Breackerie Wind Farm

Environmental Impact Assessment Report
Volume 1
Chapter 12: Noise

October 2023

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FIGURES (Volume 2 of the EIAR)

12 NOISE

Introduction

This chapter considers the likely significant effects with respect to the noise associated with the construction and operation of the proposed development. The proposed development is for 13 commercial onshore wind turbines and associated access tracks and infrastructure, with a tip height of up to 200m.

12.1 The potential impact is assessed at nearby noise sensitive receptors (i.e. residential properties), with reference to relevant planning and noise guidance. The specific objectives of the chapter are to:

12.2

- describe the noise baseline;
- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential effects;
- describe the mitigation measures proposed to address likely significant effects; and
- assess the residual effects remaining following the implementation of mitigation.

12.3 The assessment has been carried out by Alex Dell and approved my Moise Colon, both of TNEI Services Ltd. Alex Dell is an Associate Member of the Institute of Acoustics and holds a PhD in Mechanical Engineering. Moise Coulon is a Full Member of the Institute of Acoustics and holds the Diploma in Acoustics and Noise Control with over 14 years of experience in wind farm noise assessments and preparing Environmental Impact Assessments (EIA).

12.4 This chapter is supported by the following figures and technical appendices:

- Figure 12.1: Construction Noise Assessment Locations;
- Figure 12.2: Operational Noise Monitoring and Assessment Locations;
- Technical Appendix 12.1: Construction Noise Report; and
- Technical Appendix 12.2: Operational Wind Farm Noise Report.

12.5

12.6 Figures and technical appendices are referenced in the text where relevant. The technical appendices are full reports containing the detailed assumptions and findings, and this chapter presents a summary.

12.7

Assessment Methodology

Wind farms have the potential to create noise during their construction and operational phases, this chapter assesses the potential noise impacts during both phases.

In Scotland, the Scottish Ministers and Energy Consents Unit (ECU) are responsible for approving applications to build, operate or modify onshore electricity generating stations with capacities exceeding 50MW. This development will exceed 50MW and therefore the

planning application will have due regard to all material considerations, especially National Planning Policy.

Construction Noise Methodology

The construction noise assessment has been undertaken using guidance contained in BS5228: Part 1 2009+A1:2014 (BS5228). The prediction of construction noise levels was undertaken using the calculation methodology presented in ISO9613:1996 (International Standards Organisation, 1996), together with published noise data for appropriate construction plant. To undertake an assessment of the construction noise impact, the

12.8 following steps have been undertaken:

- identify noise sensitive receptors near potential construction activities and select representative Construction Noise Assessment Locations (CNALs);
- identify applicable threshold of significant effects from BS5228;
- predict noise levels for various construction noise phases;
- compare predicted noise levels against the applicable threshold;
- where necessary, develop suitable mitigation measures to minimise any significant adverse effects during the construction phase; and, if required
- assess any residual adverse effects taking into account any identified mitigation measures.

12.9 Construction of the Proposed Development would be undertaken in several successive phases. During each phase the plant and equipment, and the associated traffic, would influence the noise generated. The selection of plant and equipment to be used would be determined by the main contractor and detailed arrangements for on site management would be decided at that time. This assessment has therefore been based upon a typical selection of plant for a wind farm project of this size. In view of this, the plant has been modelled operating at the closest point to each receptor for a given

12.10 activity in each construction phase whereas in reality only certain plant would be working at the closest point.

The core hours for construction activity will likely be typical construction hours 07:00 to 19:00

12.11 Monday to Friday and 07:00 to 13:00 Saturday. There will be no working on Sundays and Public Holidays, however, it should be noted that out of necessity some activity outside of the core hours could arise.

Chapter 2: Development Description describes the outline tasks that will be undertaken during the construction period, which is estimated to last 18 months. For the purposes of this assessment noise modelling has been undertaken for a number of construction scenarios, which simulate the likely overlap of several tasks that would occur throughout the construction period:

- Scenario 01 (Month 2): Permanent felling adjacent to a number of the proposed turbine compounds; construction of the construction compound; operation of diesel generators for lighting at the construction compound.
- Scenario 02 (Month 4): Permanent felling to a number of the proposed turbine compounds; operation of diesel generators for the cabins and lighting at the

construction compound; construction of the proposed tracks; construction of several turbine compounds (including hardstands and foundations); operation of the four existing borrow pits; and concrete batching in the construction compound.

- Scenario 03 (Month 9): Permanent felling adjacent to a number of the proposed turbine compounds; operation of diesel generators for the cabins and lighting at the construction compound; construction of the proposed tracks; construction of several turbine compounds (including hardstands and foundations); operation of the four existing borrow pits; concrete batching in the construction compound; and construction of the proposed substation.
- Scenario 04 (Month 10): Permanent felling adjacent to a number of the proposed turbine compounds; operation of diesel generators for the cabins and lighting at the construction compound; construction of the proposed tracks; construction of several turbine compounds (including hardstands and foundations); operation of the four existing borrow pits; concrete batching in the construction compound; construction of the proposed substation; construction of the energy storage compound (located within the construction compound); and trench excavation.
- Scenario 05 (Month 11): Operation of diesel generators for the cabins and lighting at the construction compound; operation of the four existing borrow pits; concrete batching in the construction compound; construction of the proposed substation; construction of the energy storage compound (located within the western construction compound); trench excavation; delivery of the turbines from the main site entrance; and erection of the turbines at several of the turbine compounds.
- Scenario 06 (Month 12): Operation of diesel generators for the cabins and lighting at the construction compound; trench excavation; delivery of the turbines from the main site entrance; and erection of the turbines at several of the turbine compounds.
- Scenario 07 (Month 15): Site restoration at multiple turbine compounds.
- Scenario 08 (Night-time): Diesel generators for the cabin and lighting at the compound are operational.

12.12 The noise-generating equipment assessed for each construction phase is detailed in the Construction Noise Report (Technical Appendix 12.1). It is noted that for much of the working day the noise associated with construction activities would be less than predicted, as the assessment has assumed all equipment is constantly operating at full power and is located at the closest point to each receptor, whereas in practice equipment load and precise location varies.

12.13 To protect the amenity of local residents, construction noise activities would be controlled under The Control of Pollution Act 1974 (COPA) (HM Government, 1974), which is specifically concerned with the control of noise pollution. In particular, Section 60 Part III of the COPA refers to the control of noise on construction sites. It provides legislation by which a Local Authority can control noise from construction sites to prevent disturbance occurring. In addition, it recommends that guidance provided by BS5228 should be implemented to ensure compliance with Section 60.

12.14 *Operational Noise*

In Scotland, Planning Advice Note PAN 1/2011 'Planning and Noise' is supportive of ETSU-R-97 and the associated 'Onshore Wind Turbines' web-based planning advice states :

'The Report, "The Assessment and Rating of Noise from Wind Farms" (Final Report, Sept 1996, DTI), (ETSU-R-97), describes a framework for the measurement of wind farm noise, which should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available. This gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable burdens on wind farm developers, and suggests appropriate noise conditions.'

The web-based document then refers to the Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 (IOA GPG) as a source, which provides:

'significant support on technical issues to all users of the ETSU-R-97 method for rating and
12.15 *assessing wind turbine noise, and should be used by all IOA members and those undertaking assessments to ETSU-R-97. The Scottish Government accepts that the guide represents current industry good practice.'*

The operational noise assessment has been undertaken in accordance with ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' and the IOA GPG. ETSU-R-97 provides a
12.16 robust basis for determining acceptable noise limits for wind farm developments. Consequently, the test applied to operational noise is whether or not predicted wind farm noise levels at nearby noise sensitive receptors would be below noise limits derived in accordance with ETSU-R-97.

12.17 Limits differ between daytime and night time periods. ETSU-R-97 recommends that wind farm noise should be limited to 5 dB(A) above the prevailing background or a fixed minimum level. Following a review of the guidance in ETSU-R-97, the Noise Limits for this assessment has been set at 35 dB(A) or background plus 5 dB whichever is the greater during the daytime period and at 43 dB(A) or background plus 5 dB whichever is the
12.18 greater during the night time period.

The aim of the operational noise assessment therefore is to establish the Noise Limits, predict the wind turbine operational noise levels from the Proposed Development at the nearest noise sensitive receptors and establish if the noise limits can be met at the receptors. Depending on the levels of background noise, the satisfaction of the ETSU-R-97
12.19 derived limits can lead to a situation whereby, at some locations under some wind conditions and for a certain proportion of the time, the wind turbine noise would still be audible.

The exact model of turbine to be installed on the site will be the result of a future tendering process should consent be granted. Achievement of the noise limits determined by this
12.20 assessment will be a key determining factor in the final choice of turbine for the Proposed Development. Predictions of wind turbine noise for this assessment were made based upon the sound power level data for a candidate wind turbine, the Siemens-Gamesa SG-155 6.6 MW as this is considered representative of the type of turbine that could be installed at the site.

Noise predictions have been undertaken using all the recommendations from the IOA GPG. Typically wind farm noise assessments assume all properties are downwind of all turbines at all times (as this would result in the highest wind turbine noise levels). However,

where properties are located in between groups of turbines they cannot be downwind of all turbines simultaneously, so if appropriate this has been considered. Topographical correction, if required, were also undertaken in accordance with the IOA GPG.

More information relating to all the parameters for operational noise discussed above and on other topics such as Amplitude Modulation (AM) and Low Frequency Noise (LFN) has been provided in the Operational Noise Report (Technical Appendix 12.2). There is no evidence that LFN has adverse impacts on the health of wind farm neighbours and at time of writing there is no agreed methodology which can be used to predict the occurrence

12.21 of AM or an agreed methodology that can be used to determine whether the effects of AM, should it occur, are likely to be significant.

Cumulative Operational Noise

There are no nearby operational, consented, or proposed wind farm/ turbine developments located in the vicinity of the Proposed Development and as such a cumulative assessment was not required.

12.22

Consultation

Table 12.1 summarises the consultation responses received regarding noise and provides

12.23 information on where and/or how they have been addressed in this assessment. The following organisations made comment on noise:

- The Argyll and Bute Council; and
- The Energy Consents Unit (ECU).

Table 12.1 Consultation Responses

Consultee	Summary of Response	Response/ Action Taken
ECU scoping response	The final list of receptors for the noise assessment should be agreed with the Argyll and Bute Council. The noise report should be formatted as per Table 6.1 of the IOA GPG.	Prior to the commencement of the noise impact assessment for the Proposed Development, direct consultation was undertaken with the Environmental Health Department at the Argyll and Bute Council to agree the approach to the noise assessment and the noise monitoring locations. No response was received from the council and as such the approach set out within the consultation letter was used to conduct the noise impact assessment. The Operational Noise Report (Technical Appendix 12.1) provides all the relevant information as detailed within Table 6.1 of the IOA GPG.
Argyll and Bute Council scoping response	In the Scoping Opinion, the Argyll and Bute Council stated 'At the time of writing it has not been possible to obtain advice from the Council's Environmental Health	The operational noise assessment has been undertaken in accordance with ETSU-R-97 and the IOA GPG.

Consultee	Summary of Response	Response/ Action Taken
	Officer (EHO). It is therefore not possible to provide comment on the scope of the noise assessment.'	The construction noise assessment has been undertaken in accordance with BS5228.

Potential Effects Scoped Out

12.24 Activities that occur during the decommissioning of the Proposed Development are unlikely to produce higher noise levels than those produced during the construction and many of the activities will be similar in nature. As such it is assumed that if construction noise levels are predicted to be below the threshold levels then decommissioning noise will also be within the threshold levels.

Method of Baseline Characterisation

Extent of the Study Area

12.25 Prior to the commencement of the operational noise assessment, initial desktop noise modelling was undertaken to identify the noise sensitive receptors and suitable locations at which to monitor background noise and at which to assess potential noise impact. A draft noise contour plot, included in the EHO consultation letter (included in Annex 2 of Technical Appendix 12.2), defined the extent of the study area for the operational noise assessment based upon a 35 dB(A) contour. A very small number of noise sensitive receptors were identified within the 35 dB(A) contour and these were scattered residential properties.

12.26 Figure 12.2 shows a total of ten Noise Assessment Locations (NALs) which are the residential properties assessed in detail in this assessment. The NALs are described later in this chapter in the Assessment of Likely Effects and were selected as these were the closest in any direction.

12.27

12.28 For the construction noise assessment, noise sensitive receptors in proximity to potential construction activities were also identified following a desk-based assessment. The identified receptors are the same residential receptors as for the operational noise assessment, therefore ten Construction Noise Assessment Locations (CNALs) have been selected by TNEI for a detailed assessment as shown in Figure 12.1.

Field Survey

12.29 The noise survey to determine the existing background noise environment at noise sensitive receptors neighbouring the Proposed Development was undertaken in accordance with the guidance contained within ETSU-R-97 and current good practice (IOA GPG).

Two Noise Monitoring Locations (NMLs) were initially selected amongst the few receptors within the initial 35 dB(A) contour and an additional two monitoring locations located outside of the 35 dB contour were also suggested in order to allow for any changes in design of the scheme. These initial four NMLs were pre-selected by TNEI based on a desk-

based assessment and were subject to practical installation arrangements such as agreement to access properties with residents.

Due to accessibility issues in reaching a pre-selected property at Gartnacopaig, a nearby location at Glenahanty (derelict property) was installed for monitoring. This was deemed to be representative due to proximity.

12.30 The final four NMLs as installed are listed in Table 12.2 below and shown on Figure 12.2. Background noise monitoring was undertaken over the period 19 October - 12 December 2022 at these locations.

12.31 **Table 12.2 Summary of Noise Monitoring Locations (NMLs)**

Receptor	Easting	Northing
NML1 - Lochorodale	165919	616017
NML2 – Homeston Farm	167348	615625
NML3 – St Mary's of Dalsmirren	164355	613219
NML4 – Glenahanty	163053	614331

12.32 Concurrent wind speed/direction were recorded using a LIDAR unit which was located within the site (grid reference 164684, 615102). Wind speed data was measured at various heights between 40m and 150m. The wind data measured at 100 m and 120 m was used to calculate the hub height wind speeds at 122.5 m. These hub height wind speeds were then standardised to a height of 10m in line with 'Method A' of Section 2.6.3 of the IOA GPG to fully take account of wind shear.

12.33 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. Data recorded during periods of rainfall have been excluded from the dataset, as well as data following periods of heavy rainfall.

12.34 Criteria for the Assessment Effects

Criteria for Assessing Sensitivity of Receptors

12.35 For the purposes of this assessment, residential properties are considered to be noise sensitive receptors and all are considered to be of high sensitivity.

Criteria for Assessing Magnitude of Change

The magnitude of change is not assessed is detailed as both the construction and operational noise assessments are based on comparing to a threshold, as described below. The threshold criteria however take account of the existing baseline levels.

Criteria for Assessing Significance

Criteria for Assessing Significance – Construction Noise

The significance criteria adopted for this assessment are based on Appendix E part E.3.2 of BS5228. It use a noise metric of $L_{Aeq,T}$, as shown in Table 12.3. The L_{Aeq} is the A-weighted, equivalent continuous sound level in decibels measured over a stated period of time, ($L_{Aeq,T}$) where T is the length of the assessment period (Time).

12.36 **Table 12.3 Construction Noise Significance Criteria**

Significance of Effect	Significance Level	
	Not Significant	Significant
Category A Night-Time (23:00 – 07:00)	≤45dB L_{Aeq}, T	>45dB L_{Aeq}, T
Category A Evenings and Weekends (19:00 – 23:00)	≤55dB L_{Aeq}, T	>55dB L_{Aeq}, T
Category A Daytime (07:00 – 19:00) and Saturdays (07:00 to 13:00)	≤65dB L_{Aeq}, T*	>65dB L_{Aeq}, T

12.37 It should be noted that exceedance of the limit does not in itself indicate a significant effect, rather, the standard states "*If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect*".

12.38 *Criteria for Assessing Significance – Operational Noise*

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

12.39 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.

In terms of the EIA Regulations, the use of the term "significance" in this EIAR, in relation to operational noise 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 effect.

For the purposes of this assessment, residential properties that lawfully exist or have extant planning permission are considered to be Noise Sensitive Receptors.

Limitations and Assumptions

12.40 It has been assumed that the noise data collected during the background noise survey are representative of the typical baseline noise levels at the nearest noise sensitive receptors; the guidance in ETSU-R-97 and the IOA GPG has been followed by suitably experienced Acoustic Consultants to ensure that the data collected is as representative as possible.

12.41 A candidate wind turbine has been used for predictions of operational noise from the Proposed Development, whilst the final model of wind turbine to be used may differ from that presented in this assessment, operational noise levels would have to comply with the noise limits.

12.42

Baseline Conditions

Current Baseline

12.43 The Proposed Development is located within a rural location where existing background noise levels at the noise sensitive receptors are generally considered to be low. The predominant noise sources in the area are wind induced noise (wind passing through vegetation and around buildings), local watercourses, agricultural noise and birdsong. At some receptors the soundscape is affected by road traffic noise.

12.44 Tables 12.4 and 12.5 provide a summary of the background noise levels measured during the monitoring period for the ETSU-R-97 quiet daytime and night time periods.

Table 12.4 Summary of Prevailing Background Noise Levels during Quiet Daytime Periods (dB(A))

Noise Monitoring Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1 – Lochorodale	28.3*	28.3*	28.3	28.5	28.9	29.7	30.7	32.1	34.0	36.3	39.0	42.3
NML2 – Homeston Farm	35.2*	35.2*	35.2*	35.2	35.3	35.6	36.0	36.5	37.2	38.1	39.1	40.2
NML3 – St Mary's of Dalsmirren	33.8*	33.8*	33.8*	33.8	33.9	34.2	34.7	35.4	36.2	37.3	38.5	39.9
NML4 - Glenahanty	34.0*	34.0*	34.0*	34.0	34.3	34.9	35.8	37.0	38.6	40.5	42.6	45.1

**flatlined where derived minimum occurs at lower wind speeds*

Table 12.5 Summary of Prevailing Background Noise Levels during Night Time Periods (dB(A))

Noise Monitoring Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1 – Lochorodale	29.1*	29.1*	29.1*	29.1	29.2	29.6	30.5	31.8	33.4	35.4	37.7	40.3
NML2 – Homeston Farm	35.6*	35.6*	35.6*	35.6*	35.6*	35.6	35.8	36.2	36.7	37.3	38.1	39.0
NML3 – St Mary's of Dalsmirren	34.6*	34.6*	34.6*	34.6*	34.6*	34.6	34.8	35.2	35.7	36.4	37.2	38.2
NML4 - Glenahanty	35.0*	35.0*	35.0*	35.0*	35.0	35.1	35.6	36.3	37.4	38.7	40.4	42.3

**flatlined where derived minimum occurs at lower wind speeds*

Future Baseline

12.45 It is possible that noise propagation and resulting noise immission levels could change over the life of the project due to climate change (as noise attenuation is influenced by air temperature, relative humidity and ground conditions). However, noise limits are set based on current background noise levels in the absence of wind farm noise and would be set for the lifetime of the project. The operator would be required to meet them for the duration of the consent. There are no other known current or predicted future processes (other than the Proposed Development) that are likely to change the baseline conditions.

Assessment of Likely Effects

Summary of Noise Assessment Locations

12.46 *Construction Noise*

The Construction Noise Assessment Locations (CNALs) were chosen to be identical as the operational Noise Assessment locations (NALs) which are described in detail below. The CNALs are summarised in Table 12.6 below and are shown on Figure 12.1.

Table 12.6 Summary of Construction Noise Assessment Locations

CNAL	Easting	Northing
CNAL1 - Lochorodale	165900	616045
CNAL2 – Lochorodale House	166638	615547
CNAL3 – Homeston Farm	167354	615631
CNAL4 – Crois Lurga	168296	614702
CNAL5 - Ballybrennan	168198	614009
CNAL6 - Killlervan	169082	612182
CNAL7 - Culinlongart	165299	611915

CNAL	Easting	Northing
CNAL8 – Lecknacrieve Woods	164533	613203
CNAL9 – St Mary's of Dalsmirren	164355	613219
CNAL10 - Gartnacopaig	162772	614507

Operational Noise

12.47 The ten NALs chosen were generally the closest receptors to the Proposed Development and other wind farm developments. The NALs refer to the position in the curtilage of a property and they were selected as they provided the worst-case noise impact assessment within the area surrounding the proposed development.

The NALs are summarised in Table 12.7 below and are shown on Figure 12.2.

12.48 Table 12.7 also details which NML has been used to set noise limits for each NAL. The background noise dataset obtained at NML1 was used for all NALs. Following a review of

12.49 the dataset it was found that NML1 was the quietest noise monitoring location, with the other three monitoring locations being affected by proximity to a watercourse. Whilst the influence of the watercourse at NML2, NML3 and NML4 was deemed to be representative of the amenity areas at these three locations, it was decided to use the quietest dataset to provide a more conservative estimate to the background noise levels and hence more conservative noise limits.

Table 12.7 Noise Assessment Locations

Noise Assessment Location (NAL)	Easting (m)	Northing (m)	Elevation (m AOD)	Approximate Distance to Nearest Breackerie Turbine* (m)	Background Noise Data Used
NAL1 - Lochorodale	165900	616045	143	1213 (T6)	NML1
NAL2 – Lochorodale House	166638	615547	104	1396 (T10)	NML1
NAL3 – Homeston Farm	167354	615631	70	2038 (T10)	NML1
NAL4 – Crois Lurga	168296	614702	54	2526 (T12)	NML1
NAL5 - Ballybrennan	168198	614009	65	2221 (T13)	NML1
NAL6 - Killlervan	169082	612182	44	3193 (T13)	NML1
NAL7 - Culinlongart	165299	611915	44	1599 (T13)	NML1

Noise Assessment Location (NAL)	Easting (m)	Northing (m)	Elevation (m AOD)	Approximate Distance to Nearest Breackerie Turbine* (m)	Background Noise Data Used
NAL8 – Lecknacrieve Woods	164533	613203	60	1192 (T9)	NML1
NAL9 – St Mary's of Dalsmirren	164355	613219	60	1243 (T9)	NML1
NAL10 - Gartnacopaig	162772	614507	162	1126 (T4)	NML1

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

Potential Construction Noise Effects

12.50 The construction noise impact results show that the predicted construction noise levels are well below the 55dB(A) Category A Threshold Levels at all CNALs for all 8 construction noise scenarios considered. At the most the construction noise predictions were 46.7dB which resulted in being 8.3dB below the threshold.

12.51 Therefore there would be **no significant effects** from construction noise at the nearby noise sensitive receptors. No specific noise mitigation measures are required beyond good

12.52 practice during construction.

Full details of the modelling and assessment can be found in the Construction Noise Report (Technical Appendix 12.1).

12.53

Potential Operational Noise Effects

12.54 The locations of the turbines were arrived at following an iterative layout design process considering several environmental constraints, inclusive of noise. As such the location of

12.55 the turbines is considered an embedded mitigation.

Based on the prevailing background noise levels, the Noise Limits have been established for each of the NALs and compared to the predictions of the Proposed Development.

12.56

The results are summarised below in Table 12.8 for the daytime and Table 12.9 for the night time. All values are in LA90 dB(A) and a negative exceedance level indicates satisfaction of the noise limit. These results are also shown on graphical figures as part of the Operational Noise Report (Technical Appendix 12.2).

The predicted wind turbine noise levels when assuming all wind turbines operate in unconstrained mode would meet the limits for daytime at NALs 2 to 7 and night time at all

NALs. At NALs 2 to 7 during the daytime there would be **no significant effects,** and during the night time at all NALs there would be **no significant effects**.

A daytime exceedance of up to 1.3dB in the 6 - 7m/s range is predicted at NALs 1 and 10, a daytime exceedance of 0.7 dB at 6 m/s is predicted at NAL 8, and a daytime exceedance of 0.2dB at 6m/s is predicted at NAL9. At NALs 1 and 8 to 10 these exceedances would result in **significant effects**.

12.57 **Table 12.8 Operational Noise Levels Compliance Table – Daytime**

Location		Wind Speed (ms^{-1}) as standardised to 10m height								
		4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
NAL1	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	29.7	34.5	**36.3**	**36.3**	36.3	36.3	36.3	36.3	36.3
	Exceedance Level	-5.3	-0.5	**1.3**	**0.6**	-0.8	-2.7	-5	-7.7	-11
NAL2	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	28.1	32.9	34.7	34.7	34.7	34.7	34.7	34.7	34.7
	Exceedance Level	-6.9	-2.1	-0.3	-1	-2.4	-4.3	-6.6	-9.3	-12.6
NAL3	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	24.4	29.2	31.1	31.1	31.1	31.1	31.1	31.1	31.1
	Exceedance Level	-10.6	-5.8	-3.9	-4.6	-6	-7.9	-10.2	-12.9	-16.2
NAL4	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	20	24.8	26.7	26.7	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-15	-10.2	-8.3	-9	-10.4	-12.3	-14.6	-17.3	-20.6
NAL5	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	21.1	25.9	27.7	27.7	27.7	27.7	27.7	27.7	27.7
	Exceedance Level	-13.9	-9.1	-7.3	-8	-9.4	-11.3	-13.6	-16.3	-19.6
NAL6	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	15.5	20.3	22.1	22.1	22.1	22.1	22.1	22.1	22.1
	Exceedance Level	-19.5	-14.7	-12.9	-13.6	-15	-16.9	-19.2	-21.9	-25.2
NAL7	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	23.3	28.1	29.9	29.9	29.9	29.9	29.9	29.9	29.9
	Exceedance Level	-11.7	-6.9	-5.1	-5.8	-7.2	-9.1	-11.4	-14.1	-17.4
NAL8	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	29	33.8	**35.7**	35.7	35.7	35.7	35.7	35.7	35.7
	Exceedance Level	-6	-1.2	**0.7**	0	-1.4	-3.3	-5.6	-8.3	-11.6
NAL9	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	28.6	33.4	**35.2**	35.2	35.2	35.2	35.2	35.2	35.2
	Exceedance Level	-6.4	-1.6	**0.2**	-0.5	-1.9	-3.8	-6.1	-8.8	-12.1
NAL10	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	29.6	34.4	**36.3**	**36.3**	36.3	36.3	36.3	36.3	36.3
	Exceedance Level	-5.4	-0.6	**1.3**	**0.6**	-0.8	-2.7	-5	-7.7	-11

Table 12.9 Operational Noise Levels Compliance Table – Night-time

Location		Wind Speed (ms^{-1}) as standardised to 10m height								
		4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
NAL1	Noise Limit	43	43	43	43	43	43	43	43	45.3

Location		Wind Speed (ms^{-1}) as standardised to 10m height								
		4	5	6	7	8	9	10	11	12
	Predicted Wind Turbine Noise	29.7	34.5	36.3	36.3	36.3	36.3	36.3	36.3	36.3
	Exceedance Level	-13.3	-8.5	-6.7	-6.7	-6.7	-6.7	-6.7	-6.7	-9
NAL2	Noise Limit	43	43	43	43	43	43	43	43	45.3
	Predicted Wind Turbine Noise	28.1	32.9	34.7	34.7	34.7	34.7	34.7	34.7	34.7
	Exceedance Level	-14.9	-10.1	-8.3	-8.3	-8.3	-8.3	-8.3	-8.3	-10.6
NAL3	Noise Limit	43	43	43	43	43	43	43	43	45.3
	Predicted Wind Turbine Noise	24.4	29.2	31.1	31.1	31.1	31.1	31.1	31.1	31.1
	Exceedance Level	-18.6	-13.8	-11.9	-11.9	-11.9	-11.9	-11.9	-11.9	-14.2
NAL4	Noise Limit	43	43	43	43	43	43	43	43	45.3
	Predicted Wind Turbine Noise	20	24.8	26.7	26.7	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-23	-18.2	-16.3	-16.3	-16.3	-16.3	-16.3	-16.3	-18.6
NAL5	Noise Limit	43	43	43	43	43	43	43	43	45.3
	Predicted Wind Turbine Noise	21.1	25.9	27.7	27.7	27.7	27.7	27.7	27.7	27.7
	Exceedance Level	-21.9	-17.1	-15.3	-15.3	-15.3	-15.3	-15.3	-15.3	-17.6
NAL6	Noise Limit	43	43	43	43	43	43	43	43	45.3
	Predicted Wind Turbine Noise	15.5	20.3	22.1	22.1	22.1	22.1	22.1	22.1	22.1
	Exceedance Level	-27.5	-22.7	-20.9	-20.9	-20.9	-20.9	-20.9	-20.9	-23.2
NAL7	Noise Limit	43	43	43	43	43	43	43	43	45.3
	Predicted Wind Turbine Noise	23.3	28.1	29.9	29.9	29.9	29.9	29.9	29.9	29.9
	Exceedance Level	-19.7	-14.9	-13.1	-13.1	-13.1	-13.1	-13.1	-13.1	-15.4
NAL8	Noise Limit	43	43	43	43	43	43	43	43	45.3
	Predicted Wind Turbine Noise	29	33.8	35.7	35.7	35.7	35.7	35.7	35.7	35.7
	Exceedance Level	-14	-9.2	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-9.6
NAL9	Noise Limit	43	43	43	43	43	43	43	43	45.3
	Predicted Wind Turbine Noise	28.6	33.4	35.2	35.2	35.2	35.2	35.2	35.2	35.2
	Exceedance Level	-14.4	-9.6	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8	-10.1
NAL10	Noise Limit	43	43	43	43	43	43	43	43	45.3
	Predicted Wind Turbine Noise	29.6	34.4	36.3	36.3	36.3	36.3	36.3	36.3	36.3
	Exceedance Level	-13.4	-8.6	-6.7	-6.7	-6.7	-6.7	-6.7	-6.7	-9

12.58

Potential Cumulative Effects

12.59 There are no other anticipated large construction project that would be undertaken in the same time scale in the immediate vicinity, accordingly there would be **no significant cumulative construction noise effects**.

There are no operational, consented, or proposed wind farm/ turbine developments located in the vicinity of the Proposed Development and as such there would be **no significant cumulative operational noise effects**.

Mitigation

Mitigation during Construction

No significant effects resulting from construction noise are predicted. Nevertheless, a range of good practice measures would be detailed in a Construction Environmental Management Plan (CEMP) and employed to minimise noise impacts.

Good site practices would be implemented to minimise the likely effects to a minimum. Section 8 of BS5228 recommends a number of simple control measures as summarised below that would be employed onsite:

12.60

- 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;

12.61

- Ensure that any extraordinary site work continuing throughout 24 hours of a day (for example, crane operations lifting components onto the tower) would be programmed, when appropriate, so that haulage vehicles would not arrive at or leave the site between 19:00 and 07:00, with the exception of abnormal loads that would be scheduled to avoid significant traffic flows;
- 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 so as to minimise noise during this operation; and
- Ensure all ancillary plant such as generators and pumps would be positioned so as to cause minimum noise disturbance and if necessary, temporary acoustic screens or enclosures should be provided.

12.62

Mitigation during Operation

The exact make and model of wind turbine to be used at the proposed development would be the result of a future tendering process. Achievement of the noise limits determined by this assessment would be a key determining factor in the final choice of wind turbines for the Site. In order to present a conservative assessment of noise immissions, predictions of wind turbine noise have been based upon sound power level data for the loudest wind turbine (the Siemens Gamesa SG-155 6.6 MW with standard blades) currently being considered for the Site, and a noise prediction model procedure that can be considered to provide a realistic impact assessment. The assessment shows a marginal exceedance of the derived noise limits for a limited range of wind speeds and wind directions at NALs 1 and 8 to 10 during the daytime period and as a result, the assessment presented here assumes a targeted use of mode management for a limited range of wind speeds and directions for daytime periods to demonstrate that the noise limits can be

adhered to. Depending on the final turbine selected for the Site, blade type and confirmation of final warranted levels from the chosen manufacturer, mode management may or may not be required. It is anticipated that noise limits would be secured by an appropriately worded planning condition.

Assessment of Residual Effects

Residual Construction Effects

12.63 Predicted wind farm construction noise levels are below the assessment criteria at all receptors, for all phases of construction. Due to the low background noise levels at some locations, elements of construction noise may be audible at the closest residential receptor for certain periods during the construction phases. However, with or without the good practice construction mitigation measures outlined above there would be **no significant residual effects from construction noise.**

Residual Operational Effects

12.64 For the purpose of demonstrating the effectiveness of a potential noise mitigation measure for the candidate wind turbine considered here, the predicted noise levels in Tables 12.10 and 12.11 have been reduced to ensure that the limits are met, this would be achieved by the adoption of low noise modes, but this would only be required for a limited range of wind speeds and directions.

12.65 The results of the noise assessment show that, subject to the adoption of mitigation measures in the form of low noise mode operation when required for the candidate wind turbine, the predicted wind turbine noise levels would meet the Noise Limits under all conditions and at all locations for both daytime and night time periods. There are a number of wind turbine makes and models that would be suitable for the Proposed Development and that may not require the use of low noise modes. Should the proposal receive planning consent, the final choice of turbine would be subject to a competitive tendering process as such predictions of wind turbine noise are for information only. The

12.66 final choice of turbine would, however, have to meet the noise limits determined and contained within any condition imposed.

As detailed in Table 12.10 below for NAL 1 and 8 to 10, the predicted wind farm operational noise levels for a candidate turbine including implementation of mode management lie below the daytime noise limits at all NALs where an exceedance was predicted. At some locations, under some wind conditions and for a certain proportion of the time operational wind farm noise would be audible; however, it would be at an acceptable level in relation to the ETSU-R-97 guidelines and there would be **no significant residual effects from operational noise**.

Table 12.10 Residual Operational Noise Levels Compliance Table – Daytime

Location		Wind Speed (ms^{-1}) as standardised to 10 m height								
		4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
NAL1	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	29.7	34.5	**35***	**35.7***	36.3	36.3	36.3	36.3	36.3

Location		Wind Speed (ms^{-1}) as standardised to 10 m height								
		4	5	6	7	8	9	10	11	12
	Exceedance Level	-5.3	-0.5	**0**	**0**	-0.8	-2.7	-5	-7.7	-11
NAL8	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	29	33.8	**35***	35.7	35.7	35.7	35.7	35.7	35.7
	Exceedance Level	-6	-1.2	**0**	0	-1.4	-3.3	-5.6	-8.3	-11.6
NAL9	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	28.6	33.4	**35***	35.2	35.2	35.2	35.2	35.2	35.2
	Exceedance Level	-6.4	-1.6	**0**	-0.5	-1.9	-3.8	-6.1	-8.8	-12.1
NAL10	Noise Limit	35	35	35	35.7	37.1	39	41.3	44	47.3
	Predicted Wind Turbine Noise	29.6	34.4	**35***	**35.7***	36.3	36.3	36.3	36.3	36.3
	Exceedance Level	-5.4	-0.6	**0**	**0**	-0.8	-2.7	-5	-7.7	-11
* Mode managed										

Residual Cumulative Effects

12.67 It was found there would be no significant cumulative construction and operational noise effects, accordingly there would be **no significant residual noise effects**.

Summary

12.68 Predicted construction noise levels compared with the most stringent Category A criteria outlined in BS5228 indicate that construction noise levels are below the guidelines considered acceptable at all receptors for all construction phases and therefore no significant effects are anticipated.

12.69 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 nearby noise sensitive receptors (i.e., residential properties), wind turbine noise levels would meet the noise limits established in accordance with ETSU-R-97.

12.70 Therefore the operational noise impact is not significant, subject to noise limits being conditioned and final selection of an appropriate wind turbine model.

There are a range of wind turbine models that would be appropriate for the proposed development. Should the proposal receive planning permission, the final choice of turbine would be subject to a competitive tendering process as such predictions of wind turbine noise are for information only. The final choice of turbine would, however, have to meet the noise limits determined and contained within any condition imposed.

Table 12.9 Summary of Potential Significant Effects of the Proposed Development

Likely Significant Effect	Mitigation Proposed	Means of Implementation	Outcome/Residual Effect
Construction			
Potential construction noise effects on noise sensitive receptors	No specific measures required other than standard good practice during construction.	These would be embedded in a CEMP and good practice used during construction.	Not Significant

Potential cumulative construction noise effects on noise sensitive receptors	No specific measures required.	N/A	Not Significant
Operation			
Potential operational noise effects on noise sensitive receptors	Noise limits to be conditioned and final selection wind turbine model and operational modes to be confirmed.	Planning conditions	Not Significant
Potential cumulative operational noise effects on noise sensitive receptors	No specific measures required.	N/A	Not Significant
Decommissioning			
Potential decommissioning noise effects on noise sensitive receptors	Same as construction	Same as construction	Not Significant

Glossary and Abbreviations

Term	Definition
NAL	Noise Assessment Location
CNAL	Construction Noise Assessment Location
NML	Noise Monitoring Location
IOA	Institute of Acoustics
GPG	Good Practice Guide
dB	Decibels
EHO	Environmental Health Officer
ECU	Energy Consents Unit

References

ETSU for the DTI (Department of Trade and Industry, 1996. *The Working Group on Noise from Wind Turbines ETSU-R-97 The Assessment and Rating of Noise from Wind Farms',* s.l.: s.n.

BS5228, 2014. *Code of practice for noise and vibration control on construction and open sites. Noise.* UK: BSI.

HM Government, 1974. *Control of Pollution Act 1974 Chapter 40.* London: Her Majesty's Staionery Office.

Institute of Acoustics, 2013. *Good Practice Guidance on the application of ETSU-R-97 for wind turbine noise assessment,* s.l.: s.n.

International Standards Organisation, 1996. *ISO9613:1996 'Acoustics – Attenuation of sound during propagation outdoors' – Part 2: General method of calculation,* s.l.: s.n.

The Scottish Government, 2011. *Planning Advice Note PAN 1/2011: Planning and Noise -*

http://www.scotland.gov.uk/Resource/Doc/343210/0114180.pdf. [Online].
The Scottish Government, 2014. *Web Based Renewables Advice: 'Onshore Wind Turbines' – http://www.scotland.gov.uk/Resource/0045/00451413.pdf*. [Online].