

6. NOISE

Executive Summary

A noise assessment has been undertaken to determine the likely significant noise effects from the operational phase of the proposed varied development.

A background noise survey was undertaken at thirteen noise monitoring locations which were representative of the noise sensitive receptors surrounding the proposed varied development. The baseline noise data collected was analysed in conjunction with on site measured wind speed data and noise limits were derived in accordance with relevant guidance; ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' and the Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA GPG).

ETSU-R-97 provides a method to set noise limits which are 5 dB above the existing background noise levels, subject to a fixed minimum limit. The fixed minimum limit for night time is 43 dB whilst ETSU-R-97 suggests that the day time fixed minimum limit should be set somewhere in the range between 35 and 40 dB.

The noise assessment has been undertaken in three stages, which involved setting the Total ETSU-R-97 Noise Limits (which are limits for noise from all wind turbine developments in the area) at the nearest noise sensitive receptors, predicting the likely effects of the proposed varied development (undertaking a cumulative noise assessment where required) and setting Site Specific Noise Limits for the proposed varied development.

At this stage it has been assumed that there are no properties which should be considered Financially Involved with the proposed varied development or any of the existing consented developments as this represents a worst case scenario. It would be possible to update the Total ETSU-R-97 and the Site Specific noise limits to reflect any financial involvement if details became available.

Predicted cumulative operational noise levels indicate that for noise sensitive receptors neighbouring the proposed varied development, cumulative wind turbine noise (which considers noise predictions from all consented or operational wind turbines within the Study Area and the proposed varied development) would meet the Total ETSU-R-97 Noise Limits at the vast majority of receptors. There are a small number of receptors where predicted noise levels from existing wind turbines (consented or operational) already exceed the noise limits recommended by ETSU-R-97 even when a 40 dB day time fixed minimum limit is adopted. Where such an exceedance already exists the proposed varied development would operate such that it will cause a negligible increase in levels¹. Accordingly, whilst the combined cumulative effect of all developments in the area is significant at certain receptors, the additional cumulative effect of the proposed varied development would result in **no additional significant effects**.

The Total ETSU-R-97 Noise Limit is applicable to all operational, consented and proposed wind farms in the Study Area so Site Specific Noise Limits also have been derived to inform the need for mitigation and to control the specific noise from the proposed varied development. In accordance with the guidance in the IOA GPG, the Site Specific Noise Limits have been derived with due regard to cumulative noise by accounting for the proportion of the Total ETSU-R-97 Noise Limits which is potentially being used by other nearby developments. The Site Specific Noise Limits are therefore set equal to the Total ETSU-R-97 Noise Limits minus a cautious prediction of noise from all other nearby developments. The noise assessment has considered two scenarios; one where the lowest Site Specific fixed minimum limit of 35 dB is adopted and another where the upper limit of 40 dB is

¹ To ensure the additional contribution from the proposed varied development is negligible, where required, it would be operated such that noise is at least 10 dB below the existing wind turbine noise levels. This would result in a negligible increase as, for example, 40 dB + 30 dB = 40 dB.

utilised. Both options are presented to aid the decision maker on determining the most appropriate daytime limit for the proposed varied development. An alternative daytime limit within the 35 – 40 dB range suggested in ETSU-R-97 may also be deemed appropriate.

Predictions of wind turbine noise from the proposed varied development have been made in accordance with good practice using a candidate wind turbine, the Siemens SWT-DD-120 4.3MW. Predicted operational noise levels from the proposed varied development indicate that for noise sensitive receptors neighbouring the proposed varied development, wind turbine noise from the proposed varied development would meet the Site Specific Noise Limits at all locations. To ensure that the limits are achieved certain turbines will need to be operated in low noise mode / switched off during certain wind speeds and directions (which will vary depending on the daytime fixed minimum limit adopted and the turbine selected).

At some locations, under some wind conditions and for a certain proportion of the time operational wind farm noise from the proposed varied development would be audible; however, it would be at an acceptable level in relation to the ETSU-R-97 guidelines. The use of Site Specific Noise Limits would ensure that the proposed varied development could operate concurrently with other consented or operational turbines in the area and would also ensure that the proposed varied development's individual contribution could be measured and enforced if required.

The Siemens wind turbine model was chosen in order to allow a conservative assessment of the noise impacts. If consented a different turbine model may be chosen which would likely be quieter as the model considered in the assessment is the loudest model currently under consideration for the Site. Should the proposed varied development receive consent, the final choice of wind turbine would be subject to a competitive tendering process. The final choice of wind turbine would, however, have to meet the Site Specific Noise Limits presented in this assessment which should also be contained within any condition imposed. A set of updated noise related planning conditions have –are sought to be granted by s.57 direction.

6.1 Introduction

6.1.1 This chapter considers the likely significant effects of noise associated with the proposed varied development. The specific objectives of the chapter are to:

- describe the baseline;
- summarise the assessment methodology and significance criteria used in completing the impact assessment;
- summarise the potential effects of the consented Viking Wind Farm, based on the conclusions of the ES and ES Addendum and other information sources;
- describe the mitigation measures proposed to address likely significant effects; and
- provide an assessment of the likely significant effects of the proposed varied development and describe how these differ from the effects reported in the ES and ES Addendum that supported the relevant section 36 consent.

6.1.2 This chapter is supported by:

- Technical Appendix 6.1: Operational Noise Report

6.1.3 Figures 6.1 (Noise Monitoring and Assessment Locations) and 6.2 (Cumulative Turbine Locations) are referenced in the text where relevant.

6.2 Methodology

Scope of the Assessment

6.2.1 An initial desktop assessment was undertaken in order to identify the nearest noise sensitive receptors surrounding the Site and to determine potential locations at which to monitor background noise. A detailed review of all existing consented or operational wind turbine developments in the area was also undertaken and some additional noise sensitive receptors were added to account for potential cumulative noise effects. In total, 261 noise sensitive receptors were considered although this list was then refined and a representative sample of 29 Noise Assessment Locations (NALs) have been presented in the assessment.

6.2.2 There are a number of smaller wind energy developments located in the vicinity of the proposed varied development (as shown on Figure 6.2). Further information on these can be found in Annex 7 of Technical Appendix 6.1: Operational Noise Report and these developments have all been considered as part of the cumulative noise assessment. Further information on the cumulative noise assessment can be found in Section 6.5 of Technical Appendix 6.1: Operational Noise Report.

6.2.3 Noise associated with construction and decommissioning has been scoped out of the Variation Application for the proposed varied development because construction and decommissioning noise effects were considered in detail as part of the Environmental Statement for the consented Viking Wind Farm. As the layout has changed and turbine numbers have reduced from those originally considered in the ES (150 turbines) and the subsequent Addendum (127 turbines) it was considered that an updated construction and decommissioning noise effects assessment was not required to consider the reduced 103 turbine layout. It can therefore be reasonably assumed that noise impacts associated with construction will less than or equal to those already considered in the ES and Addendum.

6.2.4 Information on low frequency noise, vibration and amplitude modulation has been included within Section 3 of Technical Appendix 6.1: Operational Noise Report.

Policy, Legislation and Guidance

- 6.2.5 The methods of assessment used the following combination of guidance and assessment methodologies:
- Planning Advice Note PAN 1/2011: 'Planning and Noise';
 - Web Based Renewables Advice: 'Onshore Wind Turbines' (updated May 2014);
 - ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms';
 - ISO9613: 1996 'Acoustics - Attenuation of sound during propagation outdoors Part 2: General method of calculation'; and
 - Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2013) (IOA GPG).
- 6.2.6 The above documents are discussed in detail within Technical Appendix 6.1: Operational Noise Assessment, where relevant.

Consultation

- 6.2.7 Direct consultation was undertaken with the Environmental Health Department at Shetland Islands Council (SIC) in order to agree the methodology for the operational noise assessment and the proposed baseline noise monitoring locations. In order to identify the most appropriate noise monitoring locations, the main settlement areas around the site were separated into groups and then a number of potential noise monitoring locations were identified within each group using aerial photography and local knowledge provided by staff from the Applicant who reside on the island. A teleconference was then held with one of SICs Assistant Environmental Health Officers (AEHO) in order to discuss and agree each of the proposed noise monitoring locations. Based on the AEHOs own local knowledge a number of alternate locations were also suggested during the teleconference. The Applicant then approached the individual receptors to obtain permission for noise monitoring.
- 6.2.8 Details of the consultation are provided in the Annex 2 of Technical Appendix 6.1: Operational Noise Report).

Baseline Conditions

- 6.2.9 The assessment has been undertaken in accordance with ETSU-R-97 and current good practice, as specified in the Policy, Legislation and Guidance section (Section 6.2.5). 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.
- 6.2.10 Limits differ between daytime and night-time periods. The daytime criteria are based upon the 'quiet periods of the day' comprising:
- All evenings from 18:00 to 23:00; plus
 - Saturday afternoons from 13:00 to 18:00; and
 - All day Sunday 07:00 to 23:00.
- 6.2.11 Night-time periods are defined as 23:00 to 07:00 with no differentiation made between weekdays and weekends.
- 6.2.12 Background noise monitoring was undertaken at thirteen noise sensitive receptors selected and agreed with the AEHO at SIC. The AEHO could not attend the initial installation of the noise monitoring equipment therefore the final noise monitoring locations were selected by TNEI using their professional judgement following consideration of the local noise sources such as the sea, watercourses, operational wind turbines and vegetation. The AEHO subsequently visited the

installed locations with a representative for the Applicant. During the visit the AEHO recommended the installation of noise monitoring equipment at an additional location to the south of the site (the 13th kit) and also suggested moving one of the installed kits to an adjacent property. The additional noise meter was installed and the other meter moved during a subsequent site visit. Background noise monitoring was undertaken over the period June to September 2018 at eleven noise sensitive receptors and July to September 2018 at two receptors (NML12 and NML13).

- 6.2.13 Simultaneous wind speed/direction data were recorded at various heights using one 60 m and three 70 m meteorological masts, which were located within the Site. The wind speed data collected at 60 m and 40 m or 70 m and 50 m on the masts were used to derive hub height wind speeds which were standardised to 10m height in accordance with good practice. A candidate wind turbine with a hub height of 100 m which would fall within the 155 m turbine design envelope has been used for this assessment.
- 6.2.14 Wind speed/direction and rainfall data were collected over the same time scale, and averaged over the same ten-minute periods, as the noise data to allow analysis of the measured background noise as a function of wind speed and wind direction. All data analysis was undertaken in accordance with ETSU-R-97 and the IOA GPG.
- 6.2.15 ETSU-R-97 recommends that wind farm noise for the daytime periods should be limited to 5dB(A) above the prevailing background or a fixed minimum level within the range 35 - 40dB $L_{A90,10min}$, whichever is the higher. The precise choice of criterion level within the range 35 - 40 dB(A) depends on a number of factors, including the number of dwellings in the neighbourhood of the wind farm, the effect of noise limits on the number of kWh generated and the duration and level of exposure to any noise.
- 6.2.16 It is necessary to determine a suitable fixed minimum limit to use when considering cumulative noise (the Total ETSU-R-97 Noise Limit) and this can differ from the fixed minimum limit used when setting limits for the proposed varied development (the Site Specific Noise Limits). At a number of noise sensitive receptors predicted noise from existing consented or operational wind turbines (excluding the proposed varied development and the consented Viking Wind Farm) exceed the ETSU-R-97 noise limits (even if the highest day time fixed minimum limit of 40 dB is adopted). A fixed minimum daytime Total ETSU-R-97 Limit has therefore been set at 40 dB when considering cumulative noise from all developments. The limits reflect the predicted wind turbine noise levels resulting from the existing wind turbines in the area and the fact that SIC must have been satisfied with those noise levels when the existing turbine developments were consented.
- 6.2.17 This EIAR Chapter provides an assessment based on Site Specific Noise Limits derived using both the lower and upper fixed minimum limits in order to aid the decision maker in determining the most appropriate fixed minimum daytime noise limit for the proposed varied development (an alternative daytime fixed minimum limit within the range 35 – 40 dB may also be deemed appropriate). Further information on the three tests is provided within Section 6.6 of Technical Appendix 6.1: Operational Noise Report.
- 6.2.18 For night-time periods the recommended limits are 5dB(A) above prevailing background or a fixed minimum level of 43dB $L_{A90,10min}$, whichever is higher. The night time fixed minimum limits are the same for both the Total ETSU-R-97 noise limits and the Site Specific Noise Limits.
- 6.2.19 The exception to the setting of both the daytime and night time fixed minimum noise limits occurs where a property occupier has a financial involvement in the wind farm development where the fixed minimum limit can be increased to 45dB(A) or a higher permissible limit above background during the daytime and night time periods. It should be noted that for the purposes of this assessment it has been assumed that there are no financially involved properties.

Cumulative Wind Turbine Noise Assessment

6.2.20 The need for a cumulative noise assessment was considered in accordance with the guidance contained within the IOA GPG. There are a number of consented or operational wind turbine developments in proximity to the proposed varied 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 the measured background noise levels and fixed minimum limits.
- Stage 2 - undertake a likely cumulative noise assessment.
- Stage 3 - establish the Site Specific Noise Limits for the proposed varied development (through apportioning the Total ETSU-R-97 Noise Limits, where required) and compare the noise predictions from the proposed varied development on its own against the Site Specific Noise Limits. As detailed above, two sets of Site Specific Noise Limits have been derived for each NAL based on the upper and lower daytime fixed minimum criterion.

6.2.21 The aim of the operational noise assessment therefore is to establish the Total ETSU-R-97 Noise Limits, determine the likely impacts of the proposed varied development at the nearest noise sensitive receptors, derive Site Specific Noise Limits and to demonstrate whether the proposed varied development can meet (i.e. noise levels will be at or below) the limits.

6.2.22 The exact model of wind turbine to be installed on the Site would be the result of a future tendering process should consent for the proposed varied development be granted. Achievement of the noise limits determined by this assessment would be a key determining factor in the final choice of wind turbine for the proposed varied development. Predictions of wind turbine noise for the proposed varied development were made, based upon the sound power level data for a candidate wind turbine, the Siemens SWT-DD-120, as it is considered representative of the type of wind turbine likely to be installed at the Site.

6.2.23 All the proposed, operational and consented wind turbines modelled, inclusive of those used in the cumulative noise assessment, are summarised in Annex 7 of Technical Appendix 6.1: Operational Noise Report. Uncertainty in the sound power data for the proposed varied development has been accounted for using the guidance contained within Section 4.2 of the IOA GPG which is applicable to wind turbines above 50 kW. For the wind turbines of less than 50 kW noise immissions have been analysed using the data provided by the manufacturers. The location of the wind turbines for the proposed varied development and the other schemes are shown on Figure 6.2.

6.2.24 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.

6.2.25 Modelling to consider directivity effects and the inclusion of concave ground and barrier corrections have been undertaken in accordance with the IOA GPG (Section 6.3, Technical Appendix 6.1: Operational Noise Report).

Assessment of Effects

6.2.26 Planning Advice Note 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 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.

- 6.2.27 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 addition of the proposed varied development (the ‘additional cumulative effect’) is deemed to result in a significant effect.
- 6.2.28 For the purposes of this assessment, residential properties are considered to be noise sensitive receptors.

Assumptions and Limitations

- 6.2.29 It has been assumed that the noise data collected during the background noise survey are representative of the typical baseline noise levels at the nearest noise sensitive receptors; the guidance in ETSU-R-97 and the IOA GPG has been followed by suitably experienced Acoustic consultants to ensure that the data collected is as representative as possible.
- 6.2.30 A candidate wind turbine has been used for predictions of operational noise from the proposed varied development, whilst the final model of wind turbine to be used may differ from that presented here operational noise levels would have to comply with the noise limits imposed by the Scottish Government, informed by this noise assessment. No other assumptions or data gaps have been identified.

6.3 Baseline Conditions

Current Baseline

- 6.3.1 The proposed varied 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 wind induced noise (wind passing through vegetation and around buildings), sea noise, local watercourses, agricultural noise and birdsong. At some receptors the soundscape is affected by road traffic noise and noise from existing operational turbines.

Future Baseline

- 6.3.2 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 (other than the proposed varied development) that are likely to change the baseline conditions.

Identified Sensitive Receptors

- 6.3.3 A total of 29 noise sensitive receptors were chosen as representative Noise Assessment Locations (NAL). The NALs chosen were generally the closest receptors to the proposed varied development and other wind turbine developments.
- 6.3.4 As part of the NAL selection process, the receptors were separated into areas (based on individual settlements) and the individual receptors in each area were identified. Initially predictions, were undertaken at all of the 261 identified Noise Sensitive Receptors and then the results were

reviewed to determine the worst case receptors (highest wind turbine noise predictions) within each area. The refined 29 NALs were selected as they provided the worst case predictions within each area when considering predictions from the proposed varied development alone and also cumulative predictions.

6.3.5 The NALs refer to the position in the curtilage of a property. Predictions of wind turbine noise have been made at each of the NALs as detailed in Table 6.1 and shown on Figure 6.2. This approach ensures that the assessment considers the worst case (loudest) noise immission level expected at the noise sensitive receptor. Table 6.1 also details which NML has been used to set noise limits for each NAL. The noise limits have been derived for each receptor using the closest meteorological mast to a given NAL. The location of the four meteorological masts are shown on Figure 6.1.

Table 6.1 Operational Noise Assessment Locations					
Receptor	Easting	Northing	Elevation (m AOD)	Approximate Distance to Nearest Viking Turbine * (m)	Background Noise Data Used
NAL1 - Glenlea	444322	1163627	23	1,480	NML1
NAL2 – Taratet	445001	1162940	36	1,293	NML1
NAL3 - Grunnafirth	445947	1159638	16	1,491	NML2
NAL4 – New House at Dury	445673	1160441	30	1,244	NML2
NAL5 – Hamelea	448170	1157574	45	1,831	NML3
NAL6 – Whinnia Lee	446682	1155852	26	1,436	NML4
NAL7 - Hollydell	443843	1154352	30	1,143	NML5
NAL8 - Sandwater	441732	1155184	50	1,064	NML6
NAL9 – Setter House	439705	1154796	52	1,367	NML7
NAL10 - Millhouse	439460	1153086	13	1,646	NML13
NAL11 - Koopins	439511	1152903	13	1,699	NML13
NAL12 - Dykeside	436370	1151231	34	1,867	NML8
NAL13 - Breckenlea	435463	1151606	18	2,247	NML8
NAL14 - Gruids	434765	1153921	56	2,175	NML9
NAL15 – Mid Town	434695	1153637	55	2,354	NML9
NAL16 - Valhalla	436728	1157749	11	1,473	NML10
NAL17 – 12 Whitelaw Road	434911	1155664	12	1,903	NML10
NAL18 - Roadside	436191	1157714	21	1,691	NML10
NAL19 - Hoddins	437135	1161516	29	2,754	NML11
NAL20 - Rocklea	439858	1162158	60	1,571	NML12
NAL21- Norbrek	440923	1164030	58	2,593	NML12
NAL22 - Muness	445131	1153152	10	2,790	NML5
NAL23 - Parkhead	440737	1151832	37	3,065	NML13
NAL24 – Moars Park	438150	1150032	13	2,752	NML13
NAL25 - The Mark	433431	1158405	24	4,105	NML10

Table 6.1 Operational Noise Assessment Locations

Receptor	Easting	Northing	Elevation (m AOD)	Approximate Distance to Nearest Viking Turbine * (m)	Background Noise Data Used
NAL26 – Lonabrek	433980	1155778	28	2,840	NML10
NAL 27 - Adnashoor	434622	1155969	1	2,250	NML10
NAL28 – South Voxter	436072	1161942	13	3,852	NML11
NAL29 – East Lynn	436347	1165646	23	6,504	NML11

6.3.6 For the proxy locations the baseline datasets were chosen based in the proximity of the NALs to the NMLs and observations of background noise levels on site.

6.4 Assessment of Effects

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

6.4.1 Based on the prevailing background noise levels, the Total ETSU-R-97 Noise Limits have been established for each of the NALs detailed in Table 6.1 above. The Total ETSU-R-97 Noise Limits are as detailed in Table 6.3 and Table 6.4 of Technical Appendix 6.1: Operational Noise Assessment and have been based on an upper fixed minimum of 40 dB (Daytime) or background plus 5 dB and 43 dB (Night-time) or background plus 5 dB.

6.4.2 The prevailing background noise levels are shown on Figures A1.2a-A1.2m included in Annex 1 of Technical Appendix 6.1: Operational Noise Report.

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

6.4.3 A likely cumulative noise assessment was undertaken at the 29 NALs detailed in Table 6.1 above. Further details can be found in Section 6.5 and Annex 7 of Technical Appendix 6.1: Operational Noise Report.

6.4.4 There are a small number of receptors where predicted noise levels from existing wind turbines (consented or operational) already exceeds the noise limits recommended by ETSU-R-97 even when a 40 dB day time fixed minimum limit is adopted. Where such an exceedance already exists the proposed varied development would operate such that it will cause a negligible increase in the noise immission levels.

6.4.5 The results of the cumulative assessment are shown in Technical Appendix 6.1, Tables 6.5 and 6.6. The Tables detail the prevailing background noise levels, relevant noise limits and predicted wind turbine noise levels for ETSU-R-97 daytime hours and ETSU-R-97 night-time hours. The result of the likely cumulative noise assessment show that the proposed varied development can operate concurrently with the operational or consented singular turbine installations near to noise assessment locations, whilst still meeting the Total ETSU-R-97 Noise limits established in accordance with ETSU-R-97 at the vast majority of receptors. There are a small number of assessment locations where predicted noise levels from existing wind turbines (consented or operational) already exceed the noise limits recommended by ETSU-R-97 even when a 40 dB daytime fixed minimum limit is adopted. Where such an exceedance already exists, the proposed varied development would operate such that it will cause a negligible increase in levels. To ensure that the Total ETSU-R-97 Noise Limits are achieved certain turbines will need to be operated in low noise mode / switched off during certain wind speeds and directions.

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

- 6.4.6 As summarised in Table 6.7 of Technical Appendix 6.1: Operational Noise Report, for fourteen NALs, operational noise from the other schemes would be at least 10 dB below the Total ETSU-R-97 Noise Limits established for the proposed varied development. At the receptors where cumulative wind turbine predictions for all other schemes is at least 10 dB below the Total ETSU-R-97 limits it would be appropriate to allocate the entire noise limit to the proposed varied development as the other wind turbines would use a negligible proportion of the Total ETSU-R-97 Noise Limit.
- 6.4.7 For the other receptors, limit apportionment was required. Limit apportionment is a process whereby the Total ETSU-R-97 Limit is split with a portion allocated to the existing schemes and the remainder allocated to the proposed varied development. Where apportionment was required, cautious predicted noise levels were subtracted from the Total ETSU-R-97 Noise Limit to determine the residual limit available for the proposed varied development.
- 6.4.8 Two sets of daytime Site Specific Noise Limits have been derived based on the lesser of:
- The residual limit; and
 - The lower and upper daytime fixed minimum noise limits (35 and 40 dB) or the background noise level plus 5 dB (whichever is greater).
- 6.4.9 The proposed varied development Site Specific Noise Limits were compared to the predictions of the proposed varied development operating on its own and the results are summarised in Technical Appendix 6.1, Table 6.8 (based on the lower fixed minimum noise limit of 35 dB) or Table 6.9 (based on the upper fixed minimum noise limit of 40 dB) for the daytime and Table 6.10 for the night time. The tables also show the exceedance level which is the difference between the predicted wind turbine noise level and the Site Specific Noise Limit at a given wind speed. A negative exceedance level indicates satisfaction of the noise limit. The Site Specific Noise Limits and predictions are also shown on Figures A1.4a - 4ac (for 35 dB) and A1.5a – 5ac (for 40 dB) in Technical Appendix 6.1: Operational Noise Report.
- 6.4.10 The assessment shows that the predicted Wind turbine noise immission levels meet the Site Specific Noise Limits under all conditions and at all locations for both daytime and night-time periods at all receptors. In order to meet the Site Specific Noise Limits, based on the candidate wind turbine model, varying levels of mode management would be required depending on whether the lower or upper daytime fixed minimum noise limit is adopted. The mode management has also been applied to the likely calculations detailed in Tables 6.5 and 6.6 of Technical Appendix 6.1: Operational Noise Report.
- 6.4.11 The daytime noise limits included within the assessment consider the lower and upper fixed minimum noise limit only but an alternative fixed minimum limit between the range (35-40 dB) could also be considered. To inform the decision maker regarding the choice of Site Specific daytime fixed minimum limits a commentary has been provided below in Table 6.2 which discusses the three tests outlined in ETSU-R-97. A set of updated suggested noise conditions are included within Annex 8 of Technical Appendix 6.1: Operational Noise Report.

Table 6.2 Consideration of Guidance provided on Choice of FML

Factor	Guidance in ETSU-R-97	Guidance in IOA GPG	Commentary for the proposed varied development
<p>1) The number of noise affected properties</p>	<p><i>“The planning process is trying to balance the benefits arising out of the development of renewable energy sources against the local environmental impact. The more dwellings that are in the vicinity of a wind farm the tighter the limits should be as the total environmental impact will be greater. Conversely if only a few dwellings are affected, then the environmental impact is less and noise limits towards the upper end of the range may be appropriate. Developers still have to consider the interests of individuals as protected under the Environmental Protection Act 1990.”</i></p>	<p><i>“The number of neighbouring properties will depend on the nature of the area, (rural, semi-rural, urban) and is sometimes considered in relation to the size of the scheme and study area. The predicted 35 dB LA90 contour (at maximum noise output up to 12 m/s) can provide a guide to the dwellings to be considered in this respect.”</i></p>	<p>The Site itself is located in a rural area although there are a number of settlements which surround the site. The total number of noise sensitive receptors which would experience wind farm noise levels of 35 dB is relatively high in absolute terms (several hundred individual properties) however given the size of proposed varied development the number of properties affected per MW of installed capacity is relatively low.</p>
<p>2) The effect of using tighter limits on the potential power output of the wind farm:</p>	<p><i>“Similar arguments can be made when considering the effect of noise limits on uptake of wind energy. A single wind turbine causing noise levels of 40dB(A) at several nearby residences would have less planning merit (noise considerations only) than 30 wind turbines also causing the same amount of noise at several nearby residences.”</i></p>	<p><i>“This is in practice mainly based on the relative generating capacity of the development, as larger schemes have relatively more planning merit (for noise) according to the description in ETSU-R-97. In cases when the amenity fixed limit has little or no impact on the generating capacity (i.e. noise is not a significant design constraint) then a reduced limit may be applied.”</i></p>	<p>The proposed varied development, if approved, would represent one of the largest onshore wind farms in the UK and would generate a significant amount of renewable energy.</p>

Table 6.2 Consideration of Guidance provided on Choice of FML			
Factor	Guidance in ETSU-R-97	Guidance in IOA GPG	Commentary for the proposed varied development
3) The duration of exposure of these properties.	<i>“The proportion of the time at which background noise levels are low and how low the background noise level gets are both recognised as factors which could affect the setting of an appropriate lower limit. For example, a property which experienced background noise levels below 30dB(A) for a substantial proportion of the time in which the turbines would be operating could be expected to receive tighter noise limits than a property at which the background noise levels soon increased to levels above 35dB(A). This approach is difficult to formulate precisely and a degree of judgement should be exercised.”</i>	<i>“This last test is more difficult to formulate. But ETSU-R-97 notes that the likely excess of turbine noise relative to background noise levels should be a relevant consideration. In rural areas, this will often be determined by the sheltering of the property relative to the wind farm site. Account can also be taken of the effects of wind directions (including prevailing ones at the site) and likely directional effects. For cumulative developments, in some cases the effective duration of exposure may increase because of cumulative effects.”</i>	Background noise levels vary across the thirteen NMLs but in general the daytime noise levels are low. Predicted noise levels indicate that, regardless of the fixed minimum limit that is adopted, mode management will be required and this will increase the duration of exposure at certain properties (as the turbines will operate such that the noise levels will remain fairly constant, regardless of wind direction). Unlike much of the mainland UK there is no single dominant prevailing wind direction meaning that no group of properties will be downwind of the turbines for a particularly high proportion of the time.

6.4.12 It is worth noting that at present the Site Specific Noise Limits assume that none of occupiers of the properties have a financial involvement with the proposed varied development or any of the nearby wind turbines which are consented or operational. The Site Specific Noise Limits also assume that all existing / consented turbines are constructed and that they remain operational for the lifetime of the consent for the proposed varied development and that their noise immissions are as per the levels detailed in Technical Appendix 6.1: Operational Noise Report. The Site Specific Noise Limits detailed in the proposed noise conditions (Annex 8 of Technical Appendix 6.1: Operational Noise Report) can therefore be recalculated, if necessary to consider any differences in financial involvement or turbine operation, using the same methodology adopted in Technical Appendix 6.1: Operational Noise Report.

Summary of Effects

Consented Viking Wind Farm

6.4.13 The noise ES Addendum concluded that predicted wind turbine noise levels would be below the ETSU-R-97 criteria across the range of assessed wind speeds during night-time and day time periods at all receptors. The ES Addendum referred back to the original ES where it was concluded that mode management would be required for certain turbines under certain wind conditions if the lower fixed minimum daytime noise limit of 35 dB was adopted but not if the upper fixed minimum daytime noise limit of 40 dB was adopted.

Proposed varied development

- 6.4.14 Predicted wind turbine noise is less than the Site Specific Noise Limits for the daytime and night-time periods (subject to varying levels of mode management required for certain turbines for certain wind conditions depending on whether the fixed minimum noise limit adopted for the daytime period are based on the lower or upper limit (35 or 40 dB)); therefore, the predicted noise levels are **not significant**. It is important to note that the cumulative baseline has changed since the wind farm was consented and the assessment presented in the EIAR Chapter includes other operational or consented wind turbine developments.

Comparison of Potential Effects between Consented Viking Wind Farm and Proposed Varied Development

- 6.4.15 The potential operational noise effects remain the same between the consented Viking Wind Farm and the proposed varied development and are deemed **not significant**. The level of mode management required to meet the noise limits would vary between both schemes and would be dependent on the final choice of turbine for the developments and the noise limits imposed.

Cumulative Effects

- 6.4.16 Predicted cumulative wind turbine noise is less than the Total ETSU-R-97 Noise Limits for daytime and night-time periods at the vast majority of receptors (subject to mode management required for certain turbines for certain wind conditions at the proposed varied development). There are a small number of receptors where predicted noise levels from existing wind turbines (consented or operational) already exceed the noise limits recommended by ETSU-R-97 even when a 40 dB day time fixed minimum limit is adopted. Accordingly, the combined cumulative effect is considered to be significant at certain receptors. However, where such an exceedance already exists the proposed varied development would operate such that it will cause a negligible increase in levels, accordingly the additional cumulative effect of the proposed varied development would result in **no additional significant effects**.

6.5 Mitigation

- 6.5.1 The exact model of wind turbine to be used at the proposed varied 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. In order to present a conservative assessment of noise immissions, predictions of wind turbine noise have been based upon sound power level data for the loudest wind turbine currently being considered for the site, the Siemens SWT-DD-120, and a noise prediction model procedure that can be considered to provide a realistic impact assessment. To ensure predicted noise levels meet the noise limits, mode management would be applied for certain wind speeds and directions for both daytime and night-time periods. The level of mode management required depends on the daytime fixed minimum noise limit adopted for the proposed varied development. It is anticipated that the achievement of noise limits would be subject to appropriately worded planning conditions.
- 6.5.2 The relevant section 36 consent contains a number of noise related planning conditions. Conditions 42 – 47 relate to operational noise. As part of this noise assessment a new set of noise limits have been derived in accordance with current good practice.
- 6.5.3 Condition 42 states that the operator shall measure wind speed and direction data, that this data shall be retained for period of not less than 12 months and that it shall be supplied to the Local Authority upon request.
- 6.5.4 Condition 43 of the relevant section 36 consent stipulates the broadband sound power and octave band levels of the turbines and states that these levels must not exceed those stated within Table

12.9 and Table A12.9 of the May 2009 document. This condition refers to the noise generated by the turbines themselves with specific reference to the candidate machine used to model the noise impacts as part of the 2009 ES, and 2010 Addendum since the same candidate turbine was used. As such the condition limits the wind turbine noise at source to the noise parameters of the turbine modelled in the original planning application. Other noise conditions include Condition 44 which stipulates the maximum noise levels permitted in any dwelling in order to protect residential amenity and Conditions 45 - 47 which relate to noise monitoring in the event of a complaint.

- 6.5.5 Condition 43 is a non-standard condition and it is considered that it is unreasonable in that it unduly restricts the turbine options that could be used at the site. The inclusion of a condition limiting the noise emitted at source is also considered to be unnecessary as noise can be adequately controlled by setting noise limits at the nearest noise sensitive receptors in accordance with ETSU-R-97. In addition, the wording of the condition as written is unenforceable as the references to Tables 12.9 and A12.9 are incorrect. Table 12.9 does not contain octave band data and nor does Table A12.9 contain sound power level data.
- 6.5.6 Condition 44 contains references to the background noise levels recorded as part of the original ES and reported within the 2010 Addendum. The condition states:
- “The background Noise Level in this condition means the level determined at each property at the time of the Background Noise Level survey submitted with this application and as reported in Table A12.8 of the Environmental Statement Addendum. The condition will only apply to dwellings vacant or occupied, existing at the date of this Planning Permission.”*
- 6.5.7 Given that a new background noise assessment has been undertaken along with a detailed cumulative noise assessment to determine Site Specific Noise Limits it will be necessary to update the wording in Condition 44. It is proposed that the condition is replaced with the draft included within Annex 8 of Technical Appendix 6.1: Operational Noise Report. The suggested condition has been drafted based on the example condition included in the IOA GPG, takes into account the new background noise assessment, the current cumulative baseline, includes a mechanism for the investigation of complaints and is considered to reflect current good practice.
- 6.5.8 Condition 45 sets out the steps to be followed in the event of a complaint whilst condition 46 provides a method for adjusting the noise limits should noise immissions from the wind farm be tonal when assessed in accordance with ETSU-R-97.
- 6.5.9 Condition 47 sets out the steps to be taken in the event that the development is found to be in breach of the planning conditions, this is however considered to be unnecessary as this would be dealt with using the relevant enforcement powers.
- 6.5.10 The relevant elements of conditions 42 – 47 are considered and combined in the example conditions included in the IOA GPG. The Applicant therefore requests that an updated noise condition in Annex 8 of Technical Appendix 6.1 (which is based upon the example condition in the IOA GPG amended as required to be suitable for the proposed varied development) is granted by s.57 direction.

6.6 Residual Effects

- 6.6.1 Predicted wind farm operational noise levels at all the noise assessment locations lie below the Site Specific daytime and night-time criterion curves. The addition of noise from the proposed varied development would result in a negligible increase in noise where existing turbine noise levels already exceed the Total ETSU-R-97, at all other locations cumulative noise predictions from the proposed varied development and other consented or operational wind farm/turbines lie below the Total ETSU-R-97 Noise Limits. There would be **no significant residual effects** resulting from the proposed varied development after the Site Specific Noise Limits are adopted.

- 6.6.2 At some locations, under some wind conditions and for a certain proportion of the time wind farm noise from the proposed varied development would be audible; however, it would be at an acceptable level in relation to the ETSU-R-97 guidelines.

6.7 Summary and Conclusions

- 6.7.1 The guidance contained within ETSU-R-97 and the IOA GPG was used to assess the likely operational noise impact of the proposed varied development. Predicted levels and measured background noise levels indicate that for dwellings neighbouring the Site the operational noise impact of the proposed varied development is **not significant** after the Site Specific Noise Limits are adopted. In order to meet the Site Specific Noise Limits, mode management would be required for certain turbines for certain wind directions. The level of mode management will vary depending on the noise limits imposed. ETSU-R-97 recommends that the fixed minimum daytime noise limit be set within the range 35 - 40 dB therefore this assessment presents an assessment against both options to enable the decision maker to determine the most appropriate daytime limits for the proposed varied development should the proposed varied development receive consent.
- 6.7.2 There are a range of wind turbine models that may be appropriate for the proposed varied development. If the proposal 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.
- 6.7.3 Should the Scottish Ministers be minded to grant consent for the proposed varied development it would be appropriate to include an updated set of the noise conditions for the proposed varied development. A set of updated noise conditions to replace Conditions 42 and 47 are included within Annex 8 of Technical Appendix 6.1: Operational Noise Report.

List of Figures

- Figure 6.1 – Noise Monitoring and Assessment Locations
Figure 6.2 – Cumulative Wind Turbine Locations

6.8 References

- 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
- 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.
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- The Scottish Government (2011). PAN 1/2011 Planning and Noise. Scotland: The Crown
- The Scottish Government (2011). Technical Advice Note Assessment of Noise. [online] Available at: <http://www.gov.scot/Publications/2011/03/02104659/0>. [Accessed 15 May 2018]
- The Scottish Government, Web Based Renewables Advice: 'Onshore Wind Turbines' – updated May 28th 2014 - <http://www.scotland.gov.uk/Resource/0045/00451413.pdf>

Glossary and Abbreviations

Abbreviation	Expanded term / Definition
NML	Noise Monitoring Location
NAL	Noise Assessment Location
dB	Decibel
SIC	Shetland Island Council
AEHO	Assistant Environmental Health Officer