Fred. Olsen Renewables

Chapter 14

Noise

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Glossary

Term	Definition
Decibel	the ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. A logarithmic scale is used in noise level measurements because of this wide range. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound level.
L_{90}	: index represents the noise level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is often used to measure the background noise level. The $L_{A90,10min}$ is the A-weighted background noise level over a ten minute measurement sample
Noise emission	the noise energy emitted by a source (e.g. a wind turbine).

Term	Definition
Noise immission	the sound pressure level detected at a given location (e.g. the nearest dwelling).
Night Time Hours	ETSU-R-97 defines the night time hours as 23.00 to 07.00 every day
Quiet Daytime Hours	ETSU-R-97 defines the amenity hours as 18.00 to 23.00 Monday to Friday, 13.00 to 23.00 on Saturdays and 07.00 to 23.00 on Sundays.
Daytime Hours	07:00 to 23:00 every day
Standardised Wind Speed	a wind speed measured at a height different than 10 m (generally measured at the turbine hub height) which is expressed to a reference height of 10 m using a roughness length of 0.05 for standardisation purpose (in accordance with the IEC 61400-11 standard).

List of Abbreviations

Abbreviation	Description
AM	Amplitude Modulation
AOD	Above Ordnance Datum
dB	Decibel
FI	Financial Involvement
FML	Fixed Minimum Limit
GPG	Good Practice Guidance
GW	Gigawatts
IOA	Institute of Acoustics
LFN	Low Frequency Noise
MW	Megawatts
NAL	Noise Assessment Location
NWG	Noise Working Group
PAN	Planning Advice Note
SSNL	Site Specific Noise Limit
TNL	Total ETSU-R-97 Noise Limit

14.1 STATEMENT OF COMPETENCE

14.1.1 This Chapter was prepared by TNEI Services Ltd. TNEI is a specialist energy consultancy with an Acoustics team which has undertaken noise assessments for over five gigawatts (GW) of onshore wind farm developments. The assessment was carried out by Gemma Clark. Gemma has been undertaking operational noise assessments for wind farms for over 14 years and is an Associate Member of the Institute of Acoustics. The assessment has been reviewed and approved by James Mackay. James has been undertaking operational noise assessments for wind farms for over 15 years. James Mackay is a Full Member of the Institute of Acoustics and holds the Diploma in Acoustics and Noise Control.

14.2 INTRODUCTION

14.2.1 This Chapter considers the likely significant effects with respect to the noise associated with the operation 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 (including cumulative effects);
- Describe the mitigation measures proposed to address likely significant effects (if required); and
- Assess the residual effects remaining following the implementation of mitigation (if required).

This chapter is supported by the following figures and appendices:

- Figure 14.1: Operational Noise Monitoring and Assessment Locations;
- Figure 14.2: Cumulative Turbine Locations; and
- Appendix 14.1: Operational Noise Report.

14.2.2 Figures and the supporting Appendix are referenced in the text where relevant.

14.2.3 The operational noise assessment has been undertaken in a number of stages, firstly to consider the Total ETSU-R-97 Noise Limits (TNL) applicable for all wind farm schemes in the area and secondly to derive the Site Specific Noise Limit (SSNL) which would apply to the Proposed Development through apportionment of the TNL.

14.2.4 An assessment has been undertaken against both sets of limits to demonstrate that the cumulative noise predictions can meet the TNL and also to show that the noise predictions from the Proposed Development can meet the SSNL.

14.2.5 No significant noise effects have been predicted due to the operation of the Proposed Development.

14.3 LEGISLATION, POLICY AND GUIDANCE

14.3.1 The assessment used the following combination of guidance and assessment methodologies:

- Planning Advice Note (PAN) 1/2011: 'Planning and Noise' (Scottish Government, 2011)[1];
- Web Based Renewables Advice: 'Onshore Wind Turbines' (Scottish Government, 2014)[2];

[1] The Scottish Government (2011). PAN 1/2011 Planning and Noise Scotland

[2] The Scottish Government (2014) Web Based Renewables Advice: 'Onshore Wind Turbines' [Online] Available From https://www.gov.scot/publications/onshore-wind-turbines-planning-advice/ [Accessed 7th March 2022]

- ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' (NWG, 1996)[3];
- ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation' (ISO, 1996)[4]; and
- Institute of Acoustics (IOA) 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA, 2013)[5].

14.3.2 The above documents are discussed in detail within Section 2 of Appendix 14.1: Operational Noise Report, where relevant.

14.4 METHOD OF ASSESSMENT

Operational Noise Assessment Methodology

14.4.1 The assessment has been undertaken in accordance with ETSU-R-97 and current good practice. ETSU-R-97 provides a robust basis for determining acceptable noise limits for wind farm developments. Consequently, the test applied to operational noise is whether or not the calculated wind farm noise levels at nearby noise sensitive properties would be below the noise limits derived in accordance with ETSU-R-97.

14.4.2 The TNL is applicable to all operational, consented and proposed (planning application submitted) wind farms in the area so a set of SSNL are derived to control the specific noise from the Proposed Development. There are a number of operational and consented wind farm developments in close proximity to the Proposed Development and located between the Proposed Development and the nearest noise sensitive receptors (See EIAR Figure 14.2). Predicted noise levels from other nearby developments are dominant at all of the noise sensitive receptors (with the Proposed Development having a negligible effect at all but one location), therefore to ensure that the Proposed Development will have a negligible impact on the ability of the existing wind farms to meet their own limits the wind farm layout has been designed such that turbine noise immissions are at least 10 decibel (dB) below the existing noise limits already established for the consented wind farms. The SSNL have therefore been set equal to the TNL minus 10 dB.

14.4.3 The need for a cumulative noise assessment was considered in accordance with the guidance contained within the IOA Good Practice Guidance (GPG). There are a number of operational, consented and proposed wind farm developments in proximity to the Proposed Development, therefore in order to consider the likely cumulative noise impacts, the noise assessment has been undertaken in three separate stages:

- Stage 1 – establish the 'Total ETSU-R-97 Noise Limits' for each Noise Assessment Location (NAL) based on existing noise limits set for nearby wind farms;
- Stage 2 – undertake noise predictions to determine whether the contribution from the Proposed Development on its own is within 10 dB of the noise predictions from other wind turbines within the area. Where turbine predictions are within 10 dB then a likely cumulative noise assessment should be undertaken, and the results compared to the 'Total ETSU-R-97 Noise Limits'; and
- Stage 3 – establish the 'Site Specific Noise Limits' for the Proposed Development (at a level 10 dB below the TNL) and compare the noise predictions from the Proposed Development on its own against the 'Site Specific Noise Limits'.

14.4.4 The aim of the operational noise assessment therefore is to establish the TNL, determine the likely impacts of the Proposed Development at the nearest noise sensitive receptors, derive SSNL and to demonstrate that the Proposed Development can meet the limits (i.e. noise levels will be at or below).

14.4.5 The exact model of wind turbine to be used for the Proposed Development will be the result of a future tendering process should consent be granted. Achievement of the noise limits determined by this assessment would be a key determining factor in the final choice of wind turbine. Predictions of wind turbine noise for the Proposed Development were based upon the sound power level data for a candidate wind turbine, the Vestas V162, 6.2 MW with serrated trailing edge blades and a hub height of 119 m, as it is considered representative of the type of wind turbine likely to be installed at the development site.

14.4.6 All the operational, consented and proposed wind turbines modelled, inclusive of those used in the cumulative noise assessment, are shown on EIAR Figure 14.2 and summarised in Table 1.1 of Technical Appendix 14.1. Uncertainty in sound power data for the Proposed Development has been accounted for using the guidance contained within Section 4.2 of the IOA GPG. The locations of the wind turbines for the Proposed Development and the cumulative turbines are shown on Figure 14.2.

14.4.7 Noise predictions have been undertaken using the propagation model contained within Part 2 of International Standard ISO 9613-2, 'Acoustics – Attenuation of sound during propagation outdoors'. The model calculates, on an octave band basis, attenuation due to geometric spreading, atmospheric absorption and ground effects. The noise model was set up to provide realistic noise predictions, including mixed ground attenuation (G=0.5) and atmospheric attenuation relating to 70% Relative Humidity and 10°C.

14.4.8 Typically wind farm noise assessments assume all properties are downwind of all wind turbines at all times (as this would result in the highest wind turbine noise levels). However, where properties are located in between groups of wind turbines, or when turbines are spread over wide angle of view, they cannot be downwind of all wind turbines simultaneously in reality so it is appropriate to consider the effect of wind direction on predicted noise levels. Directivity has been considered using the guidance in the IOA GPG.

14.4.9 In line with the IOA GPG, an assessment has been undertaken to determine whether a concave ground profile correction (+3dB) or barrier correction (-2dB), is required due to the topography between the wind turbines and the noise sensitive receptors. Propagation across a valley (concave ground) increases the number of reflection paths, and in turn, has the potential to increase sound levels at a given receptor. Topographical screening effects from terrain surrounding a wind farm can result in reductions in the observed sound level between the source and receiver where no line of sight is present. A concave ground and barrier correction was found to be required for a number of wind turbines at a number of receptors (as detailed in Annex 3, Technical Appendix 14.1). Topographical corrections have been applied where necessary to the predictions presented in all tables and graphs.

Assessment of Effects

14.4.10 PAN 1/2011 'Planning and Noise' provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. PAN 1/2011 refers to the Web-based planning advice on renewable technologies for Onshore Wind Turbines which states that ETSU-R-97 should be used to assess and rate noise from wind energy developments. ETSU-R-97 does not define significance criteria but describes a framework for the measurement of wind farm noise and gives indicative noise levels considered to offer a reasonable degree of protection to wind

[3] The Working Group on Noise from Wind Turbines (1996). ETSU-R-97 The Assessment and Rating of Noise From Wind Farms. UK: Energy Technology Support Unit

[4] ISO (1996). ISO 9613-2:1996 Acoustics – Attenuation of Sound during Propagation Outdoors: Part 2 – General Method of Calculation. Geneva: International Organization for Standardisation.

[5] IOA (2013). A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'. UK: Institute of Acoustics.

farm neighbours, without placing unreasonable restrictions on wind farm development. Achievement of ETSU-R-97 derived noise limits ensures that wind turbine noise will comply with current Government guidance.

14.4.11 In terms of the EIA Regulations, the use of the term “significance” in this Chapter refers to compliance / non-compliance with the ETSU-R-97 derived noise limits. For situations where predicted wind turbine noise meets or is less than the noise limits defined in ETSU-R-97, then the noise effects are deemed not significant. Any breach of the ETSU-R-97 derived noise limits due to the Proposed Development is deemed to result in a significant effect.

14.4.12 For the purposes of this assessment, residential properties are considered to be noise sensitive receptors.

Limitations and Assumptions

14.4.13 A candidate wind turbine has been used for predictions of operational noise from the Proposed Development. The final model of wind turbine to be used may differ from that presented here, however the operational noise levels from the Proposed Development would have to comply with the noise limits imposed by the Scottish Government. No other assumptions or data gaps have been identified.

14.5 CONSULTATION

14.5.1 An EIA Scoping Opinion for the Proposed Development was issued in December 2021 by the Energy Consents Unit (ECU) on behalf of Scottish Ministers. A summary of consultation responses received as part of the Scoping Opinion and response / actions taken, is given in Table 14.1 below.

Table 14.1: Operational Noise Assessment Locations

Consultee	Summary of Response	Response/Action taken
ECU	The noise assessment should be undertaken in accordance with the relevant legislation and standards detailed within Chapter 19 of the scoping report.	The noise assessment has been undertaken in accordance with ETSU-R-97 and the IOA GPG (as per Section 15.3 of the Scoping Report).
	The noise report should be formatted as per Table 6.1 of the IOA GPG.	Technical Appendix 14.1 provides all the relevant information as detailed within Table 6.1 of the IOA GPG.

Features Scoped out of Assessment

14.5.2 As part of the scoping report (Section 19.4), it was proposed that the following were scoped out:

- Construction and Decommissioning Noise (due to the large separation distances between the Proposed Development and the nearest noise sensitive receptors);
- Vibration;
- Low Frequency Noise (LFN); and
- Amplitude Modulation (AM).

The existing wind turbines will be decommissioned in accordance with Condition 1 of the consent for the existing Windy Standard Wind Farm. In practice the decommissioning may occur as part of the repowering process but, given the large separation distances between the existing turbines and the nearest noise sensitive receptors, this is not likely to result in noise effects.

An assessment of the above was not requested within the scoping opinion issued by the ECU so they have been scoped out and on that basis they have not been considered further in this noise chapter.

14.6 BASELINE

Current Baseline

14.6.1 The Proposed Development is located within a rural location where existing background noise levels at the noise sensitive receptors are generally considered to be low. The predominant noise sources in the area are expected to be wind induced noise (wind passing through vegetation and around buildings), local watercourses and birdsong. There are a number of operational or consented wind farm developments surrounding the Proposed Development and they lie between the Proposed Development and the nearest residential properties. Background noise monitoring was undertaken previously as part of noise assessment works for other wind farm schemes. No background noise monitoring was undertaken for the Proposed Development because noise limits have already been set at the closest noise sensitive receptors.

Future Baseline

14.6.2 It is possible that noise propagation and resulting noise immission levels could change over the life of the project due to climate change (as noise attenuation is influenced by air temperature, relative humidity and ground conditions). However, noise limits would be set for the lifetime of the project and the operator would be required to meet them for the duration of the consent. If climate change resulted in the exceedance of limits, turbine noise could be reduced through mode management measures. There are no other known current or predicted future processes that are likely to change the baseline conditions.

Identified Sensitive Receptors

14.6.3 A total of six noise sensitive receptors were chosen as representative Noise Assessment Locations (NALs). The NALs chosen were generally the closest receptors to the Proposed Development and other wind farm developments.

14.6.4 The NALs refer to the position in the curtilage of a property as detailed in Table 14.2 and shown on EIAR Figure 14.1. This approach ensures that the assessment considers the worst case (loudest) noise immission level expected at the noise sensitive receptor.

Table 14.2: Operational Noise Assessment Locations

NAL	Easting	Northing	Elevation (mAOD)	Approximate Distance to Nearest Windy Standard 1 Repowering Turbine (m)
NAL1 - Moor Cottage	256980	603533	320	3,521
NAL2 - Craig-An-Dhu	262702	605705	351	2,858
NAL3 - Craigbraneoch	263146	606397	300	3,648
NAL4 - Lorg	266834	600883	295	4,997
NAL5 - Upper Holm	265539	599298	255	4,311
NAL6 - Brownhill	255931	602606	300	4,395

14.7 ASSESSMENT OF POTENTIAL EFFECTS

Setting the Total ETSU-R-97 Noise Limits (Stage 1)

14.7.1 The TNL have been established for each of the NALs detailed in Table 14.2 above. The TNL were derived based on the noise limits that have already been allocated to other schemes in the area.

14.7.2 A TNL based on the upper daytime Fixed Minimum Limit (FML) of 40 dB has been adopted for day time periods and 43 dB during the night time period. A TNL of 45 dB, has been used where the occupiers of a property are Financially Involved (FI) with a wind farm (e.g. the occupiers of Moor Cottage are FI with Windy Standard II and Brownhill with South Kyle).

14.7.3 The noise condition in the Windy Standard II Wind Farm Decision Notice uses a daytime FML of 40 dB and it is also used in the more recent noise assessment work undertaken for Windy Standard III.

14.7.4 The TNL are summarised in Tables 14.3 and 14.4 below.

Table 14.3: Total ETSU-R-97 Noise Limit – applicable to the daytime period

NAL	Wind Speed (ms^{-1}) as standardised to 10 m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 – Moor Cottage	45	45	45	45	45	45	45	45	45	45	45	45
NAL2 – Craig-An-Dhu	40	40	40	40	40	40	40	40	40	40	40	40
NAL3 – Craigbraneoch	40	40	40	40	40	40	40	40	40	40	40	40
NAL4 – Lorg	40	40	40	40	40	40	40	40	40	40	40	40
NAL5 – Upper Holm	40	40	40	40	40	40	40	40	40	40	40	40
NAL6 – Brownhill	45	45	45	45	45	45	45	45	45	45	45	45

Table 14.4: Total ETSU-R-97 Noise Limit – applicable to the night time period

NAL	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 – Moor Cottage	45	45	45	45	45	45	45	45	45	45	45	45
NAL2 – Craig-An-Dhu	43	43	43	43	43	43	43	43	43	43	43	43
NAL3 – Craigbraneoch	43	43	43	43	43	43	43	43	43	43	43	43
NAL4 – Lorg	43	43	43	43	43	43	43	43	43	43	43	43
NAL5 – Upper Holm	43	43	43	43	43	43	43	43	43	43	43	43
NAL6 – Brownhill	45	45	45	45	45	45	45	45	45	45	45	45

Predicting the Likely Effects and the Requirement for a Cumulative Noise Assessment (Stage 2)

14.7.5 As detailed in Section 14.4 above, where the predictions from the Proposed Development are within 10 dB of the total cumulative predictions from all other schemes then a cumulative assessment is required. In this case, the predictions from the Proposed Development are > 10 dB below the cumulative predictions from all other schemes at all locations other than NAL5 (see Annex 3 of Technical Appendix 14.1). At NALs 1-4 and 6 a cumulative assessment is not strictly required, however, given that there are a number of wind farms (operational and consented) within the immediate vicinity of the Proposed Development, most of which are located between the Proposed Development and the nearest noise sensitive receptors, cumulative noise predictions have been presented within Technical Appendix 14.1 for information purposes only.

14.7.6 In summary, the total predicted cumulative noise levels (with and without the Proposed Development) were found to be below the TNL at all NALs except NAL2 where an exceedance of the TNL was predicted during the daytime period. As is shown on Figure A1.2b (Annex 1 of Technical Appendix 14.1), the exceedance is predicted to occur without the inclusion of the Proposed Development. On that basis predictions from the Proposed Development are deemed to be having a negligible impact at the NAL and as such **no significant cumulative effects** are predicted from the addition of the Proposed Development.

14.7.7 The occupiers of the property may be financially involved with a nearby scheme or mode management may be being implemented to meet the noise limits. The cumulative modelling of all other wind farms assumes that they are operating in full mode for the purposes of this assessment.

Operational Phase - Derivation of Site Specific Noise Limits for the Proposed Development (Stage 3)

14.7.8 The noise limits already established for the other schemes at the noise sensitive receptors located closest to the Proposed Development have been used to derive site specific noise levels for the Proposed Development. In order for the Proposed Development to have a negligible impact on the ability of the existing wind farms to meet their own limits the wind farm layout has been designed such that turbine noise immissions are at least 10 dB below the existing noise limits already established for the consented wind farms.

14.7.9 The SSNL are summarised in Tables 14.5 and 14.6. Predicted noise levels from the Proposed Development were compared to the SSNL and as shown in Tables 14.5 and 14.6, the predicted wind turbine noise immission levels from the Proposed Development are below the SSNLs (TNL minus 10 dB) under all conditions and at all NALs during both daytime and night time periods. There would be **no significant effects**.

14.7.10 Figures A1.3a to A1.3f (Annex 1 of Technical Appendix 14.1 (Operational Noise Assessment) show the calculated wind turbine noise immission levels at the noise sensitive receptors which have been plotted as a function of wind speed at 10 m height.

Table 14.5: SSNL Compliance Table – Day time

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 – Moor Cottage	SSNL	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
	Predictions L_{A90}	-	-	13.5	15.3	19.5	23.2	24.1	24.1	24.1	24.1	24.1	24.1
	Exceedence Level L_{A90}	-	-	-21.5	-19.7	-15.5	-11.8	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9
NAL2 – Craig-An-Dhu	SSNL	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predictions L_{A90}	-	-	14.6	16.3	20.5	24.2	25.2	25.2	25.2	25.2	25.2	25.2
	Exceedence Level L_{A90}	-	-	-15.4	-13.7	-9.5	-5.8	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL3 – Craigbraneoch	SSNL	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predictions L_{A90}	-	-	12.2	14.0	18.2	21.9	22.9	22.9	22.9	22.9	22.9	22.9
	Exceedence Level L_{A90}	-	-	-17.8	-16.0	-11.8	-8.1	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1
NAL4 – Lorg	SSNL	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predictions L_{A90}	-	-	7.6	9.3	13.5	17.2	18.2	18.2	18.2	18.2	18.2	18.2
	Exceedence Level L_{A90}	-	-	-22.4	-20.7	-16.5	-12.8	-11.8	-11.8	-11.8	-11.8	-11.8	-11.8
NAL5 – Upper Holm	SSNL	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predictions L_{A90}	-	-	11.9	13.6	17.8	21.5	22.5	22.5	22.5	22.5	22.5	22.5
	Exceedence Level L_{A90}	-	-	-18.1	-16.4	-12.2	-8.5	-7.5	-7.5	-7.5	-7.5	-7.5	-7.5
NAL6 – Brownhill	SSNL	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
	Predictions L_{A90}	-	-	9.4	11.2	15.4	19.1	20.1	20.1	20.1	20.1	20.1	20.1
	Exceedence Level L_{A90}	-	-	-25.6	-23.8	-19.6	-15.9	-14.9	-14.9	-14.9	-14.9	-14.9	-14.9

Table 14.6: SSNL Compliance Table – Night time

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 – Moor Cottage	SSNL	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
	Predictions L_{A90}	-	-	13.5	15.3	19.5	23.2	24.1	24.1	24.1	24.1	24.1	24.1
	Exceedence Level L_{A90}	-	-	-21.5	-19.7	-15.5	-11.8	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9
NAL2 – Craig-An-Dhu	SSNL	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
	Predictions L_{A90}	-	-	14.6	16.3	20.5	24.2	25.2	25.2	25.2	25.2	25.2	25.2
	Exceedence Level L_{A90}	-	-	-18.4	-16.7	-12.5	-8.8	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL3 – Craigbraneoch	SSNL	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
	Predictions L_{A90}	-	-	12.2	14.0	18.2	21.9	22.9	22.9	22.9	22.9	22.9	22.9
	Exceedence Level L_{A90}	-	-	-20.8	-19.0	-14.8	-11.1	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1
NAL4 – Lorg	SSNL	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
	Predictions L_{A90}	-	-	7.6	9.3	13.5	17.2	18.2	18.2	18.2	18.2	18.2	18.2
	Exceedence Level L_{A90}	-	-	-25.4	-23.7	-19.5	-15.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8
NAL5 – Upper Holm	SSNL	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
	Predictions L_{A90}	-	-	11.9	13.6	17.8	21.5	22.5	22.5	22.5	22.5	22.5	22.5
	Exceedence Level L_{A90}	-	-	-21.1	-19.4	-15.2	-11.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
NAL6 – Brownhill	SSNL	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
	Predictions L_{A90}	-	-	9.4	11.2	15.4	19.1	20.1	20.1	20.1	20.1	20.1	20.1
	Exceedence Level L_{A90}	-	-	-25.6	-23.8	-19.6	-15.9	-14.9	-14.9	-14.9	-14.9	-14.9	-14.9

14.8 MITIGATION AND RESIDUAL EFFECTS

Mitigation during Construction

14.8.1 As detailed in Section 14.5 above, due to the separation distances between the Proposed Development, a construction noise assessment has not been undertaken. Nevertheless, a range of good practice measures would be detailed in the Construction and Development Environmental Management Plan (CDEMP) and employed to minimise noise impacts.

Mitigation during Operation

14.8.2 The exact model of wind turbine to be used for the Proposed Development would be the result of a future tendering process. Achievement of the noise limits determined by this assessment would be a key determining factor in the final choice of wind turbines for the site.

Residual Operational Effects

14.8.3 Predicted wind farm operational noise levels at all the NALs lie below the SSNL. **There would be no significant residual effects.**

14.8.4 At some locations, under some wind conditions and for a certain proportion of the time operational wind farm noise would be audible; however, it would be at an acceptable level in relation to the ETSU-R-97 guidelines and there would be no significant residual effects.

Residual Cumulative Effects

14.8.5 Predicted cumulative wind farm operational noise levels lie below the TNL at all NALs except NAL2 where an exceedance is predicted during the daytime period. The exceedance is predicted without the Proposed Development which is deemed to be having a negligible impact. There would be **no significant residual effects** due to the Proposed Development.

14.9 CONCLUSIONS

14.9.1 The guidance contained within ETSU-R-97 and the IOA GPG was used to assess the likely operational noise impact of the Proposed Development. Predicted levels indicate that for dwellings neighbouring the Proposed Development the operational noise impact is not significant after the SSNL are adopted.

14.9.2 There are a range of wind turbine models that may be appropriate for the Proposed Development. If the Proposed Development receives consent, further data would be obtained from the supplier for the final choice of wind turbine model to demonstrate compliance with the operational noise limits derived in this report.

14.9.3 Should the Scottish Ministers be minded to grant consent for the Proposed Development it would be appropriate to include a set of noise conditions for the Proposed Development. A set of suggested noise conditions are included within Annex 5 of Appendix 17.1: Operational Noise Report.

14.9.4 Given the low predicted levels from the Proposed Development at the NALs and the other intervening wind farms, compliance with the SSNL would be difficult to demonstrate, therefore as part of the noise conditions, the option to demonstrate compliance at a location in closer proximity to the wind farm (a proxy location) has been included. This is consistent with text included in Supplementary Guidance Note 5 of the IOA GPG which states: "*In such cases where noise limits are less than ETSU-R-97 limits (i.e. apportionment of noise impacts due to cumulative impacts) compliance measurements may need to be undertaken in closer proximity to the wind farm to ensure background noise levels do not unduly influence the readings*."