ScottishPower Renewables

Hare Hill Windfarm

Repowering and Extension

Environmental Impact Assessment Report

Volume 1

Chapter 13: Noise and Vibration

November 2025

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Abbreviations

Abbreviation	Description
AM	Amplitude modulation. A sound is modulated in amplitude when its level exhibits periodic fluctuations.
BS	British Standard
CRTN	Calculation of Road Traffic Noise
CTMP	Construction Traffic Management Plan
dB	Abbreviation for 'decibel'
dB(A)	Abbreviation for the decibel level of a sound that has been A-weighted
DMRB	Design Manual for Roads and Bridges
DGC	Dumfries and Galloway Council
EAC	East Ayrshire Council
EIA	Environmental Impact Assessment
GPG	Good Practice Guide
HH	Hare Hill
HHE	Hare Hill Extension
IOA	Institute of Acoustics UK
m	meters
MIOA	Member of the Institute of Acoustics
m/s	Meters per second
MW	Megawatts
NPF4	National Planning Framework 4
OS	Ordnance Survey
PAN	Planning Advice Note
SEP	Stakeholder Engagement Plan
SSNL	Site Specific Noise Limit
TNL	Total Noise Limit

13. Noise and Vibration

13.1. Statement of Competence

1. This assessment has been completed by Mark Jiggins MSc, Associate Acoustic Consultant at Hoare Lea. Mark is a full member of the Institute of Acoustics (MIOA) and an expert in the assessment of windfarm noise, with 33 years of experience of environmental noise, development of more than 80 windfarm projects and assessing more than 20 operational sites. Mark is one of the authors of the ETSUR97 guidelines which apply to control operational windfarm noise.

13.2. Introduction

2. This chapter summarises the assessment of the potential noise and vibration effects of the proposed Development on the residents of nearby noise-sensitive receptors. Full details of the noise assessment can be found in the Hoare Lea Technical Report, included as **Technical Appendix 13.1**. The assessment considers the proposed Development's construction and its operation.

3. The proposed Development will replace and extend the existing Hare Hill Windfarm (HH) and the Hare Hill Windfarm Extension (HHE) in two phases. There are a number of existing operational wind turbines located within the Site of the proposed Development, related to the operational HH and HHE. Phase one of the proposed Development will replace and extend the wind turbines on HH and these would operate together with the existing wind turbines on HHE. Phase two of the proposed Development will complete the development by replacing and extending the wind turbines on HHE.

4. The assessment considers the potential significant noise effects of the construction and operation of the proposed Development. Assessment of the operational noise effects accounts for the cumulative effects of the proposed Development with other windfarms. Phase one of the proposed Development would operate cumulatively with the existing wind turbines on HHE as one complete windfarm. Other windfarms considered cumulatively were those closest and consisted of the operational Afton Windfarm, the consented Pencloe Windfarm, the operational Sanqhuar Windfarm, the consented Sanquhar II Windfarm, the operational Sandy Knowe Windfarm, the proposed Sandy Knowe Windfarm Extension and the single operational wind turbine at High Park Farm. Other, more distant windfarms were not considered as they do not make an acoustically relevant contribution to cumulative noise levels[1].

13.3. Legislation, Policy and Guidance

5. Scottish National Planning Framework 4 (NPF4) (updated 2024) provides advice on how the planning system should manage the process of encouraging, approving and implementing renewable energy proposals including onshore wind farms. NPF4 suggests that renewable energy developments must demonstrate how impacts including noise are

1 The IOA GPG suggests that cumulative noise effects need not be considered where differences between existing and proposed windfarm noise levels are 10 dB(A) or more.

to be addressed through design and mitigation, going on to advise that *"In considering these impacts, significant weight will be placed on the contribution of the proposal to renewable energy generation targets and on greenhouse gas emissions reduction targets."*; however, NPF4 provides no specific advice on noise.

6. Planning Advice Note PAN1/2011 (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 wind farms.

7. The Scottish Government's online guidance ('Onshore wind turbines: planning advice', 2014), referenced in PAN 1/2011, provides further advice on noise, and confirms that the recommendations of 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97) *"should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments"*.

8. Guidance on good practice on the application of ETSU-R-97 has been provided in the IOA Good Practice Guide. The Scottish Government Onshore Wind Policy Statement 2022 mentions the potential for the advice in ETSU-R-97 to be modified in future, based on a review from the UK Government, but confirms the ETSU-R-97 methodology continues to be applicable and should be used until it is replaced or updated. Although the UK Government published in July 2025 a draft for consultation of a revision of the ETSU-R-97 guidelines, it noted that this draft guidance should not be used until a response to this consultation is published.

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 1974.

10. The Control of Pollution Act 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.

13.4. Method of Assessment

13.4.1. Assessed Effects

11. The proposed Development includes the construction and operation of wind turbines and ancillary infrastructure.

12. Noise which arises from the construction of a windfarm is of a temporary nature. The main work locations for construction of the proposed turbines are more than 1 km from the nearest noise sensitive residences. The construction and use of access tracks and some of the required infrastructure would, however, occur at lesser separation distances (320 m) but involve relatively limited works. 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. Details of construction traffic routes and proposed working hours are described in **Chapter 11: Traffic & Transport.**

13. Once constructed and operating, wind turbines may emit two types of noise:

    - aerodynamic noise from the blades; and
    - mechanical noise from other components (which can be minimised by good engineering design).

14. Aerodynamic noise tends to be perceived when the wind speeds are low; although, at very low wind speeds the blades do not rotate, or rotate very slowly and so, at these wind speeds, negligible aerodynamic noise is generated. In higher winds, aerodynamic noise is generally masked by the normal sound of wind blowing through trees and around buildings. The level of this natural 'masking' noise relative to the level of wind turbine noise determines the subjective audibility of the wind farm. The relationship between wind turbine noise and the naturally occurring masking noise at residential dwellings around the Site will, therefore, generally form the basis of the assessment of the levels of noise against accepted standards.

15. The proposed Development also includes a substation which will emit a level of noise during operation.

16. In light of the above, the following effects have been assessed:

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

13.4.2. Effects Scoped Out

17. 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':

    - British Standard (BS) 5228-2 provides general guidance on legislation, prediction, control and assessment criteria for construction vibration. 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. The primary source of ground borne vibration is likely to occur within the quarrying activities associated with borrow pits. Given that the borrow pit search areas are a minimum of 1.4 km from the nearest vibration-sensitive dwellings, it is very unlikely that adverse vibration effects would result even if blasting is used. Occasional momentary vibration can arise when heavy vehicles pass dwellings at very short separation distances, as is the case with the existing traffic in the area, but again this is not sufficient to constitute a risk of significant effects in this instance. On this basis, construction vibration effects are not considered further in this assessment.
    - The results of previous research detailed in **Annex A** of **Technical Appendix 13.1** has demonstrated that vibration resulting from the operation of wind farms is imperceptible at typical separation distances (of more than a few 100 m). Therefore, vibration effects during operation do not warrant detailed assessment and are not considered further in this assessment.

- The proposed Development will include a substation, which would emit a level of noise during operation (e.g. electrical plant and air conditioning systems). Given the separation distances between the substation and the nearest residential properties (approximately 2.7 km), the associated levels of operational noise would be negligible and not significant based upon experience of similar installations and professional judgement. Therefore, the associated effects do not warrant detailed assessment and have not been considered further.
- Other, more distant windfarms (in addition to those specifically named in the cumulative assessment) are not considered further in the operational noise assessment as they represent a relatively negligible contribution to predicted noise levels.
- Traffic during the operational phase of the proposed Development is likely to be very low and is considered unlikely to have any noise effects. Therefore, traffic-induced noise during operation does not warrant further assessment as part of the proposed Development proposal.

13.4.3. Data Sources

18. The following data sources have informed the assessment:

- Ordnance Survey (OS) information concerning the locations of all noise sensitive receptors in the vicinity of the Site;
- BS reference material for the sound emission characteristics of various construction activities associated with proposed Development;
- manufacturer data for the candidate turbines for the proposed Development and those on adjacent windfarms relevant to the assessment of cumulative effects, as set out in **Technical Appendix 13.1**; and
- EIA Reports/Environmental Statements for the other windfarms considered in the cumulative assessment (see **Technical Appendix 13.1** for details).

13.4.4. Study Area

19. The study area for the assessment of operational noise comprises noise-sensitive residential properties which could be exposed to noise from the proposed Development or other windfarms relevant to the assessment of cumulative effects. These assessment locations are shown in the maps provided in **Annex B** and listed out in detail in **Table 2** and **Table 3** of **Technical Appendix 13.1.**

20. The assessment of construction noise has considered the similar residential properties as the operational assessment, located closest to the proposed Development turbines, as well as those located alongside the Site access route.

13.4.5. Methodology for Assessing Construction Noise Impacts

21. Detailed guidance on construction noise and its control is provided by BS 5228-1: 2009. Analysis of construction noise impacts has been undertaken in accordance with the methodologies outlined in this standard, which provides methods for predicting

construction noise levels on the basis of reference data for the emissions of typical construction plant and activities. These methods include:

- the calculation of the volumes and types of construction traffic along access tracks and haul routes to the proposed Development; and
- construction activities at fixed locations, including the bases of turbines, temporary construction compounds and the substation.

22. 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.

23. Changes in the predicted traffic noise level on existing roads have been calculated using the Calculation of Road Traffic Noise (CRTN) methodology.

24. Based on the range of guidance values set out in Annex E of BS 5228-1 and other relevant guidance, the impact criteria presented in **Table 1** of **Technical Appendix 13.1** have been derived. The values have been chosen in recognition of the relatively low ambient noise typically observed in rural environments. The presented criteria have been normalised to free-field day-time noise levels occurring over a time period, T, equal to the duration of a working day on site. Specifically, the criteria relate to day-time hours from 07:00 to 19:00 on weekdays, and 07:00 to 12:00 on Saturdays.

25. When considering the impact of short-term changes in traffic associated with the construction activities on existing roads in the vicinity of the proposed Development, reference is made to the criteria set out in Design Manual for Roads and Bridges (DMRB). The classification of the magnitude of change in the predicted traffic noise level for short-term changes, such as those associated with construction activities, is set out in **Section 3** of **Technical Appendix 13.1**. For properties where the CRTN methodology cannot be used due to low traffic levels (such as on-site tracks), the criteria set out in **Section 3** of **Technical Appendix 13.1** can be referenced in relation to absolute levels of construction traffic predicted.

13.4.6. Methodology for Assessing Operational Noise Impacts

26. The assessment of operational noise impacts has been carried out in accordance with the methodology set out in ETSU-R-97, which is described in more detail in **Technical Appendix 13.1**.

27. 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 (2013) has also been referenced, as is recommended in the Scottish Government's Online Renewables Planning Advice on Onshore wind turbines.

28. ETSU-R-97 first offers an alternative simplified assessment methodology: if predicted noise levels do not exceed 35 dB(A) up to a wind speed of 10 m/s, then they are considered acceptable and background noise surveys are not considered necessary. Where this simplified approach would not be appropriate, ETSU-R-97 sets out a detailed methodology which includes the following steps:

- specify the number and locations of the wind turbines and other wind farms to be included in the assessment;

- identify the locations of the nearest, or most noise sensitive, neighbours;
- determine the background noise levels as a function of site wind speed at the nearest neighbours, or at least at a representative sample of the nearest neighbours, either through direct measurement or by reference to data already obtained during previous surveys in the area;
- determine the day-time and night-time noise limits from the measured background noise levels at the nearest neighbours;
- specify the type and noise emission characteristics of the wind turbines;
- calculate noise immission2 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 wind farms 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.

29. As set out above, the acceptable 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 will therefore need to consider the combined operational noise of the proposed Development with other windfarms in the area. The test applied to operational noise is whether or not the calculated windfarm noise immission levels (cumulative from all wind turbines) at nearby noise sensitive properties lie below the noise limits derived in accordance with ETSU-R-97. ETSU-R-97 also requires that the baseline levels on which the noise limits are based do not include a contribution from any existing turbine noise, to prevent unreasonable cumulative increases. The IOA Good Practice Guide also advises that cumulative noise effects need not be considered where differences between existing and proposed windfarm noise levels are 10 dB or more.

30. There are a number of other wind energy developments in the area of the proposed Development, some of which are operational and some consented but not yet operational. Each of these other wind energy developments were required to consider baseline information in order to derive noise limits in accordance with ETSU-R-97 and undertake an appropriate noise assessment. In addition, the existing wind turbines present on the proposed Development are controlled by noise limits which also relate to existing baseline background noise levels.

31. A review of adjacent sites and the existing turbines on the proposed Development has confirmed that suitable baseline background noise levels for all relevant noise sensitive receptors around the proposed Development have already been sufficiently defined for the purposes of an assessment in accordance with ETSU-R-97, accordingly additional baseline surveys were not undertaken for the proposed Development. The baseline data from the previous surveys remains representative of the noise environment. This approach also provides consistency when considering cumulative effects of the proposed

2 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.

Development and the appropriate noise limits which are applicable, whilst also considering the noise limits which apply to the existing turbines on the proposed Development.

32. The assessment criteria are derived from baseline noise levels previously used to define noise limits which apply to the existing wind turbines on the proposed Development (HH and HHE) or total ETSU-R-97 noise limits defined in the consents for adjacent windfarms. Based upon these, the approach to the assessment is to define assessment criteria using two approaches:

    - at 11 assessment locations, site-specific assessment criteria (referred to as 'SSNL') have been derived by consideration of either specific limits which apply to the existing wind turbines on the proposed Development (HH and HHE), or on the basis of criteria representing a negligible impact (with consideration of the contribution of existing turbines in some cases); or
    - for the remaining four assessment locations closer to the proposed Development, or where noise levels from the proposed Development are comparable to that of other windfarms, the relevant total ETSU-R-97 noise limits are used for a cumulative assessment of the proposed Development when operating with other relevant adjacent windfarms (referred to as 'TNL').

33. In assessing noise from the proposed Development this is assessed for both phases where:

    - phase one consists of the wind turbines which repower and extend the existing HH wind turbines and operate in combination with the existing wind turbines on HHE; and
    - phase two consists of the phase one turbines and those added for phase two which repower and extend the wind turbines on HHE.

34. Further details of the approach to the assessment are given in **Section 4** of **Technical Appendix 13.1.**

35. The ETSU-R-97 fixed element of the night-time limit is stipulated to be 43 dB(A). For day-time periods, the precise choice of fixed element of the noise limit within the range 35 dB(A) to 40 dB(A) according to ETSU-R-97 depends on a number of factors: the number of noise-affected properties, the likely duration and level of exposure and the consequences of the choice on the potential power generating capability of the windfarm.

36. This assessment is based on a choice of 40 dB(A) for the fixed part of the day-time limit, consistent with the choice, and directly adopting for this assessment, the cumulative noise limits consistent with the value adopted within the consents for adjacent windfarms. The choice of 40 dB(A) for these other schemes was relevant on the premise of their significant energy generating capacity, combined with the relatively low number of dwellings in the surrounding area.

37. It would be illogical to adopt a lower choice within this range when assessing the proposed Development, considering the choice of 40 dB(A) has already been made when consenting adjacent schemes at many of the receptor locations relevant to assessment of the proposed Development. The proposed Development represents a substantial increase in the energy generating capacity compared with the existing wind turbines on

the proposed Development (approximately three times once both phases are completed) and adding substantially to the generating capacity of the adjacent windfarms.

38. It is therefore considered wholly appropriate to adopt the same choice for the fixed part of the total ETSU-R-97 noise limits for consistency of control of cumulative noise levels and as the basis for assessment of the proposed Development.

39. Full details of the operational noise assessment, including details of the noise output of the candidate turbine models considered for the noise assessment and the calculation parameters on which predictions have been based, are presented in **Technical Appendix 13.1**. The calculation parameters and assumed source noise levels are in line with the IOA Good Practice Guide.

13.4.7. Low Frequency Noise, Vibration and Amplitude Modulation

40. Low frequency noise resulting from the operation of windfarms has been discussed in detail over the past 20 years, as set out in **Annex A** of **Technical Appendix 13.1**. 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. This is consistent with the Scottish Government Onshore Wind Policy Statement 2022.

41. **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.

13.4.8. Statement of Significance

42. For construction noise, the magnitude of impacts generally translate directly to their significance, given that all receptors considered are residential and these are assessed as having a high sensitivity. Negligible impacts are negligible effects, slight impacts represent minor effects. Major and moderate impacts represent major and moderate effects which are considered **'Significant'**.

43. For operational wind turbine noise, acceptable limits for wind turbine noise are clearly defined in ETSU-R-97; accordingly, predicted operational noise levels which are below the ETSU-R-97 criteria are considered '**Not Significant'** in the context of the EIA Regulations. If predicted noise levels are above the ETSU-R-97 criteria, effects are considered to be '**Significant'** in the context of the EIA Regulations.

13.4.9. Noise Predictions

44. The predictions of construction noise have been made using the BS 5228 methodology and representative emission levels based on the types and number of equipment typically associated with key phases of constructing a windfarm and precautionary assumptions about working practices and propagation (see **Technical Appendix 13.1**).

45. The level of construction noise that occurs at the surrounding properties would be highly dependent on a number of factors such as the final construction programme, equipment

types used for each process, and the operating conditions that prevail during construction. It is not practically feasible to specify each and every element of the factors that may affect 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.

46. 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 a mix of three indicative turbine models have been assumed for the operational noise assessment, being the noise specification of the Vestas V136-4.5 MW (turbines with a tip height of 150 m), the V150-6.0 MW (turbines with a tip height of 180 m) and the V162-6.8 MW (turbines with a tip height of 200 m). Levels of noise from the layout of turbines on the proposed Development for both phase one and phase two have been modelled using the layouts indicated in **Figure B2** and **Figure B3** of **Technical Appendix 13.1**. The layout of the existing wind turbines on the site of the proposed Development, as well as adjacent windfarms, are shown in **Figure B1** of **Technical Appendix 13.1**.

47. Assessment of the operational noise effects accounts for the cumulative effect of the proposed Development as well as Afton Windfarm (operational), Pencloe Windfarm (consented), Sanqhuar Windfarm (operational), Sanquhar II Windfarm (consented), Sandy Knowe Windfarm (operational), Sandy Knowe Windfarm Extension (Proposed) and the single wind turbine at High Park Farm (operational). Other, more distant windfarms have not been considered as they do not make an acoustically relevant contribution to cumulative noise levels.

48. In all cases, the assumptions made on noise emission levels and the prediction methodology used are in accordance with the IOA Good Practice Guide (see **Technical Appendix 13.1** for details).

13.4.10. Embedded Mitigation

49. To reduce the potential effects of noise associated with construction, the following mitigation measures are proposed:

- As set out in **Chapter 5: Proposed Development Description**, 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 08:00 to 12:00 on Saturdays unless otherwise approved in advance by East Ayrshire Council (EAC) and Dumfries and Galloway Council (DGC) (except in the case of an emergency). Those activities that are unlikely to give rise to noise audible at the Site boundary.
- Light vehicle traffic accessing the Site such as those involved with staff mobilisation, may continue outside of the stated hours;
- all construction activities shall adhere to good practice as set out in BS 5228-1;
- 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 to undertake some construction activities within the Site at different locations, the distance from residential properties would be maximised if possible subject to other safety and practical constraints;
- a Construction Traffic Management Plan (CTMP) will be developed and secured through planning condition to control the movement of vehicles to and from the Site;
- 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
- a detailed plan on community relations, including a Stakeholder Engagement Plan (SEP), the setting up of a noise compliance phone line, a procedure to notify residents of any necessary work outside of the permitted working hours and an approach to the investigation of complaints.

13.5. Consultation Undertaken

50. The approach to the assessment, and in particular the proposed approach to use of historical background noise data and the approach to assessment of noise from the proposed Development, was set out in a letter to both EAC and DGC on 3rd December 2024. EAC responded that the methodology proposed was acceptable, insofar as it applies to those receptors within the EAC area. No response was received from DGC.

51. The baseline background noise levels referenced, and detailed assessment methodology are discussed further in **Technical Appendix 13.1**. In summary, the detailed noise assessment has been undertaken in line with these requirements as detailed in **Section 4** of **Technical Appendix 13.1** and discussed above.

13.6. Baseline

52. The baseline noise environment at the nearest noise-sensitive location is likely to be typical of a rural area and generally characterised by 'natural' sources, such as wind disturbed vegetation, birds, farm animals, water flow sounds as well as existing wind energy developments. A number of nearby receptor locations are closer to the A76 road running approximately east to west to the north of the proposed Development, with these nearby receptors also likely to experience some road traffic noise. Other sources of noise are likely to include agricultural vehicle movements in the area, commercial forestry, occasional road traffic (for receptors further from the A76) and distant aircraft.

53. There are a number of other wind energy developments in the area around the proposed Development, some of which are operational and some consented but not yet operational. Each of these other wind energy developments were required to consider baseline information in order to derive noise limits in accordance with ETSU-R-97 and undertake an appropriate noise assessment. In addition, the existing wind turbines that form HH and HHE are controlled by noise limits which also relate to existing baseline background noise levels. A review of these adjacent sites and the existing turbines on the proposed Development has confirmed that suitable baseline background noise levels for all relevant noise sensitive receptors around the proposed Development have already been sufficiently defined for the purposes of an assessment in accordance with ETSU-R-97, accordingly additional baseline surveys were not undertaken for the proposed Development. The resulting data remains representative of the noise environment. This approach also provides consistency when considering cumulative effects of the proposed

Development and the appropriate noise limits which may apply to the proposed Development, whilst also considering the noise limits which apply to the existing turbines on the proposed Development.

54. The operational noise assessment has been completed at fifteen noise assessment locations situated around the Site and require noise impacts of the proposed Development to be assessed. This list is not intended to be exhaustive but sufficient to be representative of noise levels typical of those receptors closest to the proposed Development. Those locations which are further from the proposed Development would be less exposed to noise from the proposed Development, with consequently reduced impacts, and are not considered further. This approach is consistent with the guidance provided by ETSU-R-97 and current good practice as set out in the IOA GPG. The fifteen assessment locations are listed in **Table 2** of **Technical Appendix 13.1** and shown in the plans in Annex B of **Technical Appendix 13.1.**

13.7. Assessment of Potential Effects

13.7.1. Construction Noise Effects

55. Predicted noise levels at the closest noise sensitive receptor for each of the key activities during construction of the proposed Development are presented in **Table 8** of **Technical Appendix 13.1.**

56. The anticipated construction activities around the turbines of the proposed Development would occur at relatively long distances from residential properties, such that the resulting predicted noise levels are less than 50 dB(A). With reference to the construction noise impact criteria the noise impacts from these activities would therefore be negligible.

57. Other activities such as upgrading existing site tracks, construction of the new site track and creation of hardstanding adjacent to the existing access track, may generate levels of up to 59 dB(A) (although these are likely to be for relatively brief periods of time). Based on the construction noise impact criteria, this would correspond to a minor impact at most.

58. In addition to onsite activities, construction traffic passing to and from the Site will also represent a potential source of noise to surrounding properties. Reference was made to the assessment presented in **Chapter 11: Access, Traffic and Transport**.

59. 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 would not exceed 51 dB(A). This corresponds to a minor impact. The impact of traffic on existing roads was assessed using the CRTN methodology, with a maximum predicted increase of less than 2 dB(A) in the day-time average noise level for the roads considered. Based on the criteria set out in the DMRB, this predicted short-term change in traffic noise levels corresponds to a minor impact.

60. There is no potential for in-combination effects from the Site due to traffic and other construction activities combining to increase the potential effects, particularly as the track upgrade works would not be undertaken simultaneously with construction traffic movements to and from the Site.

61. In conclusion, noise from construction activities has been assessed and is predicted to result in a temporary negligible to minor impacts on highly sensitive receptors, which represents negligible to minor effects, which are **Not Significant**.

13.7.2. Operational Noise Effects

62. The predictions of operational noise for both phases of the proposed Development (phase one in combination with HHE and phase two) are shown in **Table 12** and **Table 13** of **Technical Appendix 13.1** respectively.

63. These predictions vary between approximately 14 dB(A) to 32 dB(A) at low wind speeds to 26 dB(A) to 42 dB(A) at higher wind speeds, over the range of 4 m/s to 12 m/s over which predictions were made (in line with ETSU-R-97 guidance). The highest predicted noise levels are those at the assessment location of Hillend, which is financially involved with the existing turbines operating on HH and HHE and will be financially involved with the proposed Development.

64. **Tables 16 to 19** of **Technical Appendix 13.1** provide comparison of predicted noise levels from both phases of the proposed Development (as discussed above) with both the day-time and night-time assessment criteria, for the eleven assessment locations where the assessment consists of comparison only with site-specific criteria ('SSNL').

65. These tables show that noise levels from phase one of the proposed Development (operating with HHE) meet these SSNL criteria at most of the assessment locations, except during the day-time at the financially involved location of Hillend (to the east) with a maximum excess of approximately 0.6 dB(A) and at two assessment locations of Craig and Craigdarroch to the south west, with a maximum excess of approximately 1.7 dB(A). During the night-time the criteria are met at all wind speeds at all assessment locations except again at Hillend, where there is similarly a 0.6 dB(A) maximum excess. Noise levels from phase two of the proposed Development meet these SSNL criteria at all of the assessment locations during both day-time and night-time periods.

66. Cumulative predictions of operational noise for the two phases of the proposed Development (phase one in combination with HHE) and phase two are shown in **Table 14** and **Table 15** of **Technical Appendix 13.1** when operating together with the adjacent Afton Windfarm, Pencloe Windfarm and the single High Park Farm turbine. Cumulative predicted noise levels are provided for the four receptor locations where a cumulative assessment is required ('TNL'), as discussed above. These predictions vary between approximately 22 dB(A) to 26 dB(A) at low wind speeds to 32 dB(A) to 36 dB(A) at higher wind speeds, over the range of 4 m/s to 12 m/s over which predictions were made (in line with ETSU-R-97 guidance).

67. **Tables 20 to 23** of **Technical Appendix 13.1** provide comparison between these cumulative predicted noise levels (phase one and phase two) with both the day-time and night-time assessment criteria, for the four assessment locations where the assessment consists of comparison with the total ETSU-R-97 criteria ('TNL'). These tables show that noise levels from operating both phase one (operating with HHE) and phase two, when operating together with adjacent windfarms meet the assessment criteria at all wind speeds during both day-time and night-time.

68. These comparisons assume unconstrained operation of the turbines on the proposed Development. Predicted operational noise levels from phase one of the proposed

Development are not compliant with the site-specific assessment criteria, whilst once phase two is complete the proposed Development would be fully compliant with the assessment criteria. Accordingly, the effects of noise from phase one are therefore significant (in the absence of mitigation) and those from phase two are not significant.

13.8. Mitigation

69. Noise immission levels from operating phase one of the proposed Development (operating with HHE) are predicted to be above the site-specific criteria defined for the assessment at two receptors the south west during the day-time, and marginally above the site-specific criteria at Hillend to the east during day-time and night-time. Once phase two of the proposed Development is completed, noise immission levels meet all criteria.

70. Some constraints could be applied to the wind turbines during operation of phase one of the proposed Development with HHE to reduce noise levels and result in operational noise levels then being compliant with the derived site-specific assessment criteria. An example of a pattern of constraints is given in **Section 5.9** of **Technical Appendix 13.1**, suggesting between one and 14 turbines on HHE be stopped in certain wind conditions to reduce levels of noise. Constraints were focussed towards the turbines on HHE, given their lower energy generating capacity compared with the turbines added for phase one of the proposed Development.

71. These constraints would only need to apply in very specific wind speed and wind direction conditions and represent only one potential example of constraints that could be suitable. With the suggested constraints applied, predicted noise levels from phase one (operating with HHE) would be compliant with the site-specific assessment criteria. Accordingly, the effects of noise from both phase one and from phase two are **Not Significant**.

72. The selection of the final turbine to be installed for the proposed Development would be made on the basis of enabling the relevant noise limits, as set out in **Tables 27** and **Table 28** of **Technical Appendix 13.1**, to be achieved. These noise limits apply only to the proposed Development (when operating with HHE as relevant) at the nearest neighbouring properties and would enable total ETSU-R-97 noise limits to be met when operating the proposed Development together with adjacent windfarms. Depending on the final turbine model retained, some of the turbines may need to be constrained, as discussed above.

13.9. Summary of Effects

73. The effects associated with construction activities would be negligible to minor and temporary and, therefore, **Not Significant.**

74. Operational noise levels from the wind turbines on the proposed Development, in combination with the adjacent windfarms are predicted to be compliant with applicable noise limits derived in accordance with the ETSU-R-97 guidance, with some mitigation applied to the existing HHE turbines during operation of phase one. This could be secured in practice through appropriate planning conditions. Depending on the levels of background noise, the satisfaction of the ETSU-R-97 derived limits could lead to a situation whereby, at some locations under some wind conditions and for a certain proportion of the time, operational wind turbine noise may be audible. However, noise levels at properties in the vicinity of the proposed Development would still be within levels

considered acceptable under the ETSU-R-97 assessment method, therefore considered **Not Significant**.

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