments are provided in **Appendix 9.2**.

Table 9.12 – Comparison of Predicted Level due to Proposed Development with Derived RNLs

Wind speed, ms^{-1}	5	6	7	8	9	10	11	12
NSR ID	**Comparison: Predicted level minus RNL, dB**							
Daytime (07:00 – 23:00)								
NSR1	*-5.2*	*-5.2*	*-5.2*	*-5.2*	*-6.9*	*-8.5*	*-9.6*	*-10.0*
NSR2	*-3.2*	*-3.2*	*-3.2*	*-3.2*	*-4.9*	*-6.5*	*-7.6*	*-8.0*
NSR3	*-3.2*	*-3.2*	*-3.2*	*-3.2*	*-4.9*	*-6.5*	*-7.6*	*-8.0*
NSR4 (FI)	*-10.5*	*-10.3*	*-10.3*	*-10.3*	*-9.3*	*-7.1*	*-3.1*	*-2.0*
NSR5	*-0.9*	*-0.9*	*-0.9*	*-0.9*	*-2.6*	*-4.2*	*-5.3*	*-5.7*
NSR6	*-10.2*	*-10.2*	*-10.2*	*-10.2*	*-11.9*	*-13.5*	*-14.6*	*-15.0*
NSR7	*-9.4*	*-2.4*	*-2.4*	*-2.4*	*-4.1*	*-5.7*	*-14.4*	*-15.1*

Wind speed, ms^{-1}	5	6	7	8	9	10	11	12
NSR ID	**Comparison: Predicted level minus RNL, dB**							
Night-time (23:00 – 07:00)								
NSR1	*-14.0*	*-6.9*	*-6.9*	*-6.9*	*-6.9*	*-6.9*	*-6.9*	*-6.9*
NSR2	*-12.8*	*-4.6*	*-4.6*	*-4.6*	*-4.6*	*-4.6*	*-4.6*	*-4.6*
NSR3	*-4.3*	*-4.3*	*-4.3*	*-4.3*	*-4.3*	*-4.3*	*-4.3*	*-4.3*
NSR4 (FI)	*-3.4*	*-3.8*	*-3.8*	*-3.8*	*-3.8*	*-3.8*	*-3.8*	*-3.8*
NSR5	*-2.1*	*-2.1*	*-2.1*	*-2.1*	*-2.1*	*-2.1*	*-2.1*	*-2.1*
NSR6	*-20.5*	*-13.1*	*-13.1*	*-13.1*	*-13.1*	*-13.1*	*-13.1*	*-13.1*
NSR7	*-14.0*	*-5.3*	*-5.3*	*-5.3*	*-5.3*	*-5.3*	*-5.3*	*-5.3*

9.8.8 The comparison presented in **Table 9.12** demonstrates that the predicted operational cumulative noise levels meet the derived RNLs across the range of operational wind speeds at all NSRs, both during the daytime and the night-time period.

9.8.9 With reference to **paragraph 9.5.33**, the resultant significance of effect is **not significant**.

Operation – Southern Development Area

9.8.10 As shown in **Table 9.10** the representative daytime and night-time background levels at NMPs representative of the NSRs in the southern development area are 30 dB or lower. Referring to **paragraph 9.3.51**, such low levels can be considered 'very low', therefore evaluation against a fixed criterion is more appropriate than evaluation against the background level. This assessment therefore adopts the 35 dB criterion discussed in **paragraph 9.3.51**.

9.8.11 The predicted night-time noise levels presented in this assessment may be considered worst case, as these include a contribution from inverters which form a component of the solar array. While some noise from the solar array may occur during the night-time period during the summer, when sunrise and sunset fall within the night-time period, during the spring, autumn and winter months, the night-time period will be dark and little or no noise will be generated by the solar arrays.

9.8.12 The predicted operational noise level from worst-case operation of the proposed solar, BESS and substation components within the southern development area are provided at the closest representative NSRs and evaluated against the adopted evaluation criterion in **Table 9.11**.

Table 9.13 – Predicted Operational Noise Levels at NSRs – Fixed Non-Turbine Plant

NSR ID	Predicted specific level, dBL_{Aeq}	Rating corrections applied, dB	Derived rating level, $dBL_{Aeq,T}$	Adopted Evaluation Criterion, dB	Comparison: rating level minus background, dB
Daytime period (07:00 – 23:00)					
NSR8	34	0	34	35	-1
NSR9	33	0	33	35	-2
NSR10	34	0	34	35	-1
NSR11	33	0	33	35	-2
NSR12	26	0	26	35	-9
NSR13	30	0	30	35	-5

NSR ID	Predicted specific level, dBL_{Aeq}	Rating corrections applied, dB	Derived rating level, $dBL_{Aeq,T}$	Adopted Evaluation Criterion, dB	Comparison: rating level minus background, dB
Night-time period (23:00 – 07:00)					
NSR8	34	0	34	35	-1
NSR9	33	0	33	35	-2
NSR10	34	0	34	35	-1
NSR11	33	0	33	35	-2
NSR12	26	0	26	35	-9
NSR13	30	0	30	35	-5

9.8.13 The predicted 1/3rd octave band specific levels at NSRs have been evaluated in accordance with BS4142 and determined to be non-tonal. Noting that noise from the solar, BESS and substation plant during operation will be continuous rather than intermittent and will not contain impulsive characteristics, no corrections have been added to the specific level to determine the rating level.

9.8.14 The predicted rating levels due to non-turbine fixed plant items within the southern development area have been determined to meet the adopted 35 $dBL_{Aeq,T}$ criterion. Noise impacts associated with this component of the Proposed Development have therefore been determined to be **not significant**.

9.9 Mitigation

9.9.1 As noted in Section 9.7.3, an outline schedule of mitigation utilising low noise mode operation of the proposed wind turbines has been considered as embedded mitigation within this assessment, where required to meet the adopted noise limits. The predicted operational noise levels presented in this assessment include the adopted mitigation.

9.9.2 No requirement for additional mitigation measures beyond the embedded mitigation set out in Section 9.7 has been identified, however, predicted compliance with the adopted rating level noise limit will be confirmed during procurement of the wind turbines, substation and BESS equipment and finalisation of the compound locations.

9.9.3 As discussed in **paragraph 9.2.3**, measures to control noise during the construction phase will be specified within a CEMP.

9.10 Residual Effects

9.10.1 No additional mitigation beyond the embedded mitigation set out in **Section 9.7** is proposed, therefore residual effects will remain unchanged and are **not significant**.

9.11 Cumulative Assessment

9.11.1 The evaluation process for operational wind turbine noise, including the derivation of noise limits, has comprised detailed cumulative consideration. No additional cumulative evaluation is therefore required for wind turbine noise.

9.11.2 As noted in **Chapter 3**, there are no other relevant large solar or BESS developments in planning, nor consented/under construction, within close proximity of the Proposed Development at the time of assessment. The closest relevant development is Carlisle Road Battery Energy Storage System, a 200 MW BESS development, located approximately 9.8 km east of the site boundary. At this distance from the Proposed Development site, there is no potential for any significant cumulative noise effects to arise in respect of fixed, non-turbine plant.

9.12 Summary

9.12.1 Detailed assessment of noise effects from the construction and decommissioning phase has been scoped out on the basis that it is unlikely to be significant and will be controlled by implementation of Best Practicable Means. Construction and decommissioning noise effects can therefore be adequately controlled through planning condition, however, appropriate noise limits for these phases have been identified. A Construction Environmental Management Plan (CEMP) will be produced detailing methods by which construction noise will be controlled, which will include a Traffic Management Plan (TMP).

9.12.2 An assessment of potential noise effects has been undertaken for the operational phase of the Proposed Development. The operational assessment has been undertaken in accordance with ESTU-R-97, the method of assessing wind turbine noise recommended by appropriate guidance and following the current best practice methods described in the IoA GPG, as endorsed by Scottish Government.

9.12.3 A review of existing noise limits applicable to operational and consented developments in the local area has also been undertaken, and ONLs defined according to the IoA GPG's recommendations. The ONLs have been apportioned to determine the RNLs at all NSRs. RNLs which will apply to the Proposed Development only, accounting for the consented noise limits and predicted noise level from identified cumulative developments, have been presented.

9.12.4 This assessment demonstrates the Proposed Development will operate within the derived RNLs, subject to implementation of a suitable noise mitigation strategy for the operation of the wind turbines which can be secured by planning condition.

Table 6.2 – Summary Table

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
During Construction & Decommissioning					
Construction noise including construction traffic	Scoped out of assessment	-	Production and implementation of CEMP and traffic management plan	Not significant	-
During Operation					
Noise from operation of the wind turbines	Not significant	Adverse	Implementation of noise mitigation strategy (embedded mitigation)	Not significant	Adverse
Operational noise from non-turbine fixed plant	Not significant	Adverse	Specification and location of plant such that noise limits are met at NSRs (embedded mitigation)	Not significant	Adverse
Cumulative Effects					
Noise from operation of the wind turbines	Not significant	Adverse	Implementation of noise mitigation strategy (embedded mitigation)	Not significant	Adverse

9.13 References

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