12. Noise

12.1 Introduction

12.1.1 This chapter considers the likely significant effects of noise of the revised Proposed Development on noise sensitive receptors arising during construction, operation and decommissioning. The assessment described below represents an update to that presented in the May 2025 EIA Report where the main change relates to predicted noise levels due to the revised locations of T2 and T13. The tip height, the candidate turbine and therefore the hub height of the candidate turbine remain unchanged. The derived ETSU-R-97 noise limits (relative to standardised 10 m height wind speeds) are valid for the assumed hub height and also remain unchanged from those presented in the May 2025 EIA Report.

12.1.2 The chapter:

- Is based on the methodology and significance criteria presented in the May 2025 EIA Report;
- Describes the potential effects, including direct, indirect and cumulative effects;
- Reaches a conclusion on the likely significant effects based on the information gathered and the analysis and assessments undertaken; and
- Highlights any necessary monitoring and/or mitigation measures recommended to prevent, minimise, reduce or offset the likely significant adverse environmental effects.

12.1.3 The assessment has been carried out by Rob Shepherd MEng, MIOA, of Hayes McKenzie Partnership Ltd (HMPL). Rob has a master's degree (MEng) in Acoustical Engineering from the Institute of Sound and Vibration Research (ISVR) at the University of Southampton and has been carrying out wind farm noise assessments for over 20 years. Rob is a member of the Institute of Acoustics (MIOA), and Hayes McKenzie are members of the Association of Noise Consultants (ANC).

12.2 Legislation, Policy & Guidance

12.3 The assessment detailed within this chapter has been informed by the guidelines/policies set out in the EIA Report which remain relevant to this assessment.

12.4 Consultation

12.4.1 The proposed methodology was set out in the Scoping Report, and the consultation undertaken was set out in the May 2025 EIA Report chapter. No additional consultation has been carried out for this revised assessment.

12.5 Assessment Methods & Significance Criteria

Study Area

12.5.1 The study area remains unchanged from the May 2025 EIA Report. The noise sensitive receptors for operational noise are set out in **Table 12.1** below. The noise sensitive receptors are also shown on **Figure 12.1**. Noise sensitive receptors were scoped into the assessment where predicted operational noise levels from the Proposed Development acting alone are greater than 30 dB $L_{A90.}$ The assessment has been carried out for the nearest residential properties (on the basis that if the limits are met at the nearest noise sensitive receptors, operational noise levels will be acceptable at more distance receptors).

Table 12.1 Summary of Sensitive Receptors Scoped In

Property Name	Easting	Northing
Rankinston Farm*	246182	613115
Ravenscroft*	245960	614206
Drumbowie	246580	615338
Seaview	245208	613319
Rankinston Village (nearest)	245143	613954
Muirston	246843	616192
Polquhairn*	247442	616240
The Castle	245752	614516

12.5.2 The residents of Rankinston Farm, Ravenscroft and Polquhairn are financially involved with the Proposed Development (identified with an '*' in **Table 12.1** above), and therefore the financially involved operational noise limits apply at these locations.

12.5.3 The potentially noise sensitive receptors shown at **Table 12.2** below were scoped out of the assessment as they are derelict, and therefore not considered to be noise sensitive.

Table 12.2 Summary of Receptors Scoped Out

Property Name	Easting	Northing
Old Polquhairn (derelict)	247909	615793
Muirston (derelict)	246970	615992

Site Visit

12.5.4 Baseline noise measurements were carried out at four locations representative of the nearest residential receptors to the Proposed Development. The details of the

measurements are set out in **Technical Appendix 12.1**, and the measurement locations are shown in **Table 12.3.**

Table 12.3 Baseline Measurement Locations

Property Name	Easting	Northing
Rankinston Farm	246182	613115
Ravenscroft	245960	614206
Drumbowie	246580	615338
Seaview	245208	613319

Assessment of Significance

Construction Noise

12.5.5 The specific daytime criterion to be applied to the Proposed Development for construction noise is 65 dB $L_{Aeq, 8\text{-hour}}$. This along with the evening and night limits are detailed in **Table 12.4**. If the criterion is met at a specific receptor location, then the noise effect at that location is considered to be not significant.

Table 12.4: Construction Noise Limits

Time Period	Limit (dB $L_{Aeq,t}$)
Weekday day-time (07:00-19:00) and Saturday morning (07:00-13:00)	65
Evenings (19:00-23:00) and weekends (Saturday 13:00-19:00 and Sunday 07:00-19:00)	55
Night time (23:00-07:00)	45

Operational Noise

12.5.6 The ETSU-R-97 noise limits apply to cumulative operational noise levels and therefore cumulative operational noise impact assessment is intrinsic to the assessment of the Proposed Development. The specific night and daytime noise limits to be applied to cumulative operational noise from all wind turbine developments in the vicinity as agreed with East Ayrshire Council (EAC) are set out in **Table 12.5**. 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 12.5: Overarching Cumulative Operational Noise Limits

Time Period	Limit
Day-time	The greater of 35 dB L_{A90} or plus 5 dB above background
Night-time	The greater of 43 dB L_{A90} or plus 5 dB above background
Night and daytime (financially involved)	The greater of 45 dB L_{A90} or plus 5 dB above background

12.5.7 It should be noted that the ETSU-R-97 daytime lower limiting value is in the range of 35-40 dB L_{A90} depending on a number of factors. EAC have advised that their preference is for the daytime lower limiting value to be set at the lower end of the

range, and in this case the lowest value of 35 dB has been applied, although that is not to say that a higher limit within the range would not be appropriate.

Limitations, Difficulties and Uncertainties

12.5.8 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 throughout the operational lifetime of the wind farm.

12.6 Baseline

Current Baseline

12.6.1 The results of the baseline noise measurements are presented in **Technical Appendix 12.1**) and have been used to derive noise limits as required by ETSU-R-97. The resultant noise limits, which apply to the cumulative operational noise from all wind farm developments in the vicinity are set out in **Table 12.6** and are unchanged from the May 2025 EIA Report**.** At baseline measurement locations that are financially involved with the Proposed Development, both the financially involved and non-involved ETSU-R-97 noise limits are shown for completeness.

Table 12.6: Derived Cumulative Noise Limits from Baseline Measurements (dB L_{A90})

Location	Time Period	Standardised 10 m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Rankinston Farm (financially involved limits)	Night-time	45.0	45.0	45.0	45.0	45.0	45.0	47.8	51.1	54.8	59.0
	Daytime	45.0	45.0	45.0	45.0	45.0	45.5	48.5	51.7	55.0	58.4
Rankinston Farm	Night-time	43.0	43.0	43.0	43.0	43.0	44.9	47.8	51.1	54.8	59.0
	Lower Daytime	35.0	35.4	37.6	40.0	42.7	45.5	48.5	51.7	55.0	58.4
Ravenscroft (financially involved limits)	Night-time	45.0	45.0	45.0	45.0	45.0	45.0	45.0	47.1	49.9	52.7
	Daytime	45.0	45.0	45.0	45.0	45.0	45.0	45.4	48.4	51.8	55.5
Ravenscroft	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	44.2	47.1	49.9	52.7
	Lower Daytime	35.0	35.0	36.1	38.0	40.1	42.6	45.4	48.4	51.8	55.5
Drumbowie	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	44.1	46.0	46.9	46.6
	Lower Daytime	35.0	35.0	35.0	36.1	39.1	42.1	45.0	47.7	50.2	52.2
Polquhairn* (financially involved limits)	Night-time	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.0	46.9	46.6
	Daytime	45.0	45.0	45.0	45.0	45.0	45.0	45.0	47.7	50.2	52.2
Seaview	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	44.8	47.3	49.4	50.6

Location	Time Period	Standardised 10 m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
	Lower Daytime	35.0	35.0	35.0	36.2	39.1	42.1	45.0	47.8	50.1	52.1

* Limits for this location have been derived from baseline measurements at Drumbowie which is not financially involved, as noted in **AI Technical Appendix 12.1**

12.6.2 The ETSU-R-97 noise limits apply to cumulative noise from all wind farm developments in the vicinity of the Proposed Development, and therefore a cumulative operational noise impact assessment is presented in addition to assessing the noise effects of the Proposed Development acting alone.

Future Baseline

12.6.3 Baseline noise levels in the absence of the Proposed Development are likely to remain broadly similar to that derived from background noise measurements, where the potential contribution from existing wind farm developments has been excluded.

12.6.4 Although the baseline noise levels for the purposes of the derivation of appropriate cumulative noise limits must not include the contribution from existing wind farm developments, currently operational wind farm noise is a feature of the existing noise environment by virtue of the existing residential receptors being in the vicinity of consented wind farm developments. There are a number of proposed wind farm developments in the vicinity and therefore the future baseline could include an increase in audible wind turbine noise at residential receptor locations, although the maximum cumulative operational noise level should be restricted to ensure that they do not exceed the derived ETSU-R-97 noise limits.

12.7 Scope of the Assessment

Spatial Scope

12.7.1 The study area is defined by the predicted operational noise levels rather than by a set distance or area, and covers all identified noise sensitive receptors as defined in **Section 12.5**.

Temporal Scope

12.7.2 The construction limits apply to all construction activities with a duration of over 1 month during the construction phase. Construction noise will be present to varying degrees during the full construction programme.

12.7.3 The operational limits apply to the lifetime of the Proposed Development, and operational effects will be present for this duration also.

Receptors Requiring Assessment

12.7.4 The receptors requiring assessment are those identified as being within the study area as defined in **Section 12.5**, and laid out in **Table 12.1**.

Environmental Measures Embedded into the Development Proposals

Construction Noise

12.7.5 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 65 dB L_{Aeq} during normal working hours will be applied in accordance with the second method from BS5228 discussed above. Further information on noise mitigation during construction is provided in **Section 12.9** of this chapter.

12.7.6 Any potential noise issues associated with the movement of construction vehicles to and from the Proposed Development Site would be sufficiently dealt with within the Construction Traffic Management Plan (CTMP) where considered necessary.

Scoped Out of Assessment

12.7.7 The following potential effects have been scoped out of the assessment, the reasons for which are set out in detail in the May 2025 EIA Report.

- Operational Substation and Battery Storage Noise
- Tonal Noise
- Low Frequency and Infrasound
- Amplitude Modulation
- Vibration
- Decommissioning Noise

12.8 Assessment of Potential Effects

Construction Effects

12.8.1 As mentioned previously, a detailed assessment of construction noise is not included because it is deemed unnecessary due to the distances between construction activities and noise sensitive receptors. The two main construction activities that have been considered are that of blasting at the borrow pits and track construction. All other construction activities are likely to result in significantly lower levels of noise at noise sensitive properties.

12.8.2 Due to the large distances (>1.5 km) between the borrow pits and sensitive receptors, general excavation activities can be deemed to have no significant effect

and therefore do not require detailed assessment. However, blasting may be required for the extraction of aggregate. This type of noise does not typically fall within the assessment of normal construction noise because of the extremely high amplitude and impulsive nature of the waveform. It is very likely that blasting noise could be heard at nearby residential locations, but a construction noise assessment would average noise levels across the day and is therefore not applicable for use for the assessment of blasting noise impacts. Mitigation to reduce the noise impact from blasting activities is set out in **Section 12.9**.

12.8.3 The closest sensitive receptor to on-site construction is Rankinston Farm at a distance of over 750 m. At this distance the worst case predicted construction noise levels are very likely to be significantly below 65 dB L_{Aeq} (i.e. the daytime construction noise limit). Therefore, the noise levels predicted for Rankinston Farm, and all other noise sensitive properties (that are further from construction activities), will meet the applicable noise limit.

12.8.4 Overall, noise from construction activities is considered to be *not significant*, but it should be noted that noise from construction activities will be assessed and mitigated through the CEMP that will be submitted prior to the commencement of construction. An outline construction programme is presented in **Revised Chapter 2: Proposed Development**.

Operational Effects

12.8.5 Operational noise impacts have been assessed by comparing predicted operational noise levels with noise limits derived from the baseline noise measurements. The noise limits at properties where measurements were not undertaken have been assigned from baseline noise measurement results at an appropriate measurement location based on geographic proximity. As Rankinston Farm, Ravenscroft and Polquhairn are all financially involved with the scheme, the lower limiting value for both night and daytime has been set to 45 dB L_{A90}. The limits applied to each location in the assessment are presented at **Table 12.7.**

Table 12.7: Applied Limits at Each Sensitive Receptor (dB L_{A90})

Location	Time Period	Standardised 10 m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Rankinston Farm	Night-time	45.0	45.0	45.0	45.0	45.0	45.0	47.8	51.1	54.8	59.0
	Daytime	45.0	45.0	45.0	45.0	45.0	45.5	48.5	51.7	55.0	58.4
Ravenscroft	Night-time	45.0	45.0	45.0	45.0	45.0	45.0	45.0	47.1	49.9	52.7
	Daytime	45.0	45.0	45.0	45.0	45.0	45.0	45.4	48.4	51.8	55.5
Drumbowie	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	44.1	46.0	46.9	46.6
	Daytime	35.0	35.0	35.0	36.1	39.1	42.1	45.0	47.7	50.2	52.2
Seaview	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	44.8	47.3	49.4	50.6
	Daytime	35.0	35.0	35.0	36.2	39.1	42.1	45.0	47.8	50.1	52.1
Rankinston Village (nearest)	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	44.8	47.3	49.4	50.6
	Daytime	35.0	35.0	35.0	36.2	39.1	42.1	45.0	47.8	50.1	52.1

Location	Time Period	Standardised 10 m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Muirston	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	44.1	46.0	46.9	46.6
	Daytime	35.0	35.0	35.0	36.1	39.1	42.1	45.0	47.7	50.2	52.2
Polquhairn	Night-time	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.0	46.9	46.6
	Daytime	45.0	45.0	45.0	45.0	45.0	45.0	45.0	47.7	50.2	52.2
The Castle	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	44.2	47.1	49.9	52.7
	Daytime	35.0	35.0	36.1	38.0	40.1	42.6	45.4	48.4	51.8	55.5

12.8.6 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 12.2** of the May 2025 EIA Report, but the main assumptions are described below:

- Receiver height of 4 m;
- Ground effect ground coefficient G=0.5;
- Atmospheric attenuation corresponding to a temperature of 10°C and a relative humidity of 70%;
- L_{Aeq} converted to equivalent L_{90} by subtracting 2 dB;
- Topographical barrier and concave ground profile corrections have been applied (and are included in AI **Technical Appendix 12.2**); and
- A margin of plus 2 dB has been added to manufacturer's sound power level data to account for uncertainty.

12.8.7 The source noise levels for the Vestas V136 4.5 MW candidate turbine on an 82 m hub height assumed for the Proposed Development are set out in **Table 12.8**. The octave band noise data taken from the manufacturer's technical specification document are also set out at **Table 12.8**. The sound power levels set out below include the plus 2 dB uncertainty discussed above.

Table 12.8: Vestas V136 4.5 MW STE Octave Band Sound Power Level (dB L_{WA})

Standardised 10 m Height Wind Speed (m/s)	Octave Band Centre Frequency								Broadband
	63	125	250	500	1000	2000	4000	8000	
3	72.5	80.7	86.0	88.4	87.9	84.4	78.0	68.7	93.4
4	75.7	83.9	89.2	91.6	91.1	87.6	81.2	71.9	96.6
5	80.5	88.7	94.0	96.4	95.9	92.4	86.0	76.7	101.4
6	84.3	92.5	97.8	100.2	99.7	96.2	89.8	80.5	105.2
7	85.0	93.2	98.5	100.9	100.4	96.9	90.5	81.2	105.9
8	85.0	93.2	98.5	100.9	100.4	96.9	90.5	81.2	105.9
9	85.0	93.2	98.5	100.9	100.4	96.9	90.5	81.2	105.9
10	85.0	93.2	98.5	100.9	100.4	96.9	90.5	81.2	105.9

Standardised 10 m Height Wind Speed (m/s)	Octave Band Centre Frequency								Broadband
	63	125	250	500	1000	2000	4000	8000	
11	85.0	93.2	98.5	100.9	100.4	96.9	90.5	81.2	105.9
12	85.0	93.2	98.5	100.9	100.4	96.9	90.5	81.2	105.9

12.8.8 Operational noise prediction results are presented in **Table 12.9** for all receptors scoped into the assessment. It should be noted that the predictions assume that each receptor location is downwind of the Proposed Development to provide a worst-case scenario. Under non-downwind conditions, operational noise levels will be lower. In addition, worst-case downwind noise contours for the maximum operational noise level (i.e. corresponding to wind speeds of 7-12 m/s) as well as the noise sensitive receptor locations are shown at **Figure 12.1**.

Table 12.9: Predicted Operational Noise Levels; Proposed Development (dB L_{A90})

Location	Standardised 10 m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
Rankinston Farm	27.2	30.4	35.2	39.0	39.7	39.7	39.7	39.7	39.7	39.7
Ravenscroft	23.6	26.8	31.6	35.4	36.0	36.0	36.0	36.0	36.0	36.0
Drumbowie	22.7	25.9	30.7	34.5	35.1	35.1	35.1	35.1	35.1	35.1
Seaview	21.5	24.7	29.5	33.3	33.9	33.9	33.9	33.9	33.9	33.9
Rankinston Village (nearest)	20.1	23.3	28.1	31.9	32.6	32.6	32.6	32.6	32.6	32.6
Muirston	18.8	22.0	26.8	30.6	31.3	31.3	31.3	31.3	31.3	31.3
Polquhairn	19.0	22.2	27.0	30.8	31.5	31.5	31.5	31.5	31.5	31.5
The Castle	21.7	24.9	29.8	33.5	34.2	34.2	34.2	34.2	34.2	34.2

12.8.9 **Table 12.10** and **Table 12.11** show the margin between predicted noise levels and the night and daytime derived noise limits respectively.

Table 12.10: Margin to Night-time Noise Limits; Proposed Development (dB L_{A90})

	Standardised 10 m height wind speed (m/s)									
Location	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Rankinston Farm	17.8	14.6	9.8	6.0	5.3	5.3	8.1	11.4	15.1	19.3
Ravenscroft	21.4	18.2	13.4	9.6	9.0	9.0	9.0	11.1	13.9	16.7
Drumbowie	20.3	17.1	12.3	8.5	7.9	7.9	9.0	10.9	11.8	11.5
Seaview	21.5	18.3	13.5	9.7	9.1	9.1	10.9	13.4	15.5	16.7
Rankinston Village (nearest)	22.9	19.7	14.9	11.1	10.4	10.4	12.2	14.7	16.8	18.0
Muirston	24.2	21.0	16.2	12.4	11.7	11.7	12.8	14.7	15.6	15.3
Polquhairn	26.0	22.8	18.0	14.2	13.5	13.5	13.5	14.5	15.4	15.1
The Castle	21.3	18.1	13.2	9.5	8.8	8.8	10.0	12.9	15.7	18.5

Table 12.11: Margin to Daytime Noise Limits; Proposed Development (dB L_{A90})

	Standardised 10 m height wind speed (m/s)									
Location	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Rankinston Farm	17.8	14.6	9.8	6.0	5.3	5.8	8.8	12.0	15.3	18.7
Ravenscroft	21.4	18.2	13.4	9.6	9.0	9.0	9.4	12.4	15.8	19.5
Drumbowie	12.3	9.1	4.3	1.6	4.0	7.0	9.9	12.6	15.1	17.1
Seaview	13.5	10.3	5.5	2.9	5.2	8.2	11.1	13.9	16.2	18.2
Rankinston Village (nearest)	14.9	11.7	6.9	4.3	6.5	9.5	12.4	15.2	17.5	19.5
Muirston	16.2	13.0	8.2	5.5	7.8	10.8	13.7	16.4	18.9	20.9
Polquhairn	26.0	22.8	18.0	14.2	13.5	13.5	13.5	16.2	18.7	20.7
The Castle	13.3	10.1	6.3	4.5	5.9	8.4	11.2	14.2	17.6	21.3

12.8.10 It can be seen from **Table 12.10** and **Table 12.11** that the derived noise limits are met by the Proposed Development acting in isolation, and therefore, operational noise from the Proposed Development acting alone can be considered to be *not significant.*

12.9 Mitigation

Mitigation during Construction

12.9.1 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.

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

12.9.3 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), unless specifically agreed otherwise. Outside these hours, construction activities on the Proposed Development site 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 EAC.

12.9.4 It is possible that blasting at the Proposed Development site borrow pits will be required to extract aggregate for construction. The most appropriate way to address blasting noise is for a pre-blasting management programme to be prepared which would identify the most sensitive receptors that could be potentially affected by blasting noise. The programme would contain details of the proposed frequency of blasting, and proposed monitoring procedures. The operator would inform the nearest residents of the proposed times of blasting and of any deviation from this programme in advance of the operations. The programme would also contain contact details which would be provided to local residents should concerns arise regarding construction and blasting activities. In addition, each blast will be

designed carefully to maximise its efficiency and to reduce the transmission of noise.

12.10 Assessment of Residual Effects

12.10.1 Noise associated with the operation of the Proposed Development is considered *not significant* and no specific mitigation measures are considered necessary.

12.11 Assessment of Cumulative Effects

12.11.1 The ETSU-R-97 derived noise limits apply to cumulative noise from all wind farms in the vicinity of the Proposed Development. Predicted cumulative operational noise levels have therefore been compared with the noise limits shown at **Table 12.6** above. It should be noted that the lower daytime (35 dB L_{A90}) noise limit has been applied, although the daytime lower limiting value can be set within the range 35-40 dB as discussed previously at paragraph 12.5.7.

12.11.2 Wind farms within 20 km of the Proposed Development shown at **Figure 5.24 of the Revised EIA Report** were considered for inclusion in the noise impact assessment, and the wind farms shown at **Table 12.12** have been included in the cumulative operational noise impact assessment based on distance from the Proposed Development. It should be noted that wind farms where the individual predicted operational noise levels are below 25 dB L_{A90} at any noise sensitive receptor considered in this assessment can be scoped out of the assessment as their contribution is considered to be negligible.

Table 12.12: Wind Farms Included in the Cumulative Assessment

Wind Farm	Status	Number of Turbines	Assumed Wind Turbine
Knockkippen	Consented	12	Vestas V136 4.0 MW, 83.5 m hub Vestas V150 6.0 MW 113.5 m hub
Knockshinnoch	Consented	2	Vestas V90, 2 MW, 80 m hub
North Kyle	Operational	49	Vestas V136 4.5 MW, 82 m hub

12.11.3 The wind farms that were considered for inclusion in the cumulative operational noise impact assessment but subsequently scoped out of the cumulative operational assessment are shown in **Table 12.13** below. They were scoped out as their predicted individual contribution was less than 25 dB L_{A90} at any of the scoped in noise sensitive receptors.

Table 12.13: Nearby Wind Farms Scoped out of the Cumulative Assessment

Wind Farm	Status	Number of Turbines	Assumed Wind Turbine
Greenburn	Consented	16	Vestas V136 4.2 MW, 82 m hub
Overhill	Consented	10	Nordex N133 4.8 MW, 120 m hub
Sclenteuch	Application	9	Vestas V150 6.0 MW, 125 m hub

12.11.4 The details of the turbine locations and sound power levels used for the cumulative prediction can be found in **Technical Appendix 12.4**. To ensure a conservative

cumulative operational noise assessment as none of the wind farms included in the cumulative assessment are operational, an additional 2 dB has been added to the standard 2 dB uncertainty included in the noise modelling. Therefore, a total of 4 dB uncertainty has been added to the sound power level data assumed for each of the wind turbines included in the cumulative operational noise modelling.

12.11.5 The results of the cumulative predictions for all receptors scoped into the assessment are presented in **Table 12.14**, and shown graphically on a noise contour plot at **Figure 12.2**.

Table 12.14: Predicted Noise Levels; Cumulative (dB L_{A90})

Location	Standardised 10 m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
Rankinston Farm	28.4	31.5	36.3	40.0	40.7	40.8	40.8	40.8	40.8	40.7
Ravenscroft	25.4	28.4	33.2	36.9	37.6	37.6	37.6	37.6	37.6	37.6
Drumbowie	24.0	27.1	31.9	35.6	36.3	36.3	36.3	36.3	36.3	36.3
Seaview	25.8	28.5	33.2	36.7	37.4	37.6	37.6	37.6	37.6	37.6
Rankinston Village (nearest)	24.7	27.2	32.0	35.5	36.2	36.4	36.4	36.4	36.4	36.3
Muirston	21.3	24.4	29.2	32.9	33.6	33.6	33.6	33.6	33.6	33.6
Polquhairn	21.6	24.8	29.6	33.3	34.0	34.0	34.0	34.0	34.0	34.0
The Castle	24.1	27.1	31.8	35.5	36.2	36.3	36.3	36.3	36.3	36.2

12.11.6 The margin between the cumulative predicted levels and the night and daytime derived noise limits are presented in **Table 12.15** and **Table 12.16** respectively.

Table 12.15: Margin to Night-time Noise Limits; Cumulative (dB L_{A90})

Location	Standardised 10 m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
Rankinston Farm	16.6	13.5	8.7	5.0	4.3	4.2	7.0	10.3	14.0	18.3
Ravenscroft	19.6	16.6	11.8	8.1	7.4	7.4	7.4	9.5	12.3	15.1
Drumbowie	19.0	15.9	11.1	7.4	6.7	6.7	7.8	9.6	10.6	10.3
Seaview	17.2	14.5	9.8	6.3	5.6	5.4	7.1	9.7	11.8	13.1
Rankinston Village (nearest)	18.3	15.8	11.0	7.5	6.8	6.6	8.4	11.0	13.0	14.3
Muirston	21.7	18.6	13.8	10.1	9.4	9.4	10.5	12.3	13.3	13.0
Polquhairn	23.4	20.2	15.4	11.7	11.0	11.0	11.0	12.0	12.9	12.6
The Castle	18.9	15.9	11.2	7.5	6.8	6.7	7.9	10.8	13.7	16.5

Table 12.16: Margin to Daytime Noise Limits; Cumulative (dB L_{A90})

Location	Standardised 10 m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
Rankinston Farm	16.6	13.5	8.7	5.0	4.3	4.7	7.8	11.0	14.3	17.7
Ravenscroft	19.6	16.6	11.8	8.1	7.4	7.4	7.8	10.8	14.2	17.9
Drumbowie	11.0	7.9	3.1	0.5	2.8	5.7	8.7	11.4	13.9	15.9

Location	Standardised 10 m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
Seaview	9.2	6.5	1.8	-0.5	1.7	4.5	7.4	10.2	12.6	14.5
Rainkinston Village (nearest)	10.3	7.8	3.0	0.7	2.9	5.7	8.6	11.4	13.8	15.7
Muirston	13.7	10.6	5.8	3.2	5.5	8.4	11.4	14.1	16.6	18.6
Polquhairn	23.4	20.2	15.4	11.7	11.0	11.0	11.0	13.7	16.2	18.2
The Castle	10.9	7.9	4.2	2.5	3.9	6.3	9.1	12.2	15.6	19.3

12.11.7 It can be seen from **Table 12.15** and **Table 12.16** that the predicted cumulative noise levels are below the derived noise limits except at Seaview, where the predicted cumulative operational noise levels are above the lower daytime noise limit by 0.5 dB at one wind speed (and still 3.3 dB below the ETSU-R-97 upper daytime noise limit), which can be considered to be an insignificant exceedance.

12.11.8 The cumulative operational noise modelling assumes downwind propagation in all directions, and an additional 2 dB was added to the 2 dB uncertainly already incorporated into the sound power levels used for the modelling of other wind farms in the vicinity. In addition, the lower daytime noise limit is met once wind direction is taken into account. Therefore, as the lower daytime noise limit would be met in practice, no significant cumulative effects are predicted.

12.11.9 Wind direction effects have been included in the prediction model by adding a supplementary term has been added to the ISO9613-2 methodology to allow for the effects of wind direction as discussed in the IOA GPG. For any given wind direction, each nearby property is classified as being either downwind, crosswind, or upwind of each of the turbines. If the house is downwind (+/-80°) of the turbine no correction is required to the predicted turbine noise level. If it is crosswind (+/-10°) of the turbine a 2 dB reduction is made to the predicted turbine noise level. If the property is upwind (+/-80°) of the turbine a reduction is made to the predicted turbine noise level due to wind shadow effects according to the methodology described in Wyle Research Report WR 88-19 as referred to in the IOA GPG. Under these conditions, this additional factor increases linearly from zero, at distances up to 5.25 x hub height, to 20 log (f) – 30, at a distance of 15.75 x hub height for flat ground. For hilly terrain this value is halved. Hayes McKenzie have modified the original Wyle methodology to include a term to scale the upwind attenuation according to the cosine of the difference between the wind direction angle and the angle corresponding to completely upwind propagation. The IOA GPG provides examples

of how upwind attenuation increases with separation distance, measured in terms of turbine tip height, for flat and complex (hilly) terrain.

12.11.10 For completeness, cumulative predicted operational noise levels at Seaview that incorporate wind direction in 30° increments are presented at **Table 12.17** below.

Table 12.17: Predicted Noise Levels; Cumulative at Seaview including wind direction effects (dB L_{A90})

Wind direction	Standardised 10 m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
0	21.4	23.5	28.3	31.9	32.7	32.8	32.8	32.8	32.8	32.8
30	21.7	24.6	29.4	33.2	33.9	33.9	33.9	33.9	33.9	33.9
60	22.9	26.0	30.8	34.5	35.2	35.3	35.3	35.3	35.2	35.2
90	23.3	26.5	31.3	35.0	35.6	35.7	35.7	35.7	35.7	35.7
120	24.1	27.4	32.1	35.7	36.3	36.5	36.5	36.5	36.4	36.4
150	24.6	27.8	32.5	36.1	36.7	36.9	36.9	36.9	36.8	36.8
180	24.8	27.6	32.4	35.9	36.6	36.8	36.8	36.7	36.7	36.7
210	24.6	27.2	31.9	35.3	36.0	36.3	36.3	36.3	36.2	36.2
240	23.5	25.8	30.5	33.8	34.5	34.9	34.9	34.8	34.8	34.7
270	22.9	25.0	29.8	33.0	33.8	34.1	34.1	34.1	34.0	34.0
300	22.0	23.6	28.4	31.7	32.6	32.9	32.9	32.8	32.8	32.8
330	21.4	22.7	27.6	31.0	31.9	32.1	32.1	32.1	32.1	32.1

12.11.11 These predicted operational noise levels including wind direction are compared with the lower daytime noise limits at **Table 12.18** below which shows the margin between the cumulative predicted noise levels and the relevant noise limits.

Table 12.18: Margin to Daytime Noise Limits; Cumulative; Seaview (dB L_{A90})

Wind Direction	Standardised 10 m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
0	13.6	11.5	6.7	4.3	6.4	9.3	12.2	14.9	17.3	19.3
30	13.3	10.4	5.6	3.1	5.3	8.2	11.1	13.9	16.3	18.2
60	12.1	9.0	4.2	1.7	3.9	6.9	9.8	12.5	14.9	16.8
90	11.7	8.5	3.7	1.3	3.5	6.4	9.3	12.1	14.5	16.4
120	10.9	7.6	2.9	0.5	2.8	5.6	8.5	11.3	13.7	15.7
150	10.4	7.2	2.5	0.2	2.4	5.2	8.2	10.9	13.3	15.3
180	10.2	7.4	2.6	0.3	2.6	5.3	8.3	11.0	13.4	15.4
210	10.4	7.8	3.1	0.9	3.1	5.8	8.8	11.5	13.9	15.9
240	11.5	9.2	4.5	2.5	4.6	7.2	10.2	12.9	15.4	17.3
270	12.1	10.0	5.2	3.3	5.4	8.0	10.9	13.7	16.1	18.1
300	13.0	11.4	6.6	4.5	6.6	9.3	12.2	14.9	17.3	19.3
330	13.6	12.3	7.4	5.2	7.3	10.0	12.9	15.6	18.0	20.0

12.11.12 The results of the additional assessment for Seaview including wind direction shows that once wind direction is taken into account, predicted operational noise levels are below the lower daytime noise limit under all wind speed and direction conditions. These results also show that predicted operational noise levels are below the upper daytime noise limit (see paragraph 12.5.7 and **Technical Appendix 12.1**) by a minimum of 3.3 dB.

12.12 Planning Conditions

12.12.1 Noise from the development is usually controlled by noise limits applied via the planning conditions attached to the consent. The assessment provided above assesses operational noise levels against cumulative noise limits. However, the noise limits applied via the planning conditions must apply to the proposed development only (as the limits cannot apply to developments outside the control of the operator).

12.12.2 The appropriate way to address this is to derive site specific noise limits by taking the derived ETSU-R-97 noise limits and performing a logarithmic subtraction of the predicted downwind noise level from other cumulative wind farms in the area. In this instance, carrying out this procedure would result in site specific daytime noise limits that may need a small amount of mitigation to be met as the cumulative predictions are conservative, and the downwind assessment shows a small exceedance (see 12.11.7). Since we know that, when taking into account wind direction, the predicted cumulative noise meets the lower daytime limits for the worst-case wind direction, it does not seem logical or fair to implement site specific noise limits which may require a small amount of mitigation to be met. A simple solution to this problem would be to use an increased lower limiting value for the daytime ETSU-R-97 noise limits as using the upper daytime noise limit could be justified (see paragraph 12.5.7). It is proposed to use a lower limiting value of 37.5 (halfway between the upper and lower limits) for the daytime ETSU-R-97 noise limits as this would mean the predicted downwind cumulative noise (see Table 12.14) meets the limits with a minimum margin of 0.7 dB and allows derivation of a site specific noise limit which can be met without mitigation.

12.12.3 Site specific noise limits have been derived for the proposed development (based on ETSU-R-97 daytime noise limits using a lower limiting value of 37.5) which will ensure that the combined effect of the proposed development other developments in the vicinity meet relevant cumulative noise limits.

12.12.4 The derived site specific noise limits that could be applied as the relevant noise limits in the planning conditions are presented at Table 12.19 and Table 12.20 below.

Table 12.19: Proposed Daytime Limits (dB L_{A90})

Location	Standardised 10 m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
Rankinston Farm	45.0	45.0	44.9	44.7	44.6	45.2	48.3	51.6	55.0	58.4
Ravenscroft	45.0	45.0	44.9	44.8	44.8	44.7	45.2	48.3	51.7	55.5

Drumbowie	37.4	37.4	37.2	36.8	38.5	41.8	44.9	47.6	50.2	52.2
Seaview	37.3	37.2	36.5	34.8	37.0	41.1	44.5	47.6	50.0	52.0
Rankinston Village (nearest)	37.4	37.3	36.7	35.6	37.6	41.4	44.6	47.6	50.0	52.0
Muirston	37.5	37.4	37.2	36.8	38.6	41.8	44.9	47.6	50.2	52.2
Polquhairn	45.0	45.0	44.9	44.9	44.9	44.8	44.8	47.6	50.2	52.2
The Castle	37.4	37.3	37.0	37.0	39.4	42.2	45.2	48.3	51.8	55.5

Table 12.20: Proposed Night-time Limits (dB L_{A90})

Location	Standardised 10 m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
Rankinston Farm	45.0	45.0	44.9	44.7	44.6	44.6	47.6	51.0	54.8	59.0
Ravenscroft	45.0	45.0	44.9	44.8	44.8	44.7	44.7	46.9	49.8	52.7
Drumbowie	43.0	43.0	42.9	42.8	42.8	42.8	43.9	45.9	46.8	46.5
Seaview	42.9	42.9	42.7	42.4	42.3	42.2	44.3	47.0	49.2	50.5
Rankinston Village (nearest)	43.0	42.9	42.8	42.5	42.5	42.4	44.4	47.1	49.3	50.5
Muirston	43.0	43.0	42.9	42.8	42.8	42.8	43.9	45.9	46.8	46.5
Polquhairn	45.0	45.0	44.9	44.9	44.9	44.8	44.8	45.9	46.8	46.5
The Castle	43.0	43.0	42.9	42.7	42.7	42.6	43.9	47.0	49.8	52.7

12.13 Summary

12.13.1 Noise levels likely to arise at residential receptors in the vicinity of the Proposed Development have been assessed against the relevant noise limits.

12.13.2 Construction noise levels will remain within the relevant noise limits, and therefore construction noise effects are predicted to be not significant. Noise during the construction phase will be controlled via the CEMP which will be prepared and submitted to the Local Authority prior to commencement of construction.

12.13.3 The results of the operational noise impact assessment indicates that the derived noise limits, which apply to the Proposed Development, are met at all noise sensitive receptors for the Proposed Development acting alone.

12.13.4 The results of the cumulative operational noise impact assessment indicates that the derived noise limits, which apply to the Proposed Development, are met at all noise sensitive receptors for the cumulative scenario when taking into account wind direction effects.

12.13.5 Noise effects during the construction, operation, and decommissioning of the Proposed Development have been assessed against noise limits derived in accordance with the requirement of national policy. Where the relevant noise limits are met, the noise effects are considered to be *not significant*.

12.13.6 The relevant noise limits during the construction, operation, and decommissioning of the Proposed Development have been shown to meet the relevant noise limits,

and therefore the effects during each phase of the development have been determined to be *not significant*.

12.13.7 Site specific noise limits have been proposed which are derived using an increase to the lower limiting value for the ETSU-R-97 daytime limit which is considered appropriate given the context and scale of the development and assessment results.

Table 12.21: Summary

Description of Effect	Significance of Potential Effect		Mitigation Measures	Significance of Residual Effect	
	Significance	Beneficial / Adverse		Significance	Beneficial / Adverse
During Construction & Decommissioning					
Noise during construction phase	Negligible	Adverse	Noise will be managed and controlled via a CEMP.	Negligible	Adverse
During Operation					
Operational noise effects	Negligible	Adverse	No specific mitigation measures required	Negligible	Adverse
Cumulative Effects					
Cumulative operational noise effects	Negligible	Adverse	No specific mitigation measures required	Negligible	Adverse

12.14 References

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