Galileo 05 Limited

Lynemore Wind Farm

Environmental Impact Assessment Report (Volume 1)

Chapter 11 – Noise & Vibration

663991 (00)

MARCH 2025

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11 NOISE AND VIBRATION

11.1 Introduction

11.1.1 This chapter summarises the assessment of the potential noise effects of the Proposed Development on the residents of nearby dwellings. Full details of the noise assessment can be found in the Hoare Lea Technical Report, included as **Technical Appendix 11.1: Environmental Noise Assessment**. The assessment considers the Proposed Development's construction, its operation and decommissioning.

11.1.2 Assessment of the operational noise effects accounts for the cumulative effect of the Proposed Development as well as the nearby operational Farr, Glen Kyllachy, and Moy, Wind Farms. Other, more distant wind farms were not considered because their potential noise contribution was considered negligible.

11.1.3 The Proposed Development consists of 14 wind turbines with a tip height of up to 200 m, a Battery Energy Storage System and ancillary infrastructure, located near the Moy hamlet southeast of Inverness, a detailed description of the Proposed Development is provided in **Chapter 2: Proposed Development**.

11.1.4 This chapter is supported by the following figure and technical appendix, which provide further information, which are referenced throughout the text:

- **Technical Appendix 11.1: Environmental Noise Assessment**
- **Figure 11.1: Noise Contours and Sensitive Receptors.**

11.2 Statutory and Planning Context

11.2.1 **Chapter 3: Renewable Energy and Planning Policy** provides the general statutory and planning context for the Environmental Impact Assessment. This section focuses on the statutory and planning context specifically relevant to noise and vibration.

11.2.2 The Environmental Protection Act 1990[1] defines the powers for local authorities to investigate and control statutory nuisance from noise. Local authorities also have powers under the Control of Pollution Act (CoPA)[2] 1974 to control noise and vibration from construction activities. Notwithstanding these powers, the aim of the planning system is to minimise and control where required construction and operational noise levels from commercial developments.

11.2.3 Scottish National Planning Framework 4 (NPF4, 2023)[3] is a national spatial strategy for development in Scotland which sets out planning policies and proposals for the development and use of land. Policy 11 sets out the national planning policy position on renewable energy proposals and aims to encourage, promote and facilitate all forms of renewable energy development, including onshore wind farms. Policy 11 (e) requires

[1] HMSO (1990): Environmental Protection Act, Part III.

[2] HMSO (1974): Control of Pollution Act, Part III.

[3] Scottish Government (2023). 'Scottish National Planning Framework (NPF4)'

that project design and mitigation demonstrates how the impact of noise has been addressed.

11.2.4 Planning Advice Note PAN1/2011 (2011)[4] provides general advice on the role of the planning system in preventing and limiting the adverse effects of noise without prejudicing investment in enterprise, development and transport. PAN1/2011 provides general advice on a range of noise related planning matters, including references to noise associated with both construction activities and operational wind farms.

11.2.5 The Scottish Government's online guidance ('Onshore wind turbines: planning advice', 2014), referenced in PAN1/2011, provides further advice on noise, and confirms that the recommendations of 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97) *"should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments"*.

11.2.6 Guidance on good practice on the application of ETSU-R-97 has been provided in the Institute of Acoustics Good Practice Guide or IOA GPG. This was subsequently endorsed by the Scottish Government which advised in the Online Renewables Planning Advice on Onshore Wind Turbines that the GPG "*should be used by all IOA members and those undertaking assessments to ETSU-R-97"*. The Scottish Government Onshore Wind Policy Statement 2022[5] also references the advice of ETSU-R-97 and the IOA GPG as relevant guidance to be applied when assessing noise from wind turbines.

11.2.7 PAN1/2011 and the Technical Advice Note accompanying PAN1/2011 note that construction noise control can be achieved through planning conditions that limit noise from temporary construction sites, or by means of the CoPA or the Pollution and Prevention Control Act 1999.

11.2.8 CoPA provides two means of controlling construction noise and vibration. Section 60 provides the Local Authority with the power to impose at any time operating conditions on the Site. Section 61 allows the developer to negotiate a prior consent for a set of operating procedures with the Local Authority before commencement of site works.

11.2.9 Planning Advice Note PAN50[6] "Controlling the Environmental Effects of Surface Mineral Workings" gives guidance on the environmental effects of stone extraction.

11.2.10 The Highland-wide Local Development Plan (HwLDP, April 2012) includes policy 67 (Renewable Energy Developments), which explains that the Highland Council (THC) will support a proposal if it is satisfied that they will not be significantly detrimental, either in isolation or cumulatively, with regards to a number of effects which include noise on occupied residential buildings. Whilst THC are in the process of preparing a new LDP, that this is at an early stage and no draft is available and therefore reference to the extant LDP remains relevant.

11.2.11 THC's Onshore Wind Energy Supplementary Guidance (Nov 2016) makes reference to the ETSU-R-97 guidance but notes (see Table 11.1) that the Council will seek to achieve noise limits at the lower end of the range associated in this national guidance and

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[4] Scottish Government (2011). Planning Advice Note 1/2011: Planning & Noise

[5] Scottish Government (2021) - Onshore wind - policy statement 2022, December 2022.

[6] The Scottish Office (1996): Planning Advice Note 50: Controlling the Environmental Effects of Surface Mineral Workings.

encourages early engagement with THC. It advises that consideration of cumulative impacts should have regard to current best practice.

ETSU-R-97 guidelines

11.2.12 The aim of the ETSU-R-97 guidelines is to provide "*indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development*".

11.2.13 In summary, the ETSU-R-97 noise limits are defined in relation to measured prevailing background noise levels during quiet periods and their variation with wind speeds:

- For day-time periods, the limit is either a fixed level between 35 and 40 dB(A), or 5 dB above the derived background noise level during quiet day-time periods, whichever is the higher; and
- For night-time periods, the limit is either a fixed level of 43 dB(A), or 5 dB above the derived background noise level, whichever is the higher.

11.2.14 The methodology is described in further detail in paragraphs 11.5.12 to 11.5.18.

11.3 Consultation Undertaken

11.3.1 To help characterise the baseline background noise environment around the Site, a baseline noise survey was undertaken at the nearest noise-sensitive property to the Proposed Development, Lynemore Cottage (see **section 11.4**). Prior to undertaking this background survey, and as recommended in the THC scoping response, the survey approach was discussed with THC representatives. The proposed monitoring location and a summary of the proposed assessment approach was forwarded to the Environmental Health Department of THC for comment, and the proposed location was agreed to be representative for the purpose of an ETSU-R-97 assessment.

11.3.2 In response to the initial scoping request, THC also expressed several requirements, including in particular a preference for more stringent noise limits than the general recommendations of ETSU-R-97, as set out in **section 11.4.** These more stringent noise limits have been adopted in the present assessment.

Table 11.1 Summary of consultation responses relevant to this chapter

Consultee	Issued Raised	Response/Action Taken
THC, scoping response 5 August 2024	THC required a detailed operational noise assessment in line with ETSU-R-97 and the IOA GPG. More stringent noise limits than those set out in ETSU-R-97 were recommended (see 11.5.16). THC also set out detailed requirements in relation to the information required and approach to the assessment of cumulative noise levels. THC recommended that background noise survey locations are agreed with the Council's Environmental Health Department. THC also presented advice regarding construction noise and amplitude modulation, and agreed infrasound and Low Frequency Noise (LFN) can be scoped out.	The advice received was taken into account in the present chapter and associated technical appendix which presents the required information. The proposed stringent noise limits were adopted in the assessment.
THC, letter to Environmental Health Department dated 3 April 2024	The proposed background noise monitoring location at Lynemore Cottage was considered acceptable as well as the use of historic background measured data from Farr and Glen Kyllachy Wind Farm Environmental Statements. An officer from the Environmental Health Department of THC was invited to site when the equipment was deployed but declined the invitation.	The details of the final installed survey location were provided to THC following installation of the monitoring equipment and no adverse comments received.

11.4 Approach to the Assessment

Scope of Assessment

11.4.1 Noise and vibration which arises from the construction of a wind farm is a factor which should be taken into account when considering the total effect of the Proposed Development. However, in assessing the effects of construction noise, it is accepted that the associated works are of a temporary nature. The main work locations for construction of the proposed turbines are 1.5 km or more from the nearest noise sensitive residences and are unlikely to cause significant effects. The construction and use of access tracks and some of the required infrastructure would, however, occur at lesser separation distances. Assessment of the temporary effects of construction noise is primarily aimed at understanding the need for dedicated management measures and, if so, the types of measures that are required. Further details of construction traffic routes and proposed working hours are described in **Chapter 2: Proposed Development**.

11.4.2 Once constructed and operating, wind turbines may emit two types of noise: aerodynamic noise from the blades, and mechanical noise from other components (which is easier to minimise by good engineering design). Aerodynamic noise tends to be perceived when the wind speeds are low, although at very low wind speeds the blades do not rotate or rotate very slowly and so, at these wind speeds, negligible aerodynamic noise is generated. In higher winds, aerodynamic noise is generally masked by the normal sound of wind blowing through trees and around buildings. The level of this natural 'masking' noise relative to the level of wind turbine noise determines the subjective audibility of the wind farm. The relationship between wind turbine noise and the naturally occurring masking noise at residential dwellings around the Site will therefore generally form the basis of the assessment of the levels of noise against accepted standards.

11.4.3 The Proposed Development will also include a substation and battery storage facility which will emit some noise during operation.

11.4.4 The following effects have been assessed in full:

- The potential effect of noise and vibration during construction and decommissioning of the Proposed Development (including construction traffic noise and potential cumulative effects).
- The potential effect of noise during operation of the Proposed Development, including cumulative effects.

11.4.5 On the basis of the desk-based work undertaken, the professional judgement of the EIA team, experience from other relevant projects and policy guidance or standards, the following effects have been 'scoped out':

- The results of previous research detailed in **Annex A** of **Technical Appendix 11.1: Environmental Noise Assessment** has demonstrated that vibration resulting from the operation of wind farms is imperceptible at typical separation distances. Therefore, vibration effects during operation do not warrant detailed assessment and have not been considered further as part of this chapter.
- Light traffic and activities which are part of routine maintenance of the Proposed Development will be very limited and unlikely to be associated with any significant effects.
- Based on professional judgement, it is considered that noise from the substation and battery storage compound is likely to have negligible effects at the nearest receptor due to the large separation distance of approximately 2 km, even accounting for the potential characteristics of the noise.

Data Sources

11.4.6 The following data sources have informed the assessment:

- Ordnance Survey (OS) information concerning the locations of all noise sensitive receptors in the vicinity of the Site.
- British Standard (BS) reference material for the sound emission characteristics of various construction activities associated with Proposed Development.
- manufacturer data for the candidate and proposed turbines considered, as set out in **Technical Appendix 11.1: Environmental Noise Assessment**.

- EIA Reports and associated consent documents for the existing Farr, Glen Kyllachy, and Moy Wind Farms considered in the cumulative assessment.

Study Area

11.4.7 The study area for the assessment of operational noise comprises noise-sensitive residential properties nearest to the proposed turbines, located at approximate distances of up to 3 km from the turbines of the Proposed Development. The cumulative assessment also considers residential properties closer to the Farr, Glen Kyllachy and Moy Wind Farms (see **Figure 11.1** showing the location of the nearby wind developments).

11.4.8 The assessment of construction noise has considered the same residential properties as the operational assessment, as well as dwellings located alongside the construction traffic route.

Noise and Vibration Predictions

11.4.9 The predictions of construction noise were made using the methodology of BS 5228 and representative emission levels based on the types and number of equipment typically associated with key phases of constructing a wind farm and precautionary assumptions about working practices and propagation (see **Technical Appendix 11.1: Environmental Noise Assessment**).

11.4.10 The level of construction noise and vibration that occurs at the surrounding properties would be highly dependent on a number of factors such as the final construction programme, equipment types used for each process, and the operating conditions that prevail during construction. It is not practically feasible to specify each and every element of the factors that may affect the resulting levels, therefore it is necessary to make reasonable allowance for the activities that may be associated with key phases of the construction. The types and number of equipment usually associated with the key phases of constructing a wind farm have been based on experience of similar sites. The conservative assumptions made would likely offset the uncertainty in the exact details of the construction activities.

11.4.11 For operational noise, the exact model of turbine to be used for the Proposed Development would be the result of a future tendering process and therefore an indicative turbine model has been assumed for the operational noise assessment. Specifically, the operational noise assessment is based upon the noise specification of the Nordex N163 wind turbine which is typical of the type and size of turbine which may be considered for this Site, and assuming worst-case downwind propagation.14 turbines have been modelled using the layout as indicated on **Figure 11.1**.

11.4.12 Assessment of the operational noise effects accounts for the cumulative effect of the Proposed Development as well as the nearby existing wind farms; namely Farr, Glen Kyllachy, and Moy Wind Farms. Other, more distant wind farms were not considered because their potential noise contribution was considered negligible.

11.4.13 In all cases, the assumptions made on noise emission levels and the operational noise prediction methodology used are in accordance with the IOA GPG (see Technical **Technical Appendix 11.1: Environmental Noise Assessment**).

Baseline Survey

11.4.14 A survey was undertaken at one noise monitoring location, to help characterise the baseline background noise environment around the Site. This location, Lynemore Cottage (276252E / 833940N), was identified as the closest noise-sensitive receptor in proximity of the Proposed Development. The monitoring location and the use of historic background measured data was agreed in consultation with THC. Specifically, background noise data previously measured at Moy More House (276625E / 835425N) and Tomatin (278976E / 829484N) was also referenced to derive suitable noise limits in accordance with ETSU-R-97 . The assessment of operational noise from the Proposed Development also considers other representative assessment locations, listed in **Technical Appendix 11.1: Environmental Noise Assessment** Table 3, for sensitive receptors in the area.

11.4.15 The background noise monitoring exercise was conducted in April and May 2024, over a period of four weeks, with full details in **Technical Appendix 11.1: Environmental Noise Assessment**. The data were measured and analysed in accordance with the guidance of the IOA GPG.

11.4.16 The noise levels measured at Lynemore Cottage were related to standardised 10 m height wind speeds, derived from measurements extrapolated to a height of 120 m, which was considered to be representative of the highest hub height which could be used at the Site, in accordance with the preferred methodology of the IOA GPG, with full details provided in Annex F of **Technical Appendix 11.1: Environmental Noise Assessment**.

11.4.17 Historic background measurement data were used for the relevant receptors (Moy More House and Tomatin): where this data has been used, the measured data was adjusted to account for the difference in wind shear calculations between the differing hub heights of the Proposed Development and Farr wind farm for which the measurement was originally undertaken. This adjustment consisted of a wind speed shift of 1 m/s to applied to the reference for the measured background levels, effectively presenting conservative limits for the respective wind speeds, as detailed in **Technical Appendix 11.1: Environmental Noise Assessment** Annex C & E.

Existing Environment

11.4.18 The baseline noise environment at the survey location at Lynemore Cottage was typically a mix of ‘natural’ noise sources such as wind disturbed vegetation with man-made noise from the nearby A9 traffic and local vehicle movements. The receptors in the area are mainly clustered north and south of the A9, therefore, the measured baseline noise levels are considered consistent with the surrounding receptors.

11.4.19 Existing noise conditions at the survey location as a function of Site wind speeds, during quiet periods, are represented in Charts E1 and E2 of Annex E in **Technical Appendix 11.1: Environmental Noise Assessment**. These measured baseline noise levels satisfy the requirements of ETSU-R-97 and the IOA GPG (as detailed in **section 4.3** of **Technical Appendix 11.1: Environmental Noise Assessment**). In particular, the measurements were not considered to have been substantially influenced by existing wind turbine noise levels. The background levels at the measurement location typically varied, during quiet daytime periods, between 25 to 35 dB $L_{A90,10min}$ at low wind speeds (up to 5 m/s) and 35-50 dB $L_{A90,10min}$ at the highest wind speeds in the range of up to

12 m/s considered under ETSU-R-97. For night-time periods, a similar range of levels was generally observed between low and high wind speeds, ranging from 25-30 dB $L_{A90,10min}$ for low wind speeds and 30-45 for higher wind speeds up to 11 m/s.

11.5 Assessment Methodology

Sensitivity of Receptors

11.5.1 All receptors considered in this assessment are residential dwellings; assessed receptors are presented in **Technical Appendix 11.1: Environmental Noise Assessment** Table 4. Residential receptors are considered as '**High**' sensitivity, as such all impacts correspond to 'High' sensitivity receptors when determining significance of effects.

Methodology for Assessing Construction Noise and Vibration Impacts

11.5.2 Detailed guidance on construction noise and its control is provided by British Standard[7] BS 5228-1: 2009. Analysis of construction noise impacts has been undertaken in accordance with the methodologies outlined in this standard, which provides methods for predicting construction noise levels based on reference data for the emissions of typical construction plant and activities. These methods include the calculation of construction traffic along access tracks and haul routes to the Proposed Development, and construction activities at fixed locations including the bases of turbines, temporary construction compounds, and the substation. The construction noise assessment has been based on indicative data for the types of plant likely to be used during the construction works, as presented in BS 5228-1.

11.5.3 Changes in the predicted traffic noise level on existing roads were calculated using the Calculation of Road Traffic Noise (CRTN)[8] methodology.

11.5.4 When considering the potential for blasting to be employed at the proposed borrow pits, reference can be made to the guidance of Planning Advice Note PAN50, which considers the environmental effects of mineral working. The main document summarises the key issues with regard to various environmental impacts relating to surface mineral extraction and processing such as road traffic, blasting, noise, dust, visual intrusion etc. In addition, several annexes to the main document have been published which consider specific aspects in more detail: Annex A, 'The Control of Noise at Surface Mineral Workings' and Annex D 'The Control of Blasting at Surface Mineral Workings'. BS 5228-1 and BS 5228-2[9] also provide guidance relating to surface mineral extraction including the assessment of noise and vibration effects associated with quarry blasting. Because of the difficulties in predicting noise and air overpressure resulting from blasting operations at the proposed borrow pits, these activities are best controlled following the use of good practice during the setting and detonation of charges (see **Technical Appendix 11.1: Environmental Noise Assessment**).

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[7] British Standard BS 5228-1:2009-A:2014 (2009). 'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise'

[8] Department of Transport (1988). 'Calculation of Road Traffic Noise'.

[9] British Standard BS 5228-2:2009-A:2014 (2009). 'Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration'.

11.5.5 Based on the range of guidance values set out in BS 5228-1 Annex E, and other relevant guidance (including consultation responses from THC set out below), the significance criteria presented in **Table 11.2** have been derived. The values have been chosen in recognition of the relatively low ambient noise typically observed in rural environments. The presented criteria have been normalised to free-field day-time noise levels occurring over a time-period T, equal to the duration of a working day on Site. Specifically, the criteria relate to daytime hours from 07:00 to 19:00 on weekdays, and 07:00 to 13:00 on Saturdays and that construction working is limited to these times.

Table 11.2 Significance Criteria for Construction Noise

Impact Significance	Definition
Major	Construction noise is generally greater than 75 dB $L_{Aeq,T}$ during the construction period, or with periods of more than 85 dB $L_{Aeq,T}$ lasting not more than 4 weeks in any 12 month period.
Moderate	Construction noise is generally less than or equal to 75 dB $L_{Aeq,T}$ during the construction period, with periods of up to 85 dB $L_{Aeq,T}$ lasting not more than 4 weeks in any 12 month period.
Minor	Construction noise is generally less than or equal to 65 dB $L_{Aeq,T}$ during the construction period, with periods of up to 75 dB $L_{Aeq,T}$ lasting not more than 4 weeks in any 12 month period.
Negligible	Construction noise is generally less than or equal to 55dB $L_{Aeq,T}$, with periods of up to 65 dB $L_{Aeq,T}$ lasting not more than 4 weeks in any 12 month period.

11.5.6 When considering the impact of short-term changes in traffic, associated with the construction activities, on existing roads in the vicinity of the Proposed Development, reference can be made to the criteria set out in the Design Manual for Roads and Bridges (DMRB)[10]. A classification of magnitudes of changes in the predicted traffic noise level for short-term changes, such as those associated with construction activities, is set out in **Table 11.3.** This classification can be considered in addition to the criteria of **Table 11.2**.

Table 11.3 Significance Criteria for Changes in Traffic Noise Associated with Construction Traffic

Impact Significance	Definition
Major	More than 5 dB
Moderate	3 to 5 dB
Minor	1 to 3 dB
Negligible	Less than 1 dB

[10] The Highways Agency, Transport Scotland, Transport Wales and The Department for Regional Development (Northern Ireland) (2020). 'Design Manual for Roads and Bridges, LA 111 Noise and vibration', revision 2.

11.5.7 BS 5228-2 provides general guidance on legislation, prediction, control and assessment criteria for construction vibration. The nature of most of the works and distances involved in the construction of the Proposed Development are such that the risk of significant effects relating to ground borne vibration are very low (excluding blasting, see below), however, some work such as the new track construction to the north of the Site, will be undertaken close to receptors and may generate vibration effects perceptible to the nearby residents. Therefore, criteria for the assessment of the magnitude of construction vibration are presented in **Table 11.4** below, based on the guidance in Section B.2 of BS 5228-2 which provides advice on human response to vibration.

Table 11.4 Significance Criteria for Vibration from Construction activity

Impact Significance	Construction Vibration
Major	>10 mm/s
Moderate	>1 mm/s and ≤10 mm/s
Minor	>0.3 mm/s and ≤1 mm/s
Negligible	≤0.3 mm/s

11.5.8 BS 5228-2 advises that any risk of building damage, even for sensitive buildings, would only occur at much stronger vibration levels than the above 10 mm/s, therefore the proposed criteria would also provide protection in this regard.

11.5.9 Occasional momentary vibration can arise when heavy vehicles pass dwellings at very short separation distances, as is the case with the existing traffic in the area, but again this is not sufficient to constitute a risk of significant effects in this instance.

Methodology for Assessing Operational Noise Impacts

11.5.10 The assessment of operational noise impacts has been carried out in accordance with the methodology set out in ETSU-R-97, which is described in more detail in **Technical Appendix 11.1**.

11.5.11 Technical guidance on current good practice in the application of the ETSU-R-97 methodology[11], as described in the Institute of Acoustics (IOA) Good Practice Guide (GPG, 2013)[12] has also been referenced, as is recommended in the Scottish Government's Online Renewables Planning Advice on Onshore wind turbines[13].

11.5.12 To undertake the assessment of noise impact in accordance with the methodology in ETSU-R-97, the following steps are required:

- Specify the number and locations of the wind turbines and other wind farms to be included in the assessment.

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[11] ETSU-R-97, the Assessment and Rating of Noise from Wind Farms, Final ETSU-R-97 Report for the Department of Trade & Industry. The Working Group on Noise from Wind Turbines, 1996.

[12] M. Cand et al (2013). 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'. Institute of Acoustics.

[13] Scottish Government (2014). Onshore Wind Turbines: Planning Advice. https://www.gov.scot/publications/onshore-wind-turbines-planning-advice

- Identify the locations of the nearest, or most noise sensitive, neighbours.
- Determine the background noise levels as a function of Site wind speed at the nearest neighbours, or at least at a representative sample of the nearest neighbours, either through direct measurement or by reference to data already obtained during previous surveys in the area.
- Determine the daytime and night-time noise limits from the measured background noise levels at the nearest neighbours.
- Specify the type and noise emission characteristics of the wind turbines.
- Calculate noise immission levels from the operation of the turbines associated with the Proposed Development as well as the contribution to cumulative noise immission levels from other nearby wind farms as a function of Site wind speed at the nearest neighbours.
- Compare the calculated wind farm noise immission levels with the derived noise limits and assess in the light of planning requirements in consultation with the local planning authority.

11.5.13 Full details of the operational noise assessment, including details of the noise output of the candidate turbine for the Proposed Development and the calculation parameters on which predictions have been based, can be found **Technical Appendix 11.1: Environmental Noise Assessment**.

11.5.14 The acceptable limits for wind turbine operational noise are clearly defined in ETSU-R-97. Consequently, the test applied to operational noise is whether the calculated wind farm noise immission levels (cumulative from all wind turbines) at nearby noise sensitive properties lie below the noise limits derived in accordance with ETSU-R-97. The assessment will therefore need to consider the combined operational noise of the Proposed Development with other wind farms in the area to be satisfied that the combined cumulative noise levels are within the relevant ETSU-R-97 criteria.

11.5.15 In summary, ETSU-R-97 noise limits are defined in relation to measured background noise levels during quiet periods and their variation with wind speeds:

- For daytime periods, the limit is either a fixed level between 35 and 40 dB(A), or 5 dB above the derived background noise level, whichever is the higher.
- For night-time periods, the limit is either a fixed level of 43 dB(A), or 5dB above the derived background noise level, whichever is the higher.

11.5.16 For daytime periods, the precise choice of fixed limit within the range 35 dB(A) to 40 dB(A) according to ETSU-R-97 depends on a number of factors: the number of noise-affected properties, the likely duration and level of exposure and the consequences of the choice on the potential power generating capability of the wind farm. During the consultation, The Highland Council (THC) have highlighted that they prefer this lower limit to be set at 35 dB(A), the lowest end of the range of 35 to 40 dB(A) prescribed in ETSU-R-97. For night-time periods, THC have suggested that a fixed level of 38 dB(A) should be used instead of 43 dB(A) set out in ETSU-R-97.

11.5.17 Where a property occupier has a financial involvement in the wind farm development, the lower fixed portion of the noise limit at that property may be increased to 45 dB(A) during both the daytime and the night-time periods. For the purpose of the assessment of the Proposed Development, it has been assumed that there are no financially involved properties.

11.5.18 ETSU-R-97 also offers an alternative simplified assessment methodology: if predicted noise levels do not exceed 35 dB(A) up to a wind speed of 10 m/s, then they are considered acceptable and background noise surveys are not considered necessary.

Low Frequency Noise, Vibration and Amplitude Modulation

11.5.19 Low-frequency noise and vibration resulting from the operation of wind farms are all issues that have been discussed in detail over the past 20 years, as detailed in Annex A of **Technical Appendix 11.1: Environmental Noise Assessment**.

11.5.20 Annex A of **Technical Appendix 11.1: Environmental Noise Assessment** also discusses the most recently published research on the subject of wind turbine blade swish or Amplitude Modulation (or AM). The IOA has recently published an objective technique developed for quantifying AM noise. The UK Government also commissioned a review on subjective responses to AM noise which outlines considerations for the control of this feature based on the IOA methodology. The Scottish Government is currently reviewing this recommendation in the context of the Scottish planning system.

11.5.21 In summary of the information provided in **Technical Appendix 11.1: Environmental Noise Assessment**, the current recommendation is that ETSU-R-97 should continue to be used for the assessment and rating of operational noise from wind farms.

Noise Limits

11.5.22 ETSU-R-97 noise limits were determined on the basis of these background levels at all properties: this results in the limits set out in Tables 5 and 6 of **Technical Appendix 11.1: Environmental Noise Assessment**. For the avoidance of doubt, these limits have been derived as follows:

- The minimum ETSU-R-97 daytime limit of 35 dB(A), or 5 dB above the prevailing background noise level, whichever is the higher.
- The minimum ETSU-R-97 night-time fixed lower limit of 38 dB(A), or 5 dB above the prevailing background noise level, whichever is the higher.

11.5.23 The derivation of the 35 dB(A) fixed limit for daytime periods, based on the criteria specified in ETSU-R-97, is considered in detail in **section 5.7** of **Technical Appendix 11.1: Environmental Noise Assessment**. The factors considered include the very low number of dwellings potentially affected relative to the scale of the Proposed Development, the limited level of exposure of turbine noise above baseline noise levels. The factors indicate that it would be considered wholly appropriate to set the limit towards the middle of the range of 35 to 40 dB(A) specified in ETSU-R-97. Nonetheless, a limit at the lowest end of the range at 35 dB(A) was selected in line with THC preferences, which represents a conservative assessment of operational noise.

Statement of Significance

11.5.24 'Major' or 'Moderate' construction impacts are considered 'significant' in the context of the EIA Regulations.

11.5.25 If predicted cumulative noise levels are within the ETSU-R-97 derived noise limits, operational noise is considered acceptable, and therefore 'not significant' in EIA terms. If predicted noise levels are above the ETSU-R-97 noise limits, operational noise is considered ‘significant’ in EIA terms.

Difficulties and Uncertainties

11.5.26 Baseline noise monitoring was undertaken at the nearest receptor to the Proposed Development, the monitoring location and use of historic data was agreed with THC. The measured data was filtered to exclude influence of traffic noise from the A9 which present conservative background levels for the assessment. Other wind farm developments were at sufficiently large separation distances and would have negligible noise contribution at the measurement locations.

11.5.27 The assessment was undertaken with uncertainty factors incorporated in the assumed noise emission levels, as well as further uplifts to account for consented noise levels: the predicted levels therefore represent a worst-case emission level in downwind conditions which will not necessarily be the case in practice.

11.5.28 The conservative measures implemented in the assessment mean that any inherent uncertainties will not affect the overall level of effects determined in this assessment.

11.6 Embedded Mitigation

Design Considerations

11.6.1 The design of the turbine layout of the Proposed Development has been iteratively developed to avoid potentially significant operational noise effects, based on a representative candidate turbine model, whilst maintaining, as far as possible, the generation capacity of the Proposed Development (in addition to other design considerations). This included consideration of the cumulative effects with neighbouring wind farms, where relevant.

Micro-siting

11.6.2 The locations of the turbines and other infrastructure would be subject to ‘micro-siting’. This process allows for minor changes in turbine or infrastructure locations to respond to possible variations in ground conditions across the Site, which would only be confirmed following detailed Site investigation work carried out immediately prior to construction. It is anticipated that the agreed 'tolerance' micro-siting distance of 50 m would form a condition accompanying any consent. A change of 50 m in position will have negligible effects (<0.5 dB) on the turbine noise levels and as such the results of this assessment remain valid and accounts for the micro-siting tolerance of 50 m.

Best Practice Measures

11.6.3 The good practice measures detailed below will be implemented to manage the effects of noise and vibration during construction activities, and will be required of all contractors:

- As proposed in **Chapter 2: Proposed Development**, those activities that may give rise to audible noise at the surrounding properties and heavy goods vehicle deliveries to the Site (except for abnormal loads, see below) would be limited to the hours 07:00 to 19:00 Monday to Friday and 08:00 to 13:00 on Saturdays unless otherwise approved in advance by THC (except in case of an emergency).

Those activities that are unlikely to give rise to noise audible at the Application Boundary, or light vehicle traffic accessing the Site such as that involved with staff mobilisation, may continue outside of the stated hours.

- Construction noise will be managed via a site-specific Noise Management Plan (NMP) provided to the Council. The embedded mitigation contained in the NMP will include the commitment to liaise directly with local residents, and the wider community.
- Where practicable, night-time working will not be carried out. Local residents shall be notified in advance of any night-time construction activities likely to generate audible noise levels, e.g., abnormal load movement;
- All equipment used would be maintained in good working order and associated noise attenuation such as engine casing and exhaust silencers shall remain fitted at all times.
- A Construction Traffic Management Plan (CTMP) will be developed and secured through planning condition to control the movement of vehicles to and from the Site. Abnormal load movement will only take place outside the working hours above with the prior consent of the relevant local authorities and the Police and this will be controlled by an Abnormal Load Transport Management Plan as part of the CTMP.
- The Site contractors shall be required to employ the best practicable means of reducing noise emissions from plant, machinery, and construction activities, as advocated in BS 5228-1.
- Where practicable, the work programme will be phased, which would help to reduce the combined effects arising from several noisy operations.
- All sub-contractors appointed by the main contractor will be formally and legally obliged, and required through contract, to comply with all environmental noise conditions.
- Any plant and equipment normally required for operation at night (23:00 - 07:00), e.g. generators or dewatering pumps, shall be silenced or suitably shielded to ensure that the night-time lower threshold of 45 dB L_{Aeq} shall not be exceeded at the nearest noise-sensitive receptors.
- Rock extraction from borrow pits by means of blasting operations is possible, and a Blast Management Plan will be prepared by the Contractor in advance of any blasting operations.

11.6.4 Site-specific mitigation measures are outlined in **Section 11.8**.

11.7 Predicted Effects

Construction Noise and Vibration Effects

11.7.1 Predicted noise levels at the closest noise sensitive receptor for each of the key activities during construction of the Proposed Development are presented in Table 9 of **Appendix 11.1**.

11.7.2 Most of the proposed construction activities within the Site will be around the turbine locations and would occur at relatively large distances from nearby residential properties, such that the resulting predicted noise levels would not exceed 65 dB L_{Aeq} for more than 4 weeks in any 12-month period and are below 55 dB(A) for most of the work duration. With reference to the derived criteria of **Table 11.2**, the noise impact from these activities would therefore be ‘Negligible’ magnitude of impact.

11.7.3 For the activities closest to northern receptors i.e., Keeper Cottage and Lynebeg properties, works including forestry felling, earthworks and Site access track construction works are predicted to result in noise levels of up to 75 to 81 dB. However, it should be noted that the period when this activity is closest to the respective receptor would represent a very short-term duration (likely to be less than 4 weeks), and noise levels will diminish as track work progresses, moving the activity further from the respective property. The predicted noise levels nevertheless categorises the impact without mitigation to be of 'moderate' magnitude according to **Table 11.2**.

11.7.4 In terms of vibration, the new access track works will likely involve vibratory ground compaction at a distance as close as 35-45 m from receptor properties to the north of Site. Using guidance in BS 5228-2, based on worst-case assumptions (0.8 mm drum vibration amplitude and a 1.5 m drum width), vibration levels at 35 m distance (closest point) will likely be less than 1 mm/s, with predicted levels of 0.7 mm/s at start-up/run-down of the compactor and 0.5 mm/s at steady state operation. It is difficult to estimate what vibration could be produced by the groundworks associated with this activity as this would depend on the ground/rock conditions however, based on the conservative assumptions above, levels are likely to be below 1 mm/s. Based on BS 5228-2 guidance, these levels can be perceptible but are unlikely to cause complaints, therefore, impacts associated with construction vibration are considered of 'minor' magnitude.

11.7.5 If blasting is employed to quarry the borrow pit (BP) located 2 km from nearest dwelling (Lynemore Cottage), see **Figure 2.2**, it is very unlikely that these activities would cause unacceptable adverse effects at such distances, and therefore no specific mitigation is considered to be required for these activities other than implementation of best practice measures as outlined in **section 11.6.3**.

11.7.6 In addition to on-site activities, construction traffic passing to and from the Site will also represent a potential source of noise to surrounding properties. Based on the prediction methodology in BS 5288, the worst-case predicted noise level, i.e., all traffic during the daytime working hours, no screening, and full angle of view, due to heavy vehicles moving on the nearest segment of the new site access track, at the closest dwelling is 53 dB L_{Aeq}[14]. This corresponds to a 'negligible' impact.

11.7.7 The effect of traffic on existing roads was assessed using the CRTN methodology with a maximum predicted increase of 0.1 dB(A) in the daytime average noise level for the roads considered in the assessment. Based on the criteria set out in the DMRB (**Table 11.3**), this predicted short-term change in traffic noise levels corresponds to a 'negligible' impact.

11.7.8 In conclusion, noise and vibration from construction activities excluding the site access track construction, are predicted to result in a temporary negligible to minor impact on highly sensitive receptors in most cases, which represents negligible to minor effects which are **not significant** in EIA terms. Predicted vibration impacts for site track activities are 'minor' as a worst-case which are also not significant. However, predicted noise impact from site access track activities to the north without mitigation represent a 'moderate' impact on highly sensitive receptors, and therefore a moderate temporary

[14] Prediction based on a Sound Power Level of 108 dB(A) for a typical HGV vehicle (based on average BS 5228-1 stated HGV passing values), with 12 HGVs (139 over 12 working hours) passing the nearest segment at 40 m from receptor boundary in an hour

adverse effect which is **significant** in EIA terms. Additional mitigation measures are therefore considered below in **section 11.8**.

Decommission Effects

11.7.9 Provided that the same management process and best practices as construction will be employed for the decommission phase, decommissioning is likely to result in less noise than during construction of the Proposed Development. The construction phase has been considered to generally have ‘moderate’ noise effects, however, activities which were associated with these effects, i.e., site access track works, would not be required for the decommissioning phase and so this is not relevant to this assessment. Therefore, most decommissioning activities would, in the worst case, have ‘minor’ to ‘negligible’ temporary adverse noise effects which are **not significant** in EIA terms.

Operational Noise effects

11.7.10 The predictions of operational noise at the nearest sensitive receptors for the Proposed Development alone are detailed in Table 12 of **Technical Appendix 11.1: Environmental Noise Assessment** and are also illustrated as contours in **Figure 11.1**. These varied between 24 dB(A) at low wind speeds to 36 dB(A) at high wind speeds at the nearest property, over the range of 3 m/s to 12 m/s over which predictions were made (in line with ETSU-R-97 guidance).

11.7.11 ETSU-R-97 also requires consideration of cumulative noise levels. The Proposed Development noise levels were added to predictions from the operational and consented wind farms in the area: see Table 15 in **Technical Appendix 11.1: Environmental Noise Assessment.** These predictions are then compared in **Section 5.7** of **Technical Appendix 11.1: Environmental Noise Assessment** with the relevant noise limits determined in line with ETSU-R-97.

11.7.12 The ETSU-R-97 assessment i.e., difference between predicted cumulative level and agreed cumulative limits, are set out in Table 16 and Table 17 of **Technical Appendix 11.1: Environmental Noise Assessment** and demonstrate that these predictions comply with the cumulative noise limits at all wind speeds. This conclusion is reached based on a lower day-time limit of 35 dB(A), and a lower night-time limit of 38 dB(A) as per THC preference.

11.7.13 This means that the predicted operational noise levels from the Proposed Development are considered acceptable in line with relevant noise limits set out in ETSU-R-97 and also accounts for cumulative levels and the consultation feedback from THC. Therefore, operational noise levels from the proposed wind turbines are considered to be **not significant**.

11.7.14 To derive noise limits applicable to the Proposed Development alone, predicted noise level from the other wind farm developments, including Farr, Glen Kyllachy, and Moy Wind Farms were logarithmically subtracted from the cumulative limits to derive apportioned noise limits for the Proposed Development in isolation. These are presented in **Table 11.5** and **Table 11.6** below for day and night-time respectively. The presented apportioned noise limits are such that compliance of the Proposed Development with these noise limits in isolation would maintain the conclusion of the cumulative assessment and result in cumulative levels which do not exceed the derived ETSU R 97 noise criteria.

Table 11.5 Apportioned Noise Limits (L_{A90}, dB) to the Proposed Development in isolation for daytime period.

Receptor	Standardised Wind Speed (m/s)											
	1	2	3	4	5	6	7	8	9	10	11	12
Moy More House	33	33	33	33	33	33	36	40	43	45	47	49
Lynemore Cottage	38	38	38	39	39	41	42	44	46	49	51	54
Lynebeg	38	38	38	39	40	41	42	44	46	49	51	54
Invermoy House	38	38	38	39	40	41	42	44	46	49	51	54
Suilven	38	38	38	39	40	41	42	44	46	49	51	54
Moybeg Cottage	38	38	38	39	40	41	42	44	46	49	51	54
The Kennels, Moy Mains	32	32	32	32	32	32	36	39	42	45	47	49

Table 11.6 Apportioned Noise Limits (L_{A90}, dB) to the Proposed Development in isolation for night-time period.

Receptor	Standardised Wind Speed (m/s)											
	1	2	3	4	5	6	7	8	9	10	11	12
Moy More House	34	34	34	34	34	34	34	34	34	39	44	49
Lynemore Cottage	36	36	36	36	36	36	36	39	42	46	49	50
Lynebeg	36	36	36	36	36	36	36	39	42	46	49	50
Invermoy House	36	36	36	36	36	36	36	39	42	46	49	50
Suilven	36	36	36	36	36	36	36	39	42	46	49	50
Moybeg Cottage	35	35	35	35	35	35	35	38	42	46	49	50
The Kennels, Moy Mains	34	34	34	34	34	34	34	34	34	39	43	49

11.8 Mitigation

11.8.1 The selection of the final turbine to be installed for the Proposed Development would be made on the basis of enabling the relevant derived noise limits, as set out in **Table 11.5** and **Table 11.6**, to be achieved at the neighbouring properties, including any relevant tonality corrections.

11.8.2 This could be secured through conditions attached to the consent, including the requirement that, in the event of a noise complaint, noise levels resulting from the operation of the wind farm are measured to demonstrate compliance with the conditioned noise limits. Such monitoring should be done in full accordance with ETSU-R-97.

11.8.3 To reduce the potential effects of construction noise, specifically for site access track construction activities near the residential properties at Lynebeg to the north of the Site, the following mitigation measures are proposed:

- Solid screening or temporary acoustic barriers would be used close to the property boundary, of a sufficient height to screen the track activities at the property (the final design and specification of such screening will be determined as part of the detailed design of the access track following ground investigations).
- The residents would be informed beforehand of the nature and duration of the construction works in proximity to their property.
- Where possible, quieter equipment models/options would be used for the activity.
- Where flexibility exists, activities would be undertaken away from residential properties, set back by the maximum possible distances.
- Construction plant capable of generating high noise and vibration levels would be operated in a manner to restrict the duration of the higher magnitude levels.
- Noise monitoring during this phase of construction activities would be undertaken at the most affected properties to assist and managing the noise impacts from the track works and would be implemented in the CEMP.

11.9 Residual Effects

11.9.1 Application of the above mitigation measures specific to track construction activities, and best practice measures to manage construction noise, will minimise effects as far as is reasonably practicable. With the implementation of the mitigation measure outlined in **section 11.8**, it is expected that noise levels at the closest and worst-affected residential properties to the Site access track construction works would not exceed 75 dB(A) for a period of less than 4 weeks, and therefore representing a 'minor' short-term impact on these highly sensitive receptors based on the criteria in **Table 11.2**. Given that predicted construction noise levels are based on worst-case assumptions based on the closest point of activity, the actual impacts from the site access track activity as a whole are anticipated to be lower in practice.

11.9.2 The residual noise and vibration effects are therefore considered to be at most 'minor' temporary adverse, which is **not significant** in EIA terms.

11.9.3 Construction noise and traffic effect are temporary and will only be in effect over the period of the construction programme, therefore, no residual effects are anticipated after completion.

11.9.4 The residual operational effects are the same as the operational effects identified as '**not significant'** in EIA terms in this assessment.

11.10 Cumulative Effects

11.10.1 As noted above and required by ETSU-R-97, cumulative operational noise effects from the turbines when operating alongside the cumulative developments considered has been incorporated into the assessment of the Proposed Development set out above. It was concluded that the cumulative operational noise levels at residential properties remain acceptable in line with ETSU-R-97 and are therefore **not significant**.

11.10.2 The assessment of noise from onsite construction activities is based on the period when each potential activity would occur closest to each of the nearest noise-sensitive locations. Therefore, onsite construction activities from other sites are considered unlikely to produce any additional noise impacts, even if the construction periods were to coincide, given the conservative nature of this approach.

11.10.3 In conclusion, cumulative operational effects in relation to noise can be considered negligible and **not significant** in EIA terms.

11.10.4 Construction works for the A9 upgrade (A9 Dualling) (Tomatin to Moy) is underway, consisting of 9.6 km of A9 near the Site, the published programme construction programme[15] for the A9 dualling works in this area is not anticipated to align with the Proposed Development construction timescales, as such cumulative effects combination of these activities is not expected.

11.11 Summary of Effects

11.11.1 The following provides a summary of the conclusions of the impact assessment taking into consideration embedded and any additional mitigation measures.

11.11.2 The adoption of the identified mitigation measures would reduce the potential noise and vibration effects during construction. In particular, mitigation measures outlined in **section 11.8** for site access track construction activities would reduce the effects. When considering the short-term duration of the works, the residual effects associated with construction activities would therefore be 'Minor' adverse and temporary, and therefore not significant in EIA terms.

11.11.3 Decommissioning is likely to result in less noise than during construction of the Proposed Development. Decommissioning would, in the worst-case, have minor temporary adverse noise effects which are not significant in EIA terms.

11.11.4 Operational noise levels from the Proposed Development were predicted to be compliant with noise limits derived in accordance with the ETSU-R-97 guidance. The cumulative noise levels were also predicted to be compliant with the stringent noise limits derived in accordance with THC preferences.

11.11.5 Depending on the levels of background noise, the satisfaction of the ETSU-R-97 derived limits could lead to a situation whereby, at some locations under some wind conditions and for a certain proportion of the time, the wind farm noise may be audible. However, noise levels at the properties in the vicinity of the Proposed Development would still be within levels considered acceptable under the ETSU-R-97 assessment method and therefore not significant in EIA terms.

11.11.6

[15] Transport Scotland – A9 Dualling Perth to Inverness Project: https://www.transport.gov.scot/projects/a9-dualling-perth-to-inverness/a9-tomatin-to-moy/a9-tomatin-to-moy/

11.11.7 **Table** 11.7 below presents a summary of effects.

Table 11.7 Summary of effects

Potential impact	Pre-mitigation		Mitigation	Residual	
	Effect	Significance		Effect	Significance
Construction Phase					
Access Track Construction near Receptors South of A9	Moderate	Significant	Screening and management of access track construction activities, liaison with residents.	Minor	Not significant
All other activities	Minor to Negligible	Not Significant	Control of working times and best practices measure identified in Section 11.6.3.	Minor to Negligible	Not Significant
Operational Phase					
All receptors	Negligible	Not Significant	None	None	Not Significant
Decommissioning Phase					
All receptors	Minor to Negligible	Not Significant	Similar measures as construction phase.	Negligible	Not Significant
Cumulative effects					
All receptors	Negligible	Not Significant	None	None	Not Significant

11.12 References

British Standard BS 5228-1:2009-A:2014 (2009). ‘Code of practice for noise and vibration control on construction and open sites – Part 1: Noise’

British Standard BS 5228-2:2009-A:2014 (2009). ‘Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration’.

Department of Transport (1988). ‘Calculation of Road Traffic Noise’.

ETSU R 97, the Assessment and Rating of Noise from Wind Farms, Final ETSU-R-97 Report for the Department of Trade & Industry. The Working Group on Noise from Wind Turbines, 1996.

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The Highways Agency, Transport Scotland, Transport Wales and The Department for Regional Development (Northern Ireland) (2020). ‘Design Manual for Roads and Bridges, LA 111 Noise and vibration’, revision 2.

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Transport Scotland – A9 Dualling Perth to Inverness Project: https://www.transport.gov.scot/projects/a9-dualling-perth-to-inverness/a9-tomatin-to-moy/a9-tomatin-to-moy/