Chapter 9

Noise

SCOTTISHPOWER RENEWABLES

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Chapter 6

9 Noise

9.1 Introduction

1. This chapter considers the potential noise and vibration effects that could arise as a result of the Proposed Development detailed on **Figure 4.1 Site Layout Plan.** Potential effects during both the construction and operation phases have been assessed. This chapter (including associated figures and appendices) should be read as part of the wider EIA Report document including **Chapter 4: Development Description.**

2. The potential noise and vibration impacts that have been assessed are:

   - impacts as a result of groundborne vibration and air overpressures[1] from possible onsite borrow pit blasting works on current sensitive receptors; and
   - impacts as a result of operational wind turbine noise on existing local noise-sensitive receptors, when the Proposed Development operating both in isolation and cumulatively with other local windfarm developments.

3. The assessment has been undertaken in accordance with national and local planning policy and following current best practice guidance, including the Department of Trade and Industry's ETSU-R-97 document: The assessment and rating of noise from windfarms (ETSU-R-97), and the Institute of Acoustics': A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise (IoA GPG), which have informed the assessment of operational noise that would be generated by the Proposed Development.

4. No construction works would be undertaken within 300 metres (m) of any noise or vibration-sensitive receptors, with turbines infrastructure works being at distances of greater than 1 kilometre (km). Assessments of construction noise and vibration have therefore been scoped-out, as no significant effects would arise.

5. The Site is to be accessed from the existing entrance to the operational Harestanes Windfarm, which is more than 300m from noise-sensitive receptors, and accessed directly via the main A701, avoiding the need to use other lesser trafficked local routes. Assessment of construction traffic noise has therefore been scoped-out, as no significant effects would arise.

6. Once operational, development generated traffic would be extremely low. Assessment of operational traffic noise has therefore been scoped-out, as no significant effects would arise.

7. The Proposed Development would connect to the operational Harestanes Windfarm substation with no new fixed plant items proposed. Assessment of fixed plant noise has therefore been scoped-out, as no significant effects would arise.

8. This chapter is necessarily technical in nature and contains terminology relating to noise and vibration. The terminology used in this chapter is defined and explained in **Appendix 9.1 Glossary of Acoustic Terminology**.

[1] Which includes noise. Both the audible (noise) and the sub-audible elements (sensed as concussion) arising from a blast event, are together known as 'air overpressure'.

9.2 Legislation, Policy and Guidance

9.2.1 Policy

9.2.1.1 National Policy

Scottish Planning Policy (SPP)

9. Published in June 2014, the SPP states that its purpose is to set out national planning policies which reflect Scottish Ministers' priorities for the operation of the planning system, and for the development and use of land. The SPP sits alongside the *National Planning Framework* (NPF) and sets out the policy that will help to deliver the objectives of the NPF.

10. With regard to on-shore wind energy development, the SPP provides overarching advice to planning authorities, for example with regard to spatial frameworks in development plans, and the need to identify where there is strategic capacity for windfarms.

11. In the section entitled 'Onshore wind' it is stated that: "*Development plans should also set out the criteria that will be considered in deciding all applications for wind farms of different scales – including extensions and re-powering, taking account of the considerations set out at paragraph 169.*" Paragraph 169 lists a number of different considerations including "*cumulative impacts*", and "*noise*".

National Planning Framework 3 (NPF3)

12. Also published in June 2014, the NPF3 is stated to be a long-term strategy, being a spatial expression of the Government's Economic Strategy and its plans for development and investment in infrastructure. Wind resource in Scotland is recognised within the NPF3, being referenced several times, but only at a high level, with no specific guidance or policies laid out with respect to noise or vibration.

Planning Advice Note 1/2011, Planning and Noise (PAN 1/2011)

13. Published in March 2011, PAN 1/2011 provides advice on the role of the planning system in helping to prevent and limit adverse effects of noise. Information and advice on noise assessment methods are provided in the accompanying Technical Advice Note (TAN): Assessment of noise. Included within PAN 1/2011 and the accompanying TAN are details of the legislation, technical standards and codes of practice for specific noise issues.

14. With regard to noise from wind turbines, paragraph 29 of PAN 1/2011 states the following:

> "*There are two sources of noise from wind turbines – the mechanical noise from the turbines and the aerodynamic noise from the blades. Mechanical noise is related to engineering design. Aerodynamic noise varies with rotor design and wind speed, and is generally greatest at low speeds. Good acoustical design and siting of turbines is essential to minimise the potential to generate noise. Web based planning advice on renewable technologies for onshore wind turbines provides advice on 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97) published by the former Department of Trade and Industry (DTI) and the findings of the Salford University report into Aerodynamic Modulation of Wind Turbine Noise.*"

15. The web-based planning advice referred to in PAN 1/2011 is contained in an online document entitled: Onshore wind turbines. This document is summarised below, and also refers to the use of ETSU-R-97.

16. The accompanying TAN to PAN 1/2011 also refers to ETSU-R-97, including a summary of the associated assessment approach. The ETSU-R-97 assessment guidance is summarised below.

17. The TAN points out that the ETSU-R-97 report presents a consensus view of a group of experts, who between them have a breadth and depth of experience in assessing and controlling the environmental impact of noise from windfarms.

18. The TAN also includes reference to Planning Advice Note 50: *Controlling the environmental effects of surface mineral workings* (PAN 50) which includes consideration to the blast-induced effects (vibration and air overpressure), as summarised below.

Planning Advisory Note 50: Controlling the Effects of Surface Mineral Workings (PAN 50)

19. Paragraphs 33 to 38 of PAN 50 are concerned with blasting, including vibration and air overpressure. It is confirmed that the levels of vibration generated by surface mineral workings are well below those required to cause structural damage to properties, but that vibration and air overpressure may give rise to nuisance. It is also confirmed that the levels of air overpressure and noise can be significantly affected by meteorological conditions.

20. It is recommended that any planning conditions pertinent to blast-induced vibration should look to set acceptable vibration level limits, but that such an approach would be impractical for air overpressures due to affecting factors outside the control of the operator (e.g. meteorological effects). It is identified that the operator will always be concerned with maximising the effectiveness of the blast, and therefore minimising lost energy through air overpressure.

21. A summary of good practice on blasting works is also presented within this document.

9.2.1.2 Local Planning Policy

Local Development Plan 2 (LDP2)

22. Adopted in October 2019, this is the Plan against which all planning applications received by Dumfries and Galloway Council are assessed and decided. It states that it provides the planning framework and guides the future use and development of land in towns, villages and the rural area across Dumfries and Galloway. The policies in LDP2 that are pertinent to noise or vibration and the Proposed Development are as follows:

- Policy OP1: *Development Considerations* (noise and vibration are included in a list of factors that may arise as a result of development);
- Policy ED 13 : *Minerals* (noise, blasting and vibration are included in a list of factors that are required to be addressed);
- Policy IN1: *Renewable Energy* (cumulative impact and noise are referenced as factors that are required to be addressed); and
- Policy IN2: *Wind Energy* (noise is included in a list of factors considerations that will be made by the Dumfries and Galloway Council).

Local Development Plan 2 Wind Energy Development Management Considerations – Supplementary Guidance – February 2020

23. This is Supplementary Guidance to the LDP 2 with the purpose of providing further detail in support of Policy IN2: *Wind Energy*, and details the main factors that will be taken into account in reaching planning decisions. The document states that it has the same weight as LDP2, and initially duplicates planning policies IN1: Renewable Energy, IN2: Wind Energy, as summarised above.

24. With regard to the "*impact on local communities and residential interests*" as referenced in Policy IN2, it confirms that the listed impacts (which include noise) can be as a result of both the construction and operational phases of a development. The following is stated:

> "*Noise*
>
> *A common concern raised regarding wind energy developments is that of noise. Noise is produced from wind energy developments in three ways:*
>
> *• during the construction phase, which is temporary*
>
> *• aerodynamically from the blades moving through the air*
>
> *• mechanically from the gearbox and generator*
>
> *Generally schemes can be sited with sufficient distance from noise sensitive development to ensure ambient noise levels are acceptable. For all large and medium turbines a full site-specific noise impact assessment following ETSU-R-97 and Institute of Acoustics methodology (or subsequent accepted national guidelines), which includes cumulative impact, would be required for all appropriate noise sensitive properties as agreed with Environmental Health. Manufacturer's noise information data should be provided for all schemes which include turbines below 50m in height to blade tip.*
>
> *Noise effects can be minimised by use of appropriate:*
>
> *• turbine positioning and separation distances from residential properties*
>
> *• turbine specification*
>
> *• technical controls*
>
> *Potential impacts from construction and decommissioning phases will be similar to that of other developments of a similar size and scale and are of limited duration (but will be considered as part of the assessment process).*"

9.2.2 Guidance

Scottish Government Online Planning Advice for Renewable Energy Technologies: Onshore Wind Turbines

25. This web-based planning advice supersedes the former PAN 45: Renewable energy. It is confirmed that operational wind turbine noise comprises two different components: "*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*". It is also stated that "*there has been significant reduction in the mechanical noise generated by wind turbines through improved turbine design*".

26. With regard to an appropriate assessment method, it is stated that:

> "*The Report, "The Assessment and Rating of Noise from Wind Farms" (Final Report, Sept 1996, DTI), (ETSU-R-97) describes a framework for the measurement of wind farm noise, which should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments*",

and 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*".

27. Reference is made to further reports by Hayes McKenzie for the Department of Energy & Climate change (DECC) suggesting that best practice guidance is required to add to the way in which ETSU-R-97 should be implemented in practice. It is confirmed that "*a previous report…by the same authors concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by the wind turbines that were tested. The Salford university report into Aerodynamic Modulation of Wind Turbine Noise…summarised the conclusions of the Hayes McKenzie report and investigated further complaints caused by amplitude modulation of aerodynamic noise (AM). Report findings were constrained by low incidence of AM and the low numbers of people adversely affected in the UK*".

28. It also recognised that the Institute of Acoustics has subsequently published the IoA GPG, which provides significant support on technical issues to all users ETSU-R-97, in applying its assessment method. It is confirmed that *"the Scottish Government accepts that the guidance represents current industry good practice*".

Energy Technology Support Units R-97 Document: The Assessment and Rating of Noise from Windfarms (ETSU-R-97)

29. As referenced for use in PAN 1/2011 and the online planning advice for renewable technologies: Onshore wind turbines, this document was written by a Noise Working Group including developers, noise consultants and environmental health officers, set up in 1995 by the Department of Trade and Industry through ETSU (the Energy Technology Support Unit).

30. This document presents a consensus view of the working group, and was prepared to present a common approach to the assessment of noise from wind turbines. This document states that noise from wind turbines or windfarms should be assessed against site specific noise limits.

31. These limits are derived based on a set of acceptable lower limits, and an allowable exceedance above the prevailing background noise levels, including consideration to a range of prevailing wind speed conditions, relevant to the proposed development. The noise limits should be derived for external areas used for relaxation, or areas where a quiet noise environment is highly desirable. Separate limits are required for night-time and daytime periods. Night-time limits are derived drawing upon measured night-time background noise levels, whilst daytime limits are derived drawing upon the background noise levels arising during 'quiet daytime' periods.

32. Night-time is defined as the period 23:00 to 07:00, whilst 'quiet daytime' periods are defined as 18:00 to 23:00 on all days, as well as 13:00 to 18:00 on Saturdays and Sundays, and 07:00 to 13:00 on Sundays.

33. For the daytime, the suggested limits are 5dB above the prevailing background noise level determined during quiet daytime periods, or 35 to 40dB(A), whichever is the higher. The absolute criterion within the 35 to 40dB(A) range is selected taking account of the site environs (e.g. number of local receptors), the energy generation capacity (e.g. number of kilowatt Hours (kWh) that can be generated) of the windfarm, and the associated duration and level of exposure.

34. During the night-time, the suggested limits are 5dB above the prevailing night-time background noise level or 43dB(A), whichever is the higher. The absolute criterion for the night-time is higher than that for the daytime, as the derivation of this limit is based on preventing sleep disturbance within a building whereas for the daytime, limits are based on occupation of external spaces used for relaxation.

35. It is required that the prevailing background noise levels be determined in terms of the $L_{A90,10min}$ noise index for both quiet daytime and night-time periods, for wind conditions ranging from 2 to 12m/s.

36. The noise limits are calculated by undertaking a regression analysis of the $L_{A90,10min}$ noise levels and the prevailing average wind speed for the same 10-minute period, when measured or determined at 10m above ground at the location of the proposed turbines. The allowable limit is then defined at +5dB above the average noise level at each wind speed (as defined by the regression analysis), or the absolute noise level lower limit (or '*fixed element*'), whichever is the higher (assuming no financial involvement within the scheme).

37. Where a property has a financial involvement in the scheme, the document allows a relaxation of the derived noise limits, stating that:

> "*It is widely accepted that the level of disturbance or annoyance caused by a noise source is not only dependent upon the level and character of noise but also the receiver's attitude towards the noise source in general. If the residents at the noise-sensitive properties were financially involved in the project then higher noise limits will be appropriate.*"

and

> "*It is recommended that both the day and night-time lower fixed limits can be increased to 45dB(A) and that consideration should be given to increasing the permissible margin above background where the occupier of the property has some financial involvement in the windfarm.*"

38. The ETSU guidance states that the derived limits should be applied to noise from the proposed windfarm or turbines in terms of the $L_{A90,T}$ index, and that the $L_{A90,T}$ of the windfarm noise is typically 1.5 to 2.5dB less than the $L_{Aeq,T}$ measured over the same period.

39. The derived noise limits are applicable to both the aerodynamic (e.g. 'blade swish') and mechanical (e.g. generator related) components of windfarm noise.

40. Where noise from the windfarm is tonal, a correction of between 2 and 5dB is to be applied to the windfarm noise. Guidance is provided on how to determine the level of correction required, but typically, the need for any applicable correction is confirmed by the turbine manufacturers.

41. It is stated within this document that:

> "*The Noise Working Group is of the opinion that absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question. It is clearly unreasonable to suggest that, because a windfarm was constructed in the vicinity in the past which resulted in increased noise levels at some properties, that residents of those properties are now able to tolerate still higher noise levels. The existing windfarm should not be considered as part of the prevailing background noise*."

42. Accordingly, where an existing windfarm contributes to the prevailing background noise levels, it is necessary to either include for the contribution of this windfarm when comparing against the allowable noise limit, or correct for this contribution when deriving a limit applicable to the proposed windfarm acting alone.

43. ETSU-R-97 also details a simplified assessment methodology, which is based on the principle that if the fixed element of the daytime noise limits (35dB $L_{A90,T}$) can be met at high wind speeds, then the need to consider the limit element which is relative to the background noise levels can be discounted, because this would only be higher at such speeds.

The Institute of Acoustics: A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IoA GPG)

44. The IoA GPG presents the report of a 'noise working group' (NWG) assembled in response to a request from the Department of Energy & Climate Change (DECC). The guide is intended to represent current good practice in applying the ETSU-R-97 method to assessing the noise impact of wind turbine developments with a power rating of over 50 kilowatts (kW).

45. The document provides clarification and updated guidance on a range of matters relating to ETSU R-97 noise assessments, including consultation with relevant stakeholders, background noise survey methodology, noise survey data analysis, derivation of noise limits, noise prediction model input data, algorithms and parameters, cumulative impact assessment procedures, assessment reporting, planning conditions and amplitude modulation. A set of supplementary guidance notes (SGNs) also form part of the publication and include further specific detail for different technical areas.

46. The detail of the IoA GPG has been considered in the preparation of this assessment. Some of the key considerations relevant to this assessment are summarised as follows:

- Calculations of predicted wind turbine noise may be carried out using ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors (International Organization for Standardization, 1996); preferred receptor heights, meteorological and ground absorption input parameters for this calculation procedure are given;
- Turbine sound power level source data should include appropriate uncertainty corrections. Guidance is given for determining when such uncertainty corrections have been inherently included in turbine source emission data;
- 'Excess amplitude modulation' (i.e. where the wind turbine noise has higher variability with momentary time than the 2 – 3dB(A) considered within ETSU-R-97) is still the subject of research; current practice (at the time of publishing of the IOA GPG) in relation to determining applications for wind turbine developments is to not impose a planning condition specific to this phenomenon; and

- A method is detailed within the IoA GPG to allow the effect of wind direction to be taken into account during noise level predictions. This method details a number of corrections based on the angle of the wind in relation to the position of the source and receiver, and the nature of the local ground (flat or complex).

47. The IoA GPG also confirms that the ETSU-R-97 noise level limits should be applied cumulatively, and provides guidance on appropriate assessment methods for a variety of different cumulative scenarios.

48. These scenarios include "*concurrent applications*", "*existing windfarm consented with less than total ETSU-R-97 limits*", "*existing windfarms consented to the total ETSU-R-97 limits currently operating*", and "*permitted windfarm consented to total ETSU-R-97 limits but not yet constructed*".

49. There is no guidance specific to the situation where the Proposed Development would be an extension to an existing operational windfarm, as is the case here. The closest considered scenario is "*existing windfarms consented to the to the total ETSU-R-97 limits currently operating"*. The guidance for that scenario states:

> "*In the first instance, the consented noise limits should be used within the cumulative noise impact calculations unless otherwise agreed with the local authority. Provided the sum of the noise limits derived for the proposed site when added to those already consented for the operational sites does not exceed the limits that would otherwise be within the requirements of ETSU-R-97 for the cumulative impact, then the noise limits derived for the proposed site can be applied directly*".

50. In practical terms this can be achieved by ensuring that the noise limits / noise levels from the proposed windfarm are 10dB or more below that permitted to be generated by the existing development/s. This is confirmed in the IoA GPG which quotes the following from the Hayes McKenzie Partnership Ltd Report on 'Analysis of How Noise Impacts are considered in the Determination of Wind Farm Planning Applications' (April 2011): "*If an existing wind farm has permission to generate noise levels up to ETSU-R-97 limits, planning permission noise limits set at any future neighbouring wind farm would have to be at least 10 dB lower than the limits set for the existing wind farm to ensure there is no potential for cumulative noise impacts to breach ETSU-R-97 limits (except in such cases where a higher fixed limit could be justified)*".

51. Similarly, in the 'Cumulative impact assessment necessary' section of the IoA GPG it is stated that "*During scoping of a new windfarm development consideration should be given to cumulative noise impacts from any other windfarms in the locality. If the proposed wind farm produces noise levels within 10dB of any existing windfarms at the same receptor location, then a cumulative noise impact assessment is necessary*". Therefore, conversely, where noise levels from the new development are 10dB(A) or more below the limits imposed on surrounding developments, further consideration to cumulative impacts is not required.

52. The following table is presented (the header line has been added) which suggests the key points which good practice suggests should be included in assessment reporting.

Topic	Reporting Requirements
Consultations	Consultation with Local Planning Authority EHO input into selection of background noise measurement equipment
Background Measurements	Number of monitoring locations Map showing monitoring locations Description of monitoring locations Description of noise environment Photos of monitoring locations Monitoring Period Description of noise measurement equipment wind shield Certification / Calibration of all equipment used and any calibration drift Wind (speed and direction) & rainfall measurement data sources Clear representation of excluded data in time histories or scatter plots Chart showing distribution of wind speeds & direction Cumulative issues in background measurements
Noise Predictions	Prediction methodology Candidate turbine model Turbine source noise data (including noise-reduced modes if used) Turbine source octave band noise levels Description of noise propagation/attenuation factors Atmospheric attenuation – assumed temperature and relative humidity Ground effects – Assumed ground factor Assumed receiver height Barrier/screening attenuation Wind direction filtering (if considered) Noise contours
Assessment	Wind shear assessment method Derivation of prevailing background noise Type, order and coefficients of regression line Scatter data shown on Plots Derivation of noise limits & numerical values Amenity noise limit Justification for amenity noise limit if chosen Night-time noise limit Financially involved noise limit Capping of noise limits at highest wind speed measured Comparison of predicted noise level with derived noise limits Correction from LAeq to LA90 Potential tonal content Properties covered by assessment Incorporated mitigation (turbines running in low noise mode) (if relevant) Cumulative issues

Table 9.1: Suggested Key Points for Inclusion in a Wind Turbine Noise Assessment Report

British Standard 5228-1:2009+A1:2014: Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise (BS 5228-1)

53. This Standard sets out guidance on the assessment of construction noise. With regards to blast-induced noise, the following is stated:

> "*Blasting can be an emotive issue for residents around an opencast site. Good liaison between operator and residents is essential to prevent unnecessary anxiety. Wherever possible, the operator should inform each resident of the proposed times of blasting and of any deviation from this programme in advance of the operations. On each day that blasting takes place it should be restricted as far as practicable to regular periods.*"

British Standard 5228-2:2009+A1:2014: Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 2: Vibration

54. This Standard sets out guidance on the assessment of construction vibration including blast induced vibration and air overpressures.

55. On page 73 of this British Standard, a calculation method for vibration levels resulting from blasting at different distances is presented. The method presented is based on analysis of the results of vibration measurements undertaken at the Site in question. This method therefore relies upon a degree of blasting works being undertaken at the Site, before accurate distance calculations can be undertaken. Once completed, the calculation method allows the resultant peak particle velocity (PPV) vibration level to be determined at different distances for known charge weights.

56. It is confirmed that the majority of energy generated within the atmosphere from surface blasting is of a sub-audible nature (i.e. at frequencies <20 Hz), although there is a component that is audible to the human ear and as such

would be heard as noise. The audible noise and the sub-audible element (sensed as concussion) are together known as 'air overpressure'.

57. Air overpressure may be sensed or felt by humans and can excite secondary vibrations at audible frequencies in buildings (e.g. rattling of windows and ornaments on shelves) that have been found to give rise to adverse comments from occupants of buildings affected by the blasting. However, this standard states that there is no known evidence of structural damage to buildings/structures from excessive air overpressure levels from quarry blasting. It is stated that:

> "*routine blasting can regularly generate air overpressure levels at adjacent premises of around 120 dB (lin). This level corresponds to an excess air pressure which is equivalent to that of a steady wind velocity of 5 m/s (Beufort force 3, gentle breeze) and is likely to be above the threshold of perception.*"

58. Research is referenced that has identified that a poorly mounted window that is pre-stressed might crack at 150dB (lin), with most windows cracking at around 170dB (lin), whereas structural damage would not be expected at levels below 180dB (lin).

59. It is stated that due to uncertainties with meteorological conditions, it is not possible to predict the location of maximum air overpressure, but a methodology for air overpressure measurement is presented, whilst it is stated that pressure variations in the atmosphere due to windy conditions can mask the blast generated air overpressure, and that for this reason, it is not accepted practice.

9.3 Consultation

60. Consultation has comprised the responses received to the submitted Scoping Report and subsequent separate discussions and correspondence with the Environmental Health Department of Dumfries and Galloway Council to seek to agree the proposed assessment scope and methodology, including the approach to the supporting baseline noise survey.

61. The received consultation responses are summarised in **Table 9.2**.

Consultee	Response / Subject	Action
The Energy Consents Unit (ECU)	Scoping Opinion: *"The noise assessment should be carried out in line with relevant legislation and standards as detailed in Chapter 10 of the scoping report. The noise assessment report should be formatted as per Table 6.1 of the IOA A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* [see **Table 9.1** above]."	The assessment of operational wind turbine noise has been undertaken in accordance with ETSU-R-97 and the IoA GPG. The assessment reporting has been made in compliance with IoA GPG guidance as outlined in **Table 9.1** above.
Dumfries and Galloway Council Environmental Health Department	Scoping Opinion: "*We have no objections in principal. However, until a site-specific noise impact assessment has been carried out following the principles detailed in the Assessment & Rating of Noise from Wind Farms ETSU Report ETSU-R-97, 1996 we would be unable to comment fully as to the expected impacts.* *We additionally suggest that a method statement for the construction project should be provided within the EIA for approval by Dumfries & Galloway Council. This should include an assessment of potentially noisy operations and outline the noise mitigation measures proposed. This will also include a programme and phases for each stage of works.*"	The assessment of operational wind turbine noise has been undertaken in accordance with ETSU-R-97 and the IoA GPG. The noise and vibration measures that would be employed during the construction of the Proposed Development, and their means of delivery (i.e. via a Construction Environmental Management Plan (CEMP)) have been outlined within the embedded mitigation section.
	Telephone Consultation undertaken with discussion regarding: • Assessment Methodology • Scoping out of construction noise and vibration assessments • That the noise chapter of the Scoping Report includes extensive detail on the proposed assessment scope, methodology and proposed baseline noise survey, and that a written submission would be made to seek agreement of that detail as well as the results of a subsequently completed desk study.	It was agreed that the assessment of operational wind turbine noise has been undertaken in accordance with ETSU-R-97 and the IoA GPG. Agreed that assessments of construction noise and vibration could be scoped-out on the basis that appropriate control measures could be incorporated as part of the CEMP and because the EHO's experience of receiving construction-related complaints for windfarm developments was that these were very scarce. Agreed that a written submission would be made to seek the EHO's comments on the noise related content of the Scoping Report and findings of the subsequent desk study, in particular the proposed assessment scope, methodology and detail of the proposed baseline noise survey. This submission was made by email on 8th September 2020 and included: • A copy of the Scoping Report and associated noise and vibration figures. • The previously made response from the Environmental Health Department as contained in the Scoping Opinion. • Confirmation of the impact areas proposed to be scoped-out of the assessment with supporting reasons. • Confirmation of the cumulative developments that had been identified and which were proposed to be scoped in and out of the assessment with supporting reasons.
	Email Correspondence from the dealing Environmental Health Officer in response to 8th September 2020 email: • Confirmed that there were no objections to the content of the 8th September emails, i.e. that assessments of construction noise, construction vibration, construction traffic noise, operational traffic noise and fixed plant noise could be scoped-out.	• Assessment of construction noise, construction vibration, construction traffic noise, operational traffic noise and fixed plant noise to be scoped-out of the assessment.

Consultee	Response / Subject	Action
	• Agreement confirmed regarding the cumulative developments to be scoped in and out of the turbine noise assessment. • Agreement confirmed regarding the noise sensitive receptors selected for assessment. • Agreement confirmed regarding the adopted baseline noise measurement locations. • Agreement confirmed regarding which of the adopted measurement locations would be applied as a proxy at each of the sensitive receptors for which monitoring was not undertaken. • Agreement confirmed that the ruin at Aukenskew cottage can be scoped out of the assessment as it is clearly not a habitable property.	• Refused and withdrawn windfarms to be scoped-out of the turbine noise assessment, as well as the Duncow Windfarm (which has not progressed from Scoping stage for an extended period). • Adoption of the baseline noise survey data, obtained following the method advised and agreed. • The turbine noise assessment to be undertaken for each of the selected noise sensitive receptors as advised and agreed. • Baseline noise measurement data to be applied as a proxy to sensitive receptors in accordance with the approach advised and agreed. • The ruin at Auckenskew Cottage to be scoped-out of the assessment.

Table 9.2 Consultation Responses

9.4 Assessment Methodology and Significance Criteria

9.4.1 Study Area

62. For the assessment of blast-induced groundborne vibration and air overpressure, the study area extends from the on-site borrow pit search areas to the closest sensitive receptors (see **Figure 4.1 Site Layout Plan**), such that the locations with the greatest potential for adverse effects are assessed.

63. For the turbine noise assessment, potential cumulative developments within 5km of the Proposed Development have been identified. The study area has then been determined by selection of the noise-sensitive receptors with the greatest potential to be subject to an adverse impact either from the Proposed Development operating in isolation, or under the cumulative scenario (i.e. simultaneously with the identified cumulative developments).

64. This has therefore included selection of:

- The closest noise-sensitive receptors to the Proposed Development; and
- The closest noise-sensitive receptors to the identified cumulative developments, but that are also in the vicinity of the Proposed Development (such that a cumulative effect could arise).

65. With regard to bullet point two, cognisance has been given to the fact that noise levels greater than 10dB below those permitted for identified cumulative development would be required in order to give rise to a cumulative impact, see **Paragraphs 50 and 51**.

9.4.2 Desk Study

66. A desk study has been undertaken to assist in determining the baseline conditions. This has included:

- identification of cumulative windfarms and associated development details (e.g. scheme layouts, installed turbine types and the noise level limits to which these developments must comply, as set out in applicable planning conditions where consented or operational);
- identification of noise-sensitive receptors including those with the greatest potential to be subject to an impact from the Proposed Development operating in isolation, or under the cumulative scenario;
- identification of possible local noise sources in the vicinity of the identified receptors (including local water courses etc.); and
- identification of information to inform the operational noise level predictions (e.g. topographic ground contour detail).

67. The desk study included consideration of the following sources of information:

- The AddressBase Plus™ database, which marries the UK postal address database with Ordnance Survey (OS) six figure grid references;
- 1:50000 Ordnance Survey (OS) Land Ranger mapping for the Site and surrounding area;
- 1:25000 OS Explorer mapping for the Site and surrounding area;
- OS Terrain5 topographic ground contour details regenerated at 1m contours for the Site and surrounding area;
- Freely available on-line aerial and street scene photography for the Site and surrounding area;
- The Dumfries and Galloway Council on-line Planning Portal, for the identification of windfarm developments both proposed (i.e. at scoping stage, application submitted or consented but yet to be commenced), and existing (i.e. under construction or operational); and
- The Scottish National Heritage Windfarm Footprint Maps, depicting all windfarm developments which NatureScot have been consulted upon including their latest known planning status.

9.4.3 Field Surveys

68. A detailed baseline noise survey has been undertaken to determine the prevailing background noise levels at a sample of noise sensitive receptors in the vicinity of the Proposed Development. Additional detail can be found in the Baseline Noise Survey section.

9.4.4 Assessment Methodology

9.4.4.1 Blast Induced Noise, Vibration and Air Overpressure

69. Given that BS 5228 identifies that the best approach to address groundborne vibration is to base any assessment on site-specific operational measurements, at this stage a qualitative assessment has been undertaken.

70. This assessment has given general consideration to the potential for blast-induced groundborne vibration and air overpressure impacts to arise drawing on the guidance contained in PAN 50, BS 5228-1 and BS 5228-2.

71. The resulting impact magnitude and significance of effect have been identified following the method detailed in the Significance Criteria section below.

9.4.4.2 Turbine Noise

72. The assessment of operational noise and been undertaken following the methodology detailed within ETSU-R-97 and the IoA GPG. This has included the following steps:

- Completion of the Desk study described above to identify cumulative developments, the noise limits applicable to those developments, the closest sensitive receptors to the Proposed Development and those which have the greatest potential to be subject to a cumulative impact;
- A representative sample of identified receptors have been selected for assessment. These receptors have been selected to ensure a good geographic spread across the local area;
- A detailed baseline noise survey has been undertaken, including measurements at four different locations. The adopted measurement locations were selected at distances from existing turbines such that the obtained measurement data would not be influenced by noise from any existing wind turbines;
- The baseline data obtained from each measurement location has been assessed in accordance with ETSU-R-97 and the IoA GPG. This has included separate consideration to ‘quiet daytime’ and night-time periods, with the relationships between background noise level and wind speed determined;

- The cumulative daytime and night-time turbine noise level limits have been identified for each measurement location for both daytime and night-time periods;
- A detailed noise model has been prepared for the Site and surrounding area, including the selected noise-sensitive receptors, the Proposed Development and the identified cumulative developments. Additional details of the noise modelling process can be found in **Appendix 9.2 Noise Modelling and Prediction**;
- The noise model has been used to determine the resulting turbine noise levels at each selected receptor for: a) the Proposed Development in isolation, b) each of the identified cumulative developments, and c) the cumulative scenario (the Proposed Development and the identified cumulative developments all operating simultaneously);
- Noise level predictions have been undertaken for each receptor for 10m height integer wind speeds between 3 and 12m/s;
- Initially, consideration has been given to the receptors closest to the identified cumulative developments. The predicted noise levels for the Proposed Development operating in isolation have been compared against the noise level limits imposed on the operational Harestanes Windfarm. Where the levels are more than 10dB below the permitted limits, a significant effect would not arise from the Proposed Development operating either in isolation or under the cumulative scenario, and no further consideration is required to be given to these receptors. Where this is not the case, the receptors are brought forward into the next stage of assessment;
- For each of the remaining receptors (those brought forward form the first stage, and those closest to the Proposed Development), the applicable noise level limits have been applied from those determined at each measurement location; and
- The predicted noise levels for the Proposed Development operating in isolation and under the cumulative scenario have then been assessed against the noise limits.

73. The resulting impact magnitude and significance of effect have been identified following the method detailed in Significance Criteria section below.

9.4.5 Significance Criteria

9.4.5.1 Receptor Sensitivity

74. The guidance contained within the TAN to PAN 1/2011 has been drawn upon in the generation of an appropriate set of receptor sensitivity criteria. These criteria are presented in **Table 9.3**.

Receptor Sensitivity	Description	Examples
High	Receptors where people or operations are particularly susceptible to noise and/or vibration.	Residential, quiet outdoor recreational areas, schools and hospitals.
Medium	Receptors moderately sensitive to noise and/or vibration, where it may cause some distraction or disturbance.	Offices and restaurants.
Low	Receptors where distraction or disturbance from noise and/or vibration is minimal.	Unoccupied buildings or factories and working environments with existing levels of noise.

Table 9.3 Noise and Vibration Receptor Sensitivity Criteria

9.4.5.2 Blast Induced Vibration and Air Overpressure

75. The significance of effect has been determined taking into consideration the receptor sensitivity and the impact magnitude applying the criteria described below

Impact Magnitude

76. Where it is identified that structural damage would not arise as a result of blast-induced groundborne vibration or air overpressures, and that embedded mitigation measures are sufficient to offset concerns about such effects from local residents, the magnitude of impact has been categorised as Slight or Low. Where there is a risk of structural damage, or there are insufficient embedded measures to offset concerns from local residents, the magnitude of impacts has been categorised as Medium or High.

Significance of Effect

77. The significance of effects has been determined by consideration to both the receptor sensitivity and the impact magnitude, by application of the matrix presented in **Table 9.4**.

Impact Magnitude	Receptor Sensitivity: High	Medium	Low
High	Major	Moderate	Minor
Medium	Moderate	Minor	Negligible/Minor
Low	Minor	Negligible/Minor	Negligible
Slight	Negligible/Minor	Negligible	Negligible

Table 9.4: Significance Matrix

80. Effects identified to be either Negligible and Minor are considered to be 'Not Significant', whilst those identified to be Moderate and Major are considered to be 'Significant' in terms of the EIA Regulations.

9.4.5.3 Operational Turbine Noise

81. For operational wind turbine noise, account has also been given to the receptor sensitivity detailed in **Table 9.3**, with the significance of effect determined based on whether or not the applicable noise level limits (as described in Section 9.4.4.2) would be met. For high sensitivity receptors, as present in this case, a significant effect (in terms of the EIA Regulations) is registered where an exceedance of the applicable noise limits is identified. Where there is no exceedance of the applicable noise level limits, a 'not significant' effect is registered.

9.4.5.4 Effect Categorisation

82. Identified effects have been categorised as:

- either 'adverse' (e.g. noise level increases) or 'beneficial' (e.g. noise level decreases);
- either 'temporary' or 'permanent';
- either 'local', 'regional' or 'national'; and
- either 'direct' or 'indirect'.

9.4.6 Limitations to Assessment

83. The turbine type to be installed at the Proposed Development is not yet known and would depend on the results of a tender process that would not be progressed until after the planning application for the Proposed Development has been determined.

84. The assessment of turbine noise has therefore necessarily been based on manufacturer's noise emission data for a candidate turbine type. The candidate turbine selected for the assessment is the Siemens SWT 5.0-145 (with noise reduction blade add-ons). This turbine type fits within the physical parameters for the Proposed Development, and so can be considered a technically feasible selection, and was also that with the highest noise emissions levels of four different candidate turbines initially considered, representing a worst case.

85. It is standard practice for windfarm development to be subject to a noise related planning condition stipulating appropriate noise level limits with which the development should comply once operational. Such noise level limits have been derived as part of this assessment, see Mitigation - Turbine Noise section below.

9.5 Baseline Conditions

9.5.1 Cumulative Developments

86. The following cumulative developments have been identified as having the potential to give rise to a cumulative noise impact with the Proposed Development:

- Harestanes Windfarm (within the Site and to the north) – operational;
- Dalswinton Windfarm (5km to the west south west) – operational; and
- Minnygap Windfarm (1km to the north east) – operational.

87. The location of the above windfarm developments can be seen in **Figure 9.1 Noise and Vibration Sensitive Receptors, Cumulative Developments and Baseline Noise Measurement Locations**.

88. The following other windfarm developments have also been identified within 5km, but as agreed with Dumfries and Galloway Council, these have been scoped-out of the assessment for the reasons stated:

- Blackwood Windfarm (5km to the south west) – refused planning permission;
- Auchencairn Windfarm (3.3km to the west) – planning application withdrawn; and
- Duncow Common windfarm (2km to the south) – at scoping but no planning submission made.

89. Whilst the Duncow Common Windfarm in currently at Scoping Stage, this has remained unchanged for an extended period. In addition, freely available information from Companies House confirms that the Duncow Common Windfarm Limited company is no longer in existence, after the company name was changed to Galawhistle Extension Wind Farm Limited in 2015 (N.B. Galawhistle Windfarm is approximately 50km from the Proposed Development). It therefore appears that the Duncow Common Windfarm is no longer being pursued and so has been scoped-out of the assessment on this basis.

9.5.1.1 Harestanes Windfarm (Operational)

90. This development comprises 68 turbines, 67 with a hub height of 80m and one with a hub height of 67m.

91. The closest receptors to Harestanes Windfarm with the potential to be subject to a cumulative impact with the Proposed Development (and the other identified cumulative developments) are:

- Craigshiels;
- Knockenshang;
- Upper Minnygap;
- Nether Minnygap;
- Glenfine; and
- Glencorse.

92. These receptors are described in **Table 9.9** below, and can be seen on **Figure 9.1: Noise and Vibration Sensitive Receptors, Cumulative Developments and Baseline Noise Measurement Locations**.

93. Planning condition 6.12 of the development consent requires that;

> "*The details of the turbines, including size, type, … sound levels…shall be provided to the planning authority prior to the commencement of the development.*"
>
> and that
>
> "*The Development shall thereafter be implemented in accordance with the approved details*".

94. The development has subsequently been installed with 25 Gamesa G87 CS turbines and 42 Gamesa G87 II turbines each with 80m hub heights and a single Gamesa G80 turbine with 67m hub height.

95. Planning Condition 6.28 states the noise level limits to which the development is required to comply. This condition is duplicated as follows:

> "*6.28 At wind speeds not exceeding 12 metres per second as measured or calculated at a height of 10 metres above ground level at the wind farm, the wind farm noise emission level at any noise sensitive property existing at the time of this permission shall comply with the following:*
>
> *i) During night-time hours, as defined in ETSU-R-97 as 23.00 to 07.00 on all days, the wind farm noise emission level shall not exceed 43 dB LA90, 10min, or the ETSU-R-97 derived 'night hours' noise limit based on the measured LA90, 10min background noise level plus 5 dB(A), whichever is the greater.*
>
> *ii) At all other times, the wind farm noise emission level shall not exceed 40 dB LA90, 10min or the ETSU-R-97 derived 'quiet waking hours' noise limit based on the measured LA90, 10min background noise level plus 5 dB(A), whichever is the greater.*
>
> *iii) The above noise emission limits may be increased to 45 dB LA90, 10min or the relevant ETSU-R-97 derived 'quiet waking hours' or 'night hours' noise limit based on the measured LA90, 10min noise level plus 5 dB(A), whichever is the greater, when measured at any dwelling owned by persons receiving direct financial benefits from the wind farm.*
>
> iv) *Measured background noise levels referred to in this condition shall be those recorded by the regression lines in SEI Figures 10.14 and 10.15 (as corrected on 19 May 2006) and SEI Figures 10.16 - 10.25 contained in the Volume 3 Figures of the SEI[2], which supersede those noise limits contained within the original Environmental Statement.*"

96. The figures referenced in points iv) detail the quiet daytime and night-time background noise level regression lines for six different measurement locations. The measurement locations closest to Proposed Development and the receptors listed in **Paragraph 91** are as follows (the OS Grid references are as specified in the Harestanes Windfarm planning conditions):

- Gubhill (OS grid reference 297250, 592200), regression lines on Graphs 10.18 and 10.19 of the SEI;
- Ingleston (OS grid reference 305320, 597340), regression lines on Graphs 10.24 and 10.25 of the SEI; and
- Glencorse (OS Grid Reference 298000, 589800), regression lines on Graphs 10.20 and 10.21 of the SEI.

97. These regression lines are presented in tabular form in **Table 9.5** below:

Period	Wind Speed Referenced to 10m Height, m/s								
	4	5	6	7	8	9	10	11	12
Measurement Location: Gubhill									
Quiet daytime hours	36.5	36.4	36.4	36.3	36.2	36.1	36.0	35.8	35.7
Night-time hours	36.1	36.9	37.5	38.1	38.7	39.2	39.6	40.0	40.3
Measurement Location: Ingleston									
Quiet daytime hours	31.1	33.7	36.3	38.9	41.4	43.9	46.4	48.8	51.3
Night-time hours	30.5	32.7	34.8	36.8	38.7	40.5	42.3	44.0	45.5
Measurement Location: Glencorse									
Quiet daytime hours	33.2	33.6	33.9	34.2	34.4	34.6	34.7	34.7	34.6
Night-time hours	32.2	33.1	33.9	34.7	35.3	35.8	36.3	36.6	36.9

Table 9.5: Background Noise Levels, Harestanes Windfarm Planning Consent, $L_{A90,T}$, dB(A)

[2] Supplementary Environmental Information

98. In accordance with Condition 6.28, the corresponding noise level limits, assuming no financial involvement (FI) in the development, are as detailed in **Table 9.6.**

Period	Wind Speed Referenced to 10m Height, m/s								
	4	5	6	7	8	9	10	11	12
Measurement Location: Gubhill									
Daytime Limit	41.5	41.4	41.4	41.3	41.2	41.1	41.0	40.8	40.7
Night-time Limit	43.0	43.0	43.0	43.1	43.7	44.2	44.6	45.0	45.3
Measurement Location: Ingleston									
Daytime Limit	40.0	40.0	41.3	43.9	46.4	48.9	51.4	53.8	56.3
Night-time Limit	43.0	43.0	43.0	43.0	43.7	45.5	47.3	49.0	50.5
Measurement Location: Glencorse									
Daytime Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Night-time Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

Table 9.6: Turbine Noise Level Limits, Harestanes Windfarm Planning Consent, $L_{A90,T}$, dB(A) – Non FI

9.5.1.2 Dalswinton Windfarm (Operational)

99. This development comprises 15 turbines all with 80m hub heights. It has been installed with 15 RePower MM82 turbines[3].

100. The closest receptors to Dalswinton Windfarm with the potential to be subject to a cumulative impact with the Proposed Development (and the other identified cumulative developments) are:

- Glenfine Farm; and
- Glencorse.

101. The receptors are described in **Table 9.9** below, and can be seen on **Figure 9.1: Noise and Vibration Sensitive Receptors, Cumulative Developments and Baseline Noise Measurement Locations.**

102. In the preparation of this EIA Report, a copy of the planning decision notice and conditions for this development was sought. However, due to the coronavirus pandemic, the Dumfries and Galloway Council planning records could not be accessed either by the public or Dumfries and Galloway Council staff, with the associated office being closed. A copy of the decision notice and conditions was therefore not available.

103. The assessment of cumulative noise the closest receptors to this development and the Proposed Development has therefore been undertaken based on the noise level limits stated within the Harestanes Windfarm planning permission, which were determined in accordance with the ETSU-R-97 assessment method.

9.5.1.3 Minnygap Windfarm (Operational)

104. This development comprises 10 turbines all with 75 m hub heights.

105. The closest receptors to Minnygap Windfarm with the potential to be subject to a cumulative impact with the Proposed Development (and the other identified cumulative developments) are:

- Upper Minnygap; and
- Nether Minnygap

106. The receptors are described in **Table 9.9** below, and can be seen on **Figure 9.1: Noise and Vibration Sensitive Receptors, Cumulative Developments and Baseline Noise Measurement Locations.**

107. Planning condition 7 of the development consent requires that:

> "*No turbines shall be erected until exact design details (including size, type… power rating and sound levels)… have been submitted to and approved in writing by the planning authority.*"
>
> and that
>
> "*The development shall not be brought into use unless it has been implemented in complete accordance with such details as may be so approved*".

108. The development has subsequently been installed with ten Nordex N100/2500 turbines[4].

109. Planning Condition 27 states the noise level limits to which the development is required to comply. This condition is duplicated as follows:

> "*27. The level of noise immissions[5] from the combined effects of the wind turbines (including the application of any tonal penalty) when calculated in accordance with the attached Guidance Notes, shall not exceed the values set out in Table 1 or Table 2 (as appropriate). Noise limits for dwellings which lawfully exist or have planning permission for construction at the date of this consent but are not listed in the tables attached shall be those of the physically closest location listed in the tables unless otherwise agreed with the planning authority. The co-ordinate locations to be used in determining the location of each of the dwellings listed in Table 1 and Table 2 shall be those listed in Table 3.*"

110. The noise limits taken from Tables 1 and 2, as applicable at the receptors of Upper Minnygap and Nether Minnygap are presented in **Table 9.7**.

Period	Wind Speed Referenced to 10m Height, m/s								
	4 or less	5	6	7	8	9	10	11	12
Receptors: Upper Minnygap and Nether Minnygap									
Daytime Limit	37.5	37.5	37.5	37.5	38.3	40.5	43.6	47.9	47.9
Night-time Limit	43.0	43.0	43.0	43.0	43.0	43.0	44.2	46.9	46.9

Table 9.7: Turbine Noise Level Limits, Minngygap Windfarm $L_{A90,T}$, dB(A)

9.5.2 Sensitive Receptors

111. Noise-sensitive receptors in the vicinity of the Proposed Development and the identified cumulative developments have been identified from a review the AddressBase Plus® database, freely available aerial and street view photography, Ordnance Survey mapping and the results of Site visits.

112. The AddressBase Plus® database allies the Royal Mail address database with Ordnance Survey six figure grid references. These data also include a categorisation scheme with primary, secondary, tertiary and quaternary codes, detailing the nature of each data entry. Examples are presented in **Table 9.8** below:

[3] https://www.ventientenergy.com/our-portfolio/dalswinton/

[4] https://www.windhoist.co.uk/2016/11/27/final-wind-turbine-erected-dumfries-galloway/ & https://www.thewindpower.net/windfarm_en_24001_minnygap.php & http://www.minnygap-windfarm.co.uk/about-us/res-in-scotland/

[5] In windfarm noise assessment, the word 'immission' can commonly be used to denote the resulting noise levels at the receiver position, and distinguish this from the sound energy emitted by the source for which the word 'emission' is commonly used.

Code	Class description	Primary code	Secondary code	Tertiary code	Quaternary code
CE03PS	Primary School	C (Commercial)	E (Education)	03 (Preparatory / First / Primary / Infant / Junior / Middle School)	PS (First School)
RD04	Terraced	R (Residential)	D (Dwelling)	04 (Terraced)	-
RG	Garage	R (Residential)	G (Garage)	-	-
RI02NC	Non-commercial lodgings	R (Residential)	I (Residential Institute)	02 (Communal Residence)	NC (Non-Commercial lodgings)

Table 9.8: Example Classification Codes for AddressBase Plus® Database

113. The categorisation scheme is extensive with more than 550 different individual codes. The full dataset for the local area has been reviewed with all entries allocated into the following categories:

- residential;
- temporary residential;
- medical;
- educational;
- religious / place of worship;
- community facilities – sensitive;
- community facilities – other;
- not noise-sensitive; and
- other.

114. The results of the above categorisation were then complemented by the addition of the findings of the wider desk review. For example, where any receptors were found not to be represented with the AddressBase data, these were added manually. The final identified sensitive receptor set can be seen in **Figure 9.1 Noise and Vibration Sensitive Receptors, Cumulative Developments and Baseline Noise Measurement Locations.**

115. There is a former residential dwelling at Glenkiln (OS grid reference: 301171, 591165), but this is no longer inhabited and is in the ownership of the Applicant. The Applicant has committed that this location would not be made available for occupancy for the duration of the operation of the Proposed Development, should it be consented. This is therefore not a noise-sensitive receptor.

116. The location of Aukenskew Cottages (OS grid reference: 303689, 591551) is not identified as residential within the AddressBase Plus® database, and does not have a postal address. It was also identified by means of a Site visit that there is only an uninhabitable ruin at this location. This is therefore not a noise-sensitive receptor.

117. **Table 9.9** details the sample of noise-sensitive receptors that have been selected for assessment. This includes those closest to the Proposed Development and those with the greatest potential to be subject to a cumulative noise impact. They also have a good geographic spread across the local area. Also presented are the approximate grid coordinates for each receptor, the distance to the closest existing and/or proposed wind turbine. These receptors can be seen in **Figure 9.1 Noise and Vibration Sensitive Receptors, Cumulative Developments and Baseline Noise Measurement Locations.**

118. None of these receptors have a financial involvement in the Proposed Development and, to represent a worst case, it has been assumed that none have a financial involvement in the identified cumulative developments.

Ref.	Name	Description	Easting (OSGB)	Northing (OSGB)	Closest Turbine	Distance to Closest Turbine
1	Upper Minnygap	Residential	304344	596734	Minnygap T5 Harestanes Extension T07	1330m 3240m
2	Nether Minnygap	Residential	304368	596512	Minnygap T5 Harestanes Extension T07	1275m 3060m
3	Barntimpin	Residential	305282	596192	Minnygap T10 Harestanes Extension T07	1990m 3430m
4	Auld Laundry Cottage	Residential	306225	594312	Harestanes Extension T08	3260m
5	Mollin Farm	Residential	305254	593018	Harestanes Extension T08	2270m
6	Holmwood	Residential	305168	591784	Harestanes Extension T08	2770m
7	Courancehill	Residential	304659	591330	Harestanes Extension T05	2680m
8	Burrancehill Cottage	Residential / Holiday Cottage	304237	591240	Harestanes Extension T05	2380m
9	Burrancebrae	Residential	304651	590689	Harestanes Extension T05	3050m
10	Kirkland Cottage	Residential	303420	589609	Harestanes Extension T03	3290m
11	Lamphitt	Residential	299942	589736	Harestanes Extension T03	2720m
12	Townhead Farm	Residential	300544	588306	Harestanes Extension T03	3865m
13	Wood Farm	Residential	299319	588893	Harestanes Extension T03	3765m
14	Woodside	Residential	298802	589307	Harestanes Extension T03	3740m
15	Glencorse	Residential	298040	589728	Dalswinton T16 Harestanes Extension T01	3095m 3460m
16	Glenfine Farm	Residential	297984	589918	Dalswinton T16 Harestanes Extension T01	3075m 3350m
17	Glenview	Residential	297212	591635	Harestanes Extension T01	3055m
18	Gubhill Farm	Residential	297210	592208	Harestanes Windfarm C20	2405m
19	Craigshiels	Outdoor Centre	298321	592876	Harestanes Windfarm C20 Harestanes Extension T01	1115m 1870m
20	Knockenshang	Residential Care Home	297090	593524	Harestanes Windfarm C19	2470m

Table 9.9: Noise-Sensitive Receptors Selected for Assessment

9.5.3 Baseline Noise Survey

119. A detailed baseline noise survey has been undertaken in the vicinity of the Proposed Development. Continuous long-term monitoring was undertaken at the following receptor locations, which were selected as representative of the receptors detailed in **Table 9.9**:

- Measurement Location A: Mollin Farm;
- Measurement Location B: Burrancehill Cottage
- Measurement Location C: Lamphitt; and
- Measurement Location D: Glenview

120. These measurement locations can be seen on **Figure 9.1 Noise and Vibration Sensitive Receptors, Cumulative Developments and Baseline Noise Measurement Locations** and were sufficiently removed from existing windfarms / located such that the measurement results were not influenced by operational wind turbine noise. This has been confirmed from a review of the obtained measurement data and associated background curves (as determined), from which there is no suggestion of any influence from existing turbine noise.

121. The survey commenced on 7 August 2020 and concluded on 8 September 2020. The obtained measurement durations at each location are detailed in **Table 9.10**.

Measurement Location	Measurement Duration	Total Number of Days Monitored
A - Mollin Farm	14:50 7 Aug 2020 to 07:20 8 Sept 2020	32
B - Burrancehill Cottage	13:10 7 Aug 2020 to 15:20 18 Aug 2020 & 16:10 1 Aug 2020 to 08:50 3 Sept 2020	27
C - Lamphitt	11:40 7 Aug 2020 to 17:10 18 Aug 2020 & 17:40 18 Aug 2020 to 16:30 3 Sept 2020	27
D - Glenview	10:30 7th Aug 2020 to 12:00 9 Sept 2020	33

Table 9.10: Noise Measurement Durations

122. The IoA GPG advises that a survey duration of less than 2 weeks is unlikely to be sufficient to obtain a dataset covering the required range of wind speeds and directions (the latter if relevant). It can be seen from **Table 9.10** that all measurement locations were subject to significantly longer measurement durations than the minimum 14-day period, to ensure that a representatively wide range of wind conditions have been captured.

123. The noise survey was undertaken using BS EN 61672-1:2013 Class 1 specification sound pressure level measurement equipment detailed in **Table 9.11** below.

WSP Equipment Reference	Equipment Item	Make and Model	Serial Number
Duo 4	Sound Pressure Level Meter	01dB-Metravib DUO	10636
	Pre-amplifier	01dB Metravib PRE 22	10183
	Microphone	GRAS 40CD	162036
	Hand Held Calibrator	01dB-Stell CAL 21	34924015
Rion G	Sound Pressure Level Meter	Rion NL-52	1021290
	Preamplifier	NH-25	21332
	Microphone	UC-59	4346
	Hand Held Calibrator	NC-74	35173440
Rion H	Sound Pressure Level Meter	Rion NL-52	1021289
	Preamplifier	NH-25	21331
	Microphone	UC-59	4345
	Hand Held Calibrator	NC-74	35173440
Fusion 2	Sound Pressure Level Meter	01dB-Metravib Fusion	10796
	Preamplifier	01dB PRE22	10882
	Microphone	GRAS 40CD	207588
	Hand Held Calibrator	01dB-Stell CAL 21	34254632

Table 9.11: Baseline Noise Survey Measurement Equipment

124. All sound level meters had been calibrated to traceable standards within the preceding 2 years and the calibrators within the preceding 12 months. Each measurement system was field-calibration-checked at the point of installation and at collection. No significant measurement drifts occurred.

125. Each of the 01dB measurement systems was fitted with a standard factory fit windshield, as well as a secondary windshield system which comprised a cylinder of 20mm thick 45ppi reticulated foam. This secondary cylinder had a diameter of approximately 220mm, a height of approximately 300mm and was mounted on a wire mesh frame. The secondary windshields were designed in line with the conclusions of the ISVR 'Noise measurements in windy conditions' document dated 1996, as referenced by ETSU-R-97. These secondary windshields were designed to comply with the following report conclusion:

> "*Overall the preferred windscreen configuration of those tested is a two layer windscreen, with an outer cover of 45 ppi foam, a diameter of 200 to 300mm, and the standard UA0237 or UA 0570/0393 as the inner screen.*"

126. Samples of the secondary windshields have been tested by an independent acoustic laboratory which found that the effect of adding the secondary windshield gave rise to an insertion loss of less than +/-1dB in all octave bands between 63Hz and 8kHz. In accordance with the above referenced ISVR document this insertion loss is considered to be "*satisfactory"* with insertion losses of between 1 and 3 dB being classified as "*marginal"*, and insertion losses of greater than 3dB considered to be "*unsatisfactory*".

127. Each of the Rion measurement systems were installed with their standard outdoor WS-15 windshields, which are of substantial dimensions (reticulated foam with approx. 200mm diameter).

128. Each measurement system was installed with the microphone mounted under free-field conditions, approximately 1.5m above ground level. The measurement location at each property was selected to be representative of the primary external living spaces, but also to minimise the influence of any local sources such as road traffic, water courses and wind through local trees/foliage etc. The installation location selected at each property is detailed in **Appendix 9.3 Baseline Noise Survey**. This appendix also includes additional survey details including photographic records of each measurement location and the installed equipment as well as the field-calibration records etc.

129. As the noise survey was undertaken entirely within the British Summer Time (BST) period, the time clocks on each measurement systems were set to UK BST, at the points of installation, such that the measurement results could be accurately time aligned with the meteorological survey results (See Meterological Data section below). The system time clocks where then checked at the end of the survey, to ensure that none had exhibited a significant drift in accordance with the IoA GPG which states:

> "*A synchronisation drift of more than 1 minute over the duration of the survey should be reported and best avoided*".

130. None of the measurement systems drifted to this degree, see **Appendix 9.3 Baseline Noise Survey**.

131. Each measurement system was set to measure the $L_{A90,T}$, and other environmental monitoring indices, in continuous 10-minute intervals over the full measurement periods. Measurement data was obtained for the periods commencing on the hour, 10 minutes past, 20 minutes past, half past, 20 minutes to and 10 minutes to each hour.

9.5.3.1 Meteorological Data

132. For the duration of this baseline noise survey, simultaneous 10-minute meteorological measurements were undertaken on the Site of the Proposed Development. The meteorological mast was installed at OS grid reference: 299697, 591819. The obtained measurement data included rainfall, average wind speed and wind direction.

133. Anemometers were installed on the mast at heights of 30m, 50.4m, 70m and 81m above ground, with a rain gauge installed at 2.5m. Wind direction vanes were installed at heights of 28m and 78m.

134. The installed anemometers had a minimum accuracy of +/- 0.12m/s, the vanes had an accuracy of approximately +/- 3° including for installation error, and the rain gauge has a resolution of 0.1mm/tip. All of these accuracies / resolutions achieve the minimum requirements specified within the IoA GPG.

135. **Appendix 9.3 Baseline Noise Survey** presents the wind direction information for the duration of the baseline noise survey from its commencement on 7 August 2020, until its conclusion on 9 September 2020.

136. It can be seen that over the duration of the baseline noise survey, wind from all directions arose, but that the predominant conditions were westerly and easterly winds.

137. For the duration of the meteorological survey, the measurement system time clock was set to Greenwich Mean Time (GMT), with data timestamps representing the end of each measurement period. The time clock was set to check against the internet time clock every 2 days, and automatically adjust if a drift of more than +/- 3 seconds was identified.

9.5.3.2 Baseline Noise Survey Results

138. In order to determine how the measured background noise levels change with windspeed at each measurement location, it is necessary to correlate the noise measurement data with the wind speed data measured on the Site.

139. The measured average wind speeds obtained at heights of 50.4m and 81m have been used to determine proposed hub height (125m) wind speed. This has then been adjusted to 10m (standardised) height using the standard wind shear profile corresponding with standard ground roughness. The method used is detailed in **Appendix 9.4 Wind Shear Correction** and is in full accordance with the IoA GPG. This standardisation process is necessary to allow a fair comparison of results against predicted turbine noise levels which are undertaken based on turbine noise emission also referenced to the same 10m standardised height.

140. The standardised 10m height average wind speed data and the measured $L_{A90,10min}$ noise level data for each measurement location have then been time-synchronised to BST (accounting for measurement start / end times). Adopting BST within the analysis ensured that it was based on the time clock to which the UK population were operating at the time of the baseline noise survey.

141. The synchronised datasets have then been filtered to remove any periods of significant rain (which has been defined as 1mm or more within the preceding 1-hour period), as well as any identified anomalous noise events not considered representative of the underlaying background noise levels. Examples of anomalous noise events might include the operation of a fixed or mobile plant item, or lawn mowing operation which falsely increased the measured background levels for a limited period. Such events were identified from a manual inspection of the noise measurement data traces (e.g. by the presence of background noise levels being clearly elevated to ether a fixed constant level, or a level with a time signature trace with regular pattern as typical of a moving engine noise or similar).

142. After filtering, the data has been split into the following sets as defined in ETSU-R-97:

- Quiet Daytime Hours - 18:00 to 23:00 on all days, as well as 13:00 to 18:00 on Saturdays and Sundays, and 07:00 to 13:00 on Sundays; and
- Night-time Hours - 23:00 and 07:00 on all days.

143. The datasets for each location are presented in **Graphs 9.5.1 to 9.5.8** of **Appendix 9.5 Baseline Noise Conditions.** Separate graphs are presented for quiet daytime and night-time periods for each Measurement Location. Each graph depicts the data that has been retained in the analysis and that which has been removed either due to rain or manually for anomalous events.

144. To define the relationship between wind speed and background noise level, each graph includes a 3rd-order polynomial line of best fit for the retained dataset.

145. The identified background noise levels (based on the polynomial lines of best fit) are presented in tabular form in **Table 9.12**.

Period	Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
	3	4	5	6	7	8	9	10	11	12
Measurement Location A: Mollin Farm										
Quiet daytime hours	26.5	27.9	29.3	30.8	32.3	33.9	35.5	37.2	38.9	40.6
Night-time hours	25.8	26.3	27.1	28.4	30.0	31.9	34.3	37.1	40.3	44.0
Measurement Location B: Burrancehill Cottage										
Quiet daytime hours	28.0	28.5	29.3	30.4	31.8	33.5	35.4	37.5	39.8	42.2
Night-time hours	26.6	26.7	27.3	28.4	30.0	31.8	33.9	36.2	38.6	41.0
Measurement Location C: Lamphitt										
Quiet daytime hours	36.3	35.9	36.1	36.7	37.9	39.5	41.5	44.0	46.9	50.3
Night-time hours	36.1	35.6	35.8	36.7	38.0	39.6	41.5	43.4	45.2	46.8
Measurement Location D: Glenview										
Quiet daytime hours	30.0	30.1	30.5	31.1	32.0	33.2	34.7	36.5	38.6	41.0
Night-time hours	29.7	29.9	30.4	31.2	32.2	33.5	34.9	36.5	38.2	39.9

Table 9.12: Measurement Location Background Noise Levels, $L_{A90,T}$, dB(A)

146. It can be seen that the measurement results for Lamphitt are generally higher than those obtained at the other measurement locations. This is due to the presence of a water course at Lamphitt, as confirmed in **Appendix 9.3 Baseline Noise Survey**. As such, the data obtained at Lamphitt have been considered as representative of this property only, and have not been used in the assessment as a proxy for any other location.

9.6 Potential Effects

9.6.1 Mitigation by Design and Embedded Mitigation

9.6.1.1 Construction Noise and Vibration

147. There are a number of safeguards that exist to minimise the effects of construction noise and vibration. These include:

- the various EC Directives and UK Statutory Instruments that limit noise emissions of a variety of construction plant; and
- the powers that exist for local authorities under Sections 60 and 61 of the Control of Pollution Act 1974 to control environmental noise on construction sites.

148. In addition, the adoption of Best Practicable Means (BPM) as defined in the Control of Pollution Act 1974 is usually the most effective means of controlling noise and vibration from construction sites. BPM would be employed including the following measures:

- Staff would receive appropriate environmental training at the beginning of the contract and throughout the construction;
- Silenced or sound reduced compressors, would be used where necessary;
- Silencers or mufflers would be fitted to pneumatic tools where required;
- Deliveries would be programmed to arrive during daytime hours only, with care being taken to minimise noise when unloading vehicles;
- Delivery vehicles would be prohibited from waiting within the site construction compound with their engines running;
- Plant items would be properly maintained and operated according to manufacturers' recommendations, in such a manner as to avoid causing excessive noise;
- Access to the site would be along agreed access routes only;
- There would be compliance with agreed working hours, e.g. construction activities audible beyond the site boundary would only be undertaken during the daytime between 07:00 to 19:00 hours Monday to Friday and 07:00 to 16:00 hours on weekends, or as agreed with the Dumfries and Galloway Council's Environmental Health Officer;
- Effective liaison with the local community would be established and maintained throughout the construction period. This would include provision of information on the on-going activities (including blasting where required) and provision of contact telephone numbers for the site to obtain information during operational

hours,a representative being identified with appropriate authority to resolve any problems and a log of complaints and actions taken to remedy these being maintained; and
- The good practice advice detailed in both BS5228-1 and BS5228-2 would be complied with.

149. Compliance with the above measures would be ensured through inclusion within a Construction Environmental Management Plan (CEMP) which the appointed contractor would be required to comply with (**Appendix 4.1** presents an Outline CEMP). The final CEMP would be subject to agreement with Dumfries and Galloway Council and the Scottish Environment Protection Agency (SEPA) and a planning condition could be used to ensure that it was followed in practice.

9.6.1.2 Blast Induced Vibration and Air Overpressure

150. Embedded mitigation measures that serve to reduce potential vibration and air overpressure from blasting works (should this be necessary) include the following:

- Three different borrow pit search areas have been identified, geographically spread across the Site, increasing the potential for stone extraction without the need for blasting, see **Figure 4.1 Site Location Plan**;
- If blasting is identified to be needed, it may be able to be spread across the three borrow pit areas, limiting the duration and extent of works in the vicinity of any individual receptor; and
- Each borrow pit search area is located at substantial distance from the closest noise and vibration-sensitive receptors (2.2km at the closet point), such that attenuation of resulting vibration and air overpressure levels as a result of geometric spreading (distance) would be substantial.

151. In addition, the following good practice measures would be included within a blasting management programme, compliance with which can be ensured through the CEMP as to be agreed with Dumfries and Galloway Council and the Scottish Environment Protection Agency (SEPA):

- care would be taken with the development of faces, and with trial blasts, as anomalous vibration levels might be produced when there is no free face to relieve the energy produced;
- appropriate burden would be ensured to avoid over- or under-confinement of the charge;
- accurate drilling and setting out would be undertaken;
- charge levels would be appropriate;
- exposed detonating cords would not be used;
- stemming with appropriate material such as sized gravel or stone chippings would be undertaken;
- decking charges/in hole delays/delay detonation would be used to ensure smaller maximum instantaneous charges (MICs);
- a series of groundborne vibration measurements and air overpressure measurements would be undertaken to check compliance with appropriate criteria (adopted from BS5228-2).
- each charge would be individually designed to maximise efficiency and reduce energy loss through vibration and air overpressure;
- the use of surface detonating cords and secondary blasting will be avoided wherever possible;
- the areas of heave and the total charges will be minimised; and
- blasting in adverse weather conditions will be avoided (i.e. wind in the direction of sensitive receptors).
- Local residents will be informed in advance of the proposed times of blasting works, along with details of the good practice mitigation measures that are in place, to ensure good relations and appropriate reassurance.

9.6.1.1 Turbine Noise

152. Embedded mitigation measures that serve to reduce the potential impact of turbine noise include the following:

- The proposed turbines have been sited at significant distances from the closest noise-sensitive receptors (1.87km at the closest point, see **Table 9.9**), such that the attention of noise as a result of geometric spreading (distance) is maximised and
- Turbines have been located such that attenuation from landform (acoustic screening) is maximised where possible.

9.6.2 Potential Effects - Blast Induced Vibration and Air Overpressure Vibration

153. PAN 50 confirms that the levels of groundborne vibration as a result of blasting during surface mineral workings "*are well below those required to give rise to structural damage*". With regard to human perception of vibration due to blasting, BS 5228-2 states that "*ground borne vibration can lead to concern being expressed by residents around open cast sites*", but that any concerns raised are "*usually over the likelihood of property damage*" rather than annoyance / nuisance (which is unsurprising given the infrequent, occasional nature of the source). The standard goes on to state that "*Good public relations have been shown to reassure the public of the fact that normal production blasting has not been found to damage property, and that even the most cosmetic of plaster cracking is extremely unlikely*".

154. Accordingly, given that the embedded mitigation measures include for local residents to be kept informed of the times of blasting works as well as the details of the good practice mitigation measures that are in place, it is considered that appropriate measures are in place to alley possible concerns from residents.

155. Notwithstanding this, the closest residential receptor to any of the borrow pit search areas is Craigshiels, at a distance of approximately 2.2km. This substantial distance is sufficient that concerns over possible impacts (either building damage or nuisance) as a result of groundborne vibration are not expected.

156. Therefore, the receptor sensitivity is High[6] and the impact magnitude is Slight, giving rise to a **Negligible adverse** effect (**Not Significant**). The resulting effect would be direct, temporary and local.

9.6.2.1 Air Overpressure

157. Provided that an exposed detonating cord is not used (which is the usual situation – see embedded mitigation section above), the characteristic noise from a blast is no longer a sharp crack but rather a 'dull thump'[7] . Peak noise levels from blasting are comparable to the sort of levels typically generated at properties by passing cars[7], but in the case of blasting would only exist for around a second and also occur relatively infrequently.

158. Because of its very brief duration, infrequent occurrence and low frequency content (much of which is below 20Hz and hence inaudible to the human ear) blast noise is usually considered not to be a significant problem with respect to disturbance to humans.

159. Air overpressure may be sensed or felt by humans and can excite secondary vibrations at audible frequencies in buildings (e.g. rattling of windows and ornaments on shelves) that has been found to give rise to adverse comments from occupants of buildings affected by the blasting. However, there is no known evidence of structural damage to buildings/structures from excessive air overpressure levels from quarry blasting[8] .

160. Noise attenuation due to topography (whether natural or man-made), ground effects and air absorption between the blast site and receiver would be much greater for the audible component of the pressure wave (i.e. above 20Hz), but relatively slight on the lower frequency (or concussive) component. As a consequence, the air overpressure from blasting can carry over large distances.

161. BS 5228-2 notes that "*meteorological conditions, over which the operator has no control, such as temperature, cloud cover, humidity, wind speed, turbulence and direction would all affect the intensity of air overpressure at any location*". These meteorological effects cannot be reliably predicted, although under still conditions, once outside the immediate vicinity of the blast, air overpressure intensity will reduce at 6dB per doubling of distance.

[6] This has been selected as a worst case for Craigshiels, such that the assessment also encompasses the closest residential property. However, given that this is an outdoor centre not subject to permanent residential occupancy it would be reasonable to apply a lower sensitivity grade if considered in isolation.

[7] PAN 50 Paragraph 50
[8] BS 5228-2 Annex 3 Section G1 paragraph 3

162. For the reasons stated above regarding blast design and the prevailing meteorological conditions, both of which would influence source levels, it is not possible to predict air overpressure from blasting with any certainty – this is confirmed in BS5228-2. Furthermore, it is not generally accepted practice to set specific limits for air overpressure. In order to control air overpressure the best practical approach is to take measures to minimize its generation at source, as outlined in the embedded mitigation section above.

163. These embedded mitigation measures are sufficient that to alley possible concerns from residents. Notwithstanding this, the substantial separation distance of at least 2.2km from the borrow pit search areas is sufficient that possible impacts as a result of air overpressures are not expected.

164. Therefore, the receptor sensitivity is High[6] and the impact magnitude is Slight, giving rise to a **Negligible adverse** effect (**Not Significant**). The resulting effect would be direct, temporary and local.

9.6.3 Potential Effects - Turbine Noise

9.6.3.1 Noise Level Predictions

165. In order to determine the noise levels that would be generated by the Proposed Development acting both in isolation and simultaneously with identified cumulative developments, a detailed noise model has been prepared for the Site and surrounding area.

166. The model has been prepared in the CadnaA® noise modelling suite. The noise model was set to use the ISO 9613-2 prediction method, which includes prescribed formulae for accounting for the effects of geometric divergence, ground absorption and atmospheric absorption. The ISO 9613-2 prediction method is for the calculation of sound pressure levels at a 'downwind' location and the research findings presented in 'Development of a windfarm noise prediction model' (Bass et al 1998), identified that this model tends to over-predict windfarm noise levels, whilst also being the best available. This noise prediction model is referenced as appropriate for use within the IoA GPG, but with the following recommendations, which have been applied:

- Topographic screening effects of the terrain should be limited to a reduction of no more than 2dB (unless a higher value can be fully justified), and only applied where there is no line of sight between the highest point on the turbine rotor and the receiver location; and
- A correction of +3dB (or + 1.5dB if using G=0.0) should be added where the propagation of noise from the turbine to a receiver is across a valley[9] (as defined in the IoA GPG).

167. Whilst the IoA GPG presents methodologies for the determination of additional corrections to account for propagation directivity, which could be used for example to account for effects of wind direction where a receptor is located between two developments, such corrections have not been included within this assessment. The predicted operational noise levels can therefore be considered worst case in this regard, assuming downwind propagation conditions from all turbines.

168. Additional information on the completed noise modelling and predictions can be found in **Appendix 9.2 Noise Modelling and Prediction.**

9.6.3.2 Turbine Sound Power Level Data

Proposed Development

169. Sound power level data for the candidate turbines (Siemens Gamesa SWT 5.0-145 with noise reduction blade add-ons, installed with 125m hub), has been provided by the manufacturer. Data has been provided for the turbine operating in unrestricted mode, power reduced modes and noise reduced modes[10]. The data provided was referenced to hub height wind speed. To represent a worst case, the data for the turbine operating in unrestricted mode has been adopted. That data has been standardised to a reference height of 10m assuming the proposed hub height of 125m, by applying the hub height to 10m height correction detailed within **Appendix 9.4 Wind Shear Correction**. The resulting turbine noise emission data is detailed in **Table 9.13.** A +2dB uncertainty correction has been included, in accordance with the IoA GPG recommendations.

Mode	Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s			
	4	5	6	7+
Unrestricted mode (with noise reduction blade add-ons)	100.9	105.8	110.1	111.3
Data includes +2dB additional uncertainty correction				

Table 9.13: Sound Power Level Data for the Siemens Gamesa SWT 5.0-145, 125m hub height, dB(A)

170. The same technical document also provides third octave band sound power level data for operation in unrestricted mode. This data has been converted into octave band format and also standardised to a reference height of 10m assuming the proposed hub height of 125m, also following the method in **Appendix 9.4 Wind Shear Correction**. The resulting octave band spectra are presented in **Table 9.14**.

Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s	Octave Band Centre Frequency (Hz)								
	32	63	125	250	500	1k	2k	4k	8k
4	69.3	81.4	87.0	90.5	91.5	93.3	92.9	86.7	73.2
5	74.3	86.4	92.0	95.5	96.5	98.3	97.9	91.7	78.2
6	78.5	90.6	96.2	99.7	100.7	102.5	102.1	95.9	82.4
7+	79.7	91.8	97.4	100.9	101.9	103.7	103.3	97.1	83.6

Table 9.14 Octave Band Sound Power Level Spectra (L_{WA}) for Siemens Gamesa SWT 5.0-145 Operating in Unrestricted Mode (with Noise Reduction Blade Add-ons), 125m hub height, dB(A)

171. For each wind speed, the adopted spectrum has been level-adjusted to correspond to the single figure sound power level data presented in **Table 9.13**.

Harestanes Windfarm

172. Sound power level data for the installed turbine types have been provided by the manufacturer for each turbine type operating in unrestricted and noise reduced modes[11]. To represent a worst case, the data for the turbine operating in unrestricted mode has been adopted. The data provided was referenced to wind speed at standardised 10m height and is presented in **Table 9.15**. A +2dB uncertainty correction has been included.

Turbine / Mode	Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s				
	3	4	5	6	7+
Gamesa G80 78m hub height[1] (Unrestricted Mode)	-	97.4	102.2	104.9	105.1
Gamesa G87 II 80m hub height (Unrestricted Mode)	94.8	99.3	104.1	108.0	108.4
Gamesa G87 CS 80m hub height (Unrestricted Mode_	-	98.4	103.3	106.3	106.3
Data includes +2dB additional uncertainty correction [1] Worst case for the Gamesa G80 turbine installed with 67m hub height					

Table 9.15: Sound Power Level Data for the Turbines Installed at Harestanes Windfarm, dB(A)

[9] i.e. a concave ground profile, or where the ground falls away significantly, between the turbine and receiver location.
[10] Siemens Gamesa technical document entitled: SG 5.0-145 Noise Emission Analysis, document code: GD411363-en Rev. 2, dated 30/06/19
[11] Gamesa technical document entitled: Noise emission analysis for G8X wind turbines, document code: GD027805-en Rev. 4 dated 26/04/10

173. The same technical document also provides 'optimistic', 'pessimistic' and 'median' third octave band sound power levels for the G80 and G87 turbines. The 'median' spectra have been adopted in this assessment. These data have been converted into octave band format and are presented in **Table 9.16**. The G87 data has been applied to both the G87II and the G87CS.

Turbine	Octave Band Centre Frequency (Hz)								
	32	63	125	250	500	1k	2k	4k	8k
Gamesa G80	71.4	80.1	87.3	92.3	94.9	94.3	90.9	84.8	75.0
Gamesa G87	72.3	80.8	87.3	92.5	94.9	93.9	89.5	81.5	68.3
Wind speed unspecified									

Table 9.16: Octave Band Sound Power Level Spectra (L_{WA}) for the Turbines Installed at Harestanes Windfarm, dB(A)

174. For each wind speed, the adopted spectrum has been level-adjusted to correspond to the single figure sound power level data presented in **Table 9.15**.

Dalswinton Windfarm

175. Sound power level data for the installed turbine type operating in unrestricted mode has been provided by the manufacturer[12]. The data provided was referenced to wind speed at standardised 10m height and is presented in **Table 9.17**. A +2dB uncertainty correction has been included.

Mode	Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s				
	3	4	5	6	7+
Unrestricted mode	91.1	96.6	102.2	105.7	106.0
Data includes +2dB additional uncertainty correction					

Table 9.17: Sound Power Level Data for the Senvion MM82, as installed at Dalswinton Windfarm, 78-80m hub height, dB(A)

176. The same technical document also provides octave band spectral data referenced to standardised 10m height, as presented in **Table 9.18.**

Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s	Octave Band Centre Frequency (Hz)								
	32	63	125	250	500	1k	2k	4k	8k
4	67.5	78.1	83.9	88.6	89.3	87.3	85.7	78.4	64.3
5	72.4	82.7	88.7	93.5	95.3	94.4	89.8	83.1	69.3
6	75.9	85.6	91.9	96.6	98.8	98	93.4	88.6	75.3
7	76.2	85.9	92.2	96.9	99.1	98.3	93.7	88.9	75.6
8	76.4	86.5	92.3	96.2	98.8	98.6	94.4	89.8	76.5
9	76.2	85.8	92	96.3	98.8	98.7	94.5	90.3	76.7
10	76.9	86.8	92.3	95.7	98.4	98.7	95.2	91.5	76.9

Table 9.18: Octave Band Sound Power Level Spectra (L_{WA}) for the Senvion MM82 as installed at Dalswinton Windfarm, 78-80m hub height, dB(A)

177. For each wind speed, the adopted spectrum has been adjusted in level to correspond to the single figure sound power level data presented in **Table 9.17**. The spectrum for 4m/s has also been applied at 3m/s.

Minnygap Windfarm

178. Sound power level data for the installed turbine type operating in unrestricted mode has been provided by the manufacturer[13]. The data provided was referenced to wind speed at standardised 10m height and is presented in **Table 9.19**. A +2dB uncertainty correction has been included.

Mode	Wind Speed Referenced to 10m (Standardised U_{10}), m/s					
	3	4	5	6	7	8+
Unrestricted mode	98.8	108.8	103.1	106.4	107.8	108.0
Data includes +2dB additional uncertainty correction						

Table 9.19: Sound Power Level Data for the Nordex N100/2500, as installed at Minnygap Windfarm, 80m hub height, dB(A)

179. Octave band sound power level data for the same operating mode was also provided[14] referenced to standardised 10m height. This data is presented in **Table 9.20.**

Wind Speed Referenced to 10m (Standardised U_{10}), m/s	Octave Band Centre Frequency (Hz)								
	32	63	125	250	500	1k	2k	4k	8k
3	-	78.9	84.3	89.8	91.5	91.5	87.6	78.3	67.1
4	-	81.0	87.5	92.8	94.0	92.1	88.7	80.3	70.2
5	-	83.3	88.5	94.0	95.9	96.0	91.0	83.7	70.6
6	-	84.2	90.4	97.7	99.8	98.6	93.7	89.6	80.8
7	-	87.5	92.9	99.7	101.3	98.9	94.2	92.8	84.9
8+	-	87.1	92.8	99.6	101.4	99.5	94.9	93.2	85.2

Table 9.20: Octave Band Sound Power Level Spectra (L_{WA}) for the Nordex N100/2500 as installed at Minnygap Windfarm, 80m hub height, dB(A))

180. For each wind speed, the adopted spectrum has been level adjusted to correspond to the single figure sound power level data presented in **Table 9.19**.

9.6.3.3 Predicted Receptor Levels

181. Applying the sound power level data detailed above, the noise model has been used to determine the turbine noise levels at each considered receptor. Separate calculations have been undertaken for:

- the Proposed Development operating in isolation;
- each of the identified cumulative development operating in isolation; and
- all developments operating simultaneous (cumulative scenario).

182. The full suite of modelled results can be found in **Appendix 9.6 Modelled Receptor Noise Levels**. The results for the Proposed Development operating in isolation, and the cumulative scenario are duplicated in **Table 9.21** and **Table 9.22**.

183. In addition, **Figures 9.2 Noise Contour – 10m/s - Proposed Development in Isolation** and **Figure 9.3 Noise Contour – 10m/s – Cumulative Scenario** present noise contour plots for the Proposed Development operating in isolation and under the cumulative condition at a wind speed of 10m/s.

[12] Senvion technical document entitled: Power curve & sound power level, MM82 [2050kW/50/60Hz*]*, document ID: *SWT-2.5-WT.PC.02-B-F-EN*, dated: 20/01/2014
[13] Nordex technical document entitled: Sale document, Noise levels, Nordex N100/2500, document number: F008_228_A03_EN Rev. 04, dated: 19/04/2014
[14] Nordex technical document entitled: Technical report, Octave sound power levels, Nordex N100/2500, document number: K0818_014289_EN, dated: 24/04/2010

Receptor	Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
	3	4	5	6	7	8	9	10	11	12
Upper Minnygap	-	15.9	20.9	25.1	26.3	26.3	26.3	26.3	26.3	26.3
Nether Minnygap	-	17.5	22.5	26.7	27.9	27.9	27.9	27.9	27.9	27.9
Barntimpin	-	16.7	21.7	25.9	27.1	27.1	27.1	27.1	27.1	27.1
Auld Laundry Cottage	-	15.2	20.2	24.4	25.6	25.6	25.6	25.6	25.6	25.6
Mollin Farm	-	20.7	25.7	29.9	31.1	31.1	31.1	31.1	31.1	31.1
Holmwood	-	19.3	24.3	28.5	29.7	29.7	29.7	29.7	29.7	29.7
Courancehill	-	19.9	24.9	29.1	30.3	30.3	30.3	30.3	30.3	30.3
Burrancehill Cottage	-	19.6	24.6	28.8	30.0	30.0	30.0	30.0	30.0	30.0
Burrancebrae	-	18.3	23.3	27.5	28.7	28.7	28.7	28.7	28.7	28.7
Kirkland Cottage	-	18.1	23.1	27.3	28.5	28.5	28.5	28.5	28.5	28.5
Lamphitt	-	19.4	24.4	28.6	29.8	29.8	29.8	29.8	29.8	29.8
Townhead Farm	-	13.8	18.8	23.0	24.2	24.2	24.2	24.2	24.2	24.2
Wood Farm	-	14.3	19.3	23.5	24.7	24.7	24.7	24.7	24.7	24.7
Woodside	-	15.9	20.9	25.1	26.3	26.3	26.3	26.3	26.3	26.3
Glencorse	-	14.4	19.4	23.6	24.8	24.8	24.8	24.8	24.8	24.8
Glenfine Farm	-	14.7	19.7	23.9	25.1	25.1	25.1	25.1	25.1	25.1
Glenview	-	15.0	20.0	24.2	25.4	25.4	25.4	25.4	25.4	25.4
Gubhill Farm	-	15.3	20.3	24.5	25.7	25.7	25.7	25.7	25.7	25.7
Craigshiels	-	19.8	24.8	29.0	30.2	30.2	30.2	30.2	30.2	30.2
Knockenshang	-	16.0	21.0	25.2	26.4	26.4	26.4	26.4	26.4	26.4

Table 9.21: Receptor Noise Levels – Proposed Development in isolation, $L_{A90,T}$, dB

Receptor	Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
	3	4	5	6	7	8	9	10	11	12
Upper Minnygap	27.5	30.8	34.0	37.4	38.4	38.5	38.5	38.5	38.5	38.5
Nether Minnygap	29.3	32.4	35.3	38.7	39.9	39.9	39.9	39.9	39.9	39.9
Barntimpin	25.1	28.7	31.8	35.3	36.4	36.4	36.4	36.4	36.4	36.4
Auld Laundry Cottage	18.3	23.2	27.2	30.7	31.6	31.6	31.6	31.6	31.6	31.6
Mollin Farm	18.4	25.1	29.5	33.3	34.2	34.2	34.2	34.2	34.2	34.2
Holmwood	16.4	23.4	27.9	31.7	32.6	32.6	32.6	32.6	32.6	32.6
Courancehill	16.4	23.7	28.3	32.1	33.0	33.0	33.0	33.0	33.0	33.0
Burrancehill Cottage	16.8	24.0	28.6	32.3	33.2	33.2	33.1	33.2	33.2	33.2
Burrancebrae	15.3	22.4	27.0	30.8	31.7	31.7	31.7	31.7	31.7	31.7
Kirkland Cottage	14.6	22.1	26.8	30.6	31.4	31.4	31.4	31.4	31.4	31.4
Lamphitt	16.3	24.1	28.9	32.7	33.4	33.4	33.4	33.4	33.4	33.4
Townhead Farm	13.5	20.6	25.3	28.9	29.6	29.5	29.5	29.5	29.5	29.5
Wood Farm	14.9	21.7	26.5	30.2	30.7	30.7	30.7	30.7	30.7	30.7
Woodside	15.0	22.3	27.1	30.8	31.4	31.4	31.4	31.4	31.4	31.4
Glencorse	15.6	22.9	27.7	31.4	31.9	31.8	31.8	31.8	31.8	31.8

[15] The applicable limits have been selected at those based on the closes baseline measurement location to each receptor.

Receptor	Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
	3	4	5	6	7	8	9	10	11	12
Glenfine Farm	16.5	23.4	28.3	32.0	32.5	32.4	32.4	32.4	32.4	32.4
Glenview	19.5	25.8	30.6	34.3	34.7	34.7	34.7	34.7	34.7	34.7
Gubhill Farm	20.1	26.1	30.9	34.6	35.0	35.0	35.0	35.0	35.0	35.0
Craigshiels	23.8	29.5	34.3	38.1	38.6	38.6	38.5	38.5	38.5	38.5
Knockenshang	22.6	28.2	32.9	36.6	37.1	37.1	37.1	37.1	37.1	37.1

Table 9.22: Receptor Noise Levels – Cumulative Scenario, $L_{A90,T}$, dB

9.6.3.4 Cumulative Scoping

184. Initially, consideration has been given to whether there is the potential for the Proposed Development to give rise to a cumulative impact at the sensitive receptors closest to the identified cumulative developments. These receptors are listed below. The closest cumulative development to each receptor is detailed in brackets:

- Upper Minnygapy (Minnygap Windfarm);
- Nether Minnygap (Minnygap Windfarm);
- Glenfine (Dalswinton Windfarm);
- Glencorse (Dalswinton Windfarm);
- Craigshiels (Harestanes Windfarm); and
- Knockenshang (Harestanes Windfarm).

Graphs 9.7.1 to 9.7.3 in **Appendix 9.7 Cumulative Scoping,** present the daytime noise level limits to which the Harestanes Windfarm must comply (taken form **Table 9.6).** Also presented are these noise level limits reduced by 10dB. For each of the above receptors, the predicted noise levels for the Proposed Development operating in isolation have also been plotted on the graph that presents the limits applicable at that receptor[15]. The daytime noise level limits have been selected as a worst case, being more stringent than the corresponding night-time limits. This assessment is present in tabular form in **Table 9.23**.

Receptor		Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s								
		4	5	6	7	8	9	10	11	12
Limit Measurement Location: Ingleston										
Upper Minnygap	Proposed Development Level [A]	15.9	20.9	25.1	26.3	26.3	26.3	26.3	26.3	26.3
	Daytime Noise Level Limit [B]	40.0	40.0	41.3	43.9	46.4	48.9	51.4	53.8	56.3
	Daytime Noise Level Limit -10dB [C]	30.0	30.0	31.3	33.9	36.4	38.9	41.4	43.8	46.3
	-10dB compliance check [A-C] = [D]	**-14.1**	**-9.1**	**-6.2**	**-7.6**	**-10.1**	**-12.7**	**-15.1**	**-17.6**	**-20.0**
Nether Minnygap	Proposed Development Level [A]	17.5	22.5	26.7	27.9	27.9	27.9	27.9	27.9	27.9
	Daytime Noise Level Limit [B]	40.0	40.0	41.3	43.9	46.4	48.9	51.4	53.8	56.3
	Daytime Noise Level Limit -10dB [C]	30.0	30.0	31.3	33.9	36.4	38.9	41.4	43.8	46.3
	-10dB compliance check [A-C] = [D]	**-12.5**	**-7.5**	**-4.6**	**-6.0**	**-8.5**	**-11.0**	**-13.5**	**-16.0**	**-18.4**
Limit Measurement Location: Glencorse										
Glencorse	Proposed Development Level [A]	14.4	19.4	23.6	24.8	24.8	24.8	24.8	24.8	24.8
	Daytime Noise Level Limit [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Daytime Noise Level Limit -10dB [C]	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
	-10dB compliance check [A-C] = [D]	**-15.6**	**-10.6**	**-6.4**	**-5.2**	**-5.2**	**-5.2**	**-5.2**	**-5.2**	**-5.2**

Receptor		Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s								
		4	5	6	7	8	9	10	11	12
Glenfine	Proposed Development Level [A]	14.7	19.7	23.9	25.1	25.1	25.1	25.1	25.1	25.1
	Daytime Noise Level Limit [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Daytime Noise Level Limit -10dB [C]	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
	-10dB compliance check [A-C] = [D]	**-15.3**	**-10.3**	**-6.1**	**-4.9**	**-4.9**	**-4.9**	**-4.9**	**-4.9**	**-4.9**
Limit Measurement Location: Gubhill										
Craigshiels	Proposed Development Level [A]	19.8	24.8	29.0	30.2	30.2	30.2	30.2	30.2	30.2
	Daytime Noise Level Limit [B]	41.5	41.4	41.4	41.3	41.2	41.1	41.0	40.8	40.7
	Daytime Noise Level Limit -10dB [C]	31.5	31.4	31.4	31.3	31.2	31.1	31.0	30.8	30.7
	-10dB compliance check [A-C] = [D]	**-11.7**	**-6.6**	**-2.4**	**-1.1**	**-1.0**	**-0.9**	**-0.8**	**-0.6**	**-0.5**
Knocken-shang	Proposed Development Level [A]	16.0	21.0	25.2	26.4	26.4	26.4	26.4	26.4	26.4
	Daytime Noise Level Limit [B]	41.5	41.4	41.4	41.3	41.2	41.1	41.0	40.8	40.7
	Daytime Noise Level Limit -10dB [C]	31.5	31.4	31.4	31.3	31.2	31.1	31.0	30.8	30.7
	-10dB compliance check [A-C] = [D]	**-15.5**	**-10.5**	**-6.2**	**-4.9**	**-4.8**	**-4.7**	**-4.6**	**-4.5**	**-4.3**

Table 9.23: Comparison of Proposed Development Noise Levels with Conditioned Harestanes Limits -10dB, dB(A)

187. It can be seen from this assessment that at each receptor, the predicted operational noise levels from the Proposed Development are more than 10dB below the applicable limits. This is denoted within **Table 9.23** by all [D] values (bold text) being negative. It is depicted in **Appendix 9.7 Cumulative Scoping** by the individual receptor levels remaining below the -10dB limits.

188. As such, the resulting noise levels from the Proposed Development can be considered inconsequential at these receptors, and significant effects would not arise from the Proposed development operating in isolation, or under the cumulative scenario. Further consideration to potential impacts at these receptors is therefore not required.

189. The receptor sensitivity is High and the identified impact magnitude is Slight, giving rise to a **Negligible adverse** effect (**Not Significant**). The resulting effect would be direct, permanent and local.

9.6.3.5 Determination of Applicable Cumulative Noise Level Limits

190. For the remaining receptors, cumulative noise level limits have been determined based on the results of the baseline noise survey, as detailed in **Table 9.12** and **Appendix 9.5 Baseline Noise Conditions.**

191. ETSU-R-97 states that during the daytime, the acceptable lower limit should be selected between 35 and 40dB(A), with further relaxation up to 45dB(A) allowable where the receptor has a financial involvement in the development. This document states that the selection of the lower limit should be made with due consideration to "*the number of dwellings in the neighbourhood of the windfarm"*, "*the effect of noise limits on the number of kWh generated"* and the "*duration and level of exposure"*. With respect to the latter, it is stated that the proportion of time during which the background noise levels are low, and how low the background noise level gets are both recognised factors which could affect the setting of an appropriate lower limit.

192. In this case, the Proposed Development is an extension to the opeartional Harestanes Windfarm for which the fixed element of the daytime noise level limit has already been set at 40dB(A), see **Table 9.6**. It would therefore be an incongruous to set the cumulative daytime noise level limits with fixed elements at anything other than the same value of 40dB(A).

193. ETSU-R-97 sets the fixed limit element for the night-time period at 43dB(A), which is also that which is adopted in the limits to which the Harestanes Windfarm must comply, see **Table 9.6**.

194. There are no properties with a financial involvement (FI) in the Proposed Development, which would otherwise allow them limit relaxation. Therefore the cumulative noise level limits have been determined on the basis of the following:

Daytime (07:00 to 23:00): The quiet daytime hours background noise level (LA90) +5dB or 40dB(A), whichever is the higher

Night-time(23:00 to 07:00): The night-time hours background noise level (LA90) +5dB or 43dB(A), whichever is the higher

195. The resulting noise level limits can be seen in **Graphs 9.8**.1 to **9.8.8** of **Appendix 9.8 Cumulative Noise Level Limits**.

196. It can be seen that for some graphs, at high wind speeds (e.g. circa 11m/s and above), the noise level limits have been 'capped', i.e. no longer rise with wind speed, but remain unchanged. This 'capping' has been applied where the background curve ceases on the graph. The background curves cease where the measurement datasets on which they are based have less than 5 data points per 1m/s wind speed bin (it can be seen that this generally occurs at the uppermost end of the wind speed range, around 11-12 m/s). This approach is in accordance with the IoA GPG and represents a worst case.

197. The resulting cumulative noise level limits are presented in Tabular form in **Table 9.24.**

	Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
	3	4	5	6	7	8	9	10	11	12
Measurement Location A: Mollin Farm										
Daytime Limit (Non FI)	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.2	43.5	43.5
Night-time Limit (Non FI)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3	47.9
Measurement Location B: Burrancehill Cottage										
Daytime Limit (Non FI)	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
Night-time Limit (Non FI)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
Measurement Location C: Lamphitt										
Daytime Limit (Non FI)	40.9	40.9	41.1	41.7	42.9	44.5	46.5	49.0	51.3	51.3
Night-time Limit (Non FI)	43.0	43.0	43.0	43.0	43.0	44.6	46.5	48.4	50.2	51.4
Measurement Location E: Glenview										
Daytime Limit (Non FI)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
Night-time Limit (Non FI)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9

Table 9.24: Cumulative Noise Level Limits, $L_{A90,T}$, dB(A)

9.6.3.6 Assessment Against Determined Limits

198. **Table 9.25** details which limits that have been applied to which receptors. The noise environment at Lamphitt was largely dictated by a local watercourse, so the limits determined at this location have been applied to this property only. With this exception, the limits applied to each receptor are those determined from the closest measurement location.

Receptor	Applied Limits / Background Noise Data
Barntimpin	Mollin Farm
Auld Laundry Cottage	
Mollin Farm	
Holmwood	Burrancehill Cottage
Courancehill	

Receptor	Applied Limits / Background Noise Data
Burrancehill Cottage	
Burrancebrae	
Kirkland Cottage	
Lamphitt	Lamphitt
Townhead Farm	
Wood Farm	
Woodside	Glenview
Glenview	
Gubhill Farm	

Table 9.25: Applied Background Noise Monitoring Locations

199. For each receptor, the predicted noise levels for the Proposed Development operating in isolation (see **Table 9.21**) and under the cumulative scenario (see **Table 9.22**) have been assessed by comparison against the applied limits. This assessment is presented in **Graphs 9.9.1 to 9.9.14** of **Appendix 9.9 Assessment Against Determined Limits.** This assessment is also presented in tabular form in **Table 9.26** and **Table 9.27. Graphs 9.6.1 to 9.9.14** also present the contributions of noise from each individual windfarm that make up the combined cumulative levels.

Receptor		Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
		3	4	5	6	7	8	9	10	11	12
Limit Measurement Location A: Mollin Farm											
Barntimpin	Proposed Development only level [A]	-	16.7	21.7	25.9	27.1	27.1	27.1	27.1	27.1	27.1
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.2	43.5	43.5
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3	47.9
	Daytime compliance check [A-B]=[D]	-	**-23.3**	**-18.3**	**-14.1**	**-12.9**	**-12.9**	**-13.4**	**-15.0**	**-16.4**	**-16.4**
	Night-time compliance check [A-C]=[E]	-	**-26.3**	**-21.3**	**-17.1**	**-15.9**	**-15.9**	**-15.9**	**-15.9**	**-18.2**	**-20.7**
Auld Laundry Cottage	Proposed Development only level [A]	-	15.2	20.2	24.4	25.6	25.6	25.6	25.6	25.6	25.6
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.2	43.5	43.5
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3	47.9
	Daytime compliance check [A-B]=[D]	-	**-24.8**	**-19.8**	**-15.6**	**-14.4**	**-14.4**	**-14.9**	**-16.6**	**-17.9**	**-17.9**
	Night-time compliance check [A-C]=[E]	-	**-27.8**	**-22.8**	**-18.6**	**-17.4**	**-17.4**	**-17.4**	**-17.4**	**-19.8**	**-22.3**
Mollin Farm	Proposed Development only level [A]	-	20.7	25.7	29.9	31.1	31.1	31.1	31.1	31.1	31.1
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.2	43.5	43.5
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3	47.9
	Daytime compliance check [A-B]=[D]	-	**-19.3**	**-14.3**	**-10.1**	**-8.9**	**-8.9**	**-9.3**	**-11.0**	**-12.4**	**-12.4**
	Night-time compliance check [A-C]=[E]	-	**-22.3**	**-17.3**	**-13.1**	**-11.9**	**-11.9**	**-11.9**	**-11.9**	**-14.2**	**-16.7**
Limit Measurement Location B: Burrancehill Cottage											
Holmwood	Proposed Development only level [A]	-	19.3	24.3	28.5	29.7	29.7	29.7	29.7	29.7	29.7
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	-	**-20.7**	**-15.7**	**-11.5**	**-10.3**	**-10.3**	**-10.6**	**-12.7**	**-14.6**	**-14.6**
	Night-time compliance check [A-C]=[E]	-	**-23.7**	**-18.7**	**-14.5**	**-13.3**	**-13.3**	**-13.3**	**-13.3**	**-13.9**	**-15.6**

Receptor		Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
		3	4	5	6	7	8	9	10	11	12
Courancehill	Proposed Development only level [A]	-	19.9	24.9	29.1	30.3	30.3	30.3	30.3	30.3	30.3
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	-	**-20.1**	**-15.1**	**-10.9**	**-9.7**	**-9.7**	**-10.1**	**-12.2**	**-14.0**	**-14.0**
	Night-time compliance check [A-C]=[E]	-	**-23.1**	**-18.1**	**-13.9**	**-12.7**	**-12.7**	**-12.7**	**-12.7**	**-13.3**	**-15.0**
Burrancehill Cottage	Proposed Development only level [A]	-	19.6	24.6	28.8	30.0	30.0	30.0	30.0	30.0	30.0
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	-	**-20.4**	**-15.4**	**-11.2**	**-10.0**	**-10.0**	**-10.3**	**-12.4**	**-14.3**	**-14.3**
	Night-time compliance check [A-C]=[E]	-	**-23.4**	**-18.4**	**-14.2**	**-13.0**	**-13.0**	**-13.0**	**-13.0**	**-13.6**	**-15.2**
Burrancebrae	Proposed Development only level [A]	-	18.3	23.3	27.5	28.7	28.7	28.7	28.7	28.7	28.7
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	-	**-21.7**	**-16.7**	**-12.5**	**-11.3**	**-11.3**	**-11.6**	**-13.7**	**-15.6**	**-15.6**
	Night-time compliance check [A-C]=[E]	-	**-24.7**	**-19.7**	**-15.5**	**-14.3**	**-14.3**	**-14.3**	**-14.3**	**-14.9**	**-16.5**
Kirkland Cottage	Proposed Development only level [A]	-	18.1	23.1	27.3	28.5	28.5	28.5	28.5	28.5	28.5
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	-	**-21.9**	**-16.9**	**-12.7**	**-11.5**	**-11.5**	**-11.8**	**-13.9**	**-15.7**	**-15.7**
	Night-time compliance check [A-C]=[E]	-	**-24.9**	**-19.9**	**-15.7**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-15.0**	**-16.7**
Limit Measurement Location C: Lamphitt											
Laphitt	Proposed Development only level [A]	-	19.4	24.4	28.6	29.8	29.8	29.8	29.8	29.8	29.8
	Daytime limit (Non FI) [B]	40.9	40.9	41.1	41.7	42.9	44.5	46.5	49.0	51.3	51.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	44.6	46.5	48.4	50.2	51.4
	Daytime compliance check [A-B]=[D]	-	**-21.5**	**-16.6**	**-13.1**	**-13.0**	**-14.7**	**-16.7**	**-19.2**	**-21.5**	**-21.5**
	Night-time compliance check [A-C]=[E]	-	**-23.6**	**-18.6**	**-14.4**	**-13.2**	**-14.8**	**-16.7**	**-18.6**	**-20.4**	**-21.5**
Limit Measurement Location D: Glenview											
Townhead Farm	Proposed Development only level [A]	-	13.8	18.8	23.0	24.2	24.2	24.2	24.2	24.2	24.2
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	-	**-26.2**	**-21.2**	**-17.0**	**-15.8**	**-15.8**	**-15.8**	**-17.3**	**-18.9**	**-18.9**
	Night-time compliance check [A-C]=[E]	-	**-29.2**	**-24.2**	**-20.0**	**-18.8**	**-18.8**	**-18.8**	**-18.8**	**-18.9**	**-20.7**
Wood Farm	Proposed Development only level [A]	-	14.3	19.3	23.5	24.7	24.7	24.7	24.7	24.7	24.7
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	-	**-25.7**	**-20.7**	**-16.5**	**-15.3**	**-15.3**	**-15.3**	**-16.7**	**-18.4**	**-18.4**
	Night-time compliance check [A-C]=[E]	-	**-28.7**	**-23.7**	**-19.5**	**-18.3**	**-18.3**	**-18.3**	**-18.3**	**-18.4**	**-20.2**

Receptor		Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
		3	4	5	6	7	8	9	10	11	12
Woodside	Proposed Development only level [A]	-	15.9	20.9	25.1	26.3	26.3	26.3	26.3	26.3	26.3
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	-	**-24.1**	**-19.1**	**-14.9**	**-13.7**	**-13.7**	**-13.7**	**-15.1**	**-16.8**	**-16.8**
	Night-time compliance check [A-C]=[E]	-	**-27.1**	**-22.1**	**-17.9**	**-16.7**	**-16.7**	**-16.7**	**-16.7**	**-16.8**	**-18.6**
Glenview	Proposed Development only level [A]	-	15.0	20.0	24.2	25.4	25.4	25.4	25.4	25.4	25.4
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	-	**-25.0**	**-20.0**	**-15.8**	**-14.6**	**-14.6**	**-14.6**	**-16.1**	**-17.7**	**-17.7**
	Night-time compliance check [A-C]=[E]	-	**-28.0**	**-23.0**	**-18.8**	**-17.6**	**-17.6**	**-17.6**	**-17.6**	**-17.8**	**-19.5**
Gubhill Farm	Proposed Development only level [A]	-	15.3	20.3	24.5	25.7	25.7	25.7	25.7	25.7	25.7
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	-	**-24.7**	**-19.7**	**-15.5**	**-14.3**	**-14.3**	**-14.3**	**-15.8**	**-17.5**	**-17.5**
	Night-time compliance check [A-C]=[E]	-	**-27.7**	**-22.7**	**-18.5**	**-17.3**	**-17.3**	**-17.3**	**-17.3**	**-17.5**	**-19.3**

Table 9.26: Comparison of Proposed Development Only Levels with Derived Limits, $L_{A90,T}$, dB(A)

Receptor		Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
		3	4	5	6	7	8	9	10	11	12
Limit Measurement Location A: Mollin Farm											
Barntimpin	Cumulative Scenario level [A]	25.1	28.7	31.8	35.3	36.4	36.4	36.4	36.4	36.4	36.4
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.2	43.5	43.5
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3	47.9
	Daytime compliance check [A-B]=[D]	**-14.9**	**-11.3**	**-8.2**	**-4.7**	**-3.6**	**-3.6**	**-4.1**	**-5.8**	**-7.1**	**-7.1**
	Night-time compliance check [A-C]=[E]	**-17.9**	**-14.3**	**-11.2**	**-7.7**	**-6.6**	**-6.6**	**-6.6**	**-6.6**	**-8.9**	**-11.5**
Auld Laundry Cottage	Cumulative Scenario level [A]	18.3	23.2	27.2	30.7	31.6	31.6	31.6	31.6	31.6	31.6
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.2	43.5	43.5
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3	47.9
	Daytime compliance check [A-B]=[D]	**-21.7**	**-16.8**	**-12.8**	**-9.3**	**-8.4**	**-8.4**	**-8.9**	**-10.6**	**-11.9**	**-11.9**
	Night-time compliance check [A-C]=[E]	**-24.7**	**-19.8**	**-15.8**	**-12.3**	**-11.4**	**-11.4**	**-11.4**	**-11.4**	**-13.7**	**-16.3**
Mollin Farm	Cumulative Scenario level [A]	18.4	25.1	29.5	33.3	34.2	34.2	34.2	34.2	34.2	34.2
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.2	43.5	43.5
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3	47.9
	Daytime compliance check [A-B]=[D]	**-21.6**	**-14.9**	**-10.5**	**-6.7**	**-5.8**	**-5.8**	**-6.3**	**-8.0**	**-9.3**	**-9.3**
	Night-time compliance check [A-C]=[E]	**-24.6**	**-17.9**	**-13.5**	**-9.7**	**-8.8**	**-8.8**	**-8.8**	**-8.8**	**-11.1**	**-13.7**

Receptor		Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
		3	4	5	6	7	8	9	10	11	12
Limit Measurement Location B: Burrancehill Cottage											
Holmwood	Cumulative Scenario level [A]	16.4	23.4	27.9	31.7	32.6	32.6	32.6	32.6	32.6	32.6
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	**-23.6**	**-16.6**	**-12.1**	**-8.3**	**-7.4**	**-7.4**	**-7.8**	**-9.9**	**-11.7**	**-11.7**
	Night-time compliance check [A-C]=[E]	**-26.6**	**-19.6**	**-15.1**	**-11.3**	**-10.4**	**-10.4**	**-10.4**	**-10.4**	**-11.0**	**-12.7**
Courancehill	Cumulative Scenario level [A]	16.4	23.7	28.3	32.1	33.0	33.0	33.0	33.0	33.0	33.0
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	**-23.6**	**-16.3**	**-11.7**	**-7.9**	**-7.0**	**-7.0**	**-7.4**	**-9.5**	**-11.3**	**-11.3**
	Night-time compliance check [A-C]=[E]	**-26.6**	**-19.3**	**-14.7**	**-10.9**	**-10.0**	**-10.0**	**-10.0**	**-10.0**	**-10.6**	**-12.3**
Burrancehill Cottage	Cumulative Scenario level [A]	16.8	24.0	28.6	32.3	33.2	33.2	33.1	33.2	33.2	33.2
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	**-23.2**	**-16.0**	**-11.4**	**-7.7**	**-6.8**	**-6.8**	**-7.3**	**-9.3**	**-11.1**	**-11.1**
	Night-time compliance check [A-C]=[E]	**-26.2**	**-19.0**	**-14.4**	**-10.7**	**-9.8**	**-9.8**	**-9.9**	**-9.8**	**-10.4**	**-12.1**
Burrancebrae	Cumulative Scenario level [A]	15.3	22.4	27.0	30.8	31.7	31.7	31.7	31.7	31.7	31.7
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	**-24.7**	**-17.6**	**-13.0**	**-9.2**	**-8.3**	**-8.3**	**-8.7**	**-10.8**	**-12.6**	**-12.6**
	Night-time compliance check [A-C]=[E]	**-27.7**	**-20.6**	**-16.0**	**-12.2**	**-11.3**	**-11.3**	**-11.3**	**-11.3**	**-11.9**	**-13.6**
Kirkland Cottage	Cumulative Scenario level [A]	14.6	22.1	26.8	30.6	31.4	31.4	31.4	31.4	31.4	31.4
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.5	44.3	44.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.6	45.3
	Daytime compliance check [A-B]=[D]	**-25.4**	**-17.9**	**-13.2**	**-9.4**	**-8.6**	**-8.6**	**-9.0**	**-11.1**	**-12.9**	**-12.9**
	Night-time compliance check [A-C]=[E]	**-28.4**	**-20.9**	**-16.2**	**-12.4**	**-11.6**	**-11.6**	**-11.6**	**-11.6**	**-12.2**	**-13.9**
Limit Measurement Location C: Lamphitt											
Laphitt	Cumulative Scenario level [A]	16.3	24.1	28.9	32.7	33.4	33.4	33.4	33.4	33.4	33.4
	Daytime limit (Non FI) [B]	40.9	40.9	41.1	41.7	42.9	44.5	46.5	49.0	51.3	51.3
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	44.6	46.5	48.4	50.2	51.4
	Daytime compliance check [A-B]=[D]	**-24.6**	**-16.8**	**-12.2**	**-9.0**	**-9.5**	**-11.1**	**-13.1**	**-15.6**	**-17.9**	**-17.9**
	Night-time compliance check [A-C]=[E]	**-26.7**	**-18.9**	**-14.1**	**-10.3**	**-9.6**	**-11.2**	**-13.1**	**-15.0**	**-16.8**	**-18.0**
Limit Measurement Location D: Glenview											
Townhead Farm	Cumulative Scenario level [A]	13.5	20.6	25.3	28.9	29.6	29.5	29.5	29.5	29.5	29.5
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	**-26.5**	**-19.4**	**-14.7**	**-11.1**	**-10.4**	**-10.5**	**-10.5**	**-12.0**	**-13.6**	**-13.6**
	Night-time compliance check [A-C]=[E]	**-29.5**	**-22.4**	**-17.7**	**-14.1**	**-13.4**	**-13.5**	**-13.5**	**-13.5**	**-13.7**	**-15.4**

Receptor		Wind Speed Referenced to 10m Height (Standardised U_{10}), m/s									
		3	4	5	6	7	8	9	10	11	12
Wood Farm	Cumulative Scenario level [A]	14.9	21.7	26.5	30.2	30.7	30.7	30.7	30.7	30.7	30.7
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	**-25.1**	**-18.3**	**-13.5**	**-9.8**	**-9.3**	**-9.3**	**-9.3**	**-10.8**	**-12.4**	**-12.4**
	Night-time compliance check [A-C]=[E]	**-28.1**	**-21.3**	**-16.5**	**-12.8**	**-12.3**	**-12.3**	**-12.3**	**-12.3**	**-12.5**	**-14.2**
Woodside	Cumulative Scenario level [A]	15.0	22.3	27.1	30.8	31.4	31.4	31.4	31.4	31.4	31.4
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	**-25.0**	**-17.7**	**-12.9**	**-9.2**	**-8.6**	**-8.6**	**-8.6**	**-10.1**	**-11.7**	**-11.7**
	Night-time compliance check [A-C]=[E]	**-28.0**	**-20.7**	**-15.9**	**-12.2**	**-11.6**	**-11.6**	**-11.6**	**-11.6**	**-11.8**	**-13.5**
Glenview	Cumulative Scenario level [A]	19.5	25.8	30.6	34.3	34.7	34.7	34.7	34.7	34.7	34.7
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	**-20.5**	**-14.2**	**-9.4**	**-5.7**	**-5.3**	**-5.3**	**-5.3**	**-6.8**	**-8.4**	**-8.4**
	Night-time compliance check [A-C]=[E]	**-23.5**	**-17.2**	**-12.4**	**-8.7**	**-8.3**	**-8.3**	**-8.3**	**-8.3**	**-8.5**	**-10.2**
Gubhill Farm	Cumulative Scenario level [A]	20.1	26.1	30.9	34.6	35.0	35.0	35.0	35.0	35.0	35.0
	Daytime limit (Non FI) [B]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.1	43.1
	Night-time limit (Non FI) [C]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	44.9
	Daytime compliance check [A-B]=[D]	**-19.9**	**-13.9**	**-9.1**	**-5.4**	**-5.0**	**-5.0**	**-5.0**	**-6.5**	**-8.1**	**-8.1**
	Night-time compliance check [A-C]=[E]	**-22.9**	**-16.9**	**-12.1**	**-8.4**	**-8.0**	**-8.0**	**-8.0**	**-8.0**	**-8.2**	**-9.9**

Table 9.27: Comparison of Cumulative Scenario Levels with Derived Limits, $L_{A90,T}$, dB(A)

200. It can be seen from the completed assessment that for all receptors, predicted noise levels from the Proposed Development operating in isolation and under the cumulative scenario remain below the determined noise level limits. This is denoted within **Table 9.26** and **Table 9.27** by all [D] and [E] values (bold text) being negative and in **Appendix 9.9 Assessment Against Determined Limits** by the cumulative windfarm levels remaining below the daytime and night-time noise level limits.

201. Therefore, for high sensitivity receptors[6], as present in this case, the resulting effect is **Not Significant**. The resulting effect would be direct, permanent and local.

9.7 Mitigation

9.7.1 Mitigation – Blast-Induced Vibration and Air Overpressure

202. The assessment has identified that, with the embedded mitigation measures in place, a significant effect would not arise. An appropriate planning condition can be used to ensure that the content of the CEMP, including the listed mitigation measures, are agreed with Dumfries and Galloway Council as well as the Scottish Environmental Protection Agency, and that the appointed contractor is required to comply with the CEMP.

9.7.2 Mitigation - Turbine Noise

203. No significant effect has been identified to arise from the Proposed Development operating in isolation, and under the cumulative scenario.

204. As the assessment has been undertaken on the basis of a candidate turbine type. It would be appropriate to control noise from the proposed development by use of a noise related planning condition, stipulating the noise level limits to which the Proposed Development must comply.

205. Appropriate noise level limits for the Proposed Development are Presented in **Appendix 9.10 Proposed Planning Condition Limits**.

9.8 Residual Effects

206. A summary of the identified impacts and effects is presented in **Table 9.28**.

Description of Effect	Pre-mitigation Effect		Mitigation Measure	Residual Effect	
	Magnitude	Significance		Magnitude	Significance
During Construction					
Blast induced vibration and air overpressure	Slight	Negligible	Adherence to best practice measures ensure through the CEMP	Slight	Negligible
During Operation					
Turbine noise	N/A	Not Significant	Adherence to appropriate noise levels limits	N/A	Not Significant

Table 9.28: Residual Effects Table

9.9 Cumulative Assessment

9.9.1 Construction

207. The nature of blast-induced groundborne vibration and air overpressure is that it is instantaneous and therefore would not occur at the same time as that caused by blast works at any other local quarries or borrow pits. Notwithstanding this, no other active quarries or borrow pits have been identified within the vicinity. A significant cumulative effect would therefore not arise as a result of the Proposed Development.

9.9.2 Operation

208. The operational windfarm noise assessment has been undertaken in accordance with the ETSU-R-97 assessment methodology and IoA GPG. This method sets out the noise level limits applicable to cumulative windfarm noise levels. The potential for a cumulative noise impact has therefore been duly considered and accounted for within the completed assessment. It has been identified that a significant cumulative effect would not arise as a result of the Proposed Development.

9.10 Summary

209. The completed assessment has considered the potential noise and vibration impacts that could arise as a result of the Proposed Development during both the construction and operational phases of development.

210. It has been identified that construction activities would be at sufficient distance from sensitive receptors that significant effects would not arise from construction noise or vibration. Further assessment of construction activities was therefore scoped-out of the assessment.

211. Access to the Site would be via the operational Harestanes Windfarm access road. The distance of this access road from the closest noise-sensitive receptors is such that a significant construction traffic noise effect would not

arise at local receptors. Access to the Site would be from the A701, avoiding the need to use other lesser-trafficked local routes. A significant effect would therefore not arise from construction traffic, and further assessment of construction traffic noise was accordingly scoped-out of the assessment.

212. An assessment of blast-induced groundborne vibration and air overpressures has been undertaken to assess potential impacts that could arise should such blasting works be found to be necessary. It has been identified that resulting effects would not be significant, due to both the substantial distances between the borrow pit search areas and the nearest noise-sensitive receptors and the good practice control measures that would be employed. These measures would minimise the levels of groundborne vibration and air overpressure and also provide further reassurance to the nearest residents.

213. An assessment of turbine noise has been undertaken in accordance with current best practice, and national and local planning policy. The assessment has been undertaken in accordance with the requirements of the Energy Technical Support Unit's 1996 ETSU-R-97 document: *The assessment and rating of noise from wind farms*, and the Institute of Acoustics': *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise*.

214. The assessment has been informed by the results of a desk-based review, Site visits, a detailed baseline noise survey, and a detailed noise modelling and prediction exercise. The assessment has considered the potential impacts that could arise from the Proposed Development operating both in isolation and under a cumulative scenario, including for the contribution of noise from other identified local windfarms.

215. It has been identified that at the closest noise-sensitive receptors to the identified cumulative developments, noise levels from the Proposed Development would be more than 10dB below the cumulative noise level limits to which the operational Harestanes Windfarm is required to comply (and which were determined in accordance with ETSU-R-97). This level of compliance is such that a cumulative noise impact would not arise as a result of the Proposed Development.

216. At the remaining noise-sensitive receptors, including those closest to the Proposed Development, noise level limits have been determined following ETSU-R-97 and the IoA GPG based on the results of an extensive baseline noise survey. It has been identified that operational noise levels from the Proposed Development operating both in isolation and under the cumulative scenario, would comply with the derived limits.

217. As such, a significant effect would not arise a result of the Proposed Development operating either in isolation or cumulatively with other local windfarms.

218. The completed assessment has included determination of appropriate noise levels limits for the Proposed Development in isolation.

219. No new fixed plant items would be introduced as part of the Proposed Development, and traffic generation during the operational phase would be extremely low. As such, no significant effects would arise and their further consideration was therefore scoped-out of the assessment.

9.11 References

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