ScottishPower Renewables

Harestanes West Windfarm

Environmental Impact Assessment Report

Volume 2

Chapter 13: Noise

December 2024

ScottishPower Renewables

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Abbreviations

AAWT	Annual Average Weekday Traffic
BPM	Best Practicable Means
CEMP	Construction Environmental Management Plan
CTMP	Construction Traffic Management Plan
DECC	Department for Energy and Climate Change
DGC	Dumfries and Galloway Council
DTI	Department of Trade and Industry
GPG	Good Practice Guide
IOA	Institute of Acoustics
RNB	Remaining Noise Budget

13. Noise

13.1. Executive Summary

1. This Chapter assesses the potential noise effects associated with the construction and operation of Harestanes West Windfarm (hereafter the 'proposed Development').

2. Assessments have been conducted for construction noise and operational noise in line with the most relevant legislation, policy, and guidance documents available.

3. In the absence of suitable baseline data representative of all identified receptor locations, the assessments have been conducted on the basis of fixed absolute noise level limits, for both construction noise and operational noise (including cumulative operational noise).

4. The construction noise assessment has considered the potential for noise from the construction of turbines, access tracks, construction compounds and a substation, as well as blasting and construction traffic noise. Residual construction noise effects are predicted to be **'Not Significant'** as the relevant noise limits are anticipated to be met other than for short duration activities. No specific mitigation is proposed, although noise will be required to be minimised during the construction phase through the adoption of Best Practicable Means.

5. Construction traffic noise will result in potentially audible increases in noise levels on the surrounding public roads, however these increases will be relatively low and will be temporary, and therefore **'Not Significant'**.

6. Cumulative construction residual effects are **'Not Significant'** as it is unlikely that relevant construction noise limits would be exceeded even if the proposed Development was constructed at a similar time to other proposed Developments in the vicinity.

7. The operational noise assessment has considered the potential for noise from the operation of the turbines. Residual operational noise effects are predicted to be **'Not Significant'**, with both night and daytime noise limits being met at all noise-sensitive properties in the vicinity of the proposed Development. No significant residual operational noise effects from the substation are anticipated.

8. No significant cumulative operational residual noise effects are predicted with both night and daytime noise limits being able to be met at all noise-sensitive properties in the vicinity of the proposed Development.

13.2. Introduction

9. This Chapter assesses the potential noise effects associated with the construction and operation of the proposed Development. The specific objectives of the chapter are to:

- Describe the assessment methodology and significance criteria used in completing the impact assessment;
- Describe the potential effects and cumulative effects;

- Describe the mitigation measures proposed to address likely effects; and
- Assess the residual effects remaining following the implementation of mitigation.

13.3. Legislation and Policy Context

13.3.1. Legislation

10. The scope of the assessment has been informed by consultation responses summarised in section 13.3.5 below along with the guidelines and policies set out in sections 13.3.2, 13.3.3 and 13.3.4 below. The relevant overarching policies are explained in more detail in **Chapter 4: Renewable Energy and Planning Policy**.

13.3.2. Planning Policy

13.3.2.1. National Planning Framework 4

11. The National Planning Framework 4 adopted in 2023 (Scottish Government, 2023) sets out the Scottish Government's overarching ambitions with regards to various national planning policies. Policy 11: Energy states that development proposals for all forms of renewable, low-carbon and zero emissions technologies will be supported, but that noise effects on communities should be assessed. Policy 23: Health and Safety states that development proposals that are likely to raise unacceptable noise issues will not be supported.

13.3.2.2. Onshore Wind Policy Statement 2022

12. The Onshore Wind Policy Statement (OWPS) 2022 (Scottish Government, 2022) references ETSU-R-97, The Assessment and Rating of Noise from Wind Farms (DTI, 1997) and the Institute of Acoustics (IOA) document, A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (GPG) (IOA, 2013) as the framework by which noise from wind energy developments is measured and assessed.

13. It is considered that adherence to the noise limits set out in ETSU-R-97 (referred to in the OWPS) ensures that the proposed Development will not give rise to unacceptable noise impacts as described in terms of the policy 23 of NPF4.

13.3.2.3. Planning Advice Note PAN1/2011: Planning and Noise

14. PAN1/2011 (Scottish Government, 2011) identifies two sources of noise from wind turbines: mechanical noise and aerodynamic noise. It states that; *"…good acoustical design and siting of turbines is essential to minimise the potential to generate noise*". It refers to the Scottish Government's 'web-based planning advice' on renewables technologies for onshore wind turbines, as discussed below.

13.3.2.4. Technical Advice Noise

15. The Technical Advice Noise (TAN) to PAN1/2011 Assessment of Noise (Scottish Government, 2011) refers to the Control of Pollution Act (Control of Pollution Act 1974) as the mechanism whereby local authorities can control noise from construction activities.

16. It lists several documents that contain advice on how to minimise such noise and includes British Standard BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites (BSI, 2014).

13.3.2.5. Scottish Government 2014: Web Based Planning Advice, Onshore Wind Turbines

17. The web-based planning advice for onshore wind turbines (Scottish Government, 2014) states that the sources of noise are; *"…the mechanical noise produced by the gearbox, generator and other parts of the drive train; and the aerodynamic noise produced by the passage of the blades through the air…"* and that; "*there has been significant reduction in the mechanical noise generated by wind turbines through improved turbine design*".

18. It states that: "*…the Report, 'The Assessment and Rating of Noise from Wind Farms' (Final Report, Sept 1996, DTI), (ETSU-R97), describes a framework for the measurement of wind farm noise, which should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available*".

19. It notes further that: "*this gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable burdens on wind farm developers, and suggests appropriate noise conditions*".

20. The document goes on to reference the IOA GPG document discussed in section 13.3.4 below in terms of assessing noise associated with wind turbine developments.

13.3.2.6. Planning Advice Note PAN 50

21. Planning Advice Note (PAN) 50 Controlling the Environmental Effects of Surface Mineral Workings (Scottish Government, 1996) provides advice on environmental effects arising from mineral working operations.

22. The advice is said to be relevant in considering planning applications, among other things, and is applicable to the construction of borrow pits which are frequently used during wind turbine construction and is relevant to blasting activities in particular.

23. PAN 50 Annex D The Control of Blasting at Surface Mineral Workings provides advice to planning authorities and the minerals industry on how to keep the effects of blasting from surface mineral workings within environmentally acceptable limits.

24. PAN 50 Annex D advocates primarily for the use of BS 5228 for the assessment of mineral workings noise, and for the minimisation of the need for blasting, as well as for engagement with the public, stating that:

25. "*The response of an individual to any such event is dependent upon the same factors as that of groundborne vibration with the understanding of the phenomenon through public relations and the attitude of the operators being of utmost importance*".

13.3.3. Local Policy

13.3.3.1. Dumfries and Galloway Local Development Plan

26. The Statutory Development Plan for the Dumfries and Galloway Council Planning Authority Area comprises the adopted NPF4, and the LDP2 (Dumfries and Galloway Council, 2019). Within the LDP2, noise from a wind turbine development is relevant primarily to the policies OP1, IN1, and IN2.

27. Policy OP1 requires that development is assessed with consideration for several parameters, including "*General Amenity*", noting that development proposals "*should be*

compatible with the character and amenity of the area and should not conflict with nearby land uses" including consideration of noise and vibration.

28. Policy IN1 states that renewable energy generation / storage development proposals will be supported where they are located, sited, and designed appropriately, with the acceptability of proposals to be assessed with consideration of the "*impact on local communities and individual dwellings, including visual impact, residential amenity, noise and shadow flicker*."

29. Policy IN2 states that wind energy proposals will be supported where they are located, sited, and designed appropriately, with the acceptability of proposals to be assessed with consideration of the "*impact on local communities and residential interests*" including "*the extent of any detrimental impact on communities, individual dwellings, residents and local amenity, including assessment of the impacts of noise, shadow flicker, visual dominance and the potential for associated mitigation*."

30. Policy IN2 further states that "*Acceptability will be determined through an assessment of the details of the proposal including its benefits and the extent to which environmental and cumulative impacts can be addressed satisfactorily*."

13.3.4. Guidance

13.3.4.1. ETSU-R-97: The Assessment and Rating of Noise from Wind Farms

31. ETSU-R-97 presents the recommendations of the Working Group on Noise from Wind Turbines, set up in 1993 by the Department of Trade and Industry (DTI) as a result of difficulties experienced in applying the noise guidelines existing at the time to windfarm noise assessments.

32. The group comprised independent experts on wind turbine noise, windfarm developers, DTI personnel and local authority Environmental Health Officers. In September 1996 the Working Group published its findings by way of report ETSU-R-97.

33. This document describes a framework for the measurement of windfarm noise and contains suggested noise limits, which were derived with reference to existing standards and guidance relating to noise emission from various sources.

34. ETSU-R-97 recommends that, although noise limits should be set relative to existing background and should reflect the variation of both turbine and background noise with wind speed, this can imply very low noise limits in particularly quiet areas, in which case "*it is not necessary to use a margin above background in such low-noise environments. This would be unduly restrictive on developments which are recognised as having wider global benefits. Such low limits are, in any event, not necessary in order to offer a reasonable degree of protection to the wind farm neighbour*."

35. For daytime periods, the noise limit specified by ETSU-R-97 is 35-40 dB L_{A90} or 5 dB(A) above the 'quiet daytime hours' prevailing background noise, whichever is the greater. The actual value within the 35-40 dB L_{A90} range (the lower limiting value) depends on the number of dwellings in the vicinity; the effect of the limit on the power able to be generated; and the duration of the level of exposure.

36. For night-time periods the noise limit specified by ETSU-R-97 is 43 dB L_{A90} or 5 dB(A) above the prevailing night-time hours background noise, whichever is the greater. The

43 dB(A) lower limit is based on a sleep disturbance criterion of 35 dB(A) with an allowance of 10 dB(A) for attenuation through an open window and 2 dB(A) subtracted to account for the use of L_{A90} rather the L_{Aeq}.

37. Quiet daytime periods are defined as: evenings from 18:00-23:00 plus Saturday afternoons from 13:00-18:00 and Sundays from 07:00-18:00. Night-time is defined as 23:00-07:00.

38. The prevailing background noise level is set by calculation of a best fit curve through values of background noise plotted against wind speed as measured during the appropriate time period with background noise measured in terms of $L_{A90,t}$. The $L_{A90,t}$ is the noise level which is exceeded for 90% of the measurement period 't'. It is recommended that at least 1 weeks' worth of measurements are required.

39. Where predicted noise levels are low at the nearest residential dwellings a simplified noise limit can be applied, such that daytime and night-time noise is restricted to the minimum ETSU-R-97 level of 35 dB L_{A90} for wind speeds up to 10 m/s at 10 m height. This removes the need for extensive background noise measurements for smaller or more remote schemes.

40. It is stated that the $L_{A90,10min}$ noise descriptor should be adopted for both background and windfarm noise levels and that, for the windfarm noise, this is likely to be between 1.5 and 2.5 dB less than the L_{Aeq} measured over the same period.

41. The $L_{Aeq,t}$ is the equivalent continuous 'A' weighted sound pressure level occurring over the measurement period 't'. It is often used as a description of the average noise level. Use of the L_{A90} descriptor for windfarm noise allows reliable measurements to be made without corruption from relatively loud, transitory noise events from other sources.

42. ETSU-R-97 also specifies that a penalty should be added to the predicted noise levels, where any tonal component is present. The level of this penalty is described and is related to the level by which any tonal components exceed audibility.

43. With regard to multiple windfarms in a given area, ETSU-R-97 specifies that the absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area contributing to the noise received at the dwellings in question.

44. Existing windfarms should therefore be included in cumulative predictions of noise level for proposed wind turbines and not considered as part of the prevailing background noise.

13.3.4.2. A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise

45. IOA published the good practice guide (GPG) in May 2013, which was subsequently endorsed in all parts of the UK. The publication of the GPG followed a review of current practice carried out for the Department of Energy and Climate Change with a subsequent report (DECC, 2011) and an IOA discussion document (IOA, 2012) which preceded the GPG.

46. The GPG includes sections on Context; Background Data Collection; Data Analysis and Noise Limit Derivation; Noise Predictions; Cumulative Issues; Reporting; and Other Matters including Planning Conditions; Amplitude Modulation; Post Completion Measurements; and Supplementary Guidance Notes.

The Context section states that the guide;

47. "*…presents current good practice in the application of the ETSU-R-97 assessment methodology for all wind turbine development above 50 kW, reflecting the original principles within ETSU-R-97, and the results of research carried out and experience gained since ETSU-R-97 was published*".

48. As well as expanding on and, in some areas, clarifying issues which are already referred to in ETSU-R-97, additional guidance is provided on noise prediction and a preferred methodology for dealing with wind shear.

13.3.4.3. BS 5228: 2009+A1: 2014

49. BS 5228: Code of practice for noise and vibration control on construction and open sites – Part 1: Noise (BS 5228-1) provides example criteria for the assessment of the significance of construction noise effects, a method for the prediction of noise levels from construction activities, and practical information on construction noise and vibration reduction measures, promoting a 'Best Practicable Means' (BPM) approach to noise and vibration control.

13.3.5. Consultation

50. Consultation was undertaken with Dumfries and Galloway Council (DGC) Environmental Health department in relation to the noise assessment methodology, whereby DGC confirmed that they had no objections to the proposed methodology , which has been subsequently implemented.

13.4. Methodology

13.4.1. Assessment

13.4.1.1. Construction Noise

51. Annex E of BS 5228-1 details several methods for the assessment of significance of construction noise effects in relation to ambient noise levels, including the 'ABC method' set out in Table E.1, which sets a series of noise thresholds depending on the existing ambient sound levels and the applicable time period. The relevant details of table E.1 are reproduced below as **Table 13.1**.

52. It is assumed as a worst-case that all receptors experience the lowest ambient sound levels, and therefore the Category A thresholds set out in **Table 13.1** are set as the significance threshold of effects.

Table 13.1 – BS 5228-1 Threshold of Potential Significant Effect at Dwellings

Assessment Category and Threshold Value Period	Threshold Value, in Decibels (dB) ($L_{Aeq,T}$)		
	Category A [A)]	Category B [B)]	Category C [C)]
Night-time (23:00-07:00)	45	50	55
Evenings and weekends [D)]	55	60	65
Daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values. C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values. D) 19:00-23:00 weekdays, 13:00-23:00 Saturdays, and 07:00-23:00 Sundays

53. Additional contextual considerations for construction noise may also apply, including:

a. The duration of the effect. BS 5228 sets out that noise levels above the threshold values lasting for either less than ten days (or 10 evening/night periods) in any 15 consecutive days, or a total of 40 days (or evening/night periods) in any 6-month period would not normally be considered **'Significant'**.

b. The time of effect. Where marginal, night-time effects are more likely to be considered **'Significant'** than daytime impacts.

c. The location of the effect. A receptor may contain areas which are more or less sensitive than others, such as kitchens and bathrooms which are considered to be less sensitive than living rooms and bedrooms.

d. The nature, time of use, and design of the receptor. A receptor which is not used at night would not be considered sensitive to night-time construction works.

54. Where separation distances are large (around 500 m or more from major construction activities) typical windfarm construction noise levels are likely to be well below the Category A thresholds and do not require detailed calculation and quantitative assessment.

55. As the separation distance between receptors and the closest proposed turbine hardstanding is over 1 km and construction activities are likely to be short-term, the detailed assessment of turbine construction noise is scoped out.

56. A qualitative assessment is provided, setting out the best practice and control measures to ensure that construction noise is adequately controlled.

57. The separation between receptors and access track construction activities is substantially less at the closest approach, than for the main construction activities. Noise levels are predicted based on indicative plant items, with sound power levels taken from BS 5228 Annex C. Details of the access track construction noise predictions are set out in **Technical Appendix 13.1: Noise Prediction Methodology** .

58. Indicative predicted noise levels are then assessed against the criteria in **Table 13.1**.

13.4.1.2. Blasting Noise

59. Blasting activities may be required in the process of creating borrow pits for the construction activities. Blasting for borrow pits is subject to the PAN 50 guidance which require an environmental assessment where the surface of mineral extraction proposals exceed 25 hectares.

60. The total surface area of all borrow pits for the proposed Development is well below this value. Blasting is therefore included as part of the overall construction noise assessment.

13.4.1.3. Construction Traffic Noise

61. Noise associated with construction traffic movements along local roads during the construction of the development will cause a short-term increase in noise levels, particularly for dwellings located along the proposed routes on public roads to the proposed Development and given the rural nature of the area.

62. The potential influence of construction traffic will be reviewed and assessed as necessary in terms of the increase in traffic noise at roadside locations based on the prediction methods in Calculation of Road Traffic Noise (CRTN, 1988), except where there is little or very little traffic movement in which case it will be assessed against the criteria in BS 5228-1.

63. Where construction traffic movements will occur along access tracks away from the public road network, a buffer of 300 m will be applied and indicative calculations will be conducted for receptors within this distance from access tracks using the method set out in BS 5228 Annex F Estimating noise from sites, sub-clause F.2.5 *Method for mobile plant using regular well-defined route (e.g. haul roads)* using the formula:

$$L_{Aeq,T} = L_{wA} - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d$$

where:

L_{WA} is the sound power level of the plant, in decibels (dB);

Q is the number of vehicles per hour;

V is the average vehicle speed, in kilometres per hour (km/h);

d is the distance of receiving position from the centre of haul road, in metres (m).

64. Such noise can be assessed against the criteria in **Table 13.1** or by assessing the predicted increase in noise level along the access route relative to the existing baseline road traffic noise levels based on the criteria set out in **Table 13.2**. Where the increase in noise due to construction vehicles on the public road network is less than 3 dB (equivalent to a doubling of the road traffic) the impact is considered to be **'Not Significant'**.

Table 13.2 Significance Criteria for a Change in Road Traffic Noise

Noise Change, dB	Magnitude of Impact
0	No change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

13.4.1.4. Operational Noise – Wind Turbine Noise

Noise Predictions

65. Noise predictions have been carried out using ISO 9613 (ISO, 1993) (ISO, 1996) as referred to within the IOA GPG. The propagation model described in Part 2 of this standard provides for the prediction of sound pressure levels based on short-term downwind (i.e., worst case) conditions. A supplementary term has been added to the methodology to allow for the effects of wind direction as discussed in the IOA GPG.

66. The propagation model calculates the predicted sound pressure level by taking the source sound power level for each turbine in separate octave bands and subtracting a number of attenuation factors. The details of the prediction methodology are set out in **Technical Appendix 13.1: Noise Prediction Methodology**.

67. The turbine locations used for the proposed Development noise predictions are shown in **Table 13.3** below.

Table 13.3 Turbine Coordinates

Turbine No.	OS Easting	OS Northing	Maximum Tip Height (m)
1	296190	593782	200
2	295607	593196	200
3	295562	592157	220
4	295394	591526	220
5	296170	591307	200
6	296331	590777	200
7	295432	590648	220
8	295878	590315	220
9	295182	590095	200
10	296285	589730	200
11	295568	589633	220
12	296082	589043	220

68. For the purposes of the assessment, a candidate turbine model has been assumed, namely a Vestas V162 STE 7.2 Megawatt (MW) turbine. As described in **Table 13.3**, the turbine tip height will not exceed 200 m or 220 m depending on the turbine, and hub heights of 119 m and 139 m have been assumed, respectively, based on a 162 m rotor diameter for this candidate turbine model, in order to reach the maximum tip heights.

69. For each of the two hub heights assumed, the octave band sound power levels used in the predictions are shown in **Table 13.4** and **Table 13.5**, with reference to standardised 10 m height integer wind speeds from 3 to 12 m/s (corrected from hub height using a reference ground roughness length of 0.05 m). Sound power levels are based on manufacturer supplied data for the turbine operating in power-optimised mode PO7200, plus an uncertainty factor of +2 dB.

Table 13.4 Vestas V162 STE 7.2 MW Sound Power Levels (dB L_{WA}) at 119 m Hub Height

Standardised 10 m Height Wind Speed, m/s	Octave Band Centre Frequency (Hz)								Overall
	63	125	250	500	1000	2000	4000	8000	
3	76.5	84.1	88.9	91.0	90.2	86.7	80.4	71.3	96.0
4	77.4	85.0	89.8	91.9	91.1	87.6	81.3	72.1	96.9
5	81.9	89.5	94.3	96.4	95.6	92.1	85.8	76.7	101.4
6	86.1	93.7	98.5	100.6	99.8	96.3	90.0	80.9	105.6
7	87.2	94.8	99.5	101.6	100.8	97.3	91.0	81.9	106.6
8	87.3	94.9	99.7	101.8	101.0	97.5	91.2	82.0	106.8
9	87.6	95.2	100.0	102.0	101.3	97.7	91.5	82.3	107.1
10	88.0	95.6	100.4	102.4	101.7	98.1	91.9	82.7	107.4
11	88.0	95.6	100.4	102.5	101.7	98.2	91.9	82.8	107.5
12	88.0	95.6	100.4	102.5	101.7	98.2	91.9	82.8	107.5

Table 13.5 Vestas V162 STE 7.2 MW Sound Power Levels (dB L_{WA}) at 139 m Hub Height

Standardised 10 m Height Wind Speed, m/s	Octave Band Centre Frequency (Hz)								Overall
	63	125	250	500	1000	2000	4000	8000	
3	76.5	84.1	88.9	91.0	90.2	86.7	80.4	71.3	96.0
4	77.5	85.1	89.9	92.0	91.2	87.7	81.4	72.3	97.0
5	82.4	90.0	94.8	96.8	96.1	92.5	86.3	77.1	101.8
6	86.6	94.2	99.0	101.0	100.3	96.7	90.5	81.3	106.0
7	87.2	94.8	99.6	101.6	100.9	97.3	91.1	81.9	106.6
8	87.3	94.9	99.7	101.8	101.0	97.5	91.2	82.1	106.8
9	87.7	95.3	100.1	102.1	101.4	97.8	91.6	82.4	107.1
10	88.0	95.6	100.4	102.5	101.7	98.2	91.9	82.8	107.5
11	88.0	95.6	100.4	102.5	101.7	98.2	91.9	82.8	107.5
12	88.0	95.6	100.4	102.5	101.7	98.2	91.9	82.8	107.5

70. The ETSU-R-97 noise limits assume that the wind turbine noise contains no audible tones. Where tones are present, a correction should be added to the measured or predicted noise level before comparison with the recommended limits.

71. Where topographical features are present between source and receiver, there is the potential for barrier effects, whereby the line-of-sight between source and receiver is obscured resulting in reduced sound propagation, and for 'concave ground profile' effects, for example across a valley, resulting in higher levels of sound propagation. These effects are further explained in **Technical Appendix 13.1**.

72. An analysis of the ground profiles between the proposed turbines and the neighbouring dwellings has been carried out and resulting corrections incorporated into the prediction calculations are set out in **Technical Appendix 13.1**.

Assessment Approach

73. Background noise measurement would usually inform the ETSU-R-97 noise limits. However, it is often possible to re-use previous baseline noise monitoring, providing the noise environment is unlikely to have changed since the noise monitoring campaign. In this instance, there exists some suitable historic data for nearby windfarm noise assessments representative of some relevant noise-sensitive receptors. The assessment has been conducted on the basis of fixed noise limits, below which the noise impacts are considered to be **'Not Significant'**. Further baseline measurements are therefore not considered to be necessary.

74. With regard to the daytime noise limit, the IOA GPG states (paragraph 3.2.2):

> *"The day amenity noise limits have been set in ETSU-R-97 on the basis of protecting the amenity of residents whilst outside their dwellings in garden areas. The daytime amenity noise limits are formed in two parts: Part 1 is a simple relationship between the prevailing background noise level (with wind speed) with an allowance of +5 dB; Part 2 is a fixed limit during periods of quiet. ETSU-R-97 describes three criteria to consider when determining the fixed part of the limit in the range of 35 dB to 40 dB LA90, all of which should be considered. They are:*
>
> *1) The number of noise-affected properties;*

2) The potential impact on the power output of the wind farm; and

3) The likely duration and level of exposure"

75. In this instance there are relatively few properties affected but there is the potential for notable implications for the power output if lower fixed daytime noise limits were applied. The nearby Harestanes and Dalswinton windfarms operate with noise limits derived using 40 dB lower limiting values for their daytime noise limits. On this basis, a 40 dB L_{A90} fixed noise limit is considered to be appropriately justified. Where predicted operational noise levels are below this level, noise effects are negligible and detailed assessment is not required.

76. The noise assessment screening thresholds and noise limits are set out in **Table 13.6**.

Table 13.6 Assessment Absolute Noise Level Thresholds

Time Period	Noise Limit
Daytime noise limit	40 dB L_{A90}
Night-time noise limit	43 dB L_{A90}

13.4.1.5. Operational Noise – Cumulative Effects

77. There are a number of proposed and operational windfarms in the vicinity of the proposed Development which have been considered in the cumulative operational noise assessment. Details of the cumulative developments are shown in **Table 13.7**.

Table 13.7 Cumulative Wind Farm Developments

Development	Status	Distance to proposed Development (m)
Dalswinton Wind Farm	Existing	600
Harestanes Windfarm	Existing	3,100
Harestanes South Windfarm Extension	Application	4,100
Minnygap Wind Farm	Existing	6,700

78. Further details of the cumulative windfarms, including details of turbine locations, models, and assumed noise data, are set out in **Technical Appendix 13.1**.

79. Cumulative noise levels are predicted using the same method as for the proposed Development.

80. Cumulative noise limits have been assumed to be identical to the noise limits from the proposed Development acting alone.

81. For each receptor, where the predicted noise levels from developments other than the proposed Development are below the noise limits identified in **Table 13.6,** the predicted noise level from these developments is logarithmically subtracted from the noise limits to derive a 'Remaining Noise Budget' (RNB). The RNB can then be set as a noise limit for an individual development acting alone.

13.4.1.6. Potential Effects Scoped Out

Construction Vibration

82. The construction phase of the development will involve vibration-generating activities. However, these effects will be short-term and negligible due to the large separation distances between receptors and the closest areas of works.

Construction of Access Tracks

83. Some sections of access tracks will require construction or alterations to facilitate construction of the proposed Development. Construction works associated with constructing or altering the access tracks has the potential to result in relatively high levels of noise close to access tracks. However, no receptors have been identified within 300 m of these works. In addition, the noise from these activities will be very short duration due to the works moving along the length of the access tracks. Therefore, any potential noise will occur for a short duration. An assessment is therefore not required.

Decommissioning Noise

84. Decommissioning activities will meet the relevant noise limits that apply to noise from construction. Decommissioning operations will be undertaken in line with the relevant standards and limits that apply at the time. Decommissioning activities typically result in the same or lower noise levels compared to those for construction, and therefore an assessment of decommissioning noise is not required.

Operational Vibration

85. An ETSU study (ETSU, 1997) found that vibration from wind turbines, as measured at 100 m from the nearest machine, was well below the BS 6472-1:2008 (British Standards Institution, 2008) criteria recommended for human exposure in critical working areas such as precision laboratories. At greater distances from turbines vibration levels will be even lower. This has been confirmed by the Keele University study (Styles et al, 2005), which showed vibration levels of around 10-8 m/s^2 at a distance of 2.4 km from the Dun Law Windfarm site under high wind conditions, orders of magnitude lower than the criteria referred to above which specify levels in the region of 0.005 m/s^2.

86. Based on the above studies, the assessment of vibration is not considered to be necessary. Operational vibration effects will be **'Not Significant'**.

Operational Noise – Road Traffic

87. The operation of the proposed Development will result in minimal additional road traffic, primarily comprising occasional maintenance visits. As such, road traffic noise effects from operational phase of the proposed Development will be negligible.

Operational Noise – Substation

88. Further operational noise may occur due to the substation proposed to be built as auxiliary infrastructure to the site. The noise from the substation is anticipated to be lower in level than that from the wind turbine noise at all locations except very close to the substation. The substation is located at large distances (>1,400 m) to all receptors. As such, substation

noise effects from the operational phase of the proposed Development are anticipated to be negligible.

Tonal Noise

89. ETSU-R-97 specifies that, in line with other noise guidance, a penalty should be added to measured or predicted wind turbine noise levels if there is tonal noise above a certain level which is audible at residential properties.

90. In this assessment, it has been assumed that there would be no tonal noise associated with the operation of the proposed Development which would give rise to such a penalty as most modern turbines operate without substantial levels of tonal noise.

91. It is anticipated that a penalty would be included in an appropriately worded planning condition such that a tonal penalty would need to be added to measured noise levels, where required, before comparing them with the noise limits. Warranty agreements with turbine suppliers seek to ensure that any such penalties will not occur in practice.

Low Frequency and Infrasound

92. Low frequency sound is typically defined as sound in the audible hearing frequency range of 20 Hz up to about 200 Hz. Noise from wind turbines is not inherently low-frequency and it is typically broad-band in nature, and close to a wind turbine the dominant frequencies are usually in the 250 to 2,000 Hz range.

93. At increasing distance from a windfarm site, the noise level decreases due to the spreading out of the sound energy and due to air absorption, which increases with increasing frequency.

94. This means that, although the energy across the whole frequency range is reduced, higher frequencies are reduced more than lower frequencies with the effect that as distance from the site increases the ratio of low to high frequencies also increases.

95. This effect may be observed with road traffic noise or natural sources, such as the sea, where higher frequency components are diminished relative to lower frequency components at long distances. At such distances, however, the overall noise level is so low, such that any bias in the frequency spectrum is negligible.

96. Work carried out in 2006 by Hayes McKenzie for the UK Department of Trade and Industry (DTI, 2006) to investigate the extent of low frequency and infrasonic noise from three UK windfarms concluded that there is no evidence of health effects arising from infrasound or low frequency sound, stating that; "*the common cause of complaints associated with noise at all three wind farms is not associated with low frequency noise, but is the audible modulation of the aerodynamic noise, especially at night*".

97. The findings that there is no evidence of health effects arising from infrasound or low frequency noise are endorsed by the Scottish Government and are included in their planning advice on windfarm noise (Scottish Government, 2014).

98. Infra-sound is noise occurring at frequencies below that at which sound is normally audible, i.e. at less than about 20 Hz, due to the substantially reduced sensitivity of the ear at such frequencies. In this frequency range, for sound to be perceptible, it has to be at very high amplitude, which is not the case for wind turbine noise.

99. In November 2016, a study into low frequency and infrasound was published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Wuerttemberg (Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg, 2016). This contained a comprehensive review of low frequency and infrasound from wind turbines and evaluated such noise in relation to other sources.

100. The results found that:

"*…the infrasound level in the vicinity of wind turbines is – at distances between 120m and 300m – well below the threshold of what humans perceive…*"

101. and that:

"*…at a distance of 700m from the wind turbines, it was observed by means of measurements that when the turbine is switched on, the measured infrasound level did not increase or only increased to a limited extent. The infrasound was generated mainly by the wind and not by the turbines.*"

102. The report concludes that:

"*Infrasound is caused by a large number of different natural and technical sources. It is an everyday part of our environment that can be found everywhere. Wind turbines make no considerable contribution to it. The infrasound level generated by them lie clearly below the limits of human perception. There is no scientifically proven evidence of adverse effects in this level range.*"

103. It is therefore considered that infrasound can be scoped out of the assessment.

104. A WSP report for the Department for Business, Energy & Industrial Strategy (WSP, 2022) states that:

"*…the weight of evidence appears to indicate that wind turbine infrasound has no adverse effects on human health at typical exposure levels…*"

105. and that;

"*…due to the inherent characteristics of wind turbine sound, suitable controls on A-weighted sound levels are expected to also provide sufficient control for the potential impact of low frequency noise*".

106. It is therefore considered that low frequency noise can be scoped out of the assessment.

Amplitude Modulation

107. The variation in noise level associated with wind turbine operation, at the rate at which turbine blades pass any fixed point of their rotation (the blade passing frequency), is often referred to as blade swish or Amplitude/ Aerodynamic Modulation (AM).

108. This effect is identified within ETSU-R-97 where it is considered that:

"*… modulation of blade noise may result in variation of the overall A-Weighted noise level by as much as 3 dB(A) (peak to trough) when measured close to a wind turbine…* "

and that at distances further from the turbine where there are:

"… more than two hard, reflective surfaces, then the increase in modulation depth may be as much as 6 dB(A) (peak to trough)".

109. There have been instances where level of AM rates are higher than this, which results in the noise being perceived as more intrusive (in the same way as tonal content makes the noise more intrusive).

110. DECC commissioned a Wind Turbine AM Review report that was published in two phases: Phase 1 in September 2015 and Phase 2 in October 2016 (although the Phase 2 report is dated August 2016) (DECC, 2016).

111. Phase 1 of the report sets out the approach and methodology to the review and research, and the Phase 2 report includes a literature review, research into human response to AM. This recommends how excessive AM might be controlled through the use of a planning condition.

112. The report includes recommendations on how AM should be addressed when quantified according to the recommendations of a separate Institute of Acoustics (IOA) working group document, A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016).

113. The AM Review reports recommend a two-tier approach whereby the first tier seeks a reduction in the depth and/or occurrence of AM with a rating level (according to the IOA Amplitude Modulation Working Group method) ≥3 dB.

114. Whether remedial action is required depends on the prevalence of any complaints, and how often AM rating levels ≥3 dB occur.

115. The second tier is that if nothing can be done to reduce the level of AM, then a penalty scheme is proposed whereby a penalty ranging from 3 dB (for a rating level of 3 dB) up to a maximum of 5 dB (for a rating level of 10 dB and above) could be added to the measured level before measured levels are compared with the relevant noise limits.

116. It should be noted that most windfarms operate without substantial AM, and that it is not possible to predict the likely occurrence of AM. At the time of writing (September 2024) there has been no official response to those recommendations from the IOA Noise Working group or endorsement from any Scottish Government Minister or Department.

117. The IOA GPG (IOA, 2013), states that:

"…the evidence in relation to 'Excess' or 'other' Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM".

13.4.2. Study Area(s)

13.4.2.1. Construction Assessment

118. The study area for the construction assessment comprises all noise-sensitive receptors within 1 km of main construction work areas, which include the substation, turbine locations, and construction compounds, and within 300 m of the access track construction areas.

119. Only one construction receptor is located within this area, CR1 Burrance, as set out in **Table 13.8**, located approximately 170 m from the access track boundary, and approximately 250 m from the access track centreline at the closest approach.

Table 13.8 Noise-Sensitive Receptors Included in the Construction Assessment

Receptor ID	Description / Address	OS Easting	OS Northing
CR1	Glencorse, DG1 1RL	287988	595236

13.4.2.2. Operational Assessment

120. The receptors considered in the operational assessment comprise 80 residential receptors and one non-residential receptor. Receptors were identified and agreed with Dumfries and Galloway Council during the scoping process.

121. Receptors have been selected for detailed assessment where the predicted noise levels from the proposed Development alone are 30 dB or greater. Receptors are set out in **Table 13.9**, including co-ordinates, and are shown in **Figure 13.1**.

122. At all other identified noise-sensitive receptor locations, noise levels from the proposed Development are predicted be lower and noise impacts are **'Not Significant'**. A detailed assessment is therefore not considered to be necessary for any receptor not included in **Table 13.9**.

Table 13.9 Noise-Sensitive Receptors Included in the Operational Assessment

Receptor ID	Description / Address	OS Easting	OS Northing
R1	Glencorse, DG1 1RL	298040	589728
R2	Glenfine Farm, DG1 1RL	297984	589918
R3	3 Gubhill (April Cottage), DG1 1RL	297258	591458
R4	4 Gubhill (Pine Cottage), DG1 1RL	297261	591449
R5	Burnfoot, DG1 1RL	297258	591486
R6	Larchview Cottage, DG1 1RL	297203	591576
R7	Glenview, DG1 1RL	297212	591635
R8	Gubhill Farm, DG1 1RL	297210	592208
R9	Windyhill, DG1 1RL	296685	592430
R10	Knockenshang, DG1 1RL	297090	593524
R11	Glenbrae, DG1 1RF	297729	589236
R12	Glenmaid, DG1 1RF	297630	589125
R13	Whitestanes, DG1 1RF	297626	588718
R14	Shaws, DG2 0YB	294906	587799
R15	Ae Village, comprising 66 residential properties on Dalcrum Rise, Birkie Knowe, Hilltops View and Hillview. Post codes DG1 1AG, DG1 1RG, DG1 1RH, DG1 1RJ and DG1 1RQ.	287988*	595236*
NR1	Ae Primary School, Ae Village, DG1 1RG	298409	589054

*Co-ordinates presented are for 3 Dalcrum Rise, the closest Ae Village property to the proposed Development

13.4.3. Data Sources

123. For the purposes of this noise assessment, the following sources of information have been used, referenced, or otherwise relied upon:

- OS and OpenStreetMap mapping data;

- OS AddressBase Plus data;
- Candidate wind turbine manufacturer sound power level specifications;
- Dalswinton Wind Farm Environmental Statement (planning reference 03/P/3/0610);
- Dalswinton Wind Farm Planning Conditions (planning reference 03/P/3/0610);
- Harestanes Windfarm Planning Conditions (planning reference EC00004193);
- Harestanes South Windfarm Extension Environmental Impact Assessment Report (planning reference ECU00002185);
- Minnygap Wind Farm Appeal Decision Notice (planning appeal reference PPA-170-2055);
- Minnygap Wind Farm (PPA-170-2055): Condition 7: Approval of Design Details; and
- Harestanes West Windfarm proposed Development design, as detailed in **Chapter 3**.

13.4.4. Mitigation Measures and Identification of Residual Effects

124. Where potentially **'Significant'** effects are identified, there are a number of mitigation measures available to reduce noise levels.

125. In the first instance, further embedded mitigation can be implemented during the final turbine selection process, whereby a turbine model with lower sound power levels may be selected in preference to a model with higher sound power levels.

126. In addition, for the purposes of the assessment a +2 dB uncertainty factor has been applied to sound power level specifications. However, warranted sound power levels can often be obtained from manufacturers, which may include a lower uncertainty factor for the same given sound power level specifications, resulting in lower predicted noise levels.

127. If required, many modern wind turbine models are able to operate in a range of noise-reduced or sound-optimised modes. These operational modes can be implemented at key wind speeds and/or directions, in order to reduce noise levels. The candidate turbine Vestas V162, for example, is able to operate in several sound-optimised modes, with indicative noise reductions of up to 6.5 dB, depending on the operational mode (and wind speed).

13.5. Baseline Conditions

128. The acoustic environment in the vicinity of the proposed Development is that of rural or semi-urban (village) areas. Soundscapes are likely to be dominated by local sound sources, such as the movement of vegetation with the wind, watercourses and sounds from domestic premises such as boiler flues. Wider contributing sound sources are likely to include sound from agriculture and local road traffic noise. The nearest A-roads, A74 and A701, are approximately 4 km from the nearest receptors within the study area and would therefore not be anticipated to result in substantial contributions to the acoustic environment at identified receptors.

129. Multiple historic baseline measurement surveys have been undertaken in the vicinity of the proposed Development for other windfarm development applications. Surveys from Dalswinton Wind Farm, Harestanes Windfarm, and Harestanes South Windfarm Extension planning applications have been reviewed. Relevant measurements were conducted at

Shaws (R14) (for Dalswinton Wind Farm), Glencorse (R1) (for Harestanes Windfarm), Gubhill Farm (R8) (for Harestanes Windfarm) and Glenview (R7) (for Harestanes South Windfarm Extension).

130. The baseline noise data has been found to be unreliable for Shaws due to bi-modal noise results being collectively averaged in a single trend line. Similarly, data for Glencorse and Gubhill Farm are not considered to be reliable due to negative or flat trend line gradients, implying that noise levels reduce or remain the same as wind speeds increase. Data at Glenview in Relation to Harestanes South Windfarm Extension appears to be suitable for consideration in the noise assessment. However, the inclusion of background sound levels for deriving noise limits makes no material difference and fixed limits based on the lower limiting values are considered suitable for this site.

13.6. Identification and Evaluation of Effects

13.6.1. Construction Noise Effects

13.6.1.1. Construction of Turbines and Substation

131. The construction of the proposed Development will occur at distances that are unlikely to breach typical construction noise limits prescribed within BS 5228 at the nearest noise sensitive receptors. This, combined with the short-term nature of the works, means that a detailed assessment of the construction noise impacts is not considered necessary.

132. All residential locations are a minimum of 1 km to the nearest turbine hardstanding area, construction compound, substation and the nearest borrow pit.

133. Nonetheless, construction noise has the potential to be audible, and is subject to BPM, which will be detailed and secured within the Construction Environmental Management Plan (CEMP). Some examples of BPM include switching off vehicles when not in use, placing materials on the ground instead of dropping them, and maximising separation distances between noise sources and noise-sensitive receptors.

134. Construction noise effects will be **'Not Significant'**, subject to the appropriate adoption of BPM mitigation measures.

13.6.1.2. Construction and Upgrades of Access Tracks

135. The upgrade of the access track to the Proposed Development will take place at a minimum distance of 170 m from the closest receptor, CR1 Burrance, and will include widening of the existing access track as well as the creation of a layby area.

136. Alongside provisions for the main construction works, access track upgrade works are also subject to BPM, which will be detailed and secured within the CEMP.

137. Indicative calculations have been undertaken using the methods described in BS 5228. Details of these predictions are included in **Technical Appendix 13.1**. The resulting predicted noise levels are up to 62 dB at CR1 Burrance during works at the closest approach to the receptor, but will likely be lower for much of the construction works. The daytime noise criteria in **Table 13.1** is therefore predicted to be met and construction noise effects will be **'Not Significant'**, subject to the appropriate adoption of BPM mitigation measures.

13.6.1.3. Blasting

138. There may be a need for blasting in the process of creating borrow pits for the construction activities. Regarding blasting and its potential effect on neighbours to site, BS 5228 states that:

"*Vibration and air overpressure from blasting operations is a special case and can under some circumstances give rise to concern or even alarm to persons unaccustomed to it. The adoption of good blasting practices will reduce the inherent and associated impulsive noise: prior warning to members of the public, individually, if necessary, is important*".

139. It is unlikely that noise from blasting will exceed the construction noise thresholds in **Table 13.1** for a sufficiently long period of time for noise effects to be **'Significant'**. As such blasting noise is considered to be **'Not Significant'**, subject to the adoption of appropriate BPM mitigation measures.

13.6.1.4. Construction Traffic Noise

140. The predicted changes in road traffic on public roads during the construction phase are assessed in **Chapter 12: Access, Traffic and Transport**, which shows that the maximum increase in traffic (during the peak month of construction) is substantially less than a doubling in road traffic.

141. Indicative calculations have been undertaken in relation to construction traffic changes, on the basis of the 18-hour Annual Average Weekday Traffic (AAWT), as well as the maximum daily vehicle movements during the construction programme.

142. One-way traffic data have been provided for ten road links in each direction, resulting in 20 sets of traffic data in total. The traffic data and predicted changes in road traffic noise levels are set out in **Table 13.10**, based on daily construction vehicles of 13 light vehicles and 131 Heavy Goods Vehicles (HGV).

Table 13.10 Predicted Construction Traffic Noise Level Changes

Link ID	Existing Baseline Traffic Flow			Baseline Plus Construction Traffic Flow			Change In Road Traffic Noise Level	Impact Significance
	Total Traffic Flow	Total HGV	% HGV	Total Traffic Flow	Total HGV	% HGV		
80199_E	5763	855	14.8%	5907	986	16.7%	0.4 dB(A)	Negligible
80199_W	5591	838	15.0%	5735	969	16.9%	0.4 dB(A)	Negligible
80285_E	4657	943	20.3%	4801	1075	22.4%	0.4 dB(A)	Negligible
80285_W	4722	862	18.3%	4866	993	20.4%	0.5 dB(A)	Negligible
80286_E	6345	856	13.5%	6489	988	15.2%	0.4 dB(A)	Negligible
80286_W	6404	895	14.0%	6548	1027	15.7%	0.4 dB(A)	Negligible
50746_E	5963	884	14.8%	6107	1015	16.6%	0.4 dB(A)	Negligible
50746_W	5985	709	11.9%	6129	841	13.7%	0.5 dB(A)	Negligible
80287_E	7234	914	12.6%	7378	1045	14.2%	0.4 dB(A)	Negligible
80287_W	7226	938	13.0%	7369	1069	14.5%	0.4 dB(A)	Negligible
80288_N	6337	992	15.6%	6481	1123	17.3%	0.4 dB(A)	Negligible
80288_S	6123	846	13.8%	6267	977	15.6%	0.4 dB(A)	Negligible
80289_E	8739	1223	14.0%	8883	1355	15.3%	0.3 dB(A)	Negligible
80289_W	8839	1126	12.7%	8983	1257	14.0%	0.3 dB(A)	Negligible
78560_N	3735	318	8.5%	3878	449	11.6%	0.8 dB(A)	Negligible
78560_S	4436	335	7.6%	4579	467	10.2%	0.7 dB(A)	Negligible
80359_N	3173	336	10.6%	3317	468	14.1%	0.9 dB(A)	Negligible
80359_S	3189	370	11.6%	3332	501	15.0%	0.8 dB(A)	Negligible
788_N	2473	325	13.1%	2500	339	13.6%	0.1 dB(A)	Negligible
788_S	2496	344	13.8%	2523	359	14.2%	0.1 dB(A)	Negligible

143. Construction vehicles will also use the access tracks away from the public road network. Calculations are conducted for the nearest receptor (CR1 Burrance) 250 m from the track centreline, based on the BS 5228 haul road calculations as set out in **Section 63**. The highest sound power levels for the construction equipment are assumed to apply for all construction vehicles using the access track, as a worst-case assumption. An average of 36 vehicles per hour are assumed, based on 144 vehicles per day each way, spread over an 8-hour day. An average speed of 20 km/h is assumed.

144. Predicted noise levels from construction vehicles using the access track away from the public road network are up to 63 dB at the closest approach.

145. Even during the most intensive periods of deliveries to the construction site, and at receptors relatively close to the access tracks, it is unlikely that noise thresholds in **Table 13.1** would be exceeded, particularly for typical daytime periods, due to the sporadic and intermittent nature of the noise from vehicles passing the neighbouring dwellings, the use of borrow pits to avoid the need for large quantities of aggregate deliveries, and the slow speeds at which construction vehicles will pass the dwellings.

146. Any deliveries which are necessary to undertake during night-time and/or other sensitive hours, and therefore have the potential to disturb the residents of neighbouring dwellings, will be agreed with the Environmental Health Officer dealing with the development and residents will be kept informed of these activities prior to any night-time deliveries taking place. These arrangements will be secured within the Construction Environmental Management Plan (See outline CEMP in **Technical Appendix 3.1**).

147. Some night-time transportation of turbine blades may be required in order to minimise the impact of slow-moving vehicles on road traffic flows. Such activities will be infrequent and are not anticipated to result in significant noise effects.

148. On the basis of the above assessment, construction traffic noise effects are therefore anticipated to be **'Not Significant'**.

13.6.2. Operational Noise Effects

149. Operational noise predictions have been carried out for the candidate wind turbine under consideration for the proposed Development in line with the methodology set out in the IOA GPG. Full details of the prediction methodology are set out in **Technical Appendix 13.1** but the main assumptions are described below:

- Receiver height of 4 m;
- Ground effect ground coefficient G = 0.5;
- Atmospheric attenuation corresponding to a temperature of 10 °C and a relative humidity of 70 %;
- Topographical barriers and concave ground profile corrections have been applied according to the IOA GPG;
- Downwind propagation is assumed for all receptors; and

- The manufacturer's sound power level data includes an increase of +2 dB to account for uncertainty.

150. Only noise sensitive properties where the predicted operational noise level from the proposed Development is above 30 dB L_{A90} have been considered since this is 10 dB below the adopted daytime noise limit. These properties have been identified using OS AddressBase Plus data and are given in **Table 13.9** and shown in **Figure 13.1**.

151. The results of the operational noise predictions at the noise-sensitive properties within the study area are shown at **Table 13.11.** The results are also presented as a noise contour plot valid for standardised 10 m height wind speeds of 11 – 12 m/s at **Figure 13.1**.

Table 13.11 Predicted Downwind Operational Noise Levels, dB L_{A90}

Receptor ID	Standardised 10 m height wind speed, m/s									
	3	4	5	6	7	8	9	10	11	12
R1	22.3	23.4	28.1	31.7	31.9	32.3	32.7	32.9	33.0	33.0
R2	22.8	23.8	28.6	32.1	32.4	32.8	33.2	33.4	33.4	33.4
R3	26.1	27.1	31.8	35.4	35.7	36.0	36.4	36.7	36.7	36.7
R4	26.1	27.1	31.8	35.4	35.7	36.0	36.4	36.7	36.7	36.7
R5	26.1	27.0	31.7	35.3	35.6	36.0	36.4	36.6	36.7	36.7
R6	26.4	27.3	32.0	35.6	35.9	36.3	36.7	36.9	36.9	36.9
R7	26.1	27.1	31.8	35.4	35.7	36.1	36.5	36.7	36.7	36.7
R8	25.3	26.3	31.0	34.5	34.8	35.2	35.6	35.8	35.9	35.9
R9	26.4	27.4	32.1	35.7	36.0	36.3	36.7	37.0	37.0	37.0
R10	25.0	25.9	30.6	34.2	34.5	34.9	35.3	35.5	35.6	35.6
R11	23.2	24.2	29.0	32.6	32.8	33.2	33.6	33.8	33.8	33.8
R12	23.3	24.3	29.1	32.6	32.8	33.2	33.6	33.8	33.9	33.9
R13	22.5	23.5	28.3	31.8	32.0	32.5	32.8	33.1	33.1	33.1
R14	21.5	22.6	27.4	30.9	31.1	31.5	31.9	32.1	32.1	32.1
R15	20.6	21.6	26.4	30.0	30.2	30.6	31.0	31.2	31.2	31.2
NR1	19.9	20.9	25.7	29.2	29.5	29.9	30.3	30.5	30.5	30.5

152. Predicted noise levels are the same for both night-time and daytime. The highest predicted noise level for each receptor is compared against the applicable fixed daytime and night-time noise limits as set out in **Table 13.6**, alongside a description of the outcome of the assessment. The highest predicted noise level for any wind speed is also presented in **Table 13.12** for comparison against the noise limits, alongside a description of the outcome of the operational assessment.

Table 13.12 Operational Noise Assessment

Receptor ID	Maximum Predicted Downwind Noise Level, dB L_{A90}	Assessment Outcome
R1	33.0	The daytime and night-time noise limits are met.
R2	33.4	The daytime and night-time noise limits are met.
R3	36.7	The daytime and night-time noise limits are met.
R4	36.7	The daytime and night-time noise limits are met.
R5	36.7	The daytime and night-time noise limits are met.
R6	36.9	The daytime and night-time noise limits are met.
R7	36.7	The daytime and night-time noise limits are met.
R8	35.9	The daytime and night-time noise limits are met.
R9	37.0	The daytime and night-time noise limits are met.
R10	35.6	The daytime and night-time noise limits are met.

Receptor ID	Maximum Predicted Downwind Noise Level, dB L_{A90}	Assessment Outcome
R11	33.8	The daytime and night-time noise limits are met.
R12	33.9	The daytime and night-time noise limits are met.
R13	33.1	The daytime and night-time noise limits are met.
R14	32.1	The daytime and night-time noise limits are met.
R15	31.2	The daytime and night-time noise limits are met.
NR1	30.5	The daytime and night-time noise limits are met.

153. At all identified receptors, the direct operational noise impact from the proposed Development meets the applicable noise limits and is therefore **'Not Significant'**.

13.6.3. Cumulative Effects

13.6.3.1. Cumulative Construction Noise

154. The Harestanes South Windfarm Extension is not currently built, and there is the potential for this, or other developments, to be constructed at a similar or overlapping time period. However, due to remote nature of the area and the large separation distances involved, the combined effect of noise from simultaneous construction activities is considered likely to be negligible.

155. Even during the most intensive periods of deliveries to multiple development construction sites, and at receptors relatively close to the access tracks, it is unlikely that noise thresholds in **Table 13.1** would be exceeded, particularly for typical daytime periods, due to the sporadic and intermittent nature of the noise from vehicles passing the neighbouring dwellings and the slow speeds at which construction vehicles will pass the dwellings.

156. Noise associated with construction traffic movements along local roads during the construction of multiple development will cause short-term increases in noise levels, particularly for dwellings located along the proposed routes to multiple developments and given the rural nature of the area.

157. However, the noise increase is likely to remain less than 3 dB as an average over a given assessment period. For this reason, as well as due to the limited duration of these potential noise increases, the cumulative increase in road traffic during the construction phase is considered to be **'Not Significant'**.

13.6.3.2. Cumulative Operational Noise

158. There are a number of proposed and operational windfarms in the vicinity of the Site which have been considered in the cumulative operational noise impact assessment. Cumulative assessments have been carried out for each of the receptors identified for the operational noise assessment.

159. The prediction method for the cumulative noise assessment is the same as that for the operational noise assessment, as set out in **Technical Appendix 13.1**. Details of the assumptions adopted for the cumulative windfarms are set out in **Technical Appendix 13.3**. In addition, due to the spread-out arrangement of the cumulative noise sources, receptors often cannot be both upwind and downwind of the proposed Development and other windfarms at the same time. However, predictions are for the combined downwind noise levels for all identified cumulative developments, as a worst-case assumption.

160. The cumulative predicted noise levels from all windfarms, including the proposed Development, are set out in **Table 13.13**. It should be noted that the predicted noise levels from other windfarm developments includes the normal uncertainty of +2 dB. The results are also presented as a noise contour plot valid for standardised 10 m height wind speeds of 11 – 12 m/s (±0.1 dB) at **Figure 13.2**.

Table 13.13 Predicted Downwind Cumulative Operational Noise Levels, dB L_{A90}

Receptor ID	Standardised 10 m height wind speed, m/s									
	3	4	5	6	7	8	9	10	11	12
R1	24.4	25.8	30.6	34.1	34.5	34.7	34.9	35.0	35.1	35.1
R2	24.9	26.2	31.0	34.5	34.9	35.1	35.3	35.4	35.4	35.4
R3	27.5	28.7	33.4	36.9	37.3	37.6	37.8	38.0	38.0	38.0
R4	27.5	28.7	33.4	36.9	37.3	37.6	37.8	38.0	38.0	38.0
R5	27.5	28.6	33.4	36.9	37.3	37.5	37.8	38.0	38.0	38.0
R6	27.7	28.8	33.6	37.1	37.5	37.7	38.0	38.2	38.2	38.2
R7	27.6	28.7	33.5	37.0	37.3	37.6	37.9	38.0	38.1	38.1
R8	27.2	28.3	33.1	36.6	36.9	37.2	37.4	37.6	37.6	37.6
R9	27.9	29.0	33.7	37.2	37.6	37.8	38.1	38.3	38.3	38.3
R10	27.7	28.7	33.4	36.9	37.2	37.4	37.7	37.8	37.8	37.8
R11	24.8	26.2	31.0	34.6	34.9	35.2	35.4	35.5	35.6	35.6
R12	24.8	26.3	31.1	34.6	35.0	35.2	35.5	35.6	35.6	35.6
R13	24.0	25.6	30.4	33.9	34.3	34.5	34.8	34.9	34.9	34.9
R14	26.4	30.6	36.0	39.5	40.1	40.1	40.1	40.0	40.0	40.0
R15	23.0	24.4	29.2	32.8	33.2	33.4	33.6	33.7	33.7	33.7
NR1	22.5	23.9	28.7	32.3	32.7	32.9	33.1	33.2	33.2	33.2

161. The highest predicted cumulative noise level for each receptor is compared against the applicable daytime and night-time cumulative noise limits in **Table 13.14**, alongside a description of the outcome of the cumulative assessment.

Table 13.14 Operational Noise Assessment

Receptor ID	Maximum Predicted Downwind Noise Level, dB L_{A90}	Assessment Outcome
R1	35.1	The daytime and night-time noise limits are met.
R2	35.4	The daytime and night-time noise limits are met.
R3	38.0	The daytime and night-time noise limits are met.
R4	38.0	The daytime and night-time noise limits are met.
R5	38.0	The daytime and night-time noise limits are met.
R6	38.2	The daytime and night-time noise limits are met.
R7	38.1	The daytime and night-time noise limits are met.
R8	37.6	The daytime and night-time noise limits are met.
R9	38.3	The daytime and night-time noise limits are met.
R10	37.8	The daytime and night-time noise limits are met.
R11	35.6	The daytime and night-time noise limits are met.
R12	35.6	The daytime and night-time noise limits are met.
R13	34.9	The daytime and night-time noise limits are met.
R14	40.1	The daytime noise limit is marginally exceeded. The night-time noise limit is met.
R15	33.7	The daytime and night-time noise limits are met.
NR1	33.2	The daytime and night-time noise limits are met.

162. The cumulative assessment identifies that the noise limits are met for all receptors except at R14 Shaws for some wind directions at wind speeds of 7 to 9 m/s by a margin of 0.1 dB. All noise limits are met at night. Where noise limits are met, noise effects are considered to be **'Not Significant'**.

163. The exceedance by 0.1 dB at R14 Shaws is marginal. At this receptor, predicted noise levels are dominated by the Dalswinton Wind Farm development, with the proposed Development providing a minor contribution. Given this scenario and the +2 dB uncertainty factor applied to both Dalswinton and the proposed Development, as well as other worst-case or otherwise conservative assumptions as described above and in **Appendix 13.1**, it is considered unlikely that cumulative noise levels of 40 dB would be exceeded in practice. Where there is the potential for this to occur, it would be infrequent, occurring only in downwind conditions, i.e. wind blowing from the north-east, which is uncommon in the UK (Met Office, 2023).

164. The cumulative noise at R14 Shaws is therefore considered to be **'Not Significant'**.

13.6.3.3. Remaining Noise Budget

165. In order to provide a practical noise limit for the proposed Development that would avoid cumulative effects, the RNB can be calculated by logarithmically subtracting the predicted noise levels from developments other than the proposed Development from the cumulative noise limits. This can form the basis of a noise limit for the proposed Development acting alone.

166. The predicted noise levels for all proposed and operational developments other than the proposed Development are presented in **Table 13.15**.

Table 13.15 Predicted Downwind Operational Noise Levels for Wind Developments Other Than the proposed Development, dB L_{A90}

Receptor ID	Standardised 10 m height wind speed, m/s									
	3	4	5	6	7	8	9	10	11	12
R1	20.2	22.1	26.9	30.4	31.0	31.0	30.9	30.9	30.9	30.9
R2	20.6	22.4	27.2	30.7	31.3	31.3	31.2	31.2	31.2	31.2
R3	21.9	23.5	28.3	31.7	32.3	32.3	32.2	32.2	32.2	32.2
R4	21.9	23.5	28.3	31.7	32.3	32.3	32.2	32.2	32.2	32.2
R5	21.9	23.5	28.3	31.8	32.3	32.3	32.2	32.2	32.2	32.2
R6	22.0	23.5	28.3	31.8	32.3	32.3	32.3	32.2	32.2	32.2
R7	22.1	23.6	28.4	31.8	32.4	32.3	32.3	32.3	32.3	32.3
R8	22.9	24.1	28.9	32.3	32.8	32.8	32.8	32.8	32.8	32.8
R9	22.4	23.8	28.6	32.0	32.5	32.5	32.4	32.4	32.4	32.4
R10	24.3	25.4	30.1	33.5	33.9	33.9	33.9	33.9	33.9	33.9
R11	19.7	21.9	26.8	30.2	30.9	30.8	30.8	30.7	30.7	30.7
R12	19.6	21.9	26.8	30.3	31.0	30.9	30.8	30.8	30.8	30.8
R13	18.9	21.4	26.3	29.8	30.4	30.3	30.3	30.2	30.2	30.2
R14	24.7	29.9	35.4	38.9	39.5	39.4	39.4	39.3	39.2	39.2
R15	19.3	21.2	26.0	29.5	30.2	30.1	30.1	30.1	30.1	30.1
NR1	19.0	21.0	25.8	29.3	29.9	29.9	29.8	29.8	29.8	29.8

167. Note that for logarithmic subtraction calculations, the closer together the input values, the higher the uncertainties associated with the resulting values due to a high sensitivity to small uncertainties such as rounding errors. Subtraction of sound levels with a difference

of less than 3 dB is considered, based on professional judgement, to have a sufficiently high uncertainty that the resulting calculated level cannot be relied upon.

168. In this instance, sound levels from Dalswinton Wind Farm at standardised 10 m height wind speeds of 6 m/s or greater are within 3 dB of the 40 dB daytime noise limit at R14 Shaws. As such, the RNB for this location cannot be reliably calculated at wind speeds of 6 m/s or greater. Noise levels 10 dB below the cumulative noise limit of 40 dB, or lower, are considered to have a negligible contribution to cumulative noise levels. Therefore, as a precautionary approach to ensure the robustness of calculations, where the RNB cannot be reliably calculated, it is set to 30 dB.

Table 13.16 Calculated Remaining Noise Budget, dB L_{A90}

Receptor ID	Standardised 10 m height wind speed, m/s									
	3	4	5	6	7	8	9	10	11	12
R1	40.0	39.9	39.8	39.5	39.4	39.4	39.4	39.4	39.4	39.4
R2	39.9	39.9	39.8	39.5	39.4	39.4	39.4	39.4	39.4	39.4
R3	39.9	39.9	39.7	39.3	39.2	39.2	39.2	39.2	39.2	39.2
R4	39.9	39.9	39.7	39.3	39.2	39.2	39.2	39.2	39.2	39.2
R5	39.9	39.9	39.7	39.3	39.2	39.2	39.2	39.2	39.2	39.2
R6	39.9	39.9	39.7	39.3	39.2	39.2	39.2	39.2	39.2	39.2
R7	39.9	39.9	39.7	39.3	39.2	39.2	39.2	39.2	39.2	39.2
R8	39.9	39.9	39.6	39.2	39.1	39.1	39.1	39.1	39.1	39.1
R9	39.9	39.9	39.7	39.3	39.1	39.1	39.2	39.2	39.2	39.2
R10	39.9	39.8	39.5	38.9	38.8	38.8	38.8	38.8	38.8	38.8
R11	40.0	39.9	39.8	39.5	39.4	39.4	39.4	39.5	39.5	39.5
R12	40.0	39.9	39.8	39.5	39.4	39.4	39.4	39.4	39.4	39.4
R13	40.0	39.9	39.8	39.6	39.5	39.5	39.5	39.5	39.5	39.5
R14	39.9	39.6	38.2	30.0	30.0	30.0	30.0	30.0	30.0	30.0
R15	40.0	39.9	39.8	39.6	39.5	39.5	39.5	39.5	39.5	39.5
NR1	40.0	39.9	39.8	39.6	39.6	39.6	39.6	39.6	39.6	39.6

169. At all locations except R14 Shaws, the RNB is close to the 40 dB daytime noise limit, typically within around 1 dB. As noted above, the uncertainties are high in relation to determining the RNB for R14 Shaws. For reference, the calculated RNB and the predicted noise from the proposed Development are compared in **Table 13.17**. Note that a negative difference indicates that the predicted noise levels are below the RNB.

Table 13.17 Comparison of RNB and Proposed Development Noise Levels at R14 Shaws, dB L_{A90}

Prediction / Calculation Scenario	Standardised 10 m height wind speed, m/s									
	3	4	5	6	7	8	9	10	11	12
RNB	39.9	39.6	38.2	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Proposed Development	21.5	22.6	27.4	30.9	31.1	31.5	31.9	32.1	32.1	32.1
Difference	-18.4	-17.0	-10.8	0.9	1.1	1.5	1.9	2.1	2.1	2.1

170. At standardised 10 m height wind speeds of 6 to 12 m/s, the proposed Development predicted noise levels are greater than the calculated RNB. In each case by a margin of around 1 to 2 dB.

171. It is noted that the candidate turbine Vestas V162 is able to operate in several noise-reduced modes to provide noise reductions of up to 6.5 dB, which would be easily able to mitigate such noise levels to below the RNB limits identified at this property in the potential event that this is required.

13.7. Summary of Effects

13.7.1.1. Residual Construction Noise Effects

172. Residual construction noise effects are predicted to be **'Not Significant'** as the relevant noise limits are anticipated to be met other than for short duration activities. No specific mitigation is proposed, although noise will be required to be minimised during the construction phase through the adoption of BPM.

13.7.1.2.Residual Construction Traffic Noise Effects

173. Residual construction traffic noise effects are predicted to be **'Not Significant'** as the increases in noise levels are anticipated to be low, even during the peak month of construction works, and would only occur temporarily.

13.7.2. Residual Operational Noise Effects

174. Residual operational noise effects are predicted to be **'Not Significant'**, with both night and daytime noise limits being met at all noise-sensitive properties in the vicinity of the proposed Development.

175. Residual operational noise effects from the substation are also anticipated to be **'Not Significant'**.

13.7.3. Cumulative Construction Residual Noise Effects

176. Cumulative construction residual effects are considered to be **'Not Significant'** as it is unlikely that relevant construction noise limits would be exceeded even if the proposed Development was constructed at a similar time to other proposed Developments in the vicinity.

13.7.4. Cumulative Operational Residual Noise Effects

177. Residual cumulative operational noise effects are predicted to be **'Not Significant'**. However, at one receptor, Shaws, with RNB noise limits are predicted to be exceeded by a margin of around 1 to 2 dB, resulting in a marginal exceedance of cumulative noise limits. Noise levels can be reduced to below the RNB noise limits through the adoption of in the form of one or more of the following:

- Implementation of a curtailment strategy for downwind conditions with wind speeds of 6 m/s or greater;
- Selection of a turbine model for installation with lower sound power levels than the candidate turbine selected for the EIA Report; or
- Securing warranted sound power levels at sufficiently low levels to meet the noise limits.

178. Subject to the adoption of mitigation as described, cumulative operational residual noise effects are predicted to be **'Not Significant',** with both night and daytime noise limits being

able to be met at all noise-sensitive properties in the vicinity of the proposed Development.

179. At noise-sensitive receptors that are further from the proposed Development, and that may be closer to other consented or proposed windfarm developments, the predicted contribution to overall noise levels from the proposed Development is sufficiently low that noise effects are predicted to be **'Not Significant'** as a result of the proposed Development.

Table 13.18 – Summary of Effects

Effect	Phase	Assessment Consequence	Effect Significance
Noise	Construction	Temporary, Adverse	**'Not Significant'**
Traffic Noise	Construction	Temporary, Adverse	**'Not Significant'**
Noise	Operation	Adverse	**'Not Significant'**
Cumulative Noise	Construction	Temporary, Adverse	**'Not Significant'**
Cumulative Noise	Operation	Adverse	**'Not Significant'**

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