



Chapter 13

Noise

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Chapter 13

Noise

13.1 Executive summary

1. Hoare Lea (HL) has undertaken the noise assessment for the construction and operation of the proposed Sheirdrim Renewable Energy Development. Noise would be emitted by equipment and vehicles used during construction and operation of the proposed Development. The level of noise emitted by the proposed Development and the distance from noise sources are the main factors determining levels of noise at nearby properties.
2. Construction noise has been assessed by a desk-based study of a potential construction programme and by assuming the proposed Development is constructed using standard and common methods. Noise levels have been calculated for properties closest to the areas of work and compared with guideline and baseline values. Construction noise, by its very nature, tends to be temporary and highly variable and, therefore, much less likely to cause adverse effects. Various mitigation methods have been suggested to reduce the effects of construction noise, the most important of these being suggested restrictions of hours of working. It is concluded that noise generated through construction activities will have a minor effect.
3. The noise generated by the ground mounted solar arrays, battery storage and the substation at the nearest residential locations was considered negligible and not significant given the separation distances involved.
4. Operational wind turbines emit noise from the rotating blades as they pass through the air. The amount of noise emitted tends to vary depending on the wind speed. When there is little wind, the turbine rotors will turn slowly and produce lower noise levels than during high winds when the turbine reaches its maximum output and maximum rotational speed. Background noise levels at nearby properties will also change with wind speed, increasing in level as wind speeds rise due to wind in trees and around buildings, etc.
5. Noise levels from operation of the proposed Development have been predicted for those locations around the Site most likely to be affected by noise. Surveys have been performed to establish existing baseline noise levels at four of these properties. Noise limits have been derived from data about the existing noise environment following the method stipulated in national planning guidance. Predicted noise levels take full account of the potential combined effect of the noise from the proposed Development along with the operational Freasdail, consented Eascairt and proposed High Constellation Windfarms. Other, more distant windfarms were not considered as they do not make a contribution to cumulative noise levels. Predicted operational noise levels have been compared to the limit values to demonstrate that turbines of the type and size which would be installed can operate within the limits so derived. It is concluded, therefore, that operational noise levels from the proposed Development would be within levels deemed, by national guidance, to be acceptable for developments of this nature.

13.2 Introduction

6. 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 in the EIA Report as **Technical Appendix 13.1**. The assessment considers both the proposed Development's construction and its operation.
7. Assessment of the operational noise effects accounts for the cumulative effect of the proposed Development with other windfarms including the operational Freasdail Windfarm, the consented Eascairt Windfarm and the proposed High Constellation Windfarm. Other, more distant windfarms were not considered as their potential noise contribution was considered negligible.

8. For the construction phase, details of relevant working practices, traffic routes, and proposed working hours are described in **Chapter 3 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 Traffic and Transport**.
9. The noise impact assessment and the reporting required for the preparation of this Chapter has been undertaken by Hoare Lea.

13.3 Approach to assessment and methods

13.3.1 Legislation, policy and guidance

10. Whilst Scottish Planning Policy (SPP) suggests noise impacts are one of the aspects that will need to be considered in the context of an application for windfarm development, it provides no specific advice with regards to noise.
11. 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:
 12. *"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."*
13. 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"*.
14. 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'.
15. 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).
16. 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.
 17. **13.3.2 Study area**
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 1 to 3 km from the turbines of the Proposed Development.

18. 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.

13.3.3 Effects assessed in full

19. The proposed Development includes the construction and operation of a Renewable Energy Development, including wind turbines, solar panels and ancillary infrastructure.

20. Noise and vibration which arises from the construction of this infrastructure is a factor which should be taken into account when considering the total effect of the proposed Development. However, when assessing the effects of construction noise, the temporary nature of the associated works can be taken into account. The main work locations for construction of the proposed turbines and solar panels 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. If there are requirements to decommission elements of the proposed Development, the activities involved would be less intensive than the construction process and would therefore have no additional effects. This is therefore not considered further in this assessment.

21. 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 development. 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.

22. The following effects have been assessed in full:

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

13.3.4 Effects scoped out

23. 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'.

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

25. The proposed Development would include solar panels, a substation and ancillary services/battery storage facility which would emit some noise during operation (e.g. electrical plant and air conditioning systems). Given the separation distances between the solar areas, substation and battery storage area to the nearest residential properties, experience of similar installations and professional judgement, the associated levels of operational noise would be negligible and not significant. Therefore, as agreed in consultation with A&BC, assessment of the associated impacts can be scoped out and have not been considered further as part of this Chapter.

26. Two other relatively small-scale single wind turbine developments are located to the north of the area studied: namely the Whitehouse Burn & Fraoch-Choile schemes. They are not considered in further detail in this Chapter as no significant impacts

are expected given their relatively smaller scale, the separation distance with the nearest receptors considered and that these receivers would not be simultaneously downwind of these turbines and the other windfarms schemes considered.

13.3.5 Baseline determination

27. 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. The baseline noise survey locations were agreed during a joint visit with a representative of A&BC (see **Table 13.3**).

28. 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.

29. There are a number of either residential or habitable dwellings in the vicinity of the Site. Preliminary studies were undertaken, based on the scoping layout (26 wind turbines) 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**.

30. 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.

31. As part of the planning assessments for Freasdail Windfarm, background noise data was already measured at a number of locations: these are highlighted on **Figure 13.1** and **Table 13.1**. The results of monitoring previously undertaken at these locations were therefore referenced, as agreed with A&BC. New measurements conducted at these locations could 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. As these previous measurements were referenced to wind speeds measured at lower height above the ground than heights representative of turbines on the proposed Development, they have been corrected in line with current good practice guidance, on a conservative basis, as set out in detail in **Technical Appendix 13.1**.

32. A number of additional measurement locations were identified in consultation with A&BC and these are set out in **Table 13.2**.

13.3.6 Data sources

33. 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 the 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.

13.3.7 Field survey

34. Some of the historical baseline noise measurements previously undertaken to support the planning assessment for Freasdail Windfarm are considered representative of several noise-sensitive locations considered. 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 60 m

height above the ground, and therefore a conservative correction of 1 m/s was applied in accordance with good practice guidance to more closely relate the measurements to wind speeds at a reference representative of the turbines of the proposed Development (with hub heights of typically up to 90 metres).

Property	Easting	Northing
Grassfield Farm	181972	660127
Housing Plots	181805	659744
Lochview	182341	660328
Redesdale House	183890	660548

Table 13.1: Historical baseline noise monitoring locations

36. Additional properties of interest for which no representative background noise data was previously measured were identified and agreed in consultation with A&BC. The chosen four measurement locations are set out in **Table 13.2** and illustrated on **Figure 13.1**.

Property	Easting	Northing
Glebe Cottage	179272	659133
Achaglass	178919	655917
Achavraid	178451	657837
Oragaig	185222	654671

Table 13.2: Additional baseline noise monitoring locations

38. The background noise monitoring exercise was conducted from June to July 2019, over a period of 41 days (almost 6 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**.
39. The measured noise levels were related to wind speed measurements from a temporary site mast of up to 70 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 (90 metres). 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**.
40. 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 method described in the IOA GPG, as detailed in **Technical Appendix 13.1**. Freasdail Windfarm is located more than 2 km away from 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.

13.3.8 Consultation

41. **Table 13.3** summarises the relevant consultation responses received and how these are considered in this Chapter.

Consultee	Summary of Key Issues	How this is addressed in this Chapter
Argyll & Bute Council (A&BC)	The response from the Council's Environmental Protection Officer (EPO) considers noise and vibration. It notes the proposed methodology and outlines a number of information requirement that will need to be	Scope of assessment agreed. The information required by A&BC is set out in full in this Chapter and/or in Technical Appendix 13.1 .

Consultee	Summary of Key Issues	How this is addressed in this Chapter
	included in the EIA report for both operational and construction noise. It is agreed that operational vibration effects as well as operational effects from the solar and energy storage elements of the development can be scoped out of the noise and vibration assessment.	
Argyll & Bute Council (A&BC)	In response to a letter from Hoare Lea, setting out the approach to Noise Monitoring and selection of Noise Monitoring Locations the EPO agreed with the proposed approach, including the use of historical survey data. A request was made to attend and witness the installation of the noise monitoring equipment if possible. A&BC provided up-to-date information on the status of other wind turbine developments in the vicinity.	The EPO joined Hoare Lea during the installation of the noise monitoring equipment and subsequently confirmed agreement with the final installed locations and their conformance with good practice guidance. The additional information provided was taken into account in the analysis of cumulative noise impacts where relevant.
Scottish Government Energy Consents Unit (ECU)	The cumulative noise assessment should be carried out in line with relevant legislation and standards as detailed in section 9 of the scoping report. This should include details about the representative background noise survey locations agreed with the relevant Planning Authority.	This was undertaken and the relevant information provided as set out in the present Chapter.

Table 13.3: Consultation responses

13.3.9 Approach to assessment of effects Construction noise and vibration

43. 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, amended 2014). 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, construction compound, 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.
44. 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.
45. 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.

46. 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 and the construction traffic route, were also considered.
47. 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.
48. 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 A&BC 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.
49. 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.

Operational noise

50. 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**.
51. 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).
52. 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 turbine 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.
53. 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 Development 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 wind turbine noise immission levels with the derived noise limits and assess in the light of planning requirements in consultation with the local planning authority.
54. 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.

55. 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.
56. Full details of the operational noise assessment, including details of the noise output of the candidate turbine for the proposed Development and the calculation parameters on which predictions have been based, can be found in **Technical Appendix 13.1**.
57. 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 10.1 and 10.2)
Achavraid	178520	657828	1421	3	Achavraid
Achaglass	178991	655914	1367	4	Achaglass
Grassfield Farm	181964	660128	1871	1	Grassfield Farm
Escart Farm	184452	653490	2963	19	Oragaig
Oragaig	185240	654664	2513	19	Oragaig
Gartavaich	185877	658890	2942	16	Redesdale House
Meadowview	180066	659563	1045	1	Grassfield Farm
Lochview	182356	660335	2215	7	Lochview
Lonlia	183841	660487	3165	15	Redesdale House
Arivore Farm	182446	660654	2543	7	Lochview
Glenreasdale House	182274	660717	2521	1	Lochview
Housing Plot 1	181474	659638	1181	1	Housing Plots
Housing Plot 2	181751	659903	1562	1	Housing Plots
Housing Plot 3	181711	659972	1588	1	Housing Plots
Glebe Cottage	179283	659087	1308	2	Glebe Cottage
Birchfield	181166	660702	2013	1	Grassfield Farm

Table 13.4: Operational noise monitoring assessment locations

59. The Scotmill property (approximate northing 656354 and easting 179350) is a derelict property under the control of a landowner of the proposed Development. For this reason, this property was not considered further in the assessment. "Housing plots 1, 2 and 3" denote three consented residential properties, which currently have not been constructed. They are nevertheless considered in this assessment.
60. 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 LA90,10min measurement index are measured contiguously over a wide range of wind speed conditions (a definition of the LA90,10min 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.
61. 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 wind turbines. These factors are assessed in Section 5.6 of **Technical Appendix 13.1** and it concluded that, considering the 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 effect a reduced limit would have on it, it is wholly appropriate to set the day-time noise limit at 38 dB(A), towards the middle of the range of 35 dB(A) to 40 dB(A).

62. 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).
63. Where a property occupier has a financial involvement in a wind turbine development, 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.
64. 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.

Low Frequency Noise, Vibration and Amplitude Modulation

65. 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.
66. 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 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.

Noise predictions

67. 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.
68. 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 associated with the key phases of constructing this renewable energy development 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. Section 13.9 provides further detail on these assumptions.
69. 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 Siemens SWT-DD-120 4.3MW wind turbine. 19 turbines have been modelled using the layout as indicated on the map on **Figure 13.1**.
70. Assessment of the operational noise effects accounts for the cumulative effect of the proposed Development with other existing windfarms nearby including the operational Freasdail Windfarm, consented Eascairt Windfarm and proposed High

Constellation Windfarm. Other, more distant windfarms were not considered because their potential noise contribution was considered negligible and not significant.

71. **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 Freasdail Windfarm, the actual installed turbine type 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. 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).
72. 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.

13.3.10 Significance of effect

73. 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.

Impact	Definition
Major	Construction noise is greater than 72dB $L_{Aeq,T}$ for any part of the construction works or exceeds 65dB $L_{Aeq,T}$ for more than 4 weeks in any 12 month period.
Moderate	Construction noise is less than or equal to 65dB $L_{Aeq,T}$ throughout the construction period, with periods of up to 72dB $L_{Aeq,T}$ lasting not more than 4 weeks in any 12 month period.
Minor	Construction noise is generally less than or equal to 60dB $L_{Aeq,T}$, with periods of up to 65dB $L_{Aeq,T}$ lasting not more than 4 weeks in any 12 month period.
Negligible	Construction noise is generally less than or equal to 55dB $L_{Aeq,T}$, with periods of up to 60dB $L_{Aeq,T}$ lasting not more than 4 weeks in any 12 month period.

Table 13.5: Impact criteria for construction noise

75. 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 1 dB(A) are considered negligible, 1 to 3 dB(A) is minor, 3 to 5 dB(A) moderate and changes of more than 5 dB(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.
76. Major or moderate construction impacts are considered 'significant' in the context of the EIA Regulations.
77. 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.

13.3.11 Limitations to the assessment

78. For construction noise, the types and number of equipment usually associated with the key phases of constructing the proposed Development 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.
79. 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.

13.4 Baseline conditions

80. 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
81. Existing noise conditions at all four 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**, along with the correction process applied.
82. The background levels at all four locations typically varied, during quiet day-time periods, between 20-25dB L_{A90} at low wind speeds to 40-45dB L_{A90} at high wind speeds.

13.4.1 Noise limits

83. 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 13.3.9**. 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 in **Tables 13.6 and 13.7**.

Standardised Wind speed (m/s)	4	5	6	7	8	9	10	11	12
Achavraid	38.0	38.0	38.0	40.7	44.2	48.1	52.3	52.3	52.3
Achaglass	38.0	38.0	38.0	38.0	38.0	40.2	45.0	45.0	45.0
Grassfield Farm	38.0	38.0	38.0	38.0	40.6	43.5	46.5	49.5	49.5
Escart Farm	38.0	38.0	38.0	38.6	40.4	42.3	44.1	44.1	44.1
Oragaig	38.0	38.0	38.0	38.6	40.4	42.3	44.1	44.1	44.1
Gartavaich	38.0	38.0	38.0	38.0	39.8	42.8	45.0	45.0	45.0
Meadowview	38.0	38.0	38.0	38.0	40.6	43.5	46.5	49.5	49.5
Lochview	38.0	38.0	38.0	39.5	41.6	43.3	44.6	45.3	45.3
Lonlia	38.0	38.0	38.0	38.0	39.8	42.8	45.0	45.0	45.0
Arivore Farm	38.0	38.0	38.0	39.5	41.6	43.3	44.6	45.3	45.3
Glenreasdale House	38.0	38.0	38.0	39.5	41.6	43.3	44.6	45.3	45.3
Housing Plot 1	38.0	38.0	38.0	38.0	40.3	43.5	47.0	50.7	50.7
Housing Plot 2	38.0	38.0	38.0	38.0	40.3	43.5	47.0	50.7	50.7

Standardised Wind speed (m/s)	4	5	6	7	8	9	10	11	12
Housing Plot 3	38.0	38.0	38.0	38.0	40.3	43.5	47.0	50.7	50.7
Glebe Cottage	38.0	38.0	38.2	40.2	42.4	42.4	42.4	42.4	42.4
Birchfield	38.0	38.0	38.0	38.0	40.6	43.5	46.5	49.5	49.5

Table 13.6: Day time L_{A90} noise limits derived from the baseline noise survey according to ETSU-R-97

Standardised Wind speed (m/s)	4	5	6	7	8	9	10	11	12
Achavraid	43.0	43.0	43.0	43.0	43.0	43.3	46.7	46.7	46.7
Achaglass	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.9	44.9
Grassfield Farm	43.0	43.0	43.0	43.0	43.0	43.0	44.6	45.7	45.7
Escart Farm	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Oragaig	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Gartavaich	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Meadowview	43.0	43.0	43.0	43.0	43.0	43.0	44.6	45.7	45.7
Lochview	43.0	43.0	43.0	43.0	43.0	43.8	46.5	48.8	48.8
Lonlia	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Arivore Farm	43.0	43.0	43.0	43.0	43.0	43.8	46.5	48.8	48.8
Glenreasdale House	43.0	43.0	43.0	43.0	43.0	43.8	46.5	48.8	48.8
Housing Plot 1	43.0	43.0	43.0	43.0	43.0	43.0	45.7	48.2	48.2
Housing Plot 2	43.0	43.0	43.0	43.0	43.0	43.0	45.7	48.2	48.2
Housing Plot 3	43.0	43.0	43.0	43.0	43.0	43.0	45.7	48.2	48.2
Glebe Cottage	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Birchfield	43.0	43.0	43.0	43.0	43.0	43.0	44.6	45.7	45.7

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

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

- the ETSU-R-97 daytime limit of 38dB(A) (or 5dB above the prevailing background noise level, whichever is the higher), as set out above in **Section 13.3.9**; 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.

13.5 Assessment of effects

13.5.1 Construction Potential construction effects

86. Predicted noise levels at the closest noise sensitive receptors for each of the key activities during construction of the proposed Development are presented in Table 7 of **Technical Appendix 13.1**. The proposed construction activities would generally occur at 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.
87. For track upgrades and track construction activities closest to Glebe Cottage, increased noise levels are predicted on a worst-case basis but likely to represent those for a very short-term period of around one month. Noise levels will quickly diminish as

track construction progresses, moving the activity further from the property. Considering the short duration of the work, no construction works other than vehicle movements to access the Site would occur within 500 metres of Glebe Cottage on Sundays (which would otherwise increase the impact), along with the likelihood of the levels being lower in practice and the criteria of **Table 13.5**, the associated effects are considered to be of minor significance.

88. If blasting is employed to quarry the proposed borrow pits, there is a potential for this to affect the nearest properties. 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 in this Chapter and in the proposed mitigation section.

89. 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. Based on the prediction methodology in BS 5288, the worst-case predicted noise level, due to heavy vehicles moving on the site access track, at the closest dwelling is 45 dB L_{Aeq}. This corresponds to a negligible impact. The effect of traffic on existing roads was assessed using the CRTN methodology, with a maximum predicted increase of 1.6 dB(A) in the day-time average noise level. Based on the criteria set out in the DMRB, this predicted short-term change in traffic noise levels corresponds to a minor impact. In conclusion, noise from construction activities has been assessed and is predicted to result in a temporary minor effect, which is not significant in EIA terms.

Embedded measures

90. An outline CEMP is provided in **Appendix 3.1**. The final CEMP would be secured through a planning condition. This would include measures to control construction noise including:

- As proposed in **Chapter 3 Proposed Development**, Construction works 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 at weekends, unless otherwise approved in advance by A&BC (except in case of an emergency). No construction works other than vehicle movements would be undertaken within 500m of Glebe Cottage on Sundays. 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; and
- 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.

Proposed mitigation

91. Unless otherwise agreed in consultation with A&BC, for example due to large separation distances, if blasting is to be employed at some of the borrow pits, the potential noise and vibration effects of blasting operations would be reduced (unless otherwise agreed with A&BC due to important separation distances) 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 A&BC;
- vibration levels at the nearest sensitive properties are best controlled through onsite testing processes carried out in consultation with A&BC. 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 A&BC for approval of blasting details, which would outline the mitigation measures to be adopted.

Residual construction effects

92. 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. 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, such as no physical construction works other than vehicle movements to occur within 500 metres of Glebe Cottage on Sundays, the associated effects would still be a negligible to minor temporary adverse impact and therefore not significant.

13.5.2 Operation

Potential operational effects

93. The predictions of operational noise for the proposed Development in isolation at the noise-sensitive locations of **Table 10.4** are detailed in **Table 12** of **Technical Appendix 13.1**. These varied between 20-30 dB(A) at low wind speeds and 24-34 dB(A) at high wind speeds.

94. The assessment presented within **Tables 14 and 15** of **Technical Appendix 13.1** demonstrates that the derived ETSU-R-97 noise limits (**Tables 10.6 and 10.7**) are predicted to be clearly achieved by the proposed Development at all wind speeds and assessment locations, by a margin of more than 3 dB.

95. In conclusion, the operational noise levels from the proposed Development in isolation are considered acceptable in line with relevant noise limits.

Embedded measures

96. 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.

Proposed mitigation

97. The selection of the final turbine to be installed at the Site would be made on the basis of enabling the ETSU-R-97 noise limits to be achieved at surrounding properties, including any relevant tonality corrections. As ETSU-R-97 noise limits apply to the cumulative noise from all windfarms in the area, this is considered below in further detail.

Residual operational effects

98. 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 renewable energy development 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.

13.6 Cumulative assessment

99. The cumulative noise predictions obtained when combining the proposed Development with other windfarms considered are set out in **Table 13** of **Technical Appendix 13.1** and are also illustrated on **Figure 13.1**. They varied between 27-30 dB(A) at low wind speeds and 35-39 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**.

100. The assessment presented within **Tables 16 and 17 of Technical Appendix 13.1** demonstrates that the derived ETSU-R-97 noise limits (**Tables 13.6 and 13.7**) are predicted to be achieved in the cumulative case at almost all wind speeds and assessment locations.
101. The only exception is for the Housing Plot 1 property, should it be constructed, where an excess above the day-time noise limit of less than 1dB is predicted at wind speeds of 6 and 7 m/s. Such an excess is not acoustically important and is unlikely to be perceptible, however this is a theoretical excess above the ETSU-R-97 criteria. Operational constraints can be applied which would enable cumulative noise immission levels to be within the ETSU-R-97 day time criteria at this location (if the housing plot is constructed). One method to achieve this reduction would be shutting down turbines 1 and 7 at the relevant wind speeds of 6 and 7 m/s. A similar reduction could be obtained with other operational constraints and/or different turbine models. Directional effects, such as those suggested in the IOA GPG, would also mean such constraints would likely only be required over a limited range of wind directions, *i.e.* when Housing Plot 1 is downwind of the proposed Development. **Table 18 of Technical Appendix 13.1** demonstrates that this operational constraint results in compliance of cumulative noise levels with the derived day-time noise limit at this property.
102. In conclusion, the cumulative operational noise levels from the proposed Development are considered acceptable in line with relevant noise limits.
103. Satisfactory control of cumulative noise immission levels would be achieved through enforcement of the individual consent limits for each of the individual windfarms. Specific noise limits for the proposed Development are set out below in **Tables 13.8 and 13.9**. They were determined such that compliance of the proposed Development with these noise limits would maintain the conclusion of the cumulative assessment (discussed below) and result in cumulative levels which do not exceed the derived ETSU-R-97 noise criteria of **Tables 13.6 and 13.7**. The selection of the final turbine to be installed at the Site would be made on the basis of enabling these derived specific noise limits to be achieved at surrounding properties, including any relevant tonality corrections.
104. Conditions attached to the planning consent should include the requirement that, in the event of a noise complaint, noise levels resulting from the operation of the proposed Development 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).

Standardised Wind speed (m/s)	4	5	6	7	8	9	10	11	12
Achavraid	37.7	37.7	37.7	40.4	43.9	47.8	52.0	52.0	52.0
Achaglass	37.5	37.5	37.5	37.5	37.5	39.7	44.5	44.5	44.5
Grassfield Farm	34.6	34.6	34.6	34.6	37.2	40.1	43.1	46.1	46.1
Escart Farm	36.3	36.3	36.3	36.9	38.7	40.6	42.4	42.4	42.4
Oragaig	35.2	35.2	35.2	35.8	37.6	39.5	41.3	41.3	41.3
Gartavaich	35.3	35.3	35.3	35.3	37.1	40.1	42.3	42.3	42.3
Meadowview	37.3	37.3	37.3	37.3	39.9	42.8	45.8	48.8	48.8
Lochview	35.4	35.4	35.4	36.9	39.0	40.7	42.0	42.7	42.7
Lonlia	29.8	29.8	29.8	29.8	31.6	34.6	36.8	36.8	36.8
Arivore Farm	36.1	36.1	36.1	37.6	39.7	41.4	42.7	43.4	43.4
Glenreasdale House	36.3	36.3	36.3	37.8	39.9	41.6	42.9	43.6	43.6
Housing Plot 1*	32.1	32.1	32.1	32.1	35.0	37.6	41.1	44.8	44.8
Housing Plot 2*	33.4	33.4	33.4	33.4	35.7	38.9	42.4	46.1	46.1
Housing Plot 3*	34.6	34.6	34.6	34.6	36.9	40.1	43.6	47.3	47.3
Glebe Cottage	37.5	37.5	37.7	39.7	41.9	41.9	41.9	41.9	41.9
Birchfield	36.5	36.5	36.5	36.5	39.1	42.0	45.0	48.0	48.0

* If constructed.

Table 13.8: specific day-time noise limits (L_{A90}) applicable to the proposed Development in isolation

Standardised Wind speed (m/s)	4	5	6	7	8	9	10	11	12
Achavraid	42.7	42.7	42.7	42.7	42.7	43.0	46.4	46.4	46.4
Achaglass	42.5	42.5	42.5	42.5	42.5	42.5	44.4	44.4	44.4
Grassfield Farm	39.6	39.6	39.6	39.6	39.6	39.6	41.2	42.3	42.3
Escart Farm	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3
Oragaig	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2
Gartavaich	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3
Meadowview	42.3	42.3	42.3	42.3	42.3	42.3	43.9	45.0	45.0
Lochview	40.4	40.4	40.4	40.4	40.4	41.2	43.9	46.2	46.2
Lonlia	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Arivore Farm	41.1	41.1	41.1	41.1	41.1	41.9	44.6	46.9	46.9
Glenreasdale House	41.3	41.3	41.3	41.3	41.3	42.1	44.8	47.1	47.1
Housing Plot 1*	37.1	37.1	37.1	37.1	37.1	37.1	39.8	42.3	42.3
Housing Plot 2*	38.4	38.4	38.4	38.4	38.4	38.4	41.1	43.6	43.6
Housing Plot 3*	39.6	39.6	39.6	39.6	39.6	39.6	42.3	44.8	44.8
Glebe Cottage	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Birchfield	41.5	41.5	41.5	41.5	41.5	41.5	43.1	44.2	44.2

* If constructed.

Table 13.9: specific night-time noise limits (L_{A90}) applicable to the proposed Development in isolation

13.7 Summary and statement of significance

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

13.8 References

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