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12.0 Noise

12.1 Introduction

This chapter considers the likely significant effects of noise associated with the construction, operation and decommissioning of the proposed development. The specific objectives of the chapter are to:

- describe the noise baseline;
- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential effects and cumulative effects;
- describe the mitigation measures proposed to address likely significant effects; and
- assess the residual effects remaining following the implementation of mitigation.

The assessment has been carried out by Robin Woodward, Principal Acoustic Consultant, Hayes McKenzie Partnership Ltd. Robin has a BSc (Hons) degree in Acoustics and Music from the University of Southampton and has been carrying out wind farm noise assessments for over 12 years.

The chapter is supported by:

- Technical Appendix 12.1 – Baseline Noise Measurements 2023
- Technical Appendix 12.2 – Baseline Noise Measurements 2007
- Technical Appendix 12.3 – Noise Prediction Methodology
- Technical Appendix 12.4 – Remaining Noise Budget Limits

Figures 12.1 – 12.2 are referenced in the text where relevant.

12.2 Policy and Guidance

The scope of the assessment has been informed by consultation responses summarised in **Technical Appendix 12.1: Baseline Noise Measurements 2023** section A.3 and the following guidelines/policies:

- Planning Policy
 - o Scottish Government 2023, National Planning Framework 4;
 - o Scottish Government 2022, Onshore Wind Policy Statement 2022;
 - o Scottish Government 2014, Web Based Planning Advice, Onshore Wind Turbines;
 - o Scottish Government 2011, Assessment of noise: technical advice note; and
 - o Moray Council 2017, Moray Onshore Wind Energy Supplementary Guidance.
- Guidance
 - o British Standard (BS) 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise;
 - o BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration;
 - o Department of Transport: Welsh Office, Calculation of Road Traffic Noise;
 - o ETSU-R-97 The Assessment and Rating of Noise from Wind Farms; and



- o Institute of Acoustics (IOA), A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise.

Further information regarding planning policy is provided in **Chapter 4: Climate Change, Renewable Energy and Planning Policy**, and in **Chapter 5: Approach to EIA and Consultation**. The **Planning Statement** addresses the planning policy position in full and should be referred to.

12.3 Scope and Consultation

12.3.1 Consultation

See **Technical Appendix 12.1: Baseline Noise Measurements 2023** section 12.1.3 for consultation with Moray Council (MC) regarding noise assessment.

12.3.2 Effects Scoped Out

The following potential effects have been scoped out of the assessment.

12.3.2.1 Tonal Noise

ETSU-R-97 specifies that, in line with other noise guidance, a penalty should be added to measured or predicted wind turbine noise levels if there is tonal noise above a certain level which is audible at residential properties. In this assessment, it has been assumed that there would be no tonal noise associated with the operation of the proposed development which would give rise to such a penalty as most modern turbines operate without significant tonal noise. It is anticipated that a penalty would be included in an appropriately worded planning condition such that a tonal penalty would need to be added to measured noise levels, where required, before comparing them with the noise limits. Warranty agreements with turbine suppliers seek to ensure that any such penalties will not occur in practice.

12.3.2.2 Low Frequency and Infrasound

Low frequency sound is typically defined as sound in the audible hearing frequency range of 20Hz up to about 200Hz. Noise from wind turbines is not inherently low-frequency and it is typically broad-band in nature, and close to a wind turbine the dominant frequencies are usually in the 250 to 2000Hz range. As the distance from a wind farm increases, the noise level decreases as a result of the spreading out of the sound energy and also due to air absorption which increases with increasing frequency. This means that, although the energy across the whole frequency range is reduced, higher frequencies are reduced more than lower frequencies with the effect that as distance from the Site increases the ratio of low to high frequencies also increases. This effect may be observed with road traffic noise or natural sources, such as the sea, where higher frequency components are diminished relative to lower frequency components at long distances. At such distances, however, the overall noise level is so low, such that any bias in the frequency spectrum can usually be considered to be insignificant.

Work carried out in 2006 by Hayes McKenzie for the UK Department of Trade and Industry (DTI, 2006) to investigate the extent of low frequency and infrasonic noise from three UK wind farms concluded that “the common cause of complaints associated with noise at all three wind farms is not associated with low frequency noise, but is the audible modulation of the aerodynamic noise, especially at night”. It is therefore considered that low frequency noise can be scoped out of the assessment.

Infra-sound is noise occurring at frequencies below that at which sound is normally audible, i.e. at less than about 20 Hz, due to the significantly reduced sensitivity of the ear at such frequencies. In this frequency range, for sound to be perceptible, it has to be at very high amplitude, which is not the case for wind turbine noise. In November 2016 a study into low frequency and infrasound was published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Wuerttemberg (Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg, 2016) that contained a comprehensive review of low frequency and



infrasound from wind turbines, and evaluated such noise in relation to other sources. The results state that “the infrasound level in the vicinity of wind turbines is – at distances between 120m and 300m – well below the threshold of what humans perceive” and that “at a distance of 700m from the wind turbines, it was observed by means of measurements that when the turbine is switched on, the measured infrasound level did not increase or only increased to a limited extent. The infrasound was generated mainly by the wind and not by the turbines”.

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

12.3.2.3 Amplitude Modulation

The variation in noise level associated with wind turbine operation, at the rate at which turbine blades pass any fixed point of their rotation (the blade passing frequency), is often referred to as blade swish or Amplitude/ Aerodynamic Modulation (AM). This effect is identified within ETSU-R-97 where it is envisaged that “... modulation of blade noise may result in variation of the overall A-Weighted noise level by as much as 3dB(A) (peak to trough) when measured close to a wind turbine...” and that at distances further from the turbine where there are “... more than two hard, reflective surfaces, then the increase in modulation depth may be as much as 6dB(A) (peak to trough)”. There have been instances where level of AM rates are higher than this, which results in the noise being perceived as more intrusive (in the same way as tonal content makes the noise more intrusive).

The Department of Energy & Climate Change (DECC) commissioned a Wind Turbine AM Review report that was published in two phases: Phase 1 in September 2015 and Phase 2 in October 2016 (although the Phase 2 report is dated August 2016) (DECC, 2016). Phase 1 of the report sets out the approach and methodology to the review and research, and the Phase 2 report includes a literature review, research into human response to AM, and recommends how excessive AM might be controlled through the use of a planning condition. The report includes recommendations on how AM should be addressed when quantified according to the recommendations of a separate Institute of Acoustics (IOA) working group document, A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016).

The AM Review reports recommend a two-tier approach whereby the first tier seeks a reduction in the depth and/or occurrence of AM with a rating level (according to the IOA Amplitude Modulation Working Group method) $\geq 3\text{dB}$. Whether remedial action is required depends on the prevalence of any complaints, and how often AM rating levels $\geq 3\text{dB}$ occur. The second tier is that if AM is deemed to be a significant issue, and if nothing can be done to reduce the level of AM, then a penalty scheme is proposed whereby a penalty ranging from 3dB (for a rating level of 3dB) up to a maximum of 5dB (for a rating level of 10dB and above) could be added to the measured level before measured levels are compared with the relevant noise limits.

It should be noted that most wind farms operate without significant AM, and that it is not possible to predict the likely occurrence of AM. At the time of writing there has been no official response to those recommendations from the IOA Noise Working group or endorsement from any Scottish Government Minister or Department. The IOA GPG (IOA, 2013), states that “the evidence in relation to “Excess” or “other” Amplitude Modulation (AM) is still developing. At the time of writing, there is no Scottish Government policy specifying a planning condition to deal with AM”, although it is possible to control such noise with an appropriately worded planning condition if necessary.

12.3.2.4 Construction Noise Assessment

BS 5228:2009 + A1:2014 provides example criteria for the assessment of the significance of construction noise effects and a method for the prediction of noise levels from construction activities. Two example methods are provided for assessing significance.



The first is based on the use of criteria defined in Department of the Environment Advisory Leaflet (AL) 72, Noise Control On Building Sites (DoE, 1976), which sets a fixed limit of 70dB(A) in rural suburban and urban areas away from main roads and traffic. Noise levels are generally taken as façade L_{Aeq} values with free-field levels taken to be 3dB lower giving an equivalent noise criterion of 67dB L_{Aeq} .

The second is based on noise change but applies minimum criteria of 45, 55 and 65dB L_{Aeq} for night-time (23:00-07:00), evening and weekends (19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00-23:00 Sundays), and daytime (07:00-19:00) including Saturdays (07:00-13:00) respectively. These limits are applicable irrespective of existing baseline noise levels, and where construction activities have a duration of one month or more. It should be noted that the time period to which each limit applies also defines the time averaging period for the calculated L_{Aeq} .

Standard best practice measures to minimise noise during construction will be implemented in accordance with a detailed Construction Environmental Management Plan (CEMP), which can be secured by means of an appropriately worded planning condition. A simplified daytime construction noise limit of 65dB L_{Aeq} during normal working hours will be applied in accordance with the second method from BS5228 discussed above.

Chapter 2 identifies that blasting may be required at up to four borrow pit locations and therefore this will require specific consideration within the CEMP to ensure impacts minimised and mitigated accordingly.

Any potential noise issues associated with the movement of construction vehicles to and from the Site would be sufficiently dealt with within the Construction Traffic Management Plan (CTMP) where considered necessary. The highest potential traffic increases are on the B9061 as identified in Chapter 11, which have the potential to impact properties such as Ryeriggs Croft which are adjacent to the B9016. The predicted increase in road traffic noise levels according to the Calculation of Road Traffic Noise (CRTN) guidance, based on the details within Table 11-18, is less than 3dB and therefore this impact can be considered negligible and no further assessment or mitigation is required from a noise perspective. As the CRTN calculation relates to noise increase, this negligible impact is applicable to all nearby properties.

Noise arising from decommissioning activities will meet the relevant noise limits that apply to noise from construction, and decommissioning operations will be undertaken in line with the relevant standards and limits that apply at the time.

As per agreement with MC, noise effects during construction and decommissioning have been scoped out of further assessment.

12.3.2.5 Vibration Assessment

The Scottish Government [Assessment of noise: technical advice note](#) specifically addresses low frequency, infrasound and ground borne vibration from wind turbines and reports the contents of an article from the IOA Bulletin, Vol 34 No 2, March/April 2009, by a number of noise professionals with significant experience covering wind turbine noise, stating '*Agreement was reached that there is no robust evidence that low frequency sound, infrasound and ground borne vibration from wind farms, generally has adverse effects on neighbours*'. It is acknowledged that this agreement dates from 2009, but the Scottish Government has not felt compelled to update its advice.

With regards to vibration related to construction activities, the only activity with the potential to generate sufficient energy to cause vibration impacts is that of blasting related to borrow pits. For predicting levels of ground borne vibration relating to blasting, BS5228-2 provides a simplified method which involves development of a site-specific model. Annex E of the standard sets out that the magnitude of vibrations are generally proportional to distance (m) from the blast divided by the square root of the maximum instantaneous charge mass (kg) and this value is referred to in the standard as 'scaled distance'. On this basis, measurements of Peak Particle Velocity at several distances can be correlated with scaled distance to create a site-specific chart that can be used to produce a regression line for predicting worst case vibrations at greater distances (or for greater charges), in line with recommendations of BS5228-2 Annex E. It is suggested that if there are concerns regarding the vibration impact from blasting, this would be managed and mitigated via the



CEMP, and could be further regulated by the imposition of a planning condition requiring a methodology for assessment and monitoring of vibration impacts related to blasting to be submitted and approved prior to commencement of any blasting activities.

12.4 Approach and Methodology

12.4.1 Scope of Assessment

This chapter considers the effects of noise associated with the operation of the proposed development on neighbouring noise sensitive receptors.

12.4.2 Baseline Characterisation

12.4.2.1 Study Area

The study area for the operational noise assessment encompasses all residential receptors with predicted noise levels from the proposed development in isolation of 30dB L_{A90} or more (see 12.4.3).

12.4.2.2 Information and Data Sources

12.4.2.3 Field Survey

Technical Appendix 12.1 and **Technical Appendix 12.2** detail the method, selection, measurement and quantification of the baseline noise environment at representative receptors in 2023 and 2007 respectively.

12.4.3 Assessment Methods

12.4.3.1 Operational Noise

The chapter assesses cumulative effects as arising from the proposed development in combination with other wind turbine developments, which are the subject of a valid planning application. Operational, under construction and consented developments are also considered as part of the cumulative assessment.

The assessment follows guidance set out in ETSU-R-97 on the assessment of noise from wind turbines which includes the following stages:

- Baseline noise survey conducted at noise sensitive receptors around Site and correlated with standardised 10m height wind speeds measured concurrently on Site;
- Plots of baseline L_{A90} noise levels against standardised 10m height wind speed used to derive prevailing daytime and night-time background noise curves for a range of wind speeds up to 12m/s;
- Derived prevailing background noise curves are used to define daytime and night-time noise limits calculated in accordance with ETSU-R-97;
- Predicted noise levels have been calculated / modelled using ISO 9613-2 methodology implemented using proprietary noise modelling software;
- Noise contour plots have been produced showing predicted L_{A90} at a height of 4m above ground level assuming downwind conditions in all directions (not possible in practice but represents worst-case for all receptor locations); and
- Worst-case downwind predicted noise levels have been compared to the noise limits.

The assessment is based on the proposed development as described in **Chapter 3: Proposed Development Description** and assumes the installation of 16 turbines up to 200m tip height and 6.6 MW power output each. For the purposes of the EIAR and this noise assessment use of a Siemens Gamesa SG170 6.6 MW candidate turbine has been assumed. It should be noted that the actual



turbine selection will depend on a number of factors that will be taken into account during the procurement process, post consent and it cannot be guaranteed that this candidate turbine would be installed on the proposed development.

Operational noise predictions have been carried out for the candidate wind turbine under consideration for the proposed development in line with the methodology set out in the IOA GPG (IOA, 2013). Full details of the prediction methodology are set out in **Technical Appendix 12.3: Noise Prediction Methodology**, but the main assumptions are described below:

- Receiver height of 4m;
- Ground effect ground coefficient $G=0.5$;
- Atmospheric attenuation corresponding to a temperature of 10°C and a relative humidity of 70%;
- Topographical barriers and concave ground profile corrections have been applied according to the IOA GPG (IOA, 2013); and
- A margin of plus 2dB has been added to manufacturer’s sound power level data to account for uncertainty.

The source noise levels for the candidate turbine assumed for the proposed development are set out at **Table 12-1**. The candidate SG170 6.6MW turbine used for the purposes of the predictions is assumed to have a hub height of 115m. The octave band noise data taken from the manufacturer’s technical specification document are also set out at **Table 12-1**.

Table 12-1: Candidate Turbine Octave Band Sound Power Level (dB L_{WA})

Standardised 10m height wind speed	Octave band centre frequency (Hz)								Broadband
	63	125	250	500	1000	2000	4000	8000	
4	81.3	88.1	90.3	91.3	94.5	94.2	89.7	77.9	99.8
5	86.2	93.0	95.2	96.2	99.4	99.1	94.6	82.8	104.7
6	88.7	96.3	98.7	98.5	101.9	102.4	97.7	86.3	107.7
7	88.7	96.4	98.9	98.9	102.4	102.6	97.4	86.4	107.9
8	88.5	95.4	98.1	99.9	103.8	101.9	95.3	85.0	108.0
9	88.5	95.4	98.1	99.9	103.8	101.9	95.3	85.0	108.0
10	88.5	95.4	98.1	99.9	103.8	101.9	95.3	85.0	108.0
11	88.5	95.4	98.1	99.9	103.8	101.9	95.3	85.0	108.0
12	88.5	95.4	98.1	99.9	103.8	101.9	95.3	85.0	108.0

12.4.3.2 Assumptions, Limitations and Confidence

As discussed above, the operational noise impact assessment is based on a candidate wind turbine which may not be the turbine that is installed in practice. However, operational noise limits will be set for the proposed development via planning conditions which will stipulate operational noise levels that cannot be exceeded at noise sensitive properties. Therefore, regardless of the model of turbine installed, these limits must be met.

12.4.4 Sensitivity Criteria

For the purposes of the noise assessment all residential property locations are treated as noise sensitive receptors with a high receptor sensitivity for noise effects.



12.4.5 Magnitude of Effect

ETSU-R-97 requires that overall turbine levels (including for the effect of other cumulative development) do not exceed derived noise limits, which take into account the balance of the need for renewable energy and the protection of the noise environment at neighbouring properties. Accordingly, no scale of magnitude is applied to the assessment, and whether or not an effect is significant depends solely on whether the derived noise limits are predicted to be met.

The criteria set out in the paragraph above would equally apply to the combined cumulative operational noise impacts including neighbouring wind farm sites.

12.4.6 Significance Criteria

The specific night and daytime noise limits to be applied to the proposed development for operational noise were derived in line with ETSU-R-97 and agreed with MC (see **Technical Appendix 12.1**) and are set out in **Table 12-2**.

If the relevant noise limits are met at a specific receptor location, then the noise effect at that location is considered to be not significant.

Table 12-2: Operational Noise Limits

Time Period	Limit (dB LA90)	Significance of Effect
At all times if predicted operational noise levels are below this no significant effects are predicted and detailed cumulative assessment is not required	30dB	Not Significant
Night-time noise limit applicable to the proposed development acting alone	The greater of 40dB or plus 5dB above background	Not Significant (depending on cumulative noise effects)
Day-time noise limit applicable to proposed development acting alone	The greater of 38dB or plus 5dB above background	Not Significant (depending on cumulative noise effects)
Night-time noise limit applicable to cumulative noise from all wind turbine developments	The greater of 40dB or plus 5dB above background	Not Significant
Day-time noise limit applicable to cumulative noise from all wind turbine developments	The greater of 40dB or plus 5dB above background	Not Significant
Night-time and Day-time noise limit applicable to cumulative noise from all wind turbine developments where receptor has a financial involvement with the proposed development	The greater of 45dB or plus 5dB above background	Not Significant
Night-time and Day-time noise limit applicable to cumulative noise from all wind turbine developments where receptor has a financial involvement with a neighbouring development	Existing agreements are applied	Not Significant (depending on proposed development alone noise effects)
At all times if predicted operational noise levels from the proposed development are at least this amount below the cumulative predicted operational noise level	10dB Below	Not significant (depending on proposed development alone noise effects)

12.5 Environmental Baseline and Potential Sources of Impact

12.5.1 Current Baseline

The results of the baseline noise measurements (presented in **Technical Appendix 12.1 and 12.2**) are summarised at **Table 12-3**. The baseline noise data was reviewed to determine whether measured noise levels were affected by noise from any of the neighbouring operational wind farms. It is



considered that, although there are times when it is possible that operational noise from an existing wind turbine could be audible at the two assessment locations used in the 2023 survey, it is unlikely to have a material influence on the results. Noise from operational wind turbines was not noted during any of the Site visits at any of the measurement locations for the 2007 survey as none were operational during this monitoring period.

Table 12-3: Baseline Noise Measurement Results (dB L_{A90})

Location	Time Period	Standardised 10m height wind speed (m/s) ¹										
		2	3	4	5	6	7	8	9	10	11	12
Auchinderran	Night-Time	19	20	22	25	28	32	36	40	44	47	50
	Quiet Day	23	24	26	29	32	34	37	41	44	46	49
Newtonbrae	Night-Time	18	19	20	22	24	27	30	33	37	40	44
	Quiet Day	20	20	21	22	25	28	31	35	39	42	46
Aultmore Lodge	Night-Time	24	26	26	28	30	34	- ²	-	-	-	-
	Quiet Day	27	28	30	33	36	39	44	-	-	-	-
Drodland	Night-Time	20	20	21	23	25	28	32	36	41	-	-
	Quiet Day	24	25	27	28	30	33	36	39	43	48	-
Hillhead Farm	Night-Time	20	22	25	28	31	35	38	41	44	-	-
	Quiet Day	24	26	28	30	33	35	38	40	42	44	-
Myreside	Night-Time	17	17	19	21	25	29	33	38	43	-	-
	Quiet Day	24	25	26	28	30	33	36	39	42	45	-
School Hill	Night-Time	20	22	23	26	28	32	36	40	44	-	-
	Quiet Day	24	25	27	30	33	36	39	43	47	51	-

12.5.1.1 Summary of Sensitive Receptors

As described above, only those receptor locations where predicted operational noise levels from the proposed development are above 30dB L_{A90} have been scoped into the assessment, this is defined as the Study Area. The receptor locations included in the assessment are shown at **Table 12-4** and **Figure 12.1**. All receptors considered in the assessment are residential properties.

Where a receptor is within the Study Area, and not a measurement location, it has been assigned limits from one of the baseline measurement locations if one is deemed representative based on similar geographical location to local background noise sources. Where an appropriately representative measurement location is not available the fixed limits detailed in **Table 12-2** have been assigned.

All other noise sensitive receptors are unlikely to experience significant noise effects and accordingly are scoped out.

¹ The standardised 10m height wind speed is the hub height wind speed corrected to 10m height using a logarithmic wind shear profile and a ground roughness length of 0.05 m.

² Where no data was measured at or above a wind speed a '-' is displayed and the associated noise limits in Table B.3 will be held at the same level as for the highest available wind speeds.



Table 12-4: Summary of Receptor Sensitivity

Receptor	Grid Reference		Limit Location
	Easting	Northing	
Aultmore Lodge	349118	859525	Aultmore Lodge
Backies	349708	858904	Aultmore Lodge
Balnamoon Hill	347539	856591	Myreside
Balnamoon Hill Cottage	347757	856807	Myreside
Beechtree Farm	339800	856519	Auchinderran
Beechtree Farm Caravan	339827	856521	Auchinderran
Blackhills	340842	859225	Auchinderran
Bossy Hillocks	348949	857295	Myreside
Burn of Aultmore Croft	345205	856022	Drodland
Burn of Aultmore Croft, 2	345502	856360	Drodland
Burn of Aultmore Croft, 3	345782	856218	Drodland
Clochmacreich	349444	858080	Aultmore Lodge
Coralside Croft	343360	855645	Newtonbrae
Craibstone Farm	349643	859447	Aultmore Lodge
Craibstone Farm Cottages	349607	859312	Aultmore Lodge
Croft of Fernking	344248	856861	Drodland
Deerhill Croft	346438	856354	Myreside
Deerhill Croft, Plot 2	346563	856303	Myreside
Deerhill Farm	346094	855989	Drodland
Drodland	345312	857575	Drodland
East Balnamoon	348405	856393	Myreside
Fernking Croft	344217	857440	Drodland
Goukstone Croft	347905	856690	Myreside
Greenwells Croft	344886	860186	Hillhead Farm
Hayfield	345255	857357	Drodland
Heads of Auchinderran	340828	855336	Auchinderran
Heads of Auchinderran Cottage	340845	855327	Auchinderran
Hillfolds	344271	860510	Hillhead Farm
Hillhead of Letterfourie	344475	860073	Hillhead Farm
Hillhead of Starhill	346968	855745	Myreside
Inkerman	344615	859769	Hillhead Farm
Langlanburn	349192	858506	Aultmore Lodge
Marchbank	348115	857435	Myreside
Muirton	346015	860748	Hillhead Farm
Myreside	348538	857433	Myreside
Near Hame	346696	855751	Myreside



Receptor	Grid Reference		Limit Location
	Easting	Northing	
Netherton of Windyhills	349280	857259	Myreside ³
Newtonbrae	342540	856004	Newtonbrae
Quarryhill Cottage	345115	860725	Hillhead Farm
Raeffin	339905	857295	Auchinderran
Redburn Farm	344554	860509	Hillhead Farm
Redroofs Croft	347922	856488	Myreside
Redroofs Croft, Plot 1	347996	856485	Myreside
Redroofs Croft, Plot 2	348031	856464	Myreside
Rowanbank	343427	856289	Newtonbrae
Rowanbrae Farm	339672	856450	Auchinderran
Rowanbrae Farm Caravan	339648	856453	Auchinderran
Ryeriggs Croft	340248	856472	Auchinderran
Ryeriggs Plot 3	340668	856300	Auchinderran
Schoolhill Croft	346311	861305	School Hill
Schoolhouse Shielburn	346125	861381	School Hill
Shielmuir	346519	861573	School Hill
Stoneybank	344481	860625	Hillhead Farm
Stripeside	348507	860973	School Hill
Sunnybrae Croft	342830	856187	Newtonbrae
Tarryfeuch	345897	855882	Drodland
Tarrymount	340183	858107	Auchinderran
The Bungalow Ryeriggs	340174	856092	Auchinderran
The Herricks Caravan	343566	856066	Newtonbrae
Upper Allaloth	340731	858573	Auchinderran
West Balnamoon	348105	856220	Myreside
Wester Windyhills	348604	857153	Myreside
Whitefield Farmhouse	344942	861035	Hillhead Farm
Williamstown	345478	860907	Hillhead Farm
Witch Wood Steading	349199	856759	Myreside ⁴
Woodside Cottage	342303	855385	Newtonbrae

³ Netherton of Windyhills, also known as Netherton Farm House, has a noise limit of 45dB LA90 within the lifetime of the Netherton wind turbines as per planning decision Ref: 18/00715/APP. Therefore this receptor will be assessed cumulatively including the Netherton wind turbines against this limit, but also cumulatively excluding the Netherton wind turbines against the standard cumulative limits derived for Myreside.

⁴ Witch Wood Steading, also known as Witchwood Steading, has an agreement to not be occupied within the lifetime of the Netherton wind turbines as per planning decision Ref: 18/00715/APP. Therefore it will not be assessed cumulatively including Netherton, but will be assessed cumulatively excluding Netherton against the standard cumulative limits derived for Myreside.



12.5.2 Future Baseline

Future baseline noise levels (in the absence of other wind turbine noise) is expected to remain largely similar, although it may be that other agricultural, industrial or residential developments in the area could cause a significant change.

12.6 Assessment of Potential Effects

12.6.1 Operational Effects

Operational noise impacts have been assessed by comparing predicted operational noise levels with noise limits derived from the baseline noise measurements. The relevant noise limits are set out at **Table 12-5**.

Table 12-5: Derived Noise Limits (dB L_{A90})

Location	Time Period	Standardised 10m height wind speed (m/s) ⁵										
		2	3	4	5	6	7	8	9	10	11	12
Auchinderran	Night-Time	40	40	40	40	40	40	41	45	49	52	55
	Day-Time Aultmore Alone	38	38	38	38	38	39	42	46	49	51	54
	Day-Time Cumulative	40	40	40	40	40	40	42	46	49	51	54
Newtonbrae	Night-Time	40	40	40	40	40	40	40	40	42	45	49
	Day-Time Aultmore Alone	38	38	38	38	38	38	38	40	44	47	51
	Day-Time Cumulative	40	40	40	40	40	40	40	40	44	47	51
Aultmore Lodge	Night-Time	40	40	40	40	40	40	40	40	40	40	40
	Day-Time Aultmore Alone	38	38	38	38	41	44	49	49	49	49	49
	Day-Time Cumulative	40	40	40	40	41	44	49	49	49	49	49
Drodland	Night-Time	40	40	40	40	40	40	40	41	46	46	46
	Day-Time Aultmore Alone	38	38	38	38	38	38	41	44	48	53	53
	Day-Time Cumulative	40	40	40	40	40	40	41	44	48	53	53
Hillhead Farm	Night-Time	40	40	40	40	40	40	43	46	49	49	49
	Day-Time Aultmore Alone	38	38	38	38	38	40	43	45	47	49	49
	Day-Time Cumulative	40	40	40	40	40	40	43	45	47	49	49
Myreside	Night-Time	40	40	40	40	40	40	40	43	48	48	48
	Day-Time Aultmore Alone	38	38	38	38	38	38	41	44	47	50	50
	Day-Time Cumulative	40	40	40	40	40	40	41	44	47	50	50
School Hill	Night-Time	40	40	40	40	40	40	41	45	49	49	49
	Day-Time Aultmore Alone	38	38	38	38	38	41	44	48	52	56	56
	Day-Time Cumulative	40	40	40	40	40	41	44	48	52	56	56

Operational noise prediction results are presented for all receptors scoped into the assessment.

The prediction results are presented at **Table 12-6**. It should be noted that the predictions assume that each receptor location is downwind of the proposed development to provide a worst-case assessment. Under non-downwind conditions, operational noise levels will be lower. In addition,

⁵ The standardised 10m height wind speed is the hub height wind speed corrected to 10m height using a logarithmic wind shear profile and a ground roughness length of 0.05 m.



worst-case downwind noise contours for the maximum operational noise level of all turbines considered cumulatively as well as the noise sensitive receptor locations are shown at **Figure 12.1** and **Figure 12.2**.

The relevant night and day-time noise limits are met at all noise sensitive receptor locations, which is illustrated by the margins below these two limits in **Table 12-7** and **Table 12-8**. Therefore the noise impact of the proposed development operating in isolation is determined to be **not significant at all receptor locations**.



Table 12-6: Operational Noise Prediction Results for Proposed Development Acting Alone (dB L_{A90})

Location	Predicted L _{A90} at Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Aultmore Lodge	25	30	33	33	33	33	33	33	33	
Backies	23	27	30	31	31	31	31	31	31	
Balnmoon Hill	27	32	34	35	35	35	35	35	35	
Balnmoon Hill Cottage	27	32	35	36	36	36	36	36	36	
Beechtree Farm	23	28	31	31	32	32	32	32	32	
Beechtree Farm Caravan	24	28	31	32	32	32	32	32	32	
Blackhills	22	26	29	30	30	30	30	30	30	
Bossy Hillocks	24	29	32	32	33	33	33	33	33	
Burn of Aultmore Croft	22	27	30	30	30	30	30	30	30	
Burn of Aultmore Croft, 2	24	28	31	32	32	32	32	32	32	
Burn of Aultmore Croft, 3	24	28	31	32	32	32	32	32	32	
Clochmacreich	24	28	31	32	32	32	32	32	32	
Coralside Croft	23	27	30	31	31	31	31	31	31	
Craibstone Farm	22	27	30	30	30	30	30	30	30	
Craibstone Farm Cottages	23	28	30	31	31	31	31	31	31	
Croft of Fernking	24	28	31	32	32	32	32	32	32	
Deerhill Croft	25	30	33	33	34	34	34	34	34	
Deerhill Croft, Plot 2	25	30	33	33	33	33	33	33	33	
Deerhill Farm	23	28	31	31	31	31	31	31	31	

Location	Predicted L _{A90} at Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Drodland	28	33	36	36	36	36	36	36	36	
East Balnmoon	23	28	31	31	31	31	31	31	31	
Fernking Croft	24	29	32	33	33	33	33	33	33	
Goukstone Croft	26	31	34	34	35	35	35	35	35	
Greenwells Croft	26	30	33	34	34	34	34	34	34	
Hayfield	27	32	35	35	35	35	35	35	35	
Heads of Auchinderran	24	28	31	32	32	32	32	32	32	
Heads of Auchinderran Cottage	24	28	31	32	32	32	32	32	32	
Hillfolds	22	27	30	30	30	30	30	30	30	
Hillhead of Letterfourie	24	29	32	32	32	32	32	32	32	
Hillhead of Starhill	22	27	30	30	31	31	31	31	31	
Inkerman	26	31	34	34	34	34	34	34	34	
Langlanburn	25	30	33	33	34	34	34	34	34	
Marchbank	30	35	37	38	38	38	38	38	38	
Muirton	25	30	33	33	34	34	34	34	34	
Myreside	27	32	35	35	36	36	36	36	36	
Near Hame	22	27	30	31	31	31	31	31	31	
Netherton of Windyhills	23	28	31	31	31	31	31	31	31	
Newtonbrae	27	32	35	35	36	36	36	36	36	
Quarryhill Cottage	24	29	32	32	32	32	32	32	32	
Raeffin	25	30	32	33	33	33	33	33	33	
Redburn Farm	23	28	31	31	31	31	31	31	31	



Location	Predicted L _{A90} at Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Redroofs Croft	25	30	33	33	33	33	33	33	33	33
Redroofs Croft, Plot 1	25	30	33	33	33	33	33	33	33	33
Redroofs Croft, Plot 2	25	30	32	33	33	33	33	33	33	33
Rowanbank	25	29	32	33	33	33	33	33	33	33
Rowanbrae Farm	23	27	30	31	31	31	31	31	31	31
Rowanbrae Farm Caravan	22	27	30	30	31	31	31	31	31	31
Ryeriggs Croft	26	31	34	34	35	35	35	35	35	35
Ryeriggs Plot 3	29	34	37	37	37	37	37	37	37	37
Schoolhill Croft	23	28	31	31	31	31	31	31	31	31
Schoolhouse Shielburn	23	27	30	31	31	31	31	31	31	31
Shielmuir	22	27	30	30	30	30	30	30	30	30
Stoneybank	22	27	30	30	30	30	30	30	30	30
Stripeside	22	27	30	30	30	30	30	30	30	30
Sunnybrae Croft	27	32	35	35	35	35	35	35	35	35
Tarryfeuch	22	27	30	30	30	30	30	30	30	30
Tarrymount	24	29	32	32	33	33	33	33	33	33
The Bungalow Ryeriggs	24	29	32	33	33	33	33	33	33	33
The Herricks Caravan	23	28	31	31	32	32	32	32	32	32
Upper Allaloth	25	30	33	33	33	33	33	33	33	33
West Balnamoon	23	28	31	31	32	32	32	32	32	32
Wester Windyhills	26	31	33	34	34	34	34	34	34	34

Location	Predicted L _{A90} at Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Whitefield Farmhouse	22	27	30	30	30	30	30	30	30	30
Williamstown	24	29	31	32	32	32	32	32	32	32
Witch Wood Steading	22	27	30	30	30	30	30	30	30	30
Woodside Cottage	24	29	32	32	33	33	33	33	33	33

Table 12-7: Margin Between Predicted Operational Noise Level and Derived Night-Time Noise Limits (dB L_{A90})

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Aultmore Lodge	15	10	8	7	7	7	7	7	7	7
Backies	18	13	10	10	9	9	9	9	9	9
Balnamoon Hill	13	8	6	5	5	8	13	13	13	13
Balnamoon Hill Cottage	13	8	5	5	4	7	12	12	12	12
Beechtree Farm	17	12	9	9	9	13	17	20	23	23
Beechtree Farm Caravan	16	12	9	8	9	13	17	20	23	23
Blackhills	18	14	11	10	11	15	19	22	25	25
Bossy Hillocks	16	11	8	8	7	10	15	15	15	15
Burn of Aultmore Croft	18	13	10	10	10	11	16	16	16	16
Burn of Aultmore Croft, 2	17	12	9	8	8	9	14	14	14	14
Burn of Aultmore Croft, 3	17	12	9	9	8	9	14	14	14	14
Clochmacreich	16	12	9	8	8	8	8	8	8	8
Coralside Croft	18	13	10	9	9	9	11	14	18	18



Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Craibstone Farm	18	13	10	10	10	10	10	10	10	10
Craibstone Farm Cottages	17	13	10	9	9	9	9	9	9	9
Croft of Fernking	17	12	9	8	8	9	14	14	14	14
Deerhill Croft	15	10	7	7	6	9	14	14	14	14
Deerhill Croft, Plot 2	15	10	7	7	7	10	15	15	15	15
Deerhill Farm	17	12	9	9	9	10	15	15	15	15
Drodland	12	7	4	4	4	5	10	10	10	10
East Balnamoon	17	12	9	9	9	12	17	17	17	17
Fernking Croft	16	11	8	8	7	8	13	13	13	13
Goukstone Croft	14	9	6	6	5	8	13	13	13	13
Greenwells Croft	15	10	7	7	9	12	15	15	15	15
Hayfield	13	8	6	5	5	6	11	11	11	11
Heads of Auchinderran	17	12	9	9	9	13	17	20	23	23
Heads of Auchinderran Cottage	17	12	9	9	9	13	17	20	23	23
Hillfolds	18	13	10	10	13	16	19	19	19	19
Hillhead of Letterfourie	16	11	8	8	11	14	17	17	17	17
Hillhead of Starhill	18	13	10	10	10	13	18	18	18	18
Inkerman	14	9	6	6	9	12	15	15	15	15
Langlanburn	15	10	7	7	6	6	6	6	6	6
Marchbank	10	5	3	2	2	5	10	10	10	10
Muirton	15	10	7	7	9	12	15	15	15	15
Myreside	13	8	5	5	5	8	13	13	13	13

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Near Hame	18	13	10	10	10	13	18	18	18	18
Netherton of Windyhills	17	12	9	9	9	12	17	17	17	17
Newtonbrae	13	8	5	5	4	4	6	9	13	13
Quarryhill Cottage	16	11	9	8	11	14	17	17	17	17
Raeffin	15	11	8	7	8	12	16	19	22	22
Redburn Farm	17	12	9	9	12	15	18	18	18	18
Redroofs Croft	15	10	7	7	7	10	15	15	15	15
Redroofs Croft, Plot 1	15	10	7	7	7	10	15	15	15	15
Redroofs Croft, Plot 2	15	11	8	7	7	10	15	15	15	15
Rowanbank	16	11	8	8	7	7	9	12	16	16
Rowanbrae Farm	18	13	10	9	10	14	18	21	24	24
Rowanbrae Farm Caravan	18	13	10	10	10	14	18	21	24	24
Ryeriggs Croft	14	9	6	6	6	10	14	17	20	20
Ryeriggs Plot 3	11	6	3	3	4	8	12	15	18	18
Schoolhill Croft	17	12	9	9	10	14	18	18	18	18
Schoolhouse Shielburn	18	13	10	10	10	14	18	18	18	18
Shielmuir	18	13	10	10	11	15	19	19	19	19
Stoneybank	18	13	10	10	13	16	19	19	19	19
Stripeside	18	13	10	10	11	15	19	19	19	19
Sunnybrae Croft	13	8	5	5	5	5	7	10	14	14
Tarryfeuch	18	13	10	10	10	11	16	16	16	16
Tarrymount	16	11	8	8	8	12	16	19	22	22



Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
The Bungalow Ryeriggs	16	11	8	8	8	12	16	19	22	
The Herricks Caravan	17	12	9	9	9	9	11	14	18	
Upper Allaloth	15	10	7	7	8	12	16	19	22	
West Balnamoon	17	12	9	9	9	12	17	17	17	
Wester Windyhills	14	10	7	6	6	9	14	14	14	
Whitefield Farmhouse	18	13	10	10	13	16	19	19	19	
Williamstown	16	11	9	8	11	14	17	17	17	
Witch Wood Steading	18	13	10	10	10	13	18	18	18	
Woodside Cottage	16	11	8	8	8	8	10	13	17	

Table 12-8: Margin Between Predicted Operational Noise Level and Derived Day-Time Noise Limits (dB L_{A90})

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Aultmore Lodge	13	8	9	11	16	16	16	16	16	
Backies	16	11	11	14	18	18	18	18	18	
Balnamoon Hill	11	6	4	3	6	9	12	15	15	
Balnamoon Hill Cottage	11	6	3	3	5	8	11	14	14	
Beechtree Farm	15	10	7	8	10	14	17	19	22	
Beechtree Farm Caravan	14	10	7	7	10	14	17	19	22	
Blackhills	16	12	9	9	12	16	19	21	24	
Bossy Hillocks	14	9	6	6	8	11	14	17	17	
Burn of Aultmore Croft	16	11	8	8	11	14	18	23	23	

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Burn of Aultmore Croft, 2	15	10	7	6	9	12	16	21	21	
Burn of Aultmore Croft, 3	15	10	7	7	9	12	16	21	21	
Clochmacreigh	14	10	10	12	17	17	17	17	17	
Coralside Croft	16	11	8	7	7	9	13	16	20	
Craibstone Farm	16	11	11	14	19	19	19	19	19	
Craibstone Farm Cottages	15	11	11	13	18	18	18	18	18	
Croft of Fernking	15	10	7	6	9	12	16	21	21	
Deerhill Croft	13	8	5	5	7	10	13	16	16	
Deerhill Croft, Plot 2	13	8	5	5	8	11	14	17	17	
Deerhill Farm	15	10	7	7	10	13	17	22	22	
Drodland	10	5	2	2	5	8	12	17	17	
East Balnamoon	15	10	7	7	10	13	16	19	19	
Fernking Croft	14	9	6	6	8	11	15	20	20	
Goukstone Croft	12	7	4	4	6	9	12	15	15	
Greenwells Croft	13	8	5	7	9	11	13	15	15	
Hayfield	11	6	4	3	6	9	13	18	18	
Heads of Auchinderran	15	10	7	8	10	14	17	19	22	
Heads of Auchinderran Cottage	15	10	7	8	10	14	17	19	22	
Hillfolds	16	11	8	10	13	15	17	19	19	
Hillhead of Letterfourie	14	9	6	8	11	13	15	17	17	
Hillhead of Starhill	16	11	8	8	11	14	17	20	20	



Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Inkerman	12	7	4	6	9	11	13	15	15	
Langlanburn	13	8	8	11	15	15	15	15	15	
Marchbank	8	3	1	0	3	6	9	12	12	
Muirton	13	8	5	7	9	11	13	15	15	
Myreside	11	6	3	3	6	9	12	15	15	
Near Hame	16	11	8	8	11	14	17	20	20	
Netherton of Windyhills	15	10	7	7	10	13	16	19	19	
Newtonbrae	11	6	3	3	2	4	8	11	15	
Quarryhill Cottage	14	9	7	8	11	13	15	17	17	
Raeffin	13	9	6	6	9	13	16	18	21	
Redburn Farm	15	10	7	9	12	14	16	18	18	
Redroofs Croft	13	8	5	5	8	11	14	17	17	
Redroofs Croft, Plot 1	13	8	5	5	8	11	14	17	17	
Redroofs Croft, Plot 2	13	9	6	5	8	11	14	17	17	
Rowanbank	14	9	6	6	5	7	11	14	18	
Rowanbrae Farm	16	11	8	8	11	15	18	20	23	
Rowanbrae Farm Caravan	16	11	8	9	11	15	18	20	23	
Ryeriggs Croft	12	7	4	5	7	11	14	16	19	
Ryeriggs Plot 3	9	4	1	2	5	9	12	14	17	
Schoolhill Croft	15	10	7	10	13	17	21	25	25	
Schoolhouse Shielburn	16	11	8	11	13	17	21	25	25	
Shielmuir	16	11	8	11	14	18	22	26	26	

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Stoneybank	16	11	8	10	13	15	17	19	19	
Stripeside	16	11	8	11	14	18	22	26	26	
Sunnybrae Croft	11	6	3	3	3	5	9	12	16	
Tarryfeuch	16	11	8	8	11	14	18	23	23	
Tarrymount	14	9	6	7	9	13	16	18	21	
The Bungalow Ryeriggs	14	9	6	7	9	13	16	18	21	
The Herricks Caravan	15	10	7	7	7	9	13	16	20	
Upper Allaloth	13	8	5	6	9	13	16	18	21	
West Balnamoon	15	10	7	7	10	13	16	19	19	
Wester Windyhills	12	8	5	4	7	10	13	16	16	
Whitefield Farmhouse	16	11	8	10	13	15	17	19	19	
Williamstown	14	9	7	8	11	13	15	17	17	
Witch Wood Steading	16	11	8	8	11	14	17	20	20	
Woodside Cottage	14	9	6	6	6	8	12	15	19	



12.6.2 Cumulative Operational Effects

The ETSU-R-97 noise limits apply to cumulative noise from all wind farm developments in the vicinity of the proposed development. There are a number of operational wind farms that have been considered in the cumulative operational noise assessment, as agreed with MC, which are listed below:

- Balnamoon; 1 Enercon E48 turbine with a hub height of 50m;
- Followsters; 1 EWT DW-54 500 turbine with a hub height of 50m;
- Lurg Hill; 3 Vestas V136 turbines with a hub height of 81.9m;
- Myreton; 3 Enercon E48 turbines with hub heights of 50m, 55m, and 65m; and
- Netherton; 2 Enercon E70 turbines with a hub height of 58m.

There are no other operational, under construction, consented or live application wind farms that would give rise to cumulative operational effects in combination with the proposed development in accordance with the criteria within the IOA GPG.

Predictions have been undertaken using the same methodology as set out in **Technical Appendix 12.3: Noise Prediction Methodology** based on the source data for the turbines at each wind farm shown in **Table 12-9** and **Table 12-10**. This data includes a 2dB uncertainty factor.

Table 12-9: Nearby Wind Farm Assumed Sound Power Levels (dB L_{WA})

Turbine Make	Model	Standardised 10m height wind speed (m/s)								
		4	5	6	7	8	9	10	11	12
Enercon	E48 50m HH	96.2	101.1	103.3	104.5	104.5	104.5	104.5	104.5	104.5
Enercon	E48 55m HH	96.5	101.3	103.4	104.5	104.5	104.5	104.5	104.5	104.5
Enercon	E48 65m HH	97.0	101.8	103.6	104.5	104.5	104.5	104.5	104.5	104.5
Enercon	E70	92.7	95.6	100.5	103.3	104.9	106.5	106.5	106.5	106.5
Vestas	V136	96.8	101.6	105.3	105.9	105.9	105.9	105.9	105.9	105.9
EWT	EWT DW-54 500	-	99.0	100.0	101.0	102.0	102.5	102.5	102.5	102.5

Table 12-10: Nearby Wind Farm Octave Band Levels (dB L_{WA})

Turbine Make	Model	Octave band centre frequency (Hz)								Broadband
		63	125	250	500	1000	2000	4000	8000	
Enercon	E48	86.2	90.3	97.2	99.5	99.3	94.1	90.3	86.9	104.5
Enercon	E70	90.4	99.0	101.5	100.1	98.6	95.3	88.4	80.8	106.5
Vestas	V136	86.8	94.5	99.3	101.0	99.9	95.8	88.8	78.6	105.9
EWT	EWT DW-54 500	84.7	90.8	96.1	97.4	96.0	93.5	86.6	74.8	102.5

The results of the cumulative operational predictions are shown in **Table 12-11**. As with the non-cumulative operational noise assessment, it is assumed that each receptor location is downwind of



the proposed development (and also all other cumulative sites) to provide a worst-case assessment. In reality, for most of the cumulative schemes the receptors most affected are between the proposed scheme and the nearest neighbouring scheme and therefore for most wind directions either the proposed development or the neighbouring scheme would have noise levels 5 to 10dB lower than those predicted here.

Note that as the cumulative predictions include the operation of Netherton, Witch Wood Steading is not included as an assessment location since this is not to be occupied during the lifespan of the Netherton wind turbines as per stipulations within the schemes planning conditions.

The noise contours for the maximum operational noise level of all turbines considered cumulatively, and the noise sensitive receptor locations, are shown at **Figure 12.2**.



Table 12-11: Cumulative Operational Noise Prediction Results (dB L_{A90})

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Aultmore Lodge	27	31	34	35	35	35	35	35	35	35
Backies	27	32	36	36	37	37	37	37	37	37
Balnemoon Hill	28	33	36	37	37	37	37	37	37	37
Balnemoon Hill Cottage	29	34	37	37	38	38	38	38	38	38
Beechtree Farm	23	29	31	32	32	32	32	32	32	32
Beechtree Farm Caravan	24	29	31	32	32	32	32	32	32	32
Blackhills	22	27	29	30	30	30	30	30	30	30
Bossy Hillocks	30	34	37	39	40	41	41	41	41	41
Burn of Aultmore Croft	22	27	30	31	31	31	31	31	31	31
Burn of Aultmore Croft, 2	24	29	32	32	32	32	32	32	32	32
Burn of Aultmore Croft, 3	24	29	32	32	32	32	32	32	32	32
Clochmacreich	29	34	37	38	39	40	40	40	40	40
Coralside Croft	23	28	31	31	31	31	31	31	31	31
Craibstone Farm	26	31	34	35	35	35	35	35	35	35
Craibstone Farm Cottages	27	32	35	36	36	36	36	36	36	36
Croft of Fernking	24	29	32	32	32	32	32	32	32	32
Deerhill Croft	26	31	34	34	35	35	35	35	35	35
Deerhill Croft, Plot 2	26	31	34	35	35	35	35	35	35	35
Deerhill Farm	24	29	32	32	33	33	33	33	33	33
Drodland	28	33	36	36	36	36	36	36	36	36

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
East Balnemoon	28	33	36	37	37	38	38	38	38	38
Fernking Croft	25	30	32	33	33	33	33	33	33	33
Goukstone Croft	28	33	36	37	37	38	38	38	38	38
Greenwells Croft	26	30	33	34	34	34	34	34	34	34
Hayfield	27	32	35	35	35	35	35	35	35	35
Heads of Auchinderran	24	30	32	33	33	34	34	34	34	34
Heads of Auchinderran Cottage	24	30	33	33	34	34	34	34	34	34
Hillfolds	22	27	30	30	31	31	31	31	31	31
Hillhead of Letterfourie	24	29	32	32	33	33	33	33	33	33
Hillhead of Starhill	27	32	35	35	36	36	36	36	36	36
Inkerman	26	31	34	34	35	35	35	35	35	35
Langlanburn	29	34	37	38	38	39	39	39	39	39
Marchbank	31	36	38	39	40	40	40	40	40	40
Muirton	25	30	33	34	34	34	34	34	34	34
Myreside	30	35	38	39	40	40	40	40	40	40
Near Hame	25	30	33	34	34	34	34	34	34	34
Netherton of Windyhills	33	37	41	43	44	45	45	45	45	45
Newtonbrae	27	33	35	36	36	36	36	36	36	36
Quarryhill Cottage	24	29	32	32	32	32	32	32	32	32
Raeffin	25	30	32	33	33	33	33	33	33	33
Redburn Farm	23	28	31	31	31	31	31	31	31	31



Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Redroofs Croft	28	33	36	37	37	37	37	37	37	
Redroofs Croft, Plot 1	28	33	36	37	37	38	38	38	38	
Redroofs Croft, Plot 2	28	33	36	37	37	38	38	38	38	
Rowanbank	25	30	33	33	33	33	33	33	33	
Rowanbrae Farm	23	28	30	31	31	31	31	31	31	
Rowanbrae Farm Caravan	22	28	30	31	31	31	31	31	31	
Ryeriggs Croft	26	31	34	34	35	35	35	35	35	
Ryeriggs Plot 3	29	34	37	37	38	38	38	38	38	
Schoolhill Croft	23	28	31	31	31	31	31	31	31	
Schoolhouse Shielburn	23	28	30	31	31	31	31	31	31	
Shielmuir	22	27	30	30	30	30	30	30	30	
Stoneybank	22	27	30	30	31	31	31	31	31	
Stripeside	23	28	31	31	31	32	32	32	32	
Sunnybrae Croft	27	32	35	35	36	36	36	36	36	
Tarryfeuch	23	28	31	31	31	31	31	31	31	
Tarrymount	24	29	32	32	33	33	33	33	33	
The Bungalow Ryeriggs	24	30	32	33	33	33	33	33	33	

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
The Herricks Caravan	23	29	31	32	32	32	32	32	32	
Upper Allaloth	25	30	33	33	33	33	33	33	33	
West Balnamoon	29	33	36	37	37	38	38	38	38	
Wester Windyhills	30	35	38	39	40	41	41	41	41	
Whitefield Farmhouse	22	27	30	30	30	30	30	30	30	
Williamstown	24	29	32	32	32	32	32	32	32	
Woodside Cottage	24	32	34	34	35	35	35	35	35	

The results of the cumulative operational noise predictions show that operational noise levels at all receptor locations other than Netherton of Windyhills and Witch Wood Steading are below the derived night-time and day-time noise limits that apply to cumulative operational noise, which is illustrated by the margins below these two limits in **Table 12-12** and **Table 12-13**. For both Netherton of Windyhills and Witch Wood Steading the predicted noise level from the proposed development is at least 12dB below that of the cumulative predicted noise level for the wind speeds where the cumulative limit is exceeded, and therefore as agreed with MC, no significant impact is considered. The cumulative operational noise impact is therefore considered to be **not significant at all receptor locations**.



Table 12-12: Margin Between Predicted Cumulative Operational Noise Level and Derived Night-Time Noise Limits (dB L_{A90})

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Aultmore Lodge	14	9	6	5	5	5	5	5	5	
Backies	13	8	5	4	4	3	3	3	3	
Balnামoon Hill	12	7	4	3	3	6	11	11	11	
Balnামoon Hill Cottage	11	6	4	3	2	5	10	10	10	
Beechtree Farm	17	12	9	8	9	13	17	20	23	
Beechtree Farm Caravan	16	11	9	8	9	13	17	20	23	
Blackhills	18	14	11	10	11	15	19	22	25	
Bossy Hillocks	10	6	3	1	0	2	7	7	7	
Burn of Aultmore Croft	18	13	10	9	9	10	15	15	15	
Burn of Aultmore Croft, 2	16	11	8	8	8	9	14	14	14	
Burn of Aultmore Croft, 3	16	11	8	8	8	9	14	14	14	
Clochmacreich	11	6	3	2	1	1	1	1	1	
Coralside Croft	17	12	9	9	9	9	11	14	18	
Craibstone Farm	14	9	6	5	5	5	5	5	5	
Craibstone Farm Cottages	13	8	5	5	4	4	4	4	4	
Croft of Fernking	16	11	8	8	8	9	14	14	14	
Deerhill Croft	14	9	6	6	5	8	13	13	13	
Deerhill Croft, Plot 2	14	9	6	6	5	8	13	13	13	
Deerhill Farm	16	11	8	8	8	8	13	13	13	

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Drodland	12	7	4	4	4	5	10	10	10	
East Balnামoon	12	7	4	3	3	5	10	10	10	
Fernking Croft	15	11	8	7	7	8	13	13	13	
Goukstone Croft	12	7	4	3	3	5	10	10	10	
Greenwells Croft	15	10	7	6	9	12	15	15	15	
Hayfield	13	8	5	5	5	6	11	11	11	
Heads of Auchinderran	17	10	8	7	8	11	15	18	21	
Heads of Auchinderran Cottage	17	10	8	7	8	11	15	18	21	
Hillfolds	18	13	10	10	13	16	19	19	19	
Hillhead of Letterfourie	16	11	8	8	11	14	17	17	17	
Hillhead of Starhill	13	8	6	5	5	7	12	12	12	
Inkerman	14	9	6	6	9	12	15	15	15	
Langlanburn	11	6	3	2	2	1	1	1	1	
Marchbank	9	5	2	1	0	3	8	8	8	
Muirton	15	10	7	7	9	12	15	15	15	
Myreside	10	5	2	1	0	3	8	8	8	
Near Hame	15	10	7	6	6	9	14	14	14	



Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Netherton of Windyhills ⁶	14	12	8	4	2	1	0	3	3	
Newtonbrae	13	8	5	4	4	4	6	9	13	
Quarryhill Cottage	16	11	8	8	11	14	17	17	17	
Raeffin	15	10	8	7	8	12	16	19	22	
Redburn Farm	17	12	9	9	12	15	18	18	18	
Redroofs Croft	12	7	4	3	3	6	11	11	11	
Redroofs Croft, Plot 1	12	7	4	3	3	5	10	10	10	
Redroofs Croft, Plot 2	12	7	4	3	3	5	10	10	10	
Rowanbank	15	10	8	7	7	7	9	12	16	
Rowanbrae Farm	18	12	10	9	10	14	18	21	24	
Rowanbrae Farm Caravan	18	13	10	9	10	14	18	21	24	
Ryeriggs Croft	14	9	6	6	6	10	14	17	20	
Ryeriggs Plot 3	11	6	3	3	4	8	12	15	18	
Schoolhill Croft	17	12	9	9	10	14	18	18	18	
Schoolhouse Shielburn	17	13	10	9	10	14	18	18	18	
Shielmuir	18	13	10	10	11	15	19	19	19	
Stoneybank	18	13	10	10	13	15	18	18	18	
Stripeside	17	12	9	9	10	14	18	18	18	
Sunnybrae Croft	13	8	5	5	5	5	7	10	14	

⁶ As these cumulative predictions include the operation of the Netherton wind turbines the financially involved noise limit is included for Netherton.

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Tarryfeuch	17	12	9	9	9	10	15	15	15	
Tarrymount	16	11	8	8	8	12	16	19	22	
The Bungalow Ryeriggs	16	10	8	7	8	12	16	19	22	
The Herricks Caravan	17	12	9	8	8	8	10	13	17	
Upper Allaloth	15	10	7	7	8	12	16	19	22	
West Balnamoon	12	7	4	3	3	5	10	10	10	
Wester Windyhills	10	5	2	1	0	2	7	7	7	
Whitefield Farmhouse	18	13	10	10	13	16	19	19	19	
Williamstown	16	11	8	8	11	14	17	17	17	
Woodside Cottage	16	8	6	6	5	5	7	10	14	

Table 12-13: Margin Between Predicted Cumulative Operational Noise Level and Derived Day-Time Noise Limits (dB LA90)

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Aultmore Lodge	14	9	7	9	14	14	14	14	14	
Backies	13	8	6	8	13	12	12	12	12	
Balnamoon Hill	12	7	4	3	4	7	10	13	13	
Balnamoon Hill Cottage	11	6	4	3	3	6	9	12	12	
Beechtree Farm	17	12	9	8	10	14	17	19	22	



Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Beechtree Farm Caravan	16	11	9	8	10	14	17	19	22	
Blackhills	18	14	11	10	12	16	19	21	24	
Bossy Hillocks	10	6	3	1	1	3	6	9	9	
Burn of Aultmore Croft	18	13	10	9	10	13	17	22	22	
Burn of Aultmore Croft, 2	16	11	8	8	9	12	16	21	21	
Burn of Aultmore Croft, 3	16	11	8	8	9	12	16	21	21	
Clochmacreich	11	6	4	6	10	10	10	10	10	
Coralside Croft	17	12	9	9	9	9	13	16	20	
Craibstone Farm	14	9	7	9	14	14	14	14	14	
Craibstone Farm Cottages	13	8	6	9	13	13	13	13	13	
Croft of Fernking	16	11	8	8	9	12	16	21	21	
Deerhill Croft	14	9	6	6	6	9	12	15	15	
Deerhill Croft, Plot 2	14	9	6	6	6	9	12	15	15	
Deerhill Farm	16	11	8	8	9	11	15	20	20	
Drodland	12	7	4	4	5	8	12	17	17	
East Balnamoon	12	7	4	3	4	6	9	12	12	
Fernking Croft	15	11	8	7	8	11	15	20	20	
Goukstone Croft	12	7	4	3	4	6	9	12	12	
Greenwells Croft	15	10	7	6	9	11	13	15	15	
Hayfield	13	8	5	5	6	9	13	18	18	
Heads of Auchinderran	17	10	8	7	9	12	15	17	20	

Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Heads of Auchinderran Cottage	17	10	8	7	9	12	15	17	20	
Hillfolds	18	13	10	10	13	15	17	19	19	
Hillhead of Letterfourie	16	11	8	8	11	13	15	17	17	
Hillhead of Starhill	13	8	6	5	6	8	11	14	14	
Inkerman	14	9	6	6	9	11	13	15	15	
Langlanburn	11	6	4	6	11	10	10	10	10	
Marchbank	9	5	2	1	1	4	7	10	10	
Muirton	15	10	7	7	9	11	13	15	15	
Myreside	10	5	2	1	1	4	7	10	10	
Near Hame	15	10	7	6	7	10	13	16	16	
Netherton of Windyhills ⁶	14	12	8	4	2	1	0	2	5	
Newtonbrae	13	8	5	4	4	4	8	11	15	
Quarryhill Cottage	16	11	8	8	11	13	15	17	17	
Raeffin	15	10	8	7	9	13	16	18	21	
Redburn Farm	17	12	9	9	12	14	16	18	18	
Redroofs Croft	12	7	4	3	4	7	10	13	13	
Redroofs Croft, Plot 1	12	7	4	3	4	6	9	12	12	
Redroofs Croft, Plot 2	12	7	4	3	4	6	9	12	12	
Rowanbank	15	10	8	7	7	7	11	14	18	
Rowanbrae Farm	18	12	10	9	11	15	18	20	23	
Rowanbrae Farm Caravan	18	13	10	9	11	15	18	20	23	



Location	Standardised 10m height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	
Ryeriggs Croft	14	9	6	6	7	11	14	16	19	
Ryeriggs Plot 3	11	6	3	3	5	9	12	14	17	
Schoolhill Croft	17	12	9	10	13	17	21	25	25	
Schoolhouse Shielburn	17	13	10	10	13	17	21	25	25	
Shielmuir	18	13	10	11	14	18	22	26	26	
Stoneybank	18	13	10	10	13	14	16	18	18	
Stripeside	17	12	9	10	13	17	21	25	25	
Sunnybrae Croft	13	8	5	5	5	5	9	12	16	
Tarryfeuch	17	12	9	9	10	13	17	22	22	
Tarrymount	16	11	8	8	9	13	16	18	21	
The Bungalow Ryeriggs	16	10	8	7	9	13	16	18	21	
The Herricks Caravan	17	12	9	8	8	8	12	15	19	
Upper Allaloth	15	10	7	7	9	13	16	18	21	
West Balnamoon	12	7	4	3	4	6	9	12	12	
Wester Windyhills	10	5	2	1	1	3	6	9	9	
Whitefield Farmhouse	18	13	10	10	13	15	17	19	19	
Williamstown	16	11	8	8	11	13	15	17	17	
Woodside Cottage	16	8	6	6	5	5	9	12	16	



There is a scenario, in terms of cumulative assessment, where the Netherton wind turbines are removed, and in this case the agreements in place for the Netherton of Windyhills and Witch Wood Steading locations would cease, and therefore they would both be subject to the standard cumulative limits. In this case the predicted cumulative noise levels and margin below these limits are detailed in **Table 12-14** below.

Table 12-14: Cumulative Assessment Without Netherton Wind Turbines (dB L_{A90})

Location, Predicted Noise Levels & Margins		Standardised 10m height wind speed (m/s)								
		4	5	6	7	8	9	10	11	12
Netherton of Windyhills	Predicted Cumulative Noise Levels	24	30	35	37	38	38	38	38	38
	Margin Between Predicted Levels and Night-Time Noise Limits	16	10	5	3	2	2	5	10	10
	Margin Between Predicted Levels and Day-Time Noise Limits	16	10	5	3	2	3	6	9	12
Witch Wood Steading	Predicted Cumulative Noise Levels	25	31	36	38	39	39	39	39	39
	Margin Between Predicted Levels and Night-Time Noise Limits	15	9	4	2	1	1	4	9	9
	Margin Between Predicted Levels and Day-Time Noise Limits	15	9	4	2	1	2	5	8	11

12.6.3 Remaining Noise Budget Noise Limits

At the request of MC, remaining noise budget noise limits have been calculated. These limits and the methodology for their derivation are detailed in **Technical Appendix 12.4**.

12.7 Mitigation

12.7.1 Proposed Mitigation during Construction

Construction noise will be minimised through the use of standard 'best practicable means' to reduce the potential level of noise generated as part of the construction activities. This will include the restriction of certain activities to certain times, use of quiet working methods and ensuring construction plant is in good working order.

Any specific mitigation measures that may be required for certain activities will be detailed within the detailed CEMP, to be secured by means of a planning condition.

The relevant BS5228 noise limits that would apply to construction activities with a duration of greater than one month are set out at Section 12.3.2.4.

Noise during construction works will be controlled by generally restricting works to standard working hours (07:00 to 19:00 Monday to Friday and 07:00 to 13:00 on Saturdays) and excluding Sundays, unless specifically agreed otherwise. Outside these hours, construction activities onsite will be limited to turbine erection, maintenance, emergency works, dust suppression, and the testing of plant and equipment, unless otherwise approved in advance in writing by Moray Council. It is therefore expected that only the weekday day-time noise limit will be applicable, but this is dependent on the working hours required at the time of construction.

With regard to noise from construction traffic, a Site management regime will be developed to control the movement of vehicles to and from the Site. This will be implemented through a Construction Traffic Management Plan (CTMP), as discussed further in **Chapter 11: Traffic and Transport**.



12.7.2 Mitigation during Operation

The proposed development is located sufficiently far from receptors such that predicted operational and cumulative operational noise levels associated with its introduction will meet the limiting requirements of ETSU-R-97, without the need to impose additional mitigation or curtail the operation of the turbines.

Suitably worded planning conditions are a common means to ensure that operational compliance measurements may be undertaken in the event of complaints relating to noise, and appropriate recourse can then be sought by the Local Authority should operational noise levels exceed consented limits. Standard conditions often require that, should a complaint be received, appropriate monitoring takes place to determine whether specified noise limits are being adhered to and whether remedial measures are required to be put in place on that basis. However, in this instance, operational noise levels from the proposed development at some receptors may be so low that it may be difficult or impossible to distinguish from other environmental noise sources and existing turbine noise immissions via typical measurement practices.

12.7.3 Mitigation during Decommissioning

Decommissioning would be managed in a similar manner to construction and would be subject to similar mitigation and controls.

12.7.4 Residual Operational Effects

Noise associated with the operation of the proposed development is considered not significant and no specific mitigation measures are considered necessary, and therefore residual operational effects are considered to be **not significant**.

12.7.5 Cumulative Operational Effects

Noise associated with the cumulative operation of the proposed development in combination with other cumulative schemes is considered not significant and no specific mitigation measures are considered necessary, and therefore residual operational effects are considered to be **not significant**.

12.8 Summary

The construction and operational noise effects associated with the proposed development operating in isolation and cumulatively with other potential development in the area are considered not significant.

Table 12-15: Summary of Residual Effects

Likely Significant Effect	Mitigation Measures	Means of Implementation	Residual Effect
Construction			
No significant effects predicted.	No specific mitigation required.	N/A	Not significant.
Operation			
No significant effects predicted.	No specific mitigation required.	N/A	Not significant.
Cumulative Operation			
No significant effects predicted.	No specific mitigation required.	N/A	Not significant.



Likely Significant Effect	Mitigation Measures	Means of Implementation	Residual Effect
Decommissioning			
No significant effects predicted.	No specific mitigation required.	N/A	Not significant.

12.9 References

- British Standards Institute (BSI) (2009 + 2014), BS 5228 + A1, Code of Practice for Noise and Vibration Control on Construction and Open Sites.
- Department of Energy and Climate Change (2011), Report on DECC Research Contract 01.08.09.01/492A (Analysis), Analysis of How Noise Impacts are Considered in the Determination of Wind Farm Planning Applications.
- Department of Energy and Climate Change (2016), Wind Turbine AM Review: Phase 1 & Phase 2 Reports. DECC.
- Department of the Environment (1976), Advisory Leaflet (AL) 72: Noise Control on Building Sites. DoE.
- Department of Trade and Industry (1996), ETSU-R-97, The Assessment and Rating of Noise from Wind Farms. ETSU/DTI
- Department of Trade and Industry (1997), ETSU W/13/00392/REP, Low Frequency Noise and Vibrations Measurement at a Modern Wind Farm. ETSU/DTI.
- Department of Trade and Industry (2000), ETSU W/13/00385/REP, A Critical Appraisal of Wind Farm Noise Propagation. ETSU/DTI
- Department of Trade and Industry (2006), ETSU W/45/00656/00/00, The Measurement of Low Frequency Noise at 3 UK Windfarms. ETSU/DTI.
- Department of Traffic: Welsh Office (1988), Calculation of Road Traffic Noise. DoT.
- Institute of Acoustics (IOA) (2015), Discussion Document on "Methods for Rating Amplitude Modulation in Wind Turbine Noise". IOA
- Institute of Acoustics (IOA) (2016), A Method for Rating Amplitude Modulation in Wind Turbine Noise - Version 1. IOA
- Institute of Acoustics (IOA) (2012), Discussion Document on "A Good Practice Guide to the Application of ETSU-R-97 for Wind Turbine Noise Assessment". IOA
- Institute of Acoustics (IOA) (2013), A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise. IOA
- Institute of Acoustics (IOA) (2009), Bulletin, Vol 34 No 2, March/April 2009. IOA
- International Organization for Standardization (ISO) (1992), ISO 9613-1, Acoustics - Attenuation of sound during propagation outdoors, Part 1: Method of calculation of the attenuation of sound by atmospheric absorption.
- International Organization for Standardization (ISO) (1996), ISO 9613-2, Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation.
- Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (2016), Low-frequency noise incl. infrasound from wind turbines and other sources. LUBW
- Moray Council (2017), Moray Onshore Wind Energy Supplementary Guidance.
- Renewable UK (RUK) (2013), Template Planning Condition on Amplitude Modulation: Noise Guidance Notes.



Renewable UK (RUK) (2013), The Development of a Penalty Scheme for Amplitude Modulated Wind Turbine Noise: Description and Justification.

RenewableUK (RUK) (2013), Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect.

Scottish Government (2023), National Planning Framework 4.

Scottish Government (2022), Onshore Wind Policy Statement 2022.

Scottish Government (2014), Onshore Wind Turbines.

Scottish Government (2011), Assessment of noise: technical advice note.

Styles, P., Stimpson, I., Toon, S., England, R. and Wright, M. . (2005), Microseismic and Infrasound Monitoring of Low Frequency Noise and Vibrations from Wind Farms. Keele University.

