



# Chapter 13

## Noise

# Table of contents

<b>13.1</b>	<b>Introduction</b>	<b>2</b>	<b>13.5</b>	<b>Summary and statement of significance</b>	<b>10</b>
<b>13.2</b>	<b>Approach to assessment and methods</b>	<b>2</b>	<b>13.6</b>	<b>References</b>	<b>10</b>
13.2.1	Legislation, policy and guidance	2	<b>List of Figures</b>		
13.2.2	Study area	2	Figure 13.1: Noise Monitoring & Assessment Locations		
13.2.3	Effects assessed in full	2	Figure 13.2: Predicted Noise Levels		
13.2.4	Effects scoped out	3	Figure 13.3: Predicted Cumulative Noise Levels		
13.2.5	Baseline determination	3	<b>List of Technical Appendices</b>		
13.2.5.1	Data sources	3	Technical Appendix 13.1: Environmental Noise Assessment		
13.2.5.2	Field survey	3			
13.2.5.3	Consultation	4			
13.2.6	Approach to assessment of effects	4			
13.2.6.1	Construction noise and vibration	4			
13.2.6.2	Operational noise	4			
13.2.6.2.1	Low frequency noise, vibration and amplitude modulation	6			
13.2.6.3	Substation and ancillary services / battery storage	6			
13.2.6.4	Noise predictions	6			
13.2.7	Significance of effect	7			
13.2.8	Limitations to the assessment	7			
<b>13.3</b>	<b>Baseline conditions</b>	<b>7</b>			
13.3.1	Noise limits	7			
<b>13.4</b>	<b>Assessment of effects</b>	<b>8</b>			
13.4.1	Potential construction effects	8			
13.4.1.1	Embedded measures	8			
13.4.1.2	Proposed mitigation	8			
13.4.1.3	Residual construction effects	8			
13.4.2	Potential operational effects	9			
13.4.3	Embedded measures	9			
13.4.3.1	Proposed mitigation	9			
13.4.3.2	Residual operational effects	10			
13.4.4	Cumulative assessment	10			



# Chapter 13

## Noise

### 13.1 Introduction

1. This Chapter summarises the assessment of the potential noise effects of the proposed Development on the residents of nearby dwellings. Full details of the noise assessment can be found in the Hoare Lea Technical Report, included as **Technical Appendix 13.1**. The assessment considers both the proposed Development's construction and its operation.
2. Assessment of the operational noise effects accounts for the cumulative effect of the proposed Development with other windfarms nearby including the operational Arcleoch, Kilgallioch and Mark Hill Windfarms, as well as the consented Chirmorie Windfarm.
3. For the construction phase, details of relevant working practices, traffic routes, and proposed working hours are described in **Chapter 3: Description of the proposed Development**. In addition, the assessment of noise and vibration from traffic associated with the construction work is based on the assessment presented in **Chapter 12: Access, Traffic & Transport**.
4. The noise impact assessment and the reporting required for the preparation of this Chapter has been undertaken by Hoare Lea.

### 13.2 Approach to assessment and methods

#### 13.2.1 Legislation, policy and guidance

5. Whilst Scottish Planning Policy (SPP) suggests noise impacts are one of the aspects that will need to be considered it provides no specific advice with regards to noise.
6. Planning Advice Note PAN1/2011 provides general advice on the role of the planning system in preventing and limiting the adverse effects of noise without prejudicing investment in enterprise, development and transport. PAN1/2011 provides general advice on a range of noise related planning matters, including references to noise associated with both construction activities and operational windfarms. In relation to operational noise from windfarms, Paragraph 29 states that:  
  
*"There are two sources of noise from wind turbines - the mechanical noise from the turbines and the aerodynamic noise from the blades. Mechanical noise is related to engineering design. Aerodynamic noise varies with rotor design and wind speed, and is generally greatest at low speeds. Good acoustical design and siting of turbines is essential to minimise the potential to generate noise. Web based planning advice on renewable technologies for Onshore wind turbines provides advice on 'The Assessment and Rating of Noise from Windfarms' (ETSU-R-97) published by the former Department of Trade and Industry [DTI] and the findings of the Salford University report into Aerodynamic Modulation of Wind Turbine Noise."*
7. The Scottish Government's Online Renewables Planning Advice on Onshore wind turbines provides further advice on noise and confirms that the recommendations of 'The Assessment and Rating of Noise from Windfarms' (ETSU-R-97) "should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments".
8. Guidance on good practice on the application of ETSU-R-97 has been provided by the Institute of Acoustics (IOA Good Practice Guide or GPG). This was subsequently endorsed by the Scottish Government which advised in the Online

Renewables Planning Advice note that the GPG 'should be used by all IOA members and those undertaking assessments to ETSU-R-97'.

9. PAN1/2011 and the Technical Advice Note accompanying PAN1/2011 note that construction noise control can be achieved through planning conditions that limit noise from temporary construction sites, or by means of the Control of Pollution Act (CoPA).
10. The Control of Pollution Act (CoPA) 1974 provides two means of controlling construction noise and vibration. Section 60 provides the Local Authority with the power to impose at any time operating conditions on the development site. Section 61 allows the developer to negotiate a prior consent for a set of operating procedures with the Local Authority before commencement of site works.
11. South Ayrshire Council (SAC) have published a Planning Submission Guidance Note (PSGN) on Wind Turbine Development which sets out information required for the assessment of the noise impacts for wind turbine developments as well as specific guidance. This guidance was also taken into account in the preparation of this Chapter.

#### 13.2.2 Study area

12. The study area for the assessment of operational noise includes the noise-sensitive residential properties nearest to the proposed turbines. In addition, properties in the vicinity of the other windfarms considered in the cumulative noise analysis were also considered, provided that there was a possibility that the contribution from the proposed Development in terms of operational noise was not negligible. The locations considered are listed below in **Table 13.4** and shown on **Figure 13.1** and they are located at approximate distances of up to 3 to 4 km from the turbines of the proposed Development.
13. The assessment of construction noise has considered the same residential properties as the operational assessment, as well as dwellings located alongside the proposed Site access track and the construction traffic route.

#### 13.2.3 Effects assessed in full

14. Noise and vibration which arises from the construction of a windfarm is a factor which should be taken into account when considering the total effect of the proposed Development. However, in assessing the effects of construction noise, it is accepted that the associated works are of a temporary nature. The main work locations for construction of the proposed turbines would be distant from the nearest noise sensitive residences and would be unlikely to cause significant effects. The construction and use of access tracks and some of the required infrastructure may, however, occur at lesser separation distances. Assessment of the temporary effects of construction noise is primarily aimed at understanding the need for dedicated management measures and, if so, the types of measures that are required.
15. Once constructed and operating, wind turbines may emit two types of noise. Firstly, aerodynamic noise is a 'broad band' noise, sometimes described as having a characteristic modulation, or 'swish', which is produced by the movement of the rotating blades through the air. Secondly, mechanical noise may emanate from components within the nacelle of a wind turbine. This is a less natural sounding noise which is generally characterised by its tonal content. Traditional sources of mechanical noise comprise gearboxes or generators. Due to the acknowledged lower acceptability of tonal noise in otherwise 'natural' noise settings such as rural areas, modern turbine designs have evolved to minimise mechanical noise radiation from wind turbines. Aerodynamic noise tends to be perceived when the wind speeds are low, although at very low wind speeds the blades do not rotate or rotate very slowly and so, at these wind speeds, negligible aerodynamic noise is generated. In higher winds, aerodynamic noise is generally masked by the normal sound of wind blowing through trees and around buildings. The level of this natural 'masking' noise relative to the level of wind turbine noise determines the subjective audibility of the windfarm. The relationship between wind turbine noise and the naturally occurring masking noise at residential dwellings lying around the project area will therefore generally form the basis of the assessment of the levels of noise against accepted standards.
16. The proposed Development would also include a substation and ancillary services/battery storage facility which would emit some noise during operation (e.g. electrical plant and air conditioning systems).
17. The following effects have been assessed in full:
  - the potential effect of noise and vibration during construction of the proposed Development (including construction and forestry extraction traffic and potential cumulative effects); and

- the potential effect of noise during operation of the proposed Development, including cumulative effects.

### 13.2.4 Effects scoped out

18. On the basis of the desk-based work undertaken, the professional judgement of the EIA team, experience from other relevant projects and policy guidance or standards, the following effects have been 'scoped out', as described in **Chapter 6**.

19. The results of previous research detailed in Annex A of **Technical Appendix 13.1** has demonstrated that vibration resulting from the operation of windfarms is imperceptible at typical separation distances. Therefore, as agreed in consultation with SAC, vibration effects during operation do not warrant detailed assessment and have not been considered further as part of this Chapter.

### 13.2.5 Baseline determination

20. The baseline noise survey has been undertaken in line with the ETSU-R-97 methodology. In addition, technical guidance on current good practice in the application of ETSU-R-97, as described in the Institute of Acoustics (IOA) Good Practice Guide (GPG) has also been referenced, as is recommended in the Scottish Government's Online Renewables Planning Advice on Onshore wind turbines.

21. The methodology in ETSU-R-97 includes the following steps:

- identify the locations of the nearest, or most noise sensitive, neighbours;
- determine the background noise levels as a function of site wind speed at the nearest neighbours, or at least at a representative sample of the nearest neighbours, either through direct measurement or by reference to data already obtained during previous surveys in the area; and
- determine the day-time and night-time noise limits from the measured background noise levels at the nearest neighbours.

22. There are a number of either residential or habitable dwellings in the vicinity of the Site, as discussed above. Preliminary studies were undertaken, based on preliminary layouts and taking into account neighbouring schemes and their potential noise emission levels. It was determined that a detailed study of the noise effects of the proposed Development would not be required at several of these receivers, either because of an important separating distance resulting in very low levels being likely or because the noise from the proposed extension would be relatively negligible compared to existing and/or consented sites (see **Technical Appendix 13.1** for details). Other noise-sensitive receptors, where further study and assessment is required, are listed below in **Table 13.4** and shown on **Figure 13.1**.

23. In considering a baseline noise survey to inform the assessment, it is necessary to consider several factors. Firstly, ETSU-R-97 is clear that the noise limits at residential properties should be set on the basis of background noise levels without contributions from existing windfarm noise. It is therefore necessary to take into account existing windfarms operating in the area and their potential contribution to the background noise.

24. As part of the planning assessments for other windfarms in the area, background noise data was already measured at a number of locations: these are highlighted on **Figure 13.1**. The results of monitoring previously undertaken at these locations was therefore considered. New measurements conducted at several of these locations are likely to be influenced by turbine noise, given their relative proximity, which would not be in line with ETSU-R-97. Furthermore, the underlying baseline noise environment (excluding the turbine noise) is expected to be relatively unchanged at these locations, thereby meaning there would be limited use in undertaking new measurements at these properties.

25. As these previous measurements were referenced to wind speeds measured at relatively low height above the ground, they have been corrected in line with current good practice guidance using historical wind anemometry data as set out in detail in **Technical Appendix 13.1**.

#### 13.2.5.1 Data sources

26. The following data sources have informed the assessment:

- Ordnance Survey information concerning the locations of all noise sensitive receptors in the vicinity of the Site;
- British Standard (BS) reference material for the sound emission characteristics of various construction activities associated with proposed Development;
- manufacturer data for the candidate and operating turbines considered, as set out in **Technical Appendix 13.1**; and

- Environmental Statements and consent conditions for the different windfarms considered in the cumulative assessment.

#### 13.2.5.2 Field survey

27. The historical baseline noise measurements discussed above are considered representative of several noise-sensitive locations considered. Specifically, some of the noise monitoring previously undertaken to support the Arcleoch Windfarm application was referenced: the relevant locations are set out in **Table 13.1**. As detailed in **Technical Appendix 13.1**, this noise monitoring was referenced to wind speeds measured at 10 m height above the ground, and therefore corrections were applied in accordance with good practice guidance to relate the measurements to wind speeds at a reference representative of the turbines of the proposed Development, in consultation with SAC.

Property	Easting	Northing
Chirmorrie	220829	576943
Laggish	223127	578220
Kilrenzie	217801	583501
Ward of Cairnlea	222658	581609

Table 13.1: Historical baseline noise monitoring locations

28. There are however other properties of interest, located in and around Barrhill, for which no representative background noise data was previously measured. Noise monitoring was undertaken at five properties in Barrhill to represent the typical levels of background noise in that area. The chosen measurement locations are set out in **Table 13.2** and illustrated on **Figure 13.1**.

Property	Easting	Northing
East Altercannoch	223731	580935
Brooklyn	223711	581745
4 Gowland Terrace	223243	582217
Queensland Caravan Park	221814	583389
White Cairn	222270	582601

Table 13.2: Additional baseline noise monitoring locations

29. The background noise monitoring exercise was conducted from November 2018 to January 2019, over a period of approximately six weeks. The total survey period was in excess of the minimum of one week required by ETSU-R-97 and the extent of the data collected and range of wind conditions obtained are compliant with the IOA GPG requirements, as detailed in **Technical Appendix 13.1**.

30. The measured noise levels were related to wind speed measurements at two temporary masts of up to 80 m height currently located on the Site of the proposed Development, which were processed to determine wind speeds at heights representative of the hub height of the proposed turbines. The derived hub height wind speeds were then expressed at 10 m height as required in ETSU-R-97, to provide a suitable reference to determine the prevailing background noise level during the quiet daytime and night-time periods. This therefore incorporates Site-specific wind shear effects, as set out in detail in Annex F of **Technical Appendix 13.1**.

31. Data from all survey locations was also inspected to identify periods which may have been influenced by rainfall or atypical sources. This analysis was undertaken in accordance with the preferred method described in the IOA GPG, as detailed in **Technical Appendix 13.1**. The Mark Hill Windfarm is located around 2 km to the north of the survey locations of **Table 13.2**, but an analysis of the measurements (detailed in **Technical Appendix 13.1**) concluded that the measurements were not influenced by this operational windfarm, as required by ETSU-R-97. The operating Arcleoch and Kilgallioch windfarms are

located 4 km or more south of the measurements locations and therefore unlikely to have influenced the monitoring results either.

**13.2.5.3 Consultation**

32. **Table 13.3** summarises the relevant consultation responses received and how these were considered in the present Chapter.

Consultee	Summary of key issues	How this is addressed in this chapter
SAC and ACCON – scoping response	In response to the scoping consultation, SAC Environmental Health made a number of recommendations in relation to construction noise, with reference in particular to BS 5228. This included proposed criteria and management methods for any borrow pit blasting. ACCON provided further comments on behalf of SAC. It was noted that reference should be made to the SAC PSGN on Wind Turbine Development. In relation to the assessment of cumulative noise, ACCON stressed the importance of a rigorous assessment in line with the IOA GPG and the PSGN, including if relevant taking account of different wind directions. ACCON noted that a cumulative lower day-time limit at the upper end of the range set out in ETSU-R-97 would be appropriate given the amount of other windfarm developments in the area. ACCON agreed that operational vibration can be scoped out.	BS 5228 is referenced in this Chapter in the assessment of construction noise and management measures proposed in line with the recommendations made. This Chapter also makes reference to the PSGN and notes that operational vibration can be scoped out. See discussion below regarding the SAC PSGN.
SAC, Environmental Health and ACCON	Prior to undertaking the background surveys, a summary of the proposed approach to baseline monitoring locations was forwarded to the Environmental Health Department of SAC for comment on 23 October 2018. ACCON reviewed this methodology on behalf of SAC and concluded that the approach proposed was acceptable. ACCON stressed the importance of considering potential wind shear effects when using baseline data measured as part of previous planning applications, and accepted the methodology proposed to address this using site-specific historical wind data in accordance with current good practice. ACCON also made some observations regarding the assessment of cumulative impacts.	The points raised by ACCON on behalf of SAC were taken into account in the assessment of baseline conditions set out in this Chapter.
Scottish Government Energy Consents Unit (ECU)	The ECU recommended that the impact of noise and vibration associated with traffic and transport should be assessed.	The potential noise and vibration impacts of traffic associated with the construction of the proposed Development.

Table 13.3: Consultation responses

33. It is noted that the SAC PSGN recommends generic noise limits at the lower end of the range in ETSU-R-97 for day-time periods (although this can be relaxed in the cumulative case) and night-time lower limits lower than those set out in ETSU-R-97. At the same time, ACCON acknowledges that limits at the upper end of the recommended range would be applicable in this case. In addition, the generic SAC PSGN is not consistent with existing consents for several neighbouring windfarms including the Arcleloch Windfarm, to which the proposed Development forms an extension. It is therefore concluded that the generic noise limits in the SAC PSGN are not applicable to the proposed Development: this is considered further in **Section 13.2.6.2** below. The rest of the PSGN document provides useful guidance. All the necessary technical information required in the PSGN document is set out in full in **Technical Appendix 13.1**.

**13.2.6 Approach to assessment of effects**

**13.2.6.1 Construction noise and vibration**

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

35. BS 5228-1 provides guidance on a range of considerations relating to construction noise including the legislative framework, general control measures, example methods for estimating construction noise levels and example criteria which may be considered when assessing effect significance. Similarly, BS 5228 2 provides general guidance on legislation, prediction, control and assessment criteria for construction vibration. Changes in the predicted traffic noise level on existing roads can be calculated using the Calculation of Road Traffic Noise (CRTN) methodology.

36. Planning Advice Note PAN50 'Controlling the Environmental Effects of Surface Mineral Workings' gives guidance on the environmental effects of mineral working. The main document summarises the key issues with regard to various environmental impacts relating to surface mineral extraction and processing such as road traffic, blasting, noise, dust, visual intrusion etc. In addition, several annexes to the main document have been published which consider specific aspects in more detail: Annex A, 'The Control of Noise at Surface Mineral Workings' and Annex D 'The Control of Blasting at Surface Mineral Workings'. BS 5228-1 and BS 5228-2 also provide guidance relating to surface mineral extraction including the assessment of noise and vibration effects associated with quarry blasting.

37. The noise-sensitive locations considered for the construction noise and vibration assessment include those closest to the proposed turbines and those considered in the operational noise assessment: see **Table 13.4**. Additional residential dwellings located alongside the proposed Site access track, borrow pit search areas and the construction traffic route were also considered.

38. The nature of works and distances involved in the construction of the proposed Development are such that the risk of significant effects relating to ground borne vibration are very low (excluding blasting). Occasional momentary vibration can arise when heavy vehicles pass dwellings at very short separation distances, but again this is not sufficient to constitute a risk of significant impacts in this instance. Accordingly, vibration effects (excluding blasting) do not warrant detailed assessment and are therefore not discussed further in this Chapter.

39. The transmission and magnitude of ground vibrations associated with blasting operations at borrow pits are subject to many complex influences including charge type and position, and importantly, the precise nature of the ground conditions (material composition, compaction, discontinuities) at the source, receiver, and at every point along all potential ground transmission paths. Clearly any estimation of such conditions is subject to considerable uncertainty, thus limiting the utility of predictive exercises. Mitigation of potential effects of these activities is best achieved through onsite testing processes carried out in consultation with SAC and/or Dumfries and Galloway Council (D&GC), so as not to exceed relevant vibration levels at neighbouring properties. In accordance with the guidance in PAN50 Annex D, ground vibration caused by blasting operations will be considered acceptable if Peak Particle Velocity (PPV) levels, at the nearest sensitive locations, do not exceed 6 mm/s for 95 % of all blasts measured over any 6-month period, and no individual blast exceeds a PPV of 12 mm/s.

40. Because of the difficulties in predicting noise and air overpressure resulting from blasting operations at the proposed borrow pits, these activities are best controlled following the use of good practice during the setting and detonation of charges.

**13.2.6.2 Operational noise**

41. The assessment of operational noise impacts has been carried out in accordance with the methodology set out in ETSU-R-97. ETSU-R-97 has become the accepted standard for such developments within the UK, and is specified as the appropriate assessment and rating guidance for windfarms in current Scottish planning policy. It is described in more detail in **Technical Appendix 13.1**.

42. Technical guidance on current good practice in the application of the ETSU-R-97 methodology, as described in the Institute of Acoustics (IOA) Good Practice Guide (GPG) has also been referenced, as is recommended in the Scottish Government's Online Renewables Planning Advice on Onshore wind turbines (Scottish Government, 2014).
43. The exact model of turbine to be used at the Site would be the result of a future tendering process and therefore an indicative turbine model has been assumed for the operational noise assessment. This model was determined to both fit the proposed turbine dimension parameters and also provide a representation of the typical noise emission levels for the range of turbines models which may be installed at the Site. Similarly, assessment of the substation and ancillary services/battery storage has been made based on experience of similar installations.
44. To undertake the assessment of noise impact in accordance with the methodology in ETSU-R-97, the following steps are required:
- specify the number and locations of the wind turbines and other windfarms to be included in the assessment;
  - determine the day-time and night-time noise limits from the measured background noise levels at the nearest neighbours (see above);
  - specify the type and noise emission characteristics of the wind turbines;
  - calculate noise immission levels from the operation of the turbines associated with the proposed windfarm as well as the contribution to cumulative noise immission levels from other nearby windfarms as a function of Site wind speed at the nearest neighbours; and
  - compare the calculated windfarm noise immission levels with the derived noise limits and assess in the light of planning requirements in consultation with the local planning authority.
45. Note the term 'noise emission' relates to the sound power level actually radiated from each wind turbine, whereas the term 'noise immission' relates to the sound pressure level (the perceived noise) at any receptor location due to the combined operation of all wind turbines on a windfarm.
46. The noise limits defined in ETSU-R-97 relate to the total noise occurring at a dwelling due to the combined noise of all operational wind turbines. The assessment therefore needs to consider the combined operational noise of the proposed Development with other windfarms in the area to be satisfied that the combined cumulative noise levels are within the relevant ETSU-R-97 criteria.
47. Full details of the operational noise assessment, including details of the noise output of the candidate turbine for this scheme and the calculation parameters on which predictions have been based, can be found in **Technical Appendix 13.1**.
48. The noise-sensitive locations considered in the operational noise assessment are set out in **Table 13.4**. Please note that this list of receptor locations is not intended to be exhaustive but sufficient to be representative of noise levels typical of those receptors closest to the Site.

Property	Easting	Northing	Approximate distance to closest turbine (m)	Closest turbine (ID)	Survey location (Tables 13.1 and 13.2)
Balkissock	214111	582010	3820	4	Kilrenzie
Bellimore-on-Tig	214900	582900	3100	4	Kilrenzie
Bents Farm	221176	583628	2670	2	Queensland Caravan park
Brooklyn	223714	581742	3980	9	Brooklyn
Cairnlea	222470	581788	2780	1	Ward of Cairnlea
Chirmorrie	220829	576943	2230	13	Chirmorrie
Craigengells	221845	583298	2980	2	Queensland Caravan park
Dochroyle Cottage	223088	579112	2960	13	Chirmorrie
Dochroyle Farm	223105	579237	2980	13	Chirmorrie
Duisk Lodge	222622	582897	3360	1	Queensland Caravan park
East Altercannoch	223729	580939	3790	9	East Altercannoch
Farden	219373	583713	1860	3	Kilrenzie
Ferngate Cottage	222616	581464	2860	9	Ward of Cairnlea
Glenour	217250	583100	1130	4	Kilrenzie
Gowlands	223111	582162	3500	1	4 Gowland terrace
Gowlands Terrace	223203	582210	3600	1	4 Gowland terrace
Kildonan Courtyard	222366	583156	3300	1	Queensland Caravan park
Kilrenzie	217794	583411	1220	4	Kilrenzie
Laggish	223141	578208	3130	13	Laggish
Laigh Altercannoch	223820	581599	4030	9	Brooklyn
Queensland Caravan Park	221680	583374	2880	2	Queensland Caravan park
Scaurhead	222736	582706	3360	1	Queensland Caravan park
The Craigs	223624	581839	3920	1	Brooklyn
The Manse	223053	582496	3560	1	Queensland Caravan park
Ward of Cairnlea	222696	581542	2960	1	Ward of Cairnlea
West Altercannoch	223450	581200	3570	9	East Altercannoch
Wheeb	217206	583624	1590	4	Kilrenzie
White Cairn	222238	582574	2870	1	White cairn

Table 13.4: Operational noise monitoring assessment locations

49. As discussed in consultation with SAC/ACCON, this list includes the property of Chirmorie: as part of the consent for the Chirmorie Windfarm, it was agreed that, if the windfarm was constructed, that property would be become unoccupied. As the Chirmorie Windfarm is not currently constructed at this stage, it has been considered as potentially inhabited for the purpose of the present assessment, in the case that Chirmorie Windfarm doesn't get constructed.
50. The Glenour property is currently unoccupied and on the register for buildings at risk. It has nevertheless been considered in this assessment. Bents Farm is financially involved with the proposed Development.
51. The day-time noise limit is derived from background noise data measured during so called 'quiet periods of the day', comprising weekday evenings (18:00 to 23:00), Saturday afternoons and evenings (13:00 to 23:00) and all day and evening on Sundays (07:00 to 23:00). Multiple samples of ten-minute background noise levels using the  $L_{A90,10min}$  measurement index are measured contiguously over a wide range of wind speed conditions (a definition of the  $L_{A90,10min}$  index is given in Annex A of **Technical Appendix 13.1**). The measured noise levels are then plotted against the simultaneously measured wind speed data and a 'best fit' curve is fitted to the data to establish the background noise level as a function of wind speed. The ETSU-R-97 day-time noise limit is then set at a level 5dB(A) above the best fit curve to the background noise data over a 0-12m/s wind speed range.
52. For wind speeds where the best fit curve to the background noise data lies below a level of 30dB(A) to 35dB(A), the limit is set at a fixed lower level in the range 35dB(A) to 40dB(A). The precise choice of fixed limit within the range 35dB(A) to 40dB(A) depends on a number of factors: the number of noise affected properties, the likely duration and level of exposure and the consequences of the choice on the potential power generating capability of the windfarm. These factors are assessed in **Section 5.6 of Technical Appendix 13.1** and it concluded that, considering the very low population density of the area of the proposed Development and its immediate surroundings, the predicted noise levels for the proposed Development in relation to the measured background noise levels, the large generation capacity of the proposed Development and the disproportionate effect a reduced limit would have on it, it is wholly appropriate to set the day-time noise limit at the upper end of the range of from 35 dB(A) to 40 dB(A).
53. As noted above, the SAC PSGN includes a general recommendation that this lower limit is set at the lowest end of the range of 35 to 40dB(A) prescribed in ETSU-R-97. However, as ACCON acknowledged on behalf of SAC (**Table 13.3**), for the proposed Development, a fixed limit at the upper end of that range (40 dB(A)) is applicable given the scale of windfarm development in the area. In addition, this is the basis of the consent for the existing Arecleoch, Kilgallioch and Mark Hill Windfarms.
54. The night time noise criterion curve is derived from background noise data measured during the night time periods (23:00 to 07:00) with no differentiation being made between weekdays and weekends. The ten minute  $L_{A90,10min}$  noise levels measured over these night time periods are again plotted against the concurrent wind speed data and a 'best fit' correlation is established. As with the day time limit, the night time noise limit is also based on a level 5dB(A) above the best fit curve over the 0-12m/s wind speed range. Where the night time noise limit is found to be below 43dB(A) it is fixed at 43dB(A). In this case as well, the generic recommendation in the SAC PSGN is to depart from ETSU-R-97 and apply a fixed lower limit of 38dB(A) for night-time periods; however, the consents for the Arecleoch, Kilgallioch and Mark Hill Windfarms are all based on the lower limit of 43dB(A) recommended in ETSU-R-97. This therefore would also form the basis of the assessment of the proposed Development.
55. Where a property occupier has a financial involvement in the windfarm development, such as Bents Farm, the lower fixed portion of the noise limit at that property may be increased to 45dB(A) during both the day time and the night time periods.
56. ETSU-R-97 also offers an alternative simplified assessment methodology: if predicted noise levels do not exceed 35dB(A) up to 10m/s, then they are considered acceptable and background noise surveys are not considered necessary.
- 13.2.6.2.1 Low frequency noise, vibration and amplitude modulation**
57. Low-frequency noise and vibration resulting from the operation of windfarms are all issues that have been discussed in detail over the past 20 years. Consequently, Annex A of **Technical Appendix 13.1** includes a detailed discussion of these topics. In summary of the information provided therein, the current recommendation is that ETSU-R-97 should continue to be used for the assessment and rating of operational noise from windfarms.
58. Annex A of **Technical Appendix 13.1** also discusses the most recently published research on the subject of wind turbine blade swish or Amplitude Modulation (or AM). The IOA has recently published an objective technique developed for quantifying AM noise. The UK Government also commissioned a review on subjective responses to AM noise which outlines considerations for the control of this feature based on the IOA methodology. The Scottish Government is currently reviewing this recommendation in the context of the Scottish planning system.
- 13.2.6.3 Substation and ancillary services / battery storage**
59. Noise from fixed plant other than the wind turbines was assessed in line with the BS 4142:2014 standard. The assessment according to this standard is based on the  $L_{Aeq}$  level from the plant, with the potential addition of penalties to account for some characteristics of the sound, which is compared to baseline LA90 noise levels at relevant noise-sensitive properties. When these are similar, this corresponds to a low impact (depending on the context) according to the standard which is considered to represent a negligible impact for EIA purposes.
- 13.2.6.4 Noise predictions**
60. The predictions of construction noise were made using the methodology of BS 5228 and representative emission levels based on the types and number of equipment typically associated with key phases of constructing a windfarm. The predictions used conservative assumptions, such as considering when each activity would be closest to the neighbouring properties, and assuming the plant would operate for between 75 % and 100 % of the working day, on a conservative basis. This would represent the upper sound emission level during the day and actual noise levels are likely to be lower. Furthermore, the calculation has assumed there were no screening effects and the ground cover was 50 % hard.
61. The level of construction noise that occurs at the surrounding properties would be highly dependent on a number of factors such as the final Site programme, equipment types used for each process, and the operating conditions that prevail during construction. It is not practically feasible to specify each and every element of the factors that may affect noise levels, therefore it is necessary to make reasonable allowance for the level of noise emissions that may be associated with key phases of the construction. The types and number of equipment usually associated with the key phases of constructing a windfarm have been based on experience of similar sites. The conservative assumptions made would likely offset the uncertainty in the exact details of the construction activities.
62. For operational noise, the exact model of turbine to be used for the proposed Development would be the result of a future tendering process and therefore an indicative turbine model has been assumed for the operational noise assessment. Specifically, the operational noise assessment is based upon the noise specification of the Vestas V150 5.6 MW wind turbine. 13 turbines have been modelled using the layout as indicated on the map on **Figure 13.1**.
63. Assessment of the operational noise effects accounts for the cumulative effect of the proposed windfarm with other existing windfarms nearby including the operational Arecleoch, Kilgallioch and Mark Hill Windfarms, as well as the consented Chirmorie Windfarm. Other, more distant windfarms were not considered because their potential noise contribution was considered negligible.
64. **Technical Appendix 13.1** details the assumptions made for each of the cumulative sites considered. In each case, robust emission data was first assumed, in line with the requirements of the IOA GPG guidance, and including an allowance for measurement uncertainty in line with IOA GPG requirements. For each operational site, the actual installed turbine model was modelled. The individual consents for each of the sites considered was reviewed to determine additional noise could realistically still be produced and still meet the required noise limit at the closest relevant property (a "controlling property"), in which case an additional uplift was applied to the assumed emission levels. This was the case in particular for the Chirmorie Windfarm which is currently not built and outside of ScottishPower Renewables' (SPR) control. The approach used is considered robust and consistent with relevant guidance on good practice set out in the IOA GPG and subsequent publications on the subject (see Bowdler et. al., 2016).
65. Operational noise predictions were made in accordance with the methodology recommended in the IOA GPG, which is based on the ISO 9631-2 standard, and assumes robust emission levels for the candidate turbine. The predictions are made assuming downwind propagation from every turbine, which will be over-stating noise levels in some cases, particularly in cases in which receptors are situated in between two sets of turbines and could not be downwind of both simultaneously.

### 13.2.7 Significance of effect

66. BS 5228-1 indicates that a number of factors are likely to affect the acceptability of construction noise including Site location, existing ambient noise levels, duration of Site operations, hours of work, attitude of the Site operator and the noise characteristics of the work being undertaken. Based on the range of guidance values set out in BS 5228 Annex E, other reference criteria provided by the World Health Organization (WHO), and the consultation received from SAC, the significance criteria presented in **Table 13.5** have been derived. The values have been chosen in recognition of the relatively low ambient noise typically observed in rural environments. The presented criteria have been normalised to free-field day time noise levels occurring over a time period, T, equal to the duration of a working day onsite. Specifically, the criteria relate to day time hours from 07:00 to 19:00 on weekdays, and 07:00 to 13:00 on Saturdays, which is consistent with the general recommendations of SAC.

Impact significance	Definition
Major	Construction noise is greater than 72dB L <sub>Aeq,T</sub> for any part of the construction works or exceeds 65dB L <sub>Aeq,T</sub> for more than 4 weeks in any 12 month period.
Moderate	Construction noise is less than or equal to 65dB L <sub>Aeq,T</sub> throughout the construction period, with periods of up to 72dB L <sub>Aeq,T</sub> lasting not more than 4 weeks in any 12 month period.
Slight	Construction noise is generally less than or equal to 60dB L <sub>Aeq,T</sub> , with periods of up to 65dB L <sub>Aeq,T</sub> lasting not more than 4 weeks in any 12 month period.
Negligible	Construction noise is generally less than or equal to 55dB L <sub>Aeq,T</sub> , with periods of up to 60dB L <sub>Aeq,T</sub> lasting not more than 4 weeks in any 12 month period.

Table 13.5: Significance criteria for construction noise

67. When considering the impact of short-term changes in traffic, associated with the construction activities, on existing roads in the vicinity of the Site, reference can be made to the criteria set out in the Design Manual for Roads and Bridges (DMRB). A classification of magnitudes of changes in the predicted traffic noise level is set out: for short-term changes, such as those associated with construction activities, a difference of less than 1dB(A) are considered negligible, 1 to 3dB(A) is slight, 3 to 5dB(A) moderate and changes of more than 5dB(A) constitute a major impact. This classification can be considered in addition to the criteria of **Table 13.5**, which can be applied when considering absolute levels of noise from construction traffic alone, as can be calculated using the haul route method included in BS 5228-1.

68. Major or moderate construction impacts are considered 'significant' in the context of the EIA Regulations.

69. The acceptable limits for wind turbine operational noise are clearly defined in ETSU-R-97. Consequently, the test applied to operational noise is whether or not the calculated windfarm noise immission levels at nearby noise sensitive properties lie below the noise limits derived in accordance with ETSU-R-97. If predicted noise levels are within the ETSU-R-97 derived noise limits, operational noise is considered acceptable, and therefore not significant in EIA terms. If predicted noise levels are above the ETSU-R-97 noise limits, operational noise is considered unacceptable and significant in EIA terms.

### 13.2.8 Limitations to the assessment

70. The level of construction noise that occurs at the surrounding properties would be highly dependent on a number of factors such as the final Site programme, equipment types used for each process, and the operating conditions that prevail during construction. It is not practically feasible to specify each and every element of the factors that may affect noise levels, therefore it is necessary to make reasonable allowance for the level of noise emissions that may be associated with key phases of the construction. The types and number of equipment usually associated with the key phases of constructing a windfarm have been based on experience of similar sites and assumed to operate between 75 % and 100 % of the working day, on a conservative basis. This would represent the upper sound emission level during the day and actual noise levels are likely to be lower. Furthermore, the calculation has assumed there were no screening effects and the ground cover was 50 % hard. These conservative assumptions would likely offset the uncertainty in the exact details of the construction activities.

71. For operational noise, the exact model of turbine to be used at the Site would be the result of a future tendering process and therefore an indicative turbine model has been assumed for the operational noise assessment. The turbine model assumed are considered representative of the range of noise emissions for turbines which may be installed at the Site. For operational,

proposed or consented sites, robust assumptions of the potential noise emissions which may be allowed for each of these sites under their consent was made in line with current good practice.

## 13.3 Baseline conditions

72. The baseline noise environment was typically dominated by 'natural' noise sources such as wind disturbed vegetation and birdsong, with water courses and occasional road traffic noise also noted in some cases. Therefore, the measured baseline noise levels are considered consistent with those that would be expected in a rural environment.

73. Existing noise conditions at all five new survey locations (**Table 13.2**) are represented in Annex E in **Technical Appendix 13.1**. Descriptions of the noise environment at each of these survey locations can be found in Annex C of **Technical Appendix 13.1**. Corrected baseline levels at all previous measurement locations of **Table 13.1** are also detailed in **Technical Appendix 13.1**, with the detailed methodology used set out in Annex F of **Technical Appendix 13.1**.

74. The background levels at all five locations typically varied, during quiet day-time periods, between 25-30dB L<sub>A90</sub> at low wind speeds to 35-45dB L<sub>A90</sub> at high wind speeds.

### 13.3.1 Noise limits

75. Following exclusion of spurious periods, typical background levels were derived using a best-fit curve. ETSU-R-97 noise limits were determined on the basis of these background levels at all properties, in accordance with the method and values set out in **Section 13.2.6**. This results in the limits set out in **Tables 5 and 6 of Technical Appendix 13.1**. The derived noise limits at all measurement locations (**Tables 13.1 and 13.2**) are also reproduced below in **Tables 13.6 and 13.7**.

Standardised wind speed at 10m height	4	5	6	7	8	9	10	11	12
East Altercannoch	40.0	40.0	40.0	40.0	40.0	41.2	43.7	45.9	47.9
Brooklyn	40.0	40.0	40.0	40.0	40.0	40.8	42.7	44.4	45.9
4 Gowland Terrace	40.1	40.5	41.2	42.2	43.3	44.6	46.1	47.6	49.2
Queensland Caravan Park	40.0	40.5	41.1	41.9	42.9	44.0	45.4	46.8	48.5
White Cairn	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.0
Kilrenzie	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Ward of Cairnlea	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1
Laggish	40.0	40.0	40.0	40.0	40.0	40.0	41.8	44.0	45.7
Chirmorrie	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0

Table 13.6: Day time L<sub>A90</sub> noise limits derived from the baseline noise survey according to ETSU-R-97

Standardised wind speed at 10m height	4	5	6	7	8	9	10	11	12
East Altercannoch	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	47.0
Brooklyn	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	45.7
4 Gowland Terrace	43.0	43.0	43.0	43.0	43.2	44.0	45.0	46.3	47.8
Queensland Caravan Park	43.0	43.0	43.0	43.0	43.0	43.0	44.0	45.5	47.2
White Cairn	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0



Kilrenzie	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Ward of Cairnlea	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Laggish	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1
Chirmorrie	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

Table 13.7: Night-time  $L_{A90}$  noise limits derived from the baseline noise survey according to ETSU-R-97

76. For the avoidance of doubt, these limits have been derived as follows:

- the ETSU-R-97 daytime limit of 40dB(A) (or 5dB above the prevailing background noise level, whichever is the higher), as set out above in **Section 13.2.6.2**; and
- the minimum ETSU-R-97 night-time fixed lower limit of 43dB(A) (prescribed in ETSU-R-97), or 5dB above the prevailing background noise level, whichever is the higher.
- At Bents Farm, the lower limit was increased to a minimum of 45 dB(A).

77. The noise limits of **Tables 13.6 and 13.7** are consistent with the relevant condition in the consent for the Arcleoch Windfarm but are based on updated baseline noise levels which take into account relevant wind shear effects in line with current best practice.

## 13.4 Assessment of effects

### 13.4.1 Potential construction effects

78. There are a number of isolated properties located between 130 and 300 metres from the general access road from the A714 to the Site, it is expected that very limited works would be required to this existing track as it has been used recently for the existing Arcleoch Windfarm and Kilgallioch Windfarms. Any potential minor repair work that may be required would be very limited in extent and duration such that no significant noise or vibration effects are expected for this aspect of the proposed Development.

79. Predicted noise levels at the closest noise sensitive receptors for each of the key activities during construction of the proposed Development are presented in **Technical Appendix 13.1**. The Arnsheen property (NGR 226947 / 576768) was specifically considered in addition to the properties of **Table 13.4** as it is the closest property to the borrow pit search areas identified (located approximately 850 metres from search area 2).

80. The proposed construction activities would occur at relatively large distances from the residential properties considered, such that the resulting predicted noise levels would not exceed 55 dB  $L_{Aeq}$ . With reference to the derived criteria of **Table 13.5**, the noise impact from these activities would therefore be negligible. The proposed construction working hours set out in **Chapter 3** include 07:00 to 16:00 on Saturdays and Sundays: if some of the noisiest activities occurred on a Saturday afternoon or on a Sunday, based on the advice in BS 5228 this would correspond to an increased impact, but the criteria of 55 dB  $L_{Aeq}$  proposed by SAC for weekend periods in their scoping response would not be exceeded: this would therefore correspond to a potential slight impact.

81. If blasting is employed to quarry the borrow pit at search area 2, there is a potential for this to affect the nearest property. These activities are best controlled through a monitoring programme and following the use of good practice during the setting and detonation of charges, as set out earlier in this Chapter and in the proposed mitigation section. For the other borrow pit search areas identified, given the separation distances between the location of borrow pits and the nearest noise sensitive receptors (approximately 2 km as a minimum) it is very unlikely that these activities would cause unacceptable residual adverse effects, and therefore no specific mitigation is considered to be required for these activities.

82. In addition to onsite activities, construction-related traffic passing to and from the Site would also represent a potential source of noise to surrounding properties. **Chapter 12: Access, Traffic and Transport** has identified the changes in traffic predicted to occur during the construction of the proposed Development on the proposed site access route. Based on worst-case assumptions, 24 two-way movements of HGVs and 200 light vehicles movements were predicted daily.

83. The site access track which leads from the site entrance at the Wheeb Bridge on the A714 will pass in some cases within approximately 130 to 300m from some relatively isolated properties such as Arnimean, Burnside or Corwar Farm. Using the prediction methodology in BS 5288, and based on 2 vehicles per hour travelling at 35 km/hr, the associated noise levels at these properties predicted in **Technical Appendix 13.1** will not exceed 41 dB  $L_{Aeq}$ , corresponding to **negligible** effects.

84. Construction traffic movements on existing local surrounding roads also represent a potential source of noise effects to surrounding properties. On the basis of the projected worst-case changes in traffic flow, and using the methodology set out in CRTN, **Technical Appendix 13.1** predicts a maximum potential increase of 1.2 dB(A) in the day time average noise level at locations adjoining the A714. Based on the criteria in the DMRB set out earlier in this chapter, the predicted short-term changes in traffic noise level will correspond to slight effects.

85. In conclusion, noise from construction activities has been assessed and is predicted to result in a temporary slight effect.

#### 13.4.1.1 Embedded measures

86. An outline CEMP is provided as **Technical Appendix 3.1** and the final CEMP would be secured through a planning condition. This would include measures to control construction noise including:

- as proposed in **Chapter 3**, those activities that may give rise to audible noise at the surrounding properties and heavy goods vehicle deliveries to the Site would be limited to the hours 07:00 to 19:00 Monday to Friday and 07:00 to 16:00 on Saturdays and Sundays unless otherwise approved in advance by SAC (except in case of an emergency). Those activities that are unlikely to give rise to noise audible at the Site boundary, or light vehicle traffic accessing the Site such as that involved with staff mobilisation, may continue outside of the stated hours;
- all construction activities shall adhere to good practice as set out in BS 5228;
- all equipment would be maintained in good working order and any associated noise attenuation such as engine casing and exhaust silencers shall remain fitted at all times;
- where flexibility exists, activities would be undertaken away from residential properties, set back by the maximum possible distances;
- a site management regime would be developed to control the movement of vehicles to and from the Site;
- construction plant capable of generating high noise and vibration levels would be operated in a manner to restrict the duration of the higher magnitude levels;
- in particular, if noise-generating activities could occur outside of the stated working hours, this could potentially lead to increased effects of potentially minor significance, but it is considered unlikely that significant effects could arise due to construction due to the large distances involved for the proposed activities in the wide majority of cases.

#### 13.4.1.2 Proposed mitigation

87. If blasting is to be employed at some of the borrow pits located less than 2 km away from noise-sensitive locations, the potential noise and vibration effects of blasting operations would be reduced according to the guidance set out in the relevant British Standards and PAN50 Annex D:

- blasting should take place under controlled conditions with the agreement of the relevant authorities, at regular times within the working week, that is, Mondays to Fridays, between the hours of 10:00 and 16:00. Blasting on Saturday mornings should be a matter for negotiation between the contractor and SAC;
- vibration levels at the nearest sensitive properties are best controlled through onsite testing processes carried out in consultation with SAC. This site testing based process would include the use of progressively increased minor charges to gauge ground conditions both in terms of propagation characteristics and the level of charge needed to release the requisite material. If required, the use of onsite monitoring at neighbouring sensitive locations during the course of this preliminary testing can then be used to define upper final charge values that would ensure vibration levels remain within the criteria set out previously, as described in BS 5228-2 and BS 6472-2;
- blasting operations would need to adhere to good practice as set out in BS 5228-2, and in PAN50, Annex D, Paragraph 95 in order to control air overpressure; and
- a scheme would be submitted to SAC and/or D&GC, for approval of blasting details, which would outline the mitigation measures to be adopted.

#### 13.4.1.3 Residual construction effects

88. The adoption of the identified mitigation measures would reduce the potential noise and vibration effects during construction and largely restrict noisy activities occurring outside of the range of hours on which the criteria of **Table 13.5** were based.

Some potential exceptions related to weekend work which would however likely remain below applicable SAC criteria. Comparing the predicted noise levels to the range of background noise levels measured around the proposed Development suggests that the noisier construction activities could be audible at various times throughout the construction phase. However, based on the considerations presented above, the associated effects would still be negligible to slight temporary adverse and therefore not significant.

### 13.4.2 Potential operational effects

89. The predictions of operational noise for the proposed Development in isolation at the noise-sensitive locations of **Table 13.4** are detailed in **Table 12** of **Technical Appendix 13.1**: these varied between 15-30 dB(A) at low wind speeds and 24-34 dB(A) at high wind speeds. The predictions obtained when combined with the noise from the existing turbines of the Arecleoch Windfarm are set out in **Table 13** of **Technical Appendix 13.1** and are shown on **Figure 13.2** and varied between 18-35 dB(A) at low wind speeds and 25-36 dB(A) at high wind speeds. These predictions are also overlaid on the measured baseline noise levels and derived noise limits in the charts of **Annex E** in **Technical Appendix 13.1**.

90. The assessment presented within **Tables 15 and 16** of **Technical Appendix 13.1** demonstrates that the derived ETSU-R-97 noise limits (**Tables 5 and 6** of **Technical Appendix 13.1**) are predicted to be achieved at all wind speeds and at all assessment locations for the combination of the existing turbines of the Arecleoch Windfarm and the proposed Development. This means that the operational noise levels from the proposed Development are considered acceptable in line with relevant noise limits.

91. The main noise sources associated with the substation are likely to be the power transformers and the cooling fans. Operational noise associated with any ancillary services such as battery energy storage facility would arise from ventilation/air conditioning systems, modular inverters and lower-voltage transformers and higher-voltage transformers associated with grid connection (were this not to be shared with the main windfarm substation).

92. Given the large separation distances of around 2 km or more between the substation and battery storage area and the nearest residential properties, experience of similar installations and professional judgement, the associated levels of operational noise would be negligible and not significant. Therefore, no specific mitigation is required in this instance.

### 13.4.3 Embedded measures

93. The layout of the proposed Development has been iteratively developed so as to achieve an acceptable noise impact on local residential amenity, based on a representative candidate turbine model, whilst maintaining as far as possible the generation capacity of the development (in addition to other design considerations). This included consideration of including for the cumulative effects of neighbouring windfarms where relevant. Specifically, the process involved the calculation of noise emission levels for the original outline scheme configuration, and layout design advice was provided on this basis to the design team to demonstrate compliance with successive iterations.

#### 13.4.3.1 Proposed mitigation

94. **Tables 13.8 and 13.9** below sets out specific day-time and night-time limits which were determined as applicable to the combination of the Arecleoch Windfarm and the proposed Development, which will effectively be operated as a single windfarm for the purpose of noise limits. Noise limits were only specific for key locations: either monitoring locations from **Tables 13.1 and 13.2** or properties where predicted levels were not clearly below 30 dB LA90. The specific noise limits of **Tables 13.8 and 13.9** were determined such that, when added to the predicted total combined contribution of the Kilgallioch, Mark Hill and Chirmorie Windfarms, the resulting cumulative noise levels would remain below the total ETSU-R-97 noise limits (**Tables 13.6 and 13.7** or **Tables 5 and 6** in **Technical Appendix 13.1**). This was generally determined on the basis of simultaneous downwind propagation from all turbines, which represents a conservative assumption for most of the properties considered. The Chirmorie property was considered separately as detailed below.

95. Satisfactory control of cumulative noise levels would be achieved through enforcement of the individual consent limits for each of the individual windfarms.

96. The selection of the final turbine to be installed at the Site would be made on the basis of enabling the derived specific noise limits set out in **Tables 13.8 and 13.9** to be achieved at surrounding properties, including any relevant tonality corrections. The noise limits for all monitoring locations of **Tables 13.1 and 13.2** are summarised below in **Tables 13.6 and 13.7**. These noise limits are consistent with the relevant condition in the consent for the Arecleoch Windfarm but are based on updated baseline noise levels which take into account relevant wind shear effects in line with current best practice.

97. Conditions attached to the consent should include the requirement that, in the event of a noise complaint, noise levels resulting from the operation of the proposed Development, in combination with that of the Arecleoch Windfarm, are measured in order to demonstrate compliance with the noise limits of **Tables 13.8 and 13.9**. Such monitoring should be done in full accordance with ETSU-R-97 and current good practice and include penalties for characteristics of the noise (if present). To prevent unnecessary protracted surveys and onerous procedures, the relevant monitoring procedure should in the first instance involve determining if measured ambient noise levels exceed the relevant total ETSU-R-97 noise limit (**Tables 13.6 and 13.7**). Only if this is the case should the specific contribution of the Arecleoch Windfarm and the proposed Development, operating together, be assessed against the specific noise limits of **Tables 13.8 and 13.9**. The details of this procedure could be agreed with SAC in a process secured through planning conditions for the proposed Development.

Standardised wind speed at 10m height	4	5	6	7	8	9	10	11	12
Balkissock	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9
Bellimore-on-Tig	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9
Brooklyn	38.7	38.7	38.7	38.7	38.7	39.6	41.4	43.1	44.6
Chirmorie*	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2
Dochroyle Cottage	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5
Dochroyle Farm	37.6	37.6	37.6	37.6	37.6	37.6	37.6	37.6	37.6
East Altercannoch	38.3	38.3	38.3	38.3	38.3	39.5	42.0	44.2	46.2
Farden	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3
Glenour	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8
Gowlands Terrace	39.3	39.7	40.4	41.3	42.4	43.8	45.2	46.8	48.4
Kilrenzie	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8
Laggish	36.5	36.5	36.5	36.5	36.5	36.5	38.3	40.5	42.3
Queensland Caravan Park	39.3	39.7	40.4	41.2	42.2	43.3	44.6	46.1	47.8
Ward of Cairnlea	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.4
West Altercannoch	38.5	38.5	38.5	38.5	38.5	39.7	42.2	44.5	46.4
Wheeb	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8
White Cairn	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	39.9

Table 13.8: Specific day time noise limits (LA90) applicable to the combination of the Arecleoch Windfarm and the proposed Development

Standardised wind speed at 10m height	4	5	6	7	8	9	10	11	12
Balkissock	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9
Bellimore-on-Tig	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9
Brooklyn	41.7	41.7	41.7	41.7	41.7	41.7	41.7	42.7	44.4
Chirmorrie*	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2
Dochroyle Cottage	40.5	40.5	40.5	40.5	40.5	40.5	40.5	40.5	40.5
Dochroyle Farm	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6
East Altercannoch	41.3	41.3	41.3	41.3	41.3	41.3	41.3	43.3	45.3
Farden	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3
Glenour	42.8	42.8	42.8	42.8	42.8	42.8	42.8	42.8	42.8
Gowlands Terrace	42.1	42.1	42.1	42.1	42.3	43.1	44.2	45.4	46.9
Kilrenzie	42.8	42.8	42.8	42.8	42.8	42.8	42.8	42.8	42.8
Laggish	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	40.6
Queensland Caravan Park	42.3	42.3	42.3	42.3	42.3	42.3	43.3	44.8	46.4
Ward of Cairnlea	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3
West Altercannoch	41.5	41.5	41.5	41.5	41.5	41.5	41.5	43.5	45.6
Wheeb	42.8	42.8	42.8	42.8	42.8	42.8	42.8	42.8	42.8
White Cairn	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9

Table 13.9: - specific night time noise limits (L<sub>A90</sub>) applicable to the combination of the Arcleoch Windfarm and the proposed Development

98. If the Chirmorrie Windfarm is constructed, the Chirmorrie(\*) property would become unoccupied and a noise limit would not apply to that property. Otherwise, this limit will apply over the range of 235 to 45 degrees from North, corresponding to broadly downwind conditions for the Arcleoch Windfarm and the proposed Development. This was determined on the basis of the more detailed predictions set out in Annex G of **Technical Appendix 13.1**.

#### 13.4.3.2 Residual operational effects

99. The basis of the ETSU-R-97 method is to define acceptable noise limits thought to offer reasonable protection to residents in areas around windfarm developments. At some locations under some wind conditions and for a certain proportion of the time, the windfarm noise may be audible; however, operational noise immission levels are acceptable in terms of the guidance commended by planning policy for the assessment of windfarm noise, and therefore considered not significant in EIA terms.

#### 13.4.4 Cumulative assessment

100. It can first be noted that at most of the properties of **Table 13.4**, with the exception of Chirmorrie and properties located to the north of the proposed Development, predicted levels for the combination of the existing turbines of the Arcleoch Windfarm and the proposed Development are of 30 dB(A) and below, and this includes properties located in Barrhill. This is more than 10 dB below the applicable noise limits, which represents a substantial difference and which would exclude further detailed assessment of cumulative noise levels according to good practice guidelines.

101. In any case, predicted cumulative noise immission levels for the proposed Development at each of the assessment locations of **Table 13.4** (except Chirmorrie) are detailed in **Table 14 of Technical Appendix 13.1**. The predictions are also illustrated on **Figure 13.3** as well as in the charts of **Annex E in Technical Appendix 13.1**. These predictions assume that all receptors are downwind of all wind turbines, which is conservative in many cases. Furthermore, as set out above, they incorporate in some cases uplifts based on potential increases above the likely emissions of the turbines considered.

102. The predicted noise levels are of no more than 38dB L<sub>A90</sub> at the relevant properties, and therefore below the applicable lower limit of 40dB(A). The detailed assessment set out in **Tables 17 and 18 of Technical Appendix 13.1** compares these predicted cumulative noise levels with the derived ETSU-R-97 noise limits. The assessment demonstrates that the derived noise limits are predicted to be achieved at all wind speeds and locations in combination with all operational and approved neighbouring schemes.
103. A separate assessment was also undertaken at Chirmorrie for the scenario in which the Chirmorrie Windfarm is not constructed and this property remains occupied: **Table 19 of Technical Appendix 13.1**. Predicted cumulative levels at this location do not exceed 40 dB(A), and therefore comply with the derived ETSU-R-97 noise limits. It should be noted that the assumption of simultaneous downwind propagation at this location is particularly conservative as it cannot in practice be downwind of both the proposed Development and the Kilgallioch Windfarm at the same time. Therefore, the predicted cumulative levels at this location would likely be lower.
104. In conclusion, cumulative operational noise levels including all operational neighbouring schemes are considered acceptable in line with relevant noise limits and are therefore not significant.
105. The nature of the construction noise assessment, based on the closest distance of the different activities to noise-sensitive properties, means that even if construction programmes of neighbouring windfarm schemes did overlap, it would be unlikely for any significant additional effects to arise in addition to the effects identified.
106. The traffic and transport assessment in **Chapter 12: Access, Traffic and Transport** has considered the potential for cumulative increases in traffic due to overlapping conduction programmes for neighbouring windfarm developments. It concluded that there should not be large cumulative increases in HGV traffic provided some measures are put in place through the TMP. On this basis, there will not be additional cumulative construction noise impacts.

## 13.5 Summary and statement of significance

107. On the basis of the embedded measures, proposed Development design and mitigation measures set out above there are no residual significant noise or vibration effects.

## 13.6 References

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