# 11 Noise

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# 11 Noise

## 11.1 Executive Summary

11.1.1 A noise assessment was undertaken to determine the likely significant noise effects from the operational phase of the Proposed Development.

11.1.2 A background noise survey was undertaken at two noise monitoring locations as part of the pre-construction noise assessment for the Operational Development. The data has been reanalysed in conjunction with on-site measured wind speed data and noise limits have been derived in accordance with relevant guidance:

- ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' (NWG, 1996); and
- The Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA GPG, 2013).

11.1.3 At receptors where background noise monitoring was not undertaken, the simplified assessment methodology detailed in ETSU-R-97 was adopted for the assessment. A total of three Noise Assessment Locations (NALs) were chosen to be representative of the noise sensitive receptors surrounding the Proposed Development.

11.1.4 The noise assessment has been undertaken in three stages, which involved setting the Total ETSU-R-97 Noise Limits (TNL) (which are limits for noise from all wind farms in the area) at the nearest noise sensitive receptors, predicting the likely effects of the Proposed Development (undertaking a cumulative noise assessment where required) and setting Site Specific Noise Limits (SSNL) for the Proposed Development.

11.1.5 Predicted cumulative operational noise levels indicate that for noise sensitive receptors neighbouring the Proposed Development, cumulative wind turbine noise (which considers noise predictions from all nearby operational wind farms and the Proposed Development) would meet the TNL at all NALs.

11.1.6 The TNL is applicable to all operational, consented and proposed wind farms in the area so SSNL have also been derived to control the specific noise from the Proposed Development. In accordance with the guidance in IOA GPG, the SSNL have been derived with due regard to cumulative noise by accounting for the proportion of the TNL which is potentially being used by other nearby developments. The SSNL have been derived in accordance with the IOA GPG and therefore were set equal to the TNL minus a cautious prediction of noise from all other nearby developments.

11.1.7 Predictions of wind turbine noise from the Proposed Development have been made in accordance with good practice using a candidate wind turbine, the Vestas V150 5.6MW with standard blades (without serrated trailing edges). Predicted operational noise levels from the Proposed Development indicate that for noise sensitive receptors neighbouring the Proposed Development, wind turbine noise from the Proposed Development would meet the SSNL at all NALs.

11.1.8 The use of SSNL would ensure that the Proposed Development could operate concurrently with other operational wind farms in the area and would also ensure that the Proposed Development's individual contribution could be measured and enforced if required.

11.1.9 The Vestas wind turbine model was chosen in order to allow a representative assessment of the noise impacts. Should the Proposed Development receive consent, the final choice of wind turbine would be subject to a competitive tendering process. The final choice of wind turbine would, however, have to meet the SSNL presented in this assessment.

## 11.2 Introduction

11.2.1 This chapter considers the likely significant effects with respect to the noise associated with the operation of the Proposed Development. The specific objectives of the chapter are to:

- describe the noise baseline;

- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential effects (including cumulative effects);
- describe the mitigation measures proposed to address likely significant effects (if required); and
- assess the residual effects remaining following the implementation of mitigation (if required).

11.2.2 This chapter is supported by the following figures and appendices:

- Figure 11.1: Operational Noise Monitoring and Assessment Locations;
- Figure 11.2: Cumulative Turbine Locations; and
- Appendix 11.1: Operational Noise Report.

11.2.3 Figures and the supporting Appendix are referenced in the text where relevant.

11.2.4 This chapter was prepared by TNEI Services Ltd. TNEI is a specialist energy consultancy with an Acoustics team which has undertaken noise assessments for over 4.5GW of onshore wind farm developments. The noise assessment was undertaken by staff who are all affiliated with the Institute of Acoustics.

11.2.5 The operational noise assessment has been undertaken in stages, firstly to TNL applicable for all wind farm schemes in the area and secondly to derive SSNL through apportionment of the TNL.

11.2.6 An assessment has been undertaken against both sets of limits to demonstrate that the cumulative noise predictions can meet the TNL, and to show that the noise predictions from the Proposed Development can also meet the SSNL.

## 11.3 Legislation, Policy and Guidelines

11.3.1 The assessment used the following combination of guidance and assessment methodologies:

- Planning Advice Note PAN 1/2011: 'Planning and Noise' (Scottish Government, 2011);
- Web Based Renewables Advice: 'Onshore Wind Turbines' (updated May 2014) (Scottish Government, 2014);
- ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' (NWG, 1996);
- ISO 9613-2:1996 'Acoustics - Attenuation of sound during propagation outdoors Part 2: General method of calculation' (ISO, 1996); and
- Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA, 2013).

11.3.2 The above documents are discussed in detail within Section 2 of Appendix 11.1: Operational Noise Report, where relevant.

## 11.4 Consultation

11.4.1 An EIA Scoping Opinion for the Proposed Development was issued on 2 September 2019 by the Energy Consents Unit (ECU) on behalf of Scottish Ministers. A summary of consultation responses received as part of the Scoping Opinion and response / actions taken, is given in Table 11.1 below.

**Table 11.1 – Summary of Consultation Responses**

| Consultee | Summary of Response | Response/ Action taken |
|---|---|---|
| ECU | The cumulative noise assessment should be carried out in line with relevant legislation and standards as detailed in Section 11 of the scoping report. This should include details about the representative background noise survey locations agreed with the relevant Planning Authority. | The noise assessment has been undertaken in accordance with ETSU-R-97 and the IOA GPG. The methodology used for setting noise limits is detailed in paragraphs 11.2.5 to 11.2.6 and 11.5.11 to 11.5.19 whereby TNL have been derived to consider all wind farms in the area and a set of SSNL have also been derived for the Proposed Development.<br>TNEI undertook additional consultation with The Highland Council's (THC) Environmental Health Department in September 2020 in order to provide further information on the methodology proposed for the noise assessment including information on the proposed use of previously collected background noise datasets. Further information on the consultation and subsequent response from THC's Environmental Health Department is summarised below. |
| The Highland Council (THC) | THC requested that the noise assessment consider operational noise in accordance with ETSU-R-97 and the IOA GPG.<br>It also details target noise levels based on simplified 35dB or a composite level of 35dB (daytime) or 38dB (night time) or background plus 5dB. It states that due to low background noise levels in the Highlands, the night time lower limit based on 43dB is not considered acceptable. The limits detailed above should also apply to cumulative noise.<br>The response also details the requirements for the cumulative assessment including what predictions should be included in the assessment. | The operational noise assessment has been undertaken in accordance with ETSU-R-97 and the IOA GPG.<br>A TNL (for all schemes to operate within) has been derived based on a fixed minimum noise of 35dB daytime and 43dB night time or background plus 5dB, whatever is the higher.<br>The SSNL have been derived using a fixed minimum limit (FML) of 35dB daytime and 43dB night time or background plus 5dB, whichever is the greater, whilst taking account of the noise limit that could theoretically be used by other schemes.<br>The night time noise limits have been derived based on Government Guidance which refers to ETSU-R-97 and the use of 43dB or background plus 5dB. For information, a set of limits based on THC lower night time limit have also been included in Annex 7 of Appendix 11.1: Operational Noise Report. |

| Consultee | Summary of Response | Response/ Action taken |
|---|---|---|
| | With regards to construction noise, the report comments on the circumstances under which a construction noise assessment would be required. The two circumstances are as follows:<br>'Where it is proposed to undertake work which is audible at the curtilage of any noise sensitive receptor, out with the hours Mon-Fri 8am to 7pm; Sat 8am to 1pm<br>OR<br>Where noise levels during the above periods are likely to exceed 75dB(A) for short term works or 55dB(A) for long term works. Both measurements to be taken as a 1hr $L_{Aeq}$ at the curtilage of any noise sensitive receptor. | The proposed hours of operation are 7am-7pm Mon-Fri, 7am-2pm Sat, No working Sunday and Bank holidays.<br>The minor difference in operating hours between those proposed and those included within the Scoping Opinion were discussed with an EHO at THC who had no objections.<br>Due to the large distances between the construction activities and the closest receptors, construction noise levels are expected to be below 75dB(A) for short term works or 55dB(A) for long term works.<br>On this basis, a construction noise assessment has not been undertaken. |

### *THC Environmental Health Department*

11.4.2 In September 2020, direct consultation was undertaken with the Environmental Health Department at THC in order to agree the methodology for the operational noise assessment. Background noise monitoring was undertaken at two properties (at Bhlaraidh and Levishie House) in 2015 as part of the pre-construction noise survey undertaken for the currently operational Bhlaraidh wind farm and was reanalysed in accordance with ETSU-R-97 and the IOA GPG.

11.4.3 Following a review of the datasets and a site visit to the monitoring locations, the noise data collected was deemed representative of the noise environment at the properties and the nearby properties within the same cluster. The datasets were provided to the Environmental Health Officer (EHO) as part of the consultation letter. A summary of the key responses from the EHO are included in Table 11.2 below. A full copy of the consultation letter and subsequent response is included in Annex 2 of Appendix 11.1: Operational Noise Report.

**Table 11.2: Summary of Consultation with Environmental Health Department**

| Consultee | Summary of Response | Response/ Action taken |
|---|---|---|
| THC EHO | **Re-use of Previously Collected Background Noise Datasets**<br>The EHO agreed with the use of the previously collected background noise datasets (collected at Bhlaraidh and Levishie House) and with the approach that was adopted with regards to rain fall data to ensure the background levels were representative. The EHO also agreed that at Achnaconeran, which is not impacted by noise from the river, a simplified ETSU limit of 35dB $L_{A90}$ is applied. | An assessment has been undertaken and the results are presented in this chapter. |

| Consultee | Summary of Response | Response/ Action taken |
|---|---|---|
| | **Approach to Setting Noise Limits**<br>The EHO agreed with the overall approach proposed for setting limits on the understanding that the cumulative figures are based on the conditioned limits for Bhlaraidh and a 2dB margin over predicted levels for other developments due to significant headroom. THE EHO agreed that where predicted levels from other developments are more than 10dB below the ETSU limits, then they could be discounted from the cumulative assessment.<br>With regard to site specific limits, the EHO stated "*my preference is to cap limits at 2dB above predicted. In some cases this will result in very low limits which would be too low to undertake compliance monitoring. It may be that proxy monitoring locations could be used or it might be reasonable to set limits only for Levishie and Achnaconeran. The latter will undoubtably be the controlling property."* | An operational noise assessment has been undertaken in accordance with ETSU-R-97 and the IOA GPG.<br>Although the EHO stated a preference for limits capped at 2dB above the predicted levels, this approach has not been adopted in the assessment. For the assessment the approach adopted for deriving SSNL follows Government Guidance which refers to the use of ETSU-R-97 and the IOA GPG. The SSNL have been derived using a fixed minimum limit (FML) of 35dB daytime and 43dB night time or background plus 5dB, whichever is the greater, whilst taking account of the noise limit that could theoretically be used by other schemes.<br>The night time noise limits have been derived based on Government Guidance which refers to ETSU-R-97 and the use of 43dB or background +5dB. |
| | **Cumulative Development**<br>An initial list of cumulative schemes was provided to the EHO. The EHO recommended contact with THC Planning Department to agree a final list. | As part of works undertaken for the landscape and visual assessment, a cumulative list was agreed with THC. |
| | **Vibration**<br>The EHO agreed that a vibration assessment was not required. | Vibration has been scoped out. |

## 11.5 Assessment Methodology and Significance Criteria

### *Study Area*

11.5.1 An initial desktop assessment was undertaken in order to identify the nearest noise sensitive receptors to the site and to determine potential Noise Assessment Locations (NALs). In total, three NALs to the south of the site were identified and considered in the assessment. The NALs are shown on Figure 11.1.

11.5.2 There are two operational wind farms located in the vicinity of the Proposed Development, these are:

- Bhlaraidh Wind Farm; and
- Corrimony Wind Farm.

11.5.3 The wind farms detailed above are the cumulative developments which have been considered as part of the cumulative noise assessment within this chapter. Further information on the cumulative noise assessment can be found in Section 1.2 of Appendix 11.1: Operational Noise Report.

### *Site Visit*

11.5.4 As detailed in Tables 11.1 and 11.2, background noise monitoring was undertaken in 2015 at two properties to the south of the Proposed Development as part of the pre-construction noise survey undertaken for the currently operational Bhlaraidh wind farm by Spectrum Acoustics. The noise survey was not undertaken by TNEI. Therefore, TNEI undertook a site visit in October 2020 to each of the NMLs in order to confirm their suitability and also to determine whether the NMLs were representative of the noise environment at the other nearby properties. Both monitoring locations were deemed representative of the noise environment at the property and nearby properties. The data collected was reanalysed by TNEI for the purposes of this assessment.

### *Operational Noise Assessment Methodology*

11.5.5 The assessment has been undertaken in accordance with ETSU-R-97 and current good practice, as specified in the Policy, Legislation and Guidance section (Section 11.3). ETSU-R-97 provides a robust basis for determining acceptable noise limits for wind farm developments. Consequently, the test applied to operational noise is whether or not the calculated wind farm noise levels at nearby noise sensitive properties would be below the noise limits derived in accordance with ETSU-R-97.

11.5.6 Limits differ between daytime and night-time periods. The daytime criteria are based upon background noise data collected during the 'quiet periods of the day' comprising:

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

11.5.7 Night-time periods are defined as 23:00 to 07:00 with no differentiation made between weekdays and weekends.

11.5.8 ETSU-R-97 states that where there are very large separation distances between turbines and the closest receptors then a simplified noise condition may be suitable. ETSU-R-97 states *"If the noise is limited to an $L_{A90,10min}$ of 35 dB(A) up to wind speeds of 10m/s at 10m height, then this condition alone would offer sufficient protection of amenity, and background noise surveys would be unnecessary".*

11.5.9 Where background noise monitoring was undertaken, the data collected was used to set noise limits at the property and those receptors in close proximity (for example where the property at which the noise monitoring was undertaken forms part of a cluster of properties). At receptors where no background noise monitoring was undertaken, the simplified assessment methodology was adopted for the assessment.

11.5.10 In addition to ETSU-R-97, the recommendations included in the IOA GPG have been considered in the noise assessment. These are discussed in detail within Appendix 11.1: Operational Noise Report.

### *Cumulative Operational Noise Assessment Methodology*

11.5.11 The TNL is applicable to all operational, consented and proposed (i.e. planning application submitted) wind farms in the area. Consequently, a set of SSNL were derived to control the noise from the Proposed Development. In accordance with the guidance in the IOA GPG, the SSNL have been derived with due regard to cumulative noise by accounting for the proportion of the TNL which is potentially being used by other nearby developments. The SSNL are therefore the TNL minus a cautious prediction of noise from all other nearby developments. The cautious prediction of noise for all other nearby developments has been undertaken using the guidance in the IOA GPG.

11.5.12 The need for a cumulative noise assessment was considered in accordance with the guidance contained within the IOA GPG. There are a number of operational wind farm developments in

proximity to the Proposed Development, therefore in order to consider the likely cumulative noise impacts, the noise assessment has been undertaken in three separate stages:

- Stage 1 – establish the TNL for each NAL based on the measured background noise levels or simplified ETSU-R-97 criterion.
- Stage 2 – undertake likely noise predictions to consider other nearby operational wind farms. The predicted 'likely' cumulative levels are the actual levels expected at an NAL and include the addition of an appropriate level of uncertainty to the turbine data as per Section 4.2 of the IOA GPG. The uncertainty level added is generally +2 dB but this can vary depending on the turbine manufacturer data available for each turbine.
- Stage 3 – establish the SSNL for the Proposed Development (through apportioning the TNL, where required) and compare the noise predictions from the Proposed Development on its own against the SSNL. In order to the derive the SSNL an additional buffer is added to the 'likely' predicted levels summarised in Stage 2 which results in 'cautious' cumulative predictions. The buffer added is generally +2 dB but can be more or less and is determined using the assessment principles identified within Section 5.4 of the IOA GPG. Further information on the buffers added to derive the SSNL are included within Table 6.7 and Annex 7 of Technical Appendix 11.1: Operational Noise Report.

11.5.13 The aim of the operational noise assessment therefore is to establish the TNL, determine the likely impacts of the Proposed Development at the nearest noise sensitive receptors, derive SSNL and to demonstrate that the Proposed Development can meet the limits.

11.5.14 The exact model of wind turbine to be used for the Proposed Development will be the result of a future tendering process should consent be granted. Achievement of the noise limits determined by this assessment would be a key determining factor in the final choice of wind turbine. Predictions of wind turbine noise for the Proposed Development were based upon the sound power level data for a candidate wind turbine, the Vestas V150 5.6MW, as it is considered representative of the type of wind turbine likely to be installed at the site.

11.5.15 All the operational wind farms modelled, inclusive of those used in the cumulative noise assessment, are summarised in Section 11.5.2 above. Uncertainty in sound power data for the Proposed Development has been accounted for using the guidance contained within Section 4.2 of the IOA GPG. The locations of the wind turbines for the Proposed Development and the cumulative turbines are shown on Figure 11.2.

11.5.16 Noise predictions have been undertaken using the propagation model contained within Part 2 of International Standard ISO 9613-2, 'Acoustics – Attenuation of sound during propagation outdoors' (ISO, 1996). The model calculates, on an octave band basis, attenuation due to geometric spreading, atmospheric absorption, and ground effects. The noise model was set up to provide realistic noise predictions, including mixed ground attenuation (G=0.5) and atmospheric attenuation relating to 70% Relative Humidity and 10°C.

11.5.17 Typically, wind farm noise assessments assume all properties are always downwind of all wind turbines (as this would result in the highest wind turbine noise levels). However, where properties are located in between groups of wind turbines, or where turbines are spread over a wide angle of view, they cannot be downwind of all wind turbines simultaneously in reality so it is appropriate to consider the effect of wind direction on predicted noise levels. Directivity has been considered using the guidance in the IOA GPG.

11.5.18 In line with the IOA GPG, an assessment has been undertaken to determine whether a concave ground profile correction (+3dB) or barrier correction (-2dB), is required due to the topography between the wind turbines and the noise sensitive receptors. Propagation across a valley (concave ground) increases the number of reflection paths, and in turn, has the potential to increase sound levels at a given receptor. Topographical screening effects from terrain surrounding a wind farm can result in reductions in the observed sound level between the source and receiver where no line of

sight is present. Concave ground and barrier corrections were found to be required for a number of wind turbines at a number of receptors (Annex 6, Appendix 11.1: Operational Noise Report).

11.5.19 Information relating to operational noise such as amplitude modulation (AM), a potential characteristic of wind turbine noise, and Low Frequency Noise are also addressed within Section 3 of Appendix 11.1: Operational Noise Report.

### *Assessment of Likely Effect Significance*

11.5.20 Planning Advice Note PAN 1/2011 'Planning and Noise' provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. PAN 1/2011 refers to the Web-based planning advice on renewable technologies for Onshore Wind Turbines which states that ETSU-R-97 should be used to assess and rate noise from wind energy developments. ETSU-R-97 does not define significance criteria but describes a framework for the measurement of wind farm noise and gives indicative noise levels considered to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development. Achievement of ETSU-R-97 derived noise limits ensures that wind turbine noise will comply with current Government guidance.

11.5.21 In terms of the EIA Regulations (Scottish Government, 2017), the use of the term "significance" in this chapter refers to compliance / non-compliance with the ETSU-R-97 derived noise limits. For situations where predicted wind turbine noise meets or is less than the noise limits defined in ETSU-R-97, then the noise effects are deemed not significant. Any breach of the ETSU-R-97 derived noise limits due to the Proposed Development is deemed to result in a significant adverse effect.

11.5.22 For the purposes of this assessment, residential properties are considered to be noise sensitive receptors.

### *Features Scoped out of Assessment*

11.5.23 The following features have been scoped out of the assessment through consultation, including EIA Scoping and those detailed in Table 11.1 and 11.2, and agreement with stakeholders:

- Detailed construction noise assessment;
- Decommissioning noise assessment; and
- Vibration assessment.

### *Limitations to Assessment*

11.5.24 A candidate wind turbine has been used for predictions of operational noise from the Proposed Development. The final model of wind turbine to be used may differ from that presented here. However, the operational noise levels from the Proposed Development would have to comply with the noise limits imposed by the requirements of planning permission. If a significantly different model of wind turbine is proposed, some degree of reassessment may be required.

11.5.25 No other assumptions or data gaps have been identified.

## 11.6 Baseline Conditions

11.6.1 The site is located within a rural location where existing background noise levels at the noise sensitive receptors are dominated by local watercourses, wind induced noise (wind passing through vegetation and around buildings) and birdsong.

11.6.2 Background noise monitoring was undertaken at two noise sensitive receptors to the south of the site as part of the pre-construction background noise survey for the currently operational Bhlaraidh wind farm. At both locations there are a small cluster of properties. The NMLs are detailed in Table 11.4 and shown on Figure 11.1 together with each cluster of properties. Background noise monitoring was undertaken over the period June to July 2015.

**Table 11.3 – Noise Monitoring Locations**

| Noise Monitoring Location | Easting | Northing |
|---|---|---|
| NML1 – Bhlaraidh | 238058 | 816633 |
| NML2 – Levishie House | 240237 | 817661 |

11.6.3 The noise data was collected by Spectrum Acoustics but was reanalysed by TNEI for the purposes of this assessment.

11.6.4 Simultaneous wind speed/direction data were recorded at various heights using a 70m meteorological mast which was located within the site (see Figure 11.1). The wind speed data collected at 50m and 70m on the mast were used to derive hub height wind speeds which were standardised to 10m height in accordance with good practice. A candidate wind turbine with a hub height of 105m has been used for this assessment.

11.6.5 Wind speed/direction and rainfall data were collected over the same time scale and averaged over the same ten-minute periods as the noise data to allow analysis of the measured background noise as a function of wind speed and wind direction. All data analysis was undertaken in accordance with ETSU-R-97 and the IOA GPG.

11.6.6 The prevailing background noise levels are shown on Figures A1.2a-A1.2b included in Annex 1 of Appendix 11.1: Operational Noise Report.

11.6.7 ETSU-R-97 recommends that wind farm noise for the daytime periods should be limited to 5dB(A) above the prevailing background or a fixed minimum level within the range 35 - 40dB $L_{A90,10min}$, whichever is the higher. The precise choice of criterion level within the range 35 - 40 dB(A) depends on a number of factors, including the number of dwellings in the neighbourhood of the wind farm, the effect of noise limits on the number of kWh generated and the duration and level of exposure to any noise.

11.6.8 It is necessary to determine a suitable fixed minimum limit to use when considering cumulative noise (the TNL) and this can differ from the fixed minimum limit used when setting limits for the Proposed Development (the SSNL). For the noise assessment the fixed minimum daytime TNL and SSNL has been set at 35dB or 5dB(A) above prevailing background when considering cumulative noise from all developments. This limit is applicable at receptors at or near where noise monitoring was undertaken. The simplified criterion in ETSU-R-97 has been adopted for setting limits at receptors where background noise monitoring was not undertaken at or in close proximity to a receptor.

11.6.9 For night-time periods the recommended limits are 5dB(A) above prevailing background or a fixed minimum level of 43dB $L_{A90,10min}$, whichever is higher. The night-time fixed minimum limits are the same for both the TNL and the SSNL. This limit is applicable at receptors at or near where noise monitoring was undertaken. The simplified criterion in ETSU-R-97 has been adopted for setting limits at receptors where background noise monitoring was not undertaken at or in close proximity to a receptor.

11.6.10 The exception to the setting of both the daytime and night time fixed minimum noise limits occurs where a property occupier has a financial involvement in the wind farm development where the fixed minimum limit can be increased to 45dB(A) or a higher permissible limit above background during the daytime and night time periods. For the purposes of this assessment it has been assumed that there are no financially involved properties.

## 11.7 Receptors Brought Forward for Assessment

11.7.1 A total of three noise sensitive receptors were chosen as representative NALs. The NALs form part of a small cluster of properties, Bhlaraidh comprises approximately 11 dwellings and Levishie and Achnaconeran comprise a cluster of approximately three dwellings. The NALs chosen within each

cluster were generally the closest receptors to the Proposed Development and other wind farm developments.

11.7.2 The NALs refer to the position in the curtilage of a property as detailed in Table 11.5 and shown on Figure 11.1. This approach ensures that the assessment considers the worst case (loudest) noise immission level expected at the noise sensitive receptor.

**Table 11.4 – Operational Noise Assessment Locations**

| Noise Assessment Location | Easting | Northing | Elevation (m AOD) | Approximate Distance to Nearest Bhlaraidh Extension Turbine (m) | Dataset used for Setting Noise Limits |
|---|---|---|---|---|---|
| NAL1 – Bhlaraidh | 238048 | 816664 | 70 | 3,690 | NML1 |
| NAL2 – Levishie | 240246 | 817772 | 67 | 2,400 | NML2 |
| NAL3 – Achnaconeran | 241628 | 817981 | 236 | 2,800 | Simplified ETSU-R-97 Criterion |

* Please note the distances to nearest turbines quoted above may differ from those reported elsewhere in the EIAR. Distances for the noise assessment are taken from the nearest turbine to the closest edge of the amenity area (usually the garden).

# 11.8 Likely Effects

## *Operation*

**Operational Effects – Setting the Total ETSU-R-97 Noise Limits (Stage 1)**

11.8.1 Based on the prevailing background noise levels, the TNLs have been established for each of the NALs where noise monitoring was undertaken at or in close proximity to the NAL as detailed in Table 11.5 above. At receptors where background noise monitoring was not undertaken the simplified ETSU-R-97 Noise criterion was used to derive the TNL.

11.8.2 The TNLs are as detailed in Table 11.6 and Table 11.7 and have been based on the lower fixed minimum of 35 dB (Daytime) or background plus 5 dB, and 43 dB (Night time) or background plus 5 dB whichever is the greater. The TNL are summarised in Table 11.6 and 11.7 below.

**Table 11.5 - Total ETSU-R-97 Noise Limit – Daytime**

| Receptor | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 – Bhlaraidh | 37.0 | 37.0 | 37.4 | 38.1 | 39.2 | 40.6 | 42.2 | 44.1 | 46.3 | 48.6 | 51.2 | 51.2 |
| NAL2 – Levishie | 41.0 | 41.0 | 41.1 | 41.7 | 42.8 | 44.2 | 45.8 | 47.6 | 49.4 | 51.2 | 52.8 | 52.8 |
| NAL3 - Achnaconeran | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 |

**Table 11.6 - Total ETSU-R-97 Noise Limit – Night time**

| Receptor | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 – Bhlaraidh | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.3 | 44.3 | 44.3 |
| NAL2 – Levishie | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.3 | 44.7 | 46.5 | 48.8 | 48.8 | 48.8 |
| NAL3 - Achnaconeran | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 |

**Operational Phase - Predicting the Likely Effects and the Requirement for a Cumulative Noise Assessment (Stage 2)**

11.8.3 A cumulative noise assessment was undertaken at the three NALs detailed in Table 11.5 above. The results are shown in Tables 11.8 and 11.9 below and are summarised on Figures A1.3a-c included within Annex 1 of Appendix 11.1: Operational Noise Report. Figures A1.3a-c show the predicted noise levels from each individual scheme as well as their combined cumulative predicted levels.

11.8.4 Table 11.8 and Table 11.9 show a comparison between the TNL and predicted cumulative wind turbine noise levels. The Tables show the exceedance level which is the difference between the predicted wind turbine noise level and the TNL at a given wind speed. A negative exceedance level indicates satisfaction of the noise limit.

11.8.5 The results of the cumulative noise assessment show that the Proposed Development can operate concurrently with the operational wind farm developments near to the NALs, whilst still meeting the TNL established in accordance with ETSU-R-97 at the three NALs.

**Table 11.7 - Compliance Table – Comparison of predicted cumulative noise levels (all schemes) against the TNLs at each receptor - Daytime**

| Receptor | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 – Bhlaraidh | Total ETSU-R-97 Noise Limit | 37.0 | 37.0 | 37.4 | 38.1 | 39.2 | 40.6 | 42.2 | 44.1 | 46.3 | 48.6 | 51.2 | 51.2 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | - | - | 27.4 | 31.2 | 32.9 | 33.2 | 33.2 | 33.2 | 33.2 | 33.2 |
| | Exceedance Level $L_{A90}$ | - | - | - | - | -11.8 | -9.4 | -9.3 | -10.9 | -13.1 | -15.4 | -18.0 | -18.0 |
| NAL2 – Levishie | Total ETSU-R-97 Noise Limit | 41.0 | 41.0 | 41.1 | 41.7 | 42.8 | 44.2 | 45.8 | 47.6 | 49.4 | 51.2 | 52.8 | 52.8 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | - | - | 28.9 | 32.4 | 33.7 | 34.2 | 34.2 | 34.2 | 34.2 | 34.2 |
| | Exceedance Level $L_{A90}$ | - | - | - | - | -13.9 | -11.8 | -12.1 | -13.4 | -15.2 | -17 | -18.6 | -18.6 |
| NAL3 - Achnaconeran | Total ETSU-R-97 Noise Limit | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | - | - | 27.6 | 31.0 | 32.3 | 32.8 | 32.8 | 32.8 | 32.8 | 32.8 |
| | Exceedance Level $L_{A90}$ | - | - | - | - | -7.4 | -4.0 | -2.7 | -2.2 | -2.2 | -2.2 | -2.2 | -2.2 |

**Table 11.8 - Compliance Table – Comparison of predicted cumulative noise levels (all schemes) against the TNLs at each receptor – Night time**

| Receptor | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 – Bhlaraidh | Total ETSU-R-97 Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.3 | 44.3 | 44.3 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | - | - | 27.4 | 31.2 | 32.9 | 33.2 | 33.2 | 33.2 | 33.2 | 33.2 |
| | Exceedance Level $L_{A90}$ | - | - | - | - | -15.6 | -11.8 | -10.1 | -9.8 | -9.8 | -11.1 | -11.1 | -11.1 |
| NAL2 – Levishie | Total ETSU-R-97 Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.3 | 44.7 | 46.5 | 48.8 | 48.8 | 48.8 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | - | - | 28.9 | 32.4 | 33.7 | 34.2 | 34.2 | 34.2 | 34.2 | 34.2 |

| Receptor | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Exceedance Level $L_{A90}$ | - | - | - | - | -14.1 | -10.6 | -9.6 | -10.5 | -12.3 | -14.6 | -14.6 | -14.6 |
| NAL3 - Achnaconeran | Total ETSU-R-97 Noise Limit | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | - | - | 27.6 | 31.0 | 32.3 | 32.8 | 32.8 | 32.8 | 32.8 | 32.8 |
| | Exceedance Level $L_{A90}$ | - | - | - | - | -7.4 | -4.0 | -2.7 | -2.2 | -2.2 | -2.2 | -2.2 | -2.2 |

**Operational Phase - Derivation of SSNL for the Development (Stage 3)**

11.8.6 As summarised in Table 6.7 of Technical Appendix 11.1: Operational Noise Report, limit apportionment was required to derive the SSNL at the three NALs. Limit apportionment is a process whereby the TNL is split with a portion allocated to the existing schemes and the remainder allocated to the Proposed Development. Where apportionment was required, cautious predicted noise levels were subtracted from the Total ETSU-R-97 Noise Limit to determine the SSNL.

11.8.7 The Proposed Development SSNLs were compared to the predictions from the Proposed Development and the results are summarised in Tables 11.10 and 11.11. The SSNL and predictions are also shown on Figures A1.5a – 5c in Annex 1 of Appendix 11.1: Operational Noise Report.

**Table 11.9 - Compliance Table – Comparison of predicted noise levels from the Proposed Development against the SSNL at each receptor - Daytime**

| Receptor | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 – Bhlaraidh | Site Specific Noise Limit | 37.0 | 37.0 | 37.4 | 38.1 | 39.2 | 39.9 | 41.3 | 43.5 | 46.3 | 48.6 | 51.2 | 51.2 |
| | Predicted Wind Turbine Noise $L_{A90}$ | - | - | 15.2 | 18.9 | 23.2 | 26.2 | 26.8 | 27.5 | 27.5 | 27.5 | 27.5 | 27.5 |
| | Exceedance Level $L_{A90}$ | - | - | -22.2 | -19.2 | -16.0 | -13.7 | -14.5 | -16.0 | -18.8 | -21.1 | -23.7 | -23.7 |
| NAL2 – Levishie | Site Specific Noise Limit | 41.0 | 41.0 | 41.1 | 41.7 | 42.8 | 44.2 | 45.8 | 47.6 | 49.4 | 51.2 | 52.8 | 52.8 |
| | Predicted Wind Turbine Noise $L_{A90}$ | - | - | 19.0 | 22.7 | 27.0 | 30.0 | 30.6 | 31.3 | 31.3 | 31.3 | 31.3 | 31.3 |
| | Exceedance Level $L_{A90}$ | - | - | -22.1 | -19.0 | -15.8 | -14.2 | -15.2 | -16.3 | -18.1 | -19.9 | -21.5 | -21.5 |
| NAL3 - Achnaconeran | Site Specific Noise Limit | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 33.8 | 32.9 | 32.7 | 32.7 | 32.7 | 32.7 | 32.7 |
| | Predicted Wind Turbine Noise $L_{A90}$ | - | - | 18.0 | 21.7 | 26.0 | 29.0 | 29.6 | 30.3 | 30.3 | 30.3 | 30.3 | 30.3 |
| | Exceedance Level $L_{A90}$ | - | - | -17 | -13.3 | -9.0 | -4.8 | -3.3 | -2.4 | -2.4 | -2.4 | -2.4 | -2.4 |

**Table 11.10 - Compliance Table – Comparison of predicted noise levels from the Proposed Development against the SSNL at each receptor – Night time**

| Receptor | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 – Bhlaraidh | Site Specific Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 42.3 | 42.3 | 42.3 | 43.8 | 43.8 | 43.8 |
| | Predicted Wind Turbine Noise $L_{A90}$ | - | - | 15.2 | 18.9 | 23.2 | 26.2 | 26.8 | 27.5 | 27.5 | 27.5 | 27.5 | 27.5 |

| Receptor | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Exceedance Level $L_{A90}$ | - | - | -27.8 | -24.1 | -19.8 | -16.8 | -15.5 | -14.8 | -14.8 | -16.3 | -16.3 | -16.3 |
| NAL2 – Levishie | Site Specific Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 42.6 | 44.2 | 46.5 | 48.8 | 48.8 | 48.8 |
| | Predicted Wind Turbine Noise $L_{A90}$ | - | - | 19.0 | 22.7 | 27.0 | 30.0 | 30.6 | 31.3 | 31.3 | 31.3 | 31.3 | 31.3 |
| | Exceedance Level $L_{A90}$ | - | - | -24 | -20.3 | -16.0 | -13.0 | -12.0 | -12.9 | -15.2 | -17.5 | -17.5 | -17.5 |
| NAL3 - Achnaconeran | Site Specific Noise Limit | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 33.8 | 32.9 | 32.7 | 32.7 | 32.7 | 32.7 | 32.7 |
| | Predicted Wind Turbine Noise $L_{A90}$ | - | - | 18.0 | 21.7 | 26.0 | 29.0 | 29.6 | 30.3 | 30.3 | 30.3 | 30.3 | 30.3 |
| | Exceedance Level $L_{A90}$ | - | - | -17.0 | -13.3 | -9.0 | -4.8 | -3.3 | -2.4 | -2.4 | -2.4 | -2.4 | -2.4 |

11.8.8 The assessment shows that the predicted wind turbine noise immission levels for the Proposed Development meet the SSNL under all conditions and at all locations for both daytime and night-time periods at all receptors.

### *Summary of Effects*

11.8.9 Predicted wind turbine noise is less than the SSNL for the daytime and night-time; therefore, the predicted noise levels are **not significant.**

### *Cumulative Effects*

11.8.10 The result of the likely cumulative operational noise assessment show that the proposed development can operate concurrently with the operational wind farms near to the NALs, whilst still meeting the TNL established in accordance with ETSU-R-97 at all NALs. There would be **no significant cumulative operational noise effects**.

## 11.9 Additional Mitigation and Enhancement

### *Mitigation during Construction*

11.9.1 Due to the separation distances between the NALs and construction activities, a construction noise assessment was not required. Nevertheless, a range of good practice measures would be detailed in the Construction Environmental Management Plan (CEMP) and employed to minimise noise impacts.

11.9.2 Good site practices would be implemented to ensure no significant adverse effects. Section 8 of BS5228-1:2009+A1:2014 (BSI, 2008) recommends a number of simple control measures as summarised below that would be employed onsite:

- Keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern.
- Ensure that any extraordinary site work (for example, crane operations lifting components onto the tower) would be programmed and agreed in advance with the Local Authority as detailed in the CEMP.
- Ensure all vehicles and mechanical plant would be fitted with effective exhaust silencers and be subject to programmed maintenance.

- Select inherently quiet plant where appropriate - all major compressors would be 'sound reduced' models fitted with properly lined and sealed acoustic covers, which would be kept closed whenever the machines are in use.
- Ensure all ancillary pneumatic percussive tools would be fitted with mufflers or silencers of the type recommended by the manufacturers.
- Instruct that machines would be shut down between work periods or throttled down to a minimum.
- Regularly maintain all equipment used on site, including maintenance related to noise emissions.
- Vehicles would be loaded carefully to ensure minimal drop heights to minimise noise during this operation.
- Ensure all ancillary plant such as generators and pumps would be positioned to cause minimum noise disturbance and, if necessary, temporary acoustic screens or enclosures should be provided.

### *Mitigation during Operation*

11.9.3 No mitigation measures are required to control noise impacts during operation of the Proposed Development.

## 11.10 Residual Effects

### *Operation*

11.10.1 Predicted wind farm operational noise levels at all the NALs lie below the SSNLs during the daytime and night-time periods. In addition, the cumulative noise predictions from the Proposed Development and other operational wind farms lie below the TNLs. There would be **no significant residual effects.**

11.10.2 At some locations, under some wind conditions and for a certain proportion of the time wind farm noise from the Proposed Development would be audible; however, it would be at an acceptable level in relation to the ETSU-R-97 guidelines.

## 11.11 Summary

11.11.1 Construction noise would not be significant and has been scoped-out of this assessment. Nevertheless, a range of standard best practice mitigation measures is proposed to ensure no significant adverse effects during construction.

11.11.2 In terms of operational noise, the guidance contained within ETSU-R-97 was used to assess the likely operational noise impact of the Proposed Development. Predicted levels and measured background noise levels indicate that for dwellings neighbouring the Site, wind turbine noise would not exceed the noise criteria established in accordance with ETSU-R-97, therefore the operational noise impact is **not significant**.

11.11.3 There are a range of wind turbine models that may be appropriate for the Proposed Development. If the Proposed Development receives consent, further data would be obtained from the supplier for the final choice of wind turbine model to demonstrate compliance with the operational noise limits derived in this chapter.

11.11.4 Should the Scottish Ministers be minded to grant consent for the Proposed Development it would be appropriate to include a set of noise conditions for the Proposed Development. A set of suggested noise conditions are included within Annex 7 of Appendix 11.1: Operational Noise Report.

**Table 11.12– Summary of Effects**

| Description of Effect | Significance of Likely Effect | Mitigation Measure | Significance of Residual Effect |
|---|---|---|---|
| | Significance | | Significance |
| Operation | | | |
| Potential operational noise effects on noise sensitive receptors | Not significant | No specific measures required | Not significant |

**Table 11.13 – Summary of Cumulative Effects**

| Receptor | Cumulative Developments | Significance of Cumulative Effect |
|---|---|---|
| | | Significance |
| Potential cumulative operational noise effects on noise sensitive receptors | Operational Development, Bhlaraidh Wind Farm and Corrimony Wind Farm | Not significant |

## 11.12 References


BSI (2008). *BS5228-1:2009+A1:2014.* Code of practice for noise and vibration control on construction and open sites.

IOA (2013). *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'*. UK: Institute of Acoustics.

ISO (1996). *ISO 9613-2:1996 Acoustics – Attenuation of Sound during Propagation Outdoors: Part 2 – General Method of Calculation*. Geneva: International Organization for Standardisation.

Scottish Government (2011). *PAN 1/2011: Planning and Noise.* Scotland: The Crown

Scottish Government (2014). *Web Based Renewables Advice: 'Onshore Wind Turbines'* – updated May 28th 2014. [online] Available at: https://www.webarchive.org.uk/wayback/archive/3000/https://www.gov.scot/Resource/0045/00451413.pdf [Accessed on: 4 March 2021].

Scottish Government (2017). *The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017*. Available at: http://www.legislation.gov.uk/ssi/2017/101/contents/made

The Working Group on Noise from Wind Turbines (NWG) (1996). *ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms'.* UK: Energy Technology Support Unit