

11 Noise

Introduction

- 11.1 The construction and operation of a windfarm has the potential to create noise. This chapter considers the potential noise effects of the Development and summarises the findings of the noise assessments which are included in full in **Technical Appendix 11.1: Construction Noise Assessment** and **Technical Appendix 11.2: Operational Noise Assessment**.
- 11.2 Planning policies of relevance to this assessment are provided in **Chapter 5: Policy Context**.
- 11.3 The noise assessment was undertaken by TNEI Services Ltd.

Scope of the Assessment

Effects Assessed in Full

- 11.4 The following key issues were identified at the scoping stage, as noted in **Table 11.1** for detailed consideration in the assessment :
- Noise effects during construction;
 - Noise effects during operation;
 - Cumulative noise effects during operation.

Effects scoped out

- 11.5 The following effects have been scoped out:
- Noise effects during blasting. Whilst the extent of any blasting requirement cannot be determined until intrusive site investigation tests are completed, should blasting be required, a condition will be attached to the consent to ensure that effects from blasting are not significant. Further details are provided in the 'assessment limitations' section.

Assessment Methodology

Legislation and Guidance

- 11.6 This assessment is carried out in accordance with the principles contained within the following documents:
- Planning Advice Note PAN 1/2011: 'Planning and Noise'ⁱ;
 - Web Based Renewables Advice: 'Onshore Wind Turbines' (updated May 2014)ⁱⁱ;
 - ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms'ⁱⁱⁱ;
 - ISO9613: 1996 'Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation'^{iv};
 - 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) and associated Supplementary Guidance Notes^v;
 - BS5228-1: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open developments - Noise'^{vi}.

The above documents are discussed in detail within **Technical Appendix 11.1** and **Technical Appendix 11.2** and **Chapter 5**, where relevant.

Construction Noise Methodology

- 11.7 The construction noise assessment has been undertaken using guidance contained in BS5228: Part 1 2009+A1:2014. The prediction of construction noise levels was undertaken using the calculation methodology presented in ISO9613:1996, together with published noise data for appropriate construction plant.
- 11.8 At the present time BS5228: Part 1 2009+A1:2014 is an Approved Code of Practice under the Control of Pollution Act 1974 in England only, by virtue of The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015. In Scotland the earlier BS5228: 1997 Part 1^{vii} remains as the Approved Code of Practice, however since the content of the codes is not statutory and has no greater status than any other relevant source of best practice the latest version of the standard has been used in preference, providing as it does, extensive guidance on practical noise control. The guidance includes an update of noise measurements to inform noise data, the inclusion of octave band sound power data rather than broadband only data, and the provision of significance criteria, all of which were not included in the former document. Part 1 provides recommendations for basic methods of noise control including sections on community relations, training, occupational noise effects, neighbourhood nuisance, and project supervision. The annexes provide information on noise sources, mitigation measures and their effectiveness.
- 11.9 The BS5228-1:2009+A1:2014 document also contains sound power level data for a variety of construction plant. The data tabulated in the guidance document was obtained from field measurements of actual plant operating on construction and open sites in the United Kingdom.
- 11.10 For much of the working day the noise associated with construction activities will be less than predicted, as the assessment has assumed all equipment is constantly operating at full power and is located at the closest point to each receptor, whereas in practice equipment load and precise location varies throughout the day. This approach has been adopted to represent a worst case assessment.
- 11.11 Machinery on sites such as windfarm developments will produce noise levels that are transient in nature and fluctuate due both to the mobility of the activities and the load on any individual machine. The works generally comprise both moving and static sources. The moving sources include mobile construction plant and HGVs, while static construction plant such as generators, lighting rigs and pumps are usually located at a fixed location for a period of time.
- 11.12 To undertake an assessment of the construction noise effect using relevant data from BS5228: Part 1 2009+A1:2014, the following steps have been undertaken:
- identify the noise sensitive receptors and select representative Noise Assessment Locations;
 - identify the applicable threshold of significant effects from BS5228:1 2009+A1:2014;
 - predict the noise levels for various construction noise activities;
 - compare predicted noise levels against the applicable threshold;
 - where necessary, develop suitable mitigation measures to minimise any significant adverse effects during the construction phase; and, if required
 - assess any residual adverse effects taking into account any identified mitigation measures.
- 11.13 The construction process will be undertaken in several successive phases. During each stage the plant and equipment, and the associated traffic, will influence the noise generated. The selection of plant and equipment to be used will be determined by the main contractor and detailed arrangements for onsite management will be decided at that time. This assessment has therefore been based upon a typical selection of plant for a windfarm project of this size.
- 11.14 The core hours for construction activity are anticipated to be 07:00 to 19:00 weekdays and Saturdays 07:00 to 13:00 for all phases. It should be noted that out of necessity some activity, for example abnormal load deliveries, during large concrete pours and also during the lifting of the turbine rotors, may occur outside the specified hours stated above. However, the activities will not result in noise levels greater than those predicted in the construction noise assessment.
- 11.15 As outlined in **Chapter 4: Scheme Description**, for the purposes of this assessment the 24 month indicative construction programme has broadly been split into seven phases (many of which overlap), with all plant assumed to be operations at the same time at the closest point to a receptor for each activity per phase. In reality however, only certain plant will be working at the closest point and for a limited time:

- Phase 1 – site establishment, felling activities, soil handling, and distribution of hardcore required for the construction of the site compound(s);
- Phase 2 – forest felling activities, construction of the temporary site compound(s), borrow pit construction, removal of soil and distribution of hardcore material (if required);
- Phase 3 - construction of the accesses and onsite tracks, borrow pit activity, installation of cables, soil handling, and distribution of hardcore material;
- Phase 4 - construction of the crane hardstandings, borrow pit activity, soil handling and distribution of hardcore material;
- Phase 5 - construction of the turbine foundations which involves borrow pit activity, soil handling, on-site concrete batching and distribution of hardcore material;
- Phase 6 - delivery and erection of the wind turbines;
- Phase 7 – construction of the substation and distribution of hardcore material.

11.16 The noise-generating equipment assessed for each construction phase is detailed in **Technical Appendix 11.1**, which shows actual noise data measured at 10m from the noise source. Using the data contained in these tables the noise levels for Phases 1-7 have been calculated.

11.17 The assessment has assumed that gravity based foundations will be used onsite. To protect the amenity of local residents, the construction noise activities can be controlled under The Control of Pollution Act 1974 (COPA) which is specifically concerned with the control of noise pollution. In particular Section 60, Part III of the COPA refers to the control of noise on construction sites. It provides legislation by which a Local Authority can control noise from construction sites to prevent noise disturbance occurring. In addition, it recommends that guidance provided by BS5228 be implemented to ensure compliance with Section 60.

11.18 Further details regarding the methodology used in the construction noise assessment is provided within the Construction Noise Report (**Technical Appendix 11.1**).

Operational Noise

11.19 The assessment has been undertaken in accordance with ETSU-R-97 and current good practice, as specified in the Legislation and Guidance section above. ETSU-R-97 provides a robust basis for determining acceptable noise limits for windfarm developments. Consequently, the test applied to operational noise is whether or not the calculated windfarm noise levels at nearby noise sensitive properties will be below the noise limits derived in accordance with ETSU-R-97.

11.20 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 18:00.

11.21 For the avoidance of doubt the limits set based upon the background data collected during the quiet daytime period applies to the entire daytime (07:00 – 23:00).

11.22 Night-time periods are defined as 23:00 to 07:00 with no differentiation made between weekdays and weekends.

11.23 ETSU-R-97 recommends that windfarm 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 - 40dB(A) depends on a number of factors, including:

- the number of dwellings in the neighbourhood of the windfarm (relatively few dwellings suggest a figure towards the upper end),
- the effect of noise limits on the number of kWh generated (larger sites tend to suggest a higher figure), and;
- the duration and level of exposure to any noise.

11.24 The exception to the setting of both the daytime and night time fixed minimum limit on the noise limits occurs where a property occupier has a financial involvement in the windfarm development, in such cases the fixed minimum limit can be increased to 45dB(A), or a higher permissible limit above background during the daytime and night time periods.

11.25 Following a review of the guidance in ETSU-R-97, the daytime limit for noise associated with the Development has been set at 35dB(A) or background plus 5dB, whichever is the greater. This represents the lower end of the limits that can be applied under ETSU-R-97.

11.26 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.

11.27 In addition to ETSU-R-97, the recommendations included in the IOA GPG have been considered in the noise assessment. These are summarised in detail within **Technical Appendix 11.2**.

Cumulative Wind Turbine Noise Assessment

11.28 The need for a cumulative operational noise assessment was considered in accordance with the guidance contained within the IOA GPG. There are a number of consented and proposed wind turbine developments within the vicinity of the Development; therefore a cumulative noise assessment was undertaken. 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 noise predictions to determine whether noise predictions from the Development on its own are within 10 decibels (dB) of the total noise predictions from the other wind turbines within the area. Where turbine predictions are within 10dB then a likely cumulative noise assessment is undertaken.
- Stage 3 – establish the Site Specific Noise Limits for the Development (through apportioning the Total ETSU-R-97 Noise Limits) and compare the noise predictions from the Development on its own against the Site Specific Noise Limits.

11.29 The aim of the operational noise assessment therefore is to establish the Total ETSU-R-97 Noise Limits, determine the likely effects of the Development (where a cumulative assessment is required) at the nearest noise sensitive receptors, derive Site Specific Noise Limits and to demonstrate that the Development can meet (i.e. noise levels will be at or below) the limits.

11.30 The exact model of turbine to be installed will be the result of a future tendering process, should consent be granted. Achievement of the noise limits determined by this assessment will be a key determining factor in the final choice of turbine for the Development. A range of candidate turbines with varying capacity were initially considered for the Development, these included:

- Vestas V112 3.6MW;
- Nordex N100 2.5MW, N100 3.3MW, N117 2.4MW;
- Siemens 4.2 MW 120¹;
- Siemens SWT-101-3.2MW;
- GE 103 2.85MW, GE120 2.75MW;
- Senvion 114, 3.4MW.

11.31 For the purposes of this assessment, predictions of wind turbine noise for the Development have been based upon the sound power level data for a candidate wind turbine, the Vestas V112 3.6 MW (which was the loudest candidate considered (at the key wind speeds) and is considered representative of the type of turbine that will be installed. In addition, another turbine, the Nordex N100 2.5MW, has also been included for comparative purposes. Of the turbines for which noise data are available, these are among the ones with the higher sound power levels. The final turbine selection will be based on a competitive tendering process, although the turbine selected will be required to comply with the limits set out in this chapter. The modelling of these two machines demonstrates that the noisier turbines available within the range of turbines considered are able to comply with the limits proposed. The tables below summarise the turbine predictions based on the Vestas V112 3.6MW candidate turbine (the

¹ The Siemens 4.2 MW machine is expected to be available in late 2017. At the time of writing noise data for this turbine are not available.

loudest of the two candidates modelled, at the key wind speeds), whilst the impact assessment figures included as Figures A1.5a-w (**Technical Appendix 11.2**) also show the predictions for the Nordex N100 2.5MW for comparison.

- 11.32 The final choice of turbine will be selected post consent and following a competitive tendering process. It will be selected based on a range of technical and economic factors at the time, and in selecting the final turbine the Developer will be required to ensure that it can be operated to comply with the conditions of the Consent.
- 11.33 The turbines modelled in the assessment, inclusive of those considered in the cumulative noise assessment, are summarised in **Annex 7 of Technical Appendix 11.2**. Uncertainty in sound power data for the Development has been accounted for using the guidance contained within Section 4.2 of the IOA GPG. The location and the numbering of the wind turbines for the Development and the other schemes included in the cumulative assessment are shown on **Figure 11.3**.
- 11.34 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 temperature.
- 11.35 Typically windfarm noise assessments assume all properties are downwind of all turbines at all times (as this will result in the highest wind turbine noise levels i.e. 'worst case scenario'). However, where properties are located in between groups of turbines they cannot be downwind of all turbines simultaneously and so it is appropriate to consider the effect of wind direction on predicted noise levels. Further information on the methodology adopted where this condition comes into effect is provided in section 6.4 of **Appendix 11.2**.
- 11.36 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 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. Terrain screening effects (barrier corrections) act as blocking points, subsequently reductions in sound levels at a given receptor can potentially be observed. A concave ground and barrier correction was found to be required for a number of turbines at a number of receptors (as detailed in **Table 2 of Annex 8, Technical Appendix 11.2**).
- 11.37 Information relating to operational noise such as Amplitude Modulation (AM), a potential characteristic of wind turbine noise and Low Frequency Noise are also addressed within **Technical Appendix 11.2**.

Consultation

- 11.38 In undertaking the assessment, consideration has been given to the scoping responses and other consultation undertaken as detailed in **Table 11.1**.

Table 11.1: Consultation Responses

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
Dumfries and Galloway Council Environmental Health Officer (EHO), dated 25/02/2016	Formal Scoping Opinion	The design of the windfarm should be such that cumulative noise levels at noise receptive properties is limited to 35dB or 5dB above background noise levels.	TNEI undertook further consultation with the Council in which it was confirmed that cumulative noise will be assessed against a Total Noise Limit based on 35dB or background plus 5dB during the daytime or 43dB or background plus 5dB night time or 45dB(A) where the occupiers of a property are financially involved.
South Lanarkshire Council (SLC) Environment Services, dated	Formal Scoping Opinion	Requested that noise sensitive receptors within South Lanarkshire are	Preliminary noise modelling indicated that there were no noise

04/03/2016		included in the assessment. Cumulative noise effects should be considered in the ES. The developer should consider the cumulative effects of turbines plus substation and switchgear compound on noise sensitive properties. The developer should consider the effects on wind shear and amplitude modulation of aerodynamic noise related the operation of the turbines. The turbine specification chosen for noise modelling must be representative of the installed turbines.	sensitive receptors within SLC boundary with predicted noise levels > 35dB therefore baseline noise monitoring was not undertaken at any receptor within SLC, however some receptors within the SLC area were considered as noise assessment locations. A cumulative assessment has been included within Section 6.6 of Technical Appendix 11.2 and is summarised in Sections 11.78-11.80 below. An assessment to consider the potential effect of the cumulative operation of the wind turbines plus substation and switchgear has been included within Section 6.3 of Technical Appendix 11.2 . Further information on Amplitude modulation can be found within Section 3.3 of Technical Appendix 11.2 . The turbine modelled in the assessment is deemed representative of the turbine which will be installed. The final chosen turbine for the Development will have to operate within the derived Site Specific ETSU-R-97 Noise limits included in Table 11.12 and 11.13 below.
Transport Scotland, dated 23/02/2016	Formal Scoping Opinion	The noise assessment should consider trunk road receptors during construction where necessary. The ES should include an assessment of noise effects of operational traffic unless it can be demonstrated that this is not necessary. The ES should include an assessment of cumulative noise effects.	A construction noise assessment has been included within Technical Appendix 11.1 . As per Chapter 12: Access Traffic and Transport , the operational traffic will generate a negligible volume of traffic as such a detailed assessment has not been undertaken.
Leadhills Community Council, dated 22/02/2016	Formal Scoping Opinion	Raised concerns in relation to Access Option C in relation to safety, noise and disturbance caused by construction traffic. Requested that the significance of the noise effect be assessed in	Access C is no longer proposed to be included as part of the Development and has therefore not been included in the noise assessment. PAN 1/2011 (paragraph 29) and the associated

		accordance with the EIA Regulations as well as ETSU-R-97. Requested an assessment of the risk of Amplitude Modulation	Technical Advice Note provide generic guidance on noise impact assessment but refers users to specific guidance within web based 'Onshore wind turbines' which directs that ETSU 'should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available'. No alternative assessments are specified. Information on Amplitude Modulation is included within Section 3.3 of Technical Appendix 11.2.
Leadhills Parent Teacher Council (PTC), dated 22/02/2016	Formal Scoping Opinion	Raised concerns in relation to Access Option C and the potential noise and vibration effects in Leadhills town centre as a result of construction traffic.	Access C is no longer proposed to be included as part of the Development and has therefore not been included in the noise assessment.
Wanlockhead Village Council	Formal Scoping Opinion	Requested that the significance of the noise effect be assessed in accordance with the EIA Regulations as well as ETSU-R-97. Expressed concerns on certain weather conditions and how the local topography amplifies sound	PAN 1/2011 (paragraph 29) and the associated Technical Advice Note provide generic guidance on noise impact assessment but refer users to specific guidance in web based 'Onshore wind turbines' which directs that ETSU 'should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available'. No alternative assessments are specified. The noise model used presents worst case downwind conditions and realistic topographic corrections (valley or barrier corrections).
Dumfries and Galloway Council Environmental Health Officer (EHO), dated 09/02/2016, 16/02/2016, 10/03/2016, 15/03/2016	Other Consultation	Direct consultation was undertaken with the Environmental Health Officer (EHO) at the Council to agree the approach to the construction and operational noise assessments and the proposed noise monitoring locations. The EHO was also invited to attend the installation of the noise monitoring equipment.	No response received.

		Full details on the consultation undertaken with the EHO can be found in Annex 2, Technical Appendix 11.2.	
Dumfries and Galloway Council Environmental Health Officer (EHO), dated 25/11/2016	Other Consultation	Additional consultation was undertaken with the Environmental Health Officer (EHO) at the Council to agree the approach to the cumulative noise assessment	A response was received via email on 30/11/2016 which stated: 'I have no objections to the approach being taken for apportionment of ETSU-R-97 noise levels for North Lowther as it stands as its own development and in addition I have no objections to the cumulative assessment proposed in your recent correspondence.'

Study Area

- 11.39 Prior to the commencement of the operational noise assessment, initial desktop noise modelling was undertaken using ReSoft WindFarm Release 4.2.1.7 (WindFarm) software to identify suitable locations at which to monitor background noise. A 42 wind turbine scoping layout² was input into the 'WindFarm' software, and, using noise data for a candidate turbine representative of the type that could be installed at the Development, a noise contour plot was produced. The noise contour plot defined the extent of the assessment area for the operational noise assessment based upon a 35dB(A) contour. An additional assessment location outside of the 35dB contour was included to allow for any changes in design of the Development. The background Noise Monitoring Locations (NML) are shown on **Figure 11.2** and more information on the NML can be found in Section 5 of **Technical Appendix 11.2.**
- 11.40 The assessment locations for the construction noise assessment are shown on **Figure 11.1** and detailed in full in **Table 4.1** of **Technical Appendix 11.1.** The assessment locations are the closest receptors to the construction activities that will occur as part of the Development (for example new access tracks).
- 11.41 There is an operational and a proposed windfarm located in the vicinity of the Development (as shown on **Figure 11.3**), namely:
- Sunnyside (Operational - 2 turbines, total generating capacity 500kW)
 - Harryburn (Proposed - 17 turbines, total generating capacity ~72MW).
- 11.42 The windfarms detailed above have been considered as part of the cumulative operational noise assessment. Further information on the cumulative noise assessment can be found in Section 6.6 of **Technical Appendix 11.2.**
- Field Survey**
- 11.43 The noise survey to determine the existing background noise environment at noise sensitive receptors within the study area of the Development was undertaken in accordance with the guidance contained within ETSU-R-97 and current good practice (IOA GPG).
- 11.44 Background noise monitoring was undertaken from 18 March to 12 May 2016 at eight noise sensitive receptors selected as being representative of the noise sensitive receptors located closest to the Development. The noise monitoring locations are show on **Figure 11.2.**
- 11.45 The measurement locations were selected on the basis of preliminary noise predictions, which indicated those properties that for a wind condition of 10ms⁻¹ at 10 metres above ground level, will be exposed to turbine noise immissions at or above 35dB(A). A total of twenty four noise sensitive receptors were chosen as representative Noise Assessment Locations (NAL). The NALs chosen were the closest receptors to the Development and the other wind turbine developments included in the cumulative assessment. NALs refer to the position on the notional curtilage of a property. Predictions of wind turbine noise have been made at each of the NALs as detailed in **Table 11.3** and the NAL locations shown on **Figure 11.2.** This approach ensures that the report models the worst case (loudest) noise immission level expected at

² A 42 turbine layout was used as this was the draft layout being considered at the time of the consultation.

the noise sensitive receptor. **Table 11.2** also details which NML has been used to set noise limits for each NAL.

- 11.46 For two of the noise assessment locations, NAL12 – New Glendorch and NAL13 – Leadhills, baseline noise monitoring was undertaken by Innogy as part of the proposed Harryburn Wind Farm. Innogy have provided the derived background noise polynomials, and these have been used to set the 'Total ETSU-R97 Noise Limits' at each receptor for the purposes of this assessment.

Table 11.2: Operational Noise Assessment Locations (NAL)

Receptor	Easting	Northing	Elevation (m AOD)	Approximate Distance to Nearest Turbine** (m)	Background Noise Data Used
NAL1 – Corsebank*	280577	616707	220	1,564	NML1
NAL2 – Spango Bank*	283211	618832	260	2,311	NML2
NAL3 – Meadowfoot*	286330	613725	349	2,254	NML3
NAL4 – Muirhead*	282593	610253	245	1,570	NML4
NAL5 – Howatsburnfoot*	282832	609585	182	1,997	NML5
NAL6 – Brandleys Farm*	281788	610554	265	2,046	NML6
NAL7 – Clenries Farm*	280613	612545	282	1,390	NML7
NAL8 – Nether Cog*	280628	615155	208	1,497	NML8
NAL9 – Spango Bridge	282168	617812	239	1,243	NML2
NAL10 – Glenanners	280620	616844	219	1,591	NML1
NAL11 – Snar Farm	286279	619999	276	3,277	NML3
NAL12 – New Glendorch	288765	617693	326	3,611	***
NAL13 – Leadhills	288349	615246	411	2,808	***
NAL14 – Glenim Cottage	283779	609775	185	1,469	NML5
NAL15 – Brandleys Cottage	281179	611241	265	1,740	NML6
NAL16 – Mossend	280475	612801	282	1,773	NML7
NAL17 – Spoth	279629	614024	192	1,351	NML8
NAL18 – Carco	278828	613943	188	2,569	NML8
NAL19 – Meikle Carco	278317	613705	183	3,083	NML8
NAL20 – Orchard	278213	612807	172	3,355	NML8
NAL21 – Carcoside	277546	612772	258	4,003	NML3
NAL22 – Towerhill Cottage	276111	612873	281	5,378	NML3
NAL23 – Sunnyside	276381	611876	194	5,396	NML3
NAL24 – Duntercleuch	284831	615400	318	851	NML3

*This location was also a Noise Monitoring Location (NML)

** Please note the distances to nearest turbines quoted above may differ slightly from those reported in other chapters. This is because distances for the noise assessment are taken from the nearest turbine to the closest edge of the amenity area (usually the garden).

***Background noise polynomials derived as part of the Harryburn baseline noise assessment, as provided by Innogy.

- 11.47 The sound level meters were set to log the L_{A90} (as required by ETSU-R-97) and L_{Aeq} noise levels over the required ten minute intervals continuously over the deployment period.
- 11.48 Simultaneous wind speed/direction data were recorded at various heights using two SoDAR Units, which were located within the northern and southern areas of the Development site (grid references 281951 615850, 283341 612275). The wind speed data collected at a worst case hub height (100m) was standardised to 10m height. For the Development, turbines with a hub height of 89m, which fall within the 149m turbine design envelope have been used for this assessment.

- 11.49 Wind speed/direction data 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.

- 11.50 As detailed above, 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 temperature.

- 11.51 In line with current good practice, 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 turbines and the noise sensitive receptors. Details of the analysis are contained in **Technical Appendix 11.2**.

Assessing Significance Construction Noise

- 11.52 BS5228-1:2009+A1:2014, Appendix E Part E.3.2 provides example thresholds of potential significant effects at dwellings for assessing the significance of construction noise effects and gives examples of acceptable threshold values for construction noise. For the purposes of this assessment, having due regard to the existing ambient noise levels measured during background noise monitoring for the operational noise survey around the Development, the Category A noise threshold values are considered applicable for all properties. This category has been utilised to assess the significance of the construction and effects during each of the key construction phases. The significance criteria adopted for this assessment are based on Appendix E part E.3.2 of BS5228-1:2009+A1:2014 as detailed in Section 2.3 of the Construction Noise Report (**Technical Appendix 11.1**).

- 11.53 The criteria for determining the significance of construction noise effects are provided in **Table 11.3**.

Table 11.3: Significance Criteria

Significance of Effect	Significance Level	
	Not Significant	Significant
Category A Daytime (07:00 – 19:00) and Saturdays (07:00 to 13:00)	$\leq 65\text{dB } L_{Aeq, 12\text{ hr}}$	$> 65\text{dB } L_{Aeq, 12\text{ hr}}$
Category A Evenings and Weekends (19:00 – 23:00)	$\leq 55\text{dB } L_{Aeq, 5\text{ hr}}$	$> 55\text{dB } L_{Aeq, 5\text{ hr}}$

Operational Noise

- 11.54 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 windfarm noise and gives indicative noise levels considered to offer a reasonable degree of protection to windfarm neighbours, without placing unreasonable restrictions on windfarm development. Achievement of ETSU-R-97 derived noise limits ensures that wind turbine noise will meet current Government guidance.

- 11.55 In terms of the EIA Regulations^{viii}, the terminology of significance used 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 Development is deemed to result in a significant effect.

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

Assessment Limitations

- 11.57 At the current design stage, the assessment assumes there will be no requirement for piling activities during the construction works, and also that excavation of material from the borrow pits will be carried out using standard quarrying techniques, which may include blasting and mechanical excavation. However, all blasting work will be undertaken by a specialist contractor who will assume responsibility for blast design and implementation. The extent of any blasting requirement cannot be determined until intrusive site investigation tests are completed, and therefore the potential impact associated with blasting has not been assessed as part of the construction noise assessment.
- 11.58 As blasting can not be assessed at this stage, the following condition is proposed to be included should the Development obtain consent;
- 'Ground borne vibration resulting from any blasting activities shall not exceed a Peak Particle Velocity of 6mm/s-1 for 90% of blasts, with no blast exceeding 12.5mms-1, as measured at the nearest vibration sensitive properties in accordance with BS 7385-2:1993. Prior to the commencement of work on site a vibration monitoring protocol shall be submitted to and approved in writing by the Local Authority, the protocol shall detail the approach to be followed in the event of a complaint and the timescales for submission of a compliance report. Within 28 days from receipt of a written request from the Local Authority following a complaint to it from an occupant of a dwelling alleging noise disturbance at that dwelling, the wind farm operator shall, at its expense, employ a consultant approved by the Local Authority to assess the level of ground borne vibration in accordance with the approved protocol.'*
- 11.59 This will ensure that effects from blasting, if it is required, are not significant.
- 11.60 Whilst an information gap (noise during blasting) has been identified, it is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely significant noise impacts.

Existing Conditions

- 11.61 The Development is located within a rural location where existing background noise levels are considered to be relatively low. The predominant noise sources in the area are wind induced noise (wind passing through vegetation and around buildings), noise from nearby watercourses, distant and local road traffic noise, agricultural noise and birdsong.
- 11.62 The noise survey to determine the existing background noise environment at noise sensitive receptors neighbouring the Development was undertaken in accordance with the guidance contained within ETSU-R-97 and current good practice (IOA GPG).
- 11.63 **Table 11.4** provides a summary of the range of background noise levels measured during the monitoring period. Background noise data recorded during periods of rainfall (including the preceding 10 minute period in line with IOA GPG) have been excluded from the dataset, as well as periods of birdsong (also in line with IOA GPG) and when noise levels were atypical.

Table 11.4: Summary of Background Noise Levels (dB(A))

Receptor	Quiet Daytime	Night-time
	L _{A90} , 10 min	L _{A90} , 10 min
NML1 – Corsebank	30.1-50	30.2-49.5
NML2 – Spango Farm	18.4-47.2	18.0-47.3
NML3 – Wanlockhead	23.2-45.3	23.1-43.5
NML4 – Muirend	15.6-54.7	15.4-55.1
NML5 – Howatsburnfoot	26.0-49.3	26.2-47.8
NML6 – Brandleys Farm	16.8-54.3	16.5-49.7
NML7 – Clenries	20.6-50.7	19.5-51.5
NML8 – Nether Cog	26.3-44.7	27.3-46.9

- 11.64 In line with the recommendations included in Section 3.1.19 of the IOA GPG, a polynomial line of best fit has been derived through each dataset for the daytime and night time periods as shown on Figures A1.2a - A1.2h of **Technical Appendix 11.2**. In addition as per Section 3.1.21 of the IOA GPG, the polynomial background curve has been flatlined (where applicable) at the lower wind speeds where the derived minimum occurs.
- 11.65 In the interest of protecting residential amenity, the noise limits for higher wind speeds where data have not been collected have been set equal to those derived for lower wind speeds, as detailed in Section 5.8 of **Technical Appendix 11.2**.

NLEI Design Considerations

- 11.66 Throughout the design process the layout of the Development was repeatedly reviewed to optimise its turbine numbers and locations, subject to a wide range of constraints identified during the design process, including noise. Each turbine layout modification was 'tested' through the noise assessment to ensure noise limits could be met. The design process is detailed in **Chapter 3: Site Selection and Design Strategy**. The design process therefore satisfactorily minimised any increase in ambient noise levels at two levels: firstly through several iterations of site specific design as is detailed in **Table 3.1** of **Chapter 3** and secondly, at a higher level, through the use of ETSU-R-97 itself which provides a robust basis for determining appropriate noise limits for Developments.

Micrositing

- 11.67 The requirement to include a concave ground profile correction and/or a barrier correction may change depending on the final location of the turbines (following micrositing), in addition to the final turbine hub height. Nevertheless, turbine noise levels will have to meet the noise limits established in this assessment regardless of any increases in noise propagation caused by topography. If the Development receives consent, the need to apply a concave slope/barrier correction will need to be considered by the Applicant prior to the final selection of a turbine model for the Development.

Assessment of Effects

- 11.68 The assessment of effects is based on the project description as outlined in **Chapter 4**. Unless otherwise stated, potential effects identified are considered to be negative.

Construction Effects

Predicted Construction Effects

- 11.69 For the proposed construction year (2020), **Table 11.5** below details the anticipated annual average daily traffic flow for the proposed routes used during construction of the Development - these are as detailed in **Chapter 12**. It should be noted that the peak month for construction traffic generation (taken as being months eleven and twelve as per **Chapter 12**) has been used to provide a 'worst case scenario' in terms of the increase in traffic volume resulting in the construction of the Development.

Table 11.5: Construction Year Traffic Movements

Road	Traffic flow estimations in the construction year					5dB level change assessment (based on 125% increase)
	All, without construction traffic	Construction traffic only	All, with construction traffic	125% increase Threshold	Percentage Change	
B740	518	247	765	1166	48	<125 % Change -No Significant Impact
B7078	692	187	879	1557	27	<125 % Change -No Significant Impact

A76(T) - West of Kirkconnell	3304	98	3402	7434	3	<125 % Change -No Significant Impact
A76(T) - Enterkinfoot	3607	98	3705	8116	3	<125 % Change -No Significant Impact

11.70 Based upon the information above, the worst case estimated traffic levels for each of the locations are below the specified thresholds and as such no significant effects are anticipated.

11.71 **Table 11.5** details the results of the Construction Noise assessment. Full details of the modelling and assessment can be found in **Technical Appendix 11.1**.

11.72 The closest noise assessment locations in each direction were assessed as part of the construction noise assessment, as detailed in **Table 11.6** below.

Table 11.6: Predicted Construction Noise Effects (Phase 1-7)

Location	Category A Daytime Threshold dB	Construction Phase – Predicted daytime noise levels $L_{Aeq, 12h}$ for each phase (dB)						
		Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7
Spango Bank (NAL1)	65	54	53	54	53	53	33	36
Meadowfoot (NAL2)	65	36	35	41	35	35	29	26
Muirhead (NAL3)	65	33	33	34	34	35	34	22
Clenries Farm (NAL4)	65	32	31	32	32	32	26	25
Nether Cog (NAL5)	65	58	52	51	50	50	39	24
Spango Bridge (NAL6)	65	60	51	50	50	50	27	29
Glenanners (NAL7)	65	41	40	40	40	40	22	20
New Glendorch (NAL8)	65	24	24	25	25	27	26	20
Leadhills (NAL9)	65	27	27	27	27	26	16	22
Mossend (NAL10)	65	32	31	33	32	32	27	26
Spoth (NAL11)	65	31	32	33	31	31	24	17
Duntercleuch (NAL12)	65	36	36	42	41	44	48	29

11.73 As detailed in **Table 11.6** the predicted levels are below guidelines considered acceptable within BS5228 and are therefore deemed to be not significant.

11.74 It should also be noted that the proposed construction phases are temporary and short-term and therefore will not give rise to any long-term effects during the construction period. In practice, for much of the working day, the noise associated with construction activities will be less than predicted as the assessment has assumed all equipment is constantly operating at full load at the closest point to each receptor.

Proposed Mitigation

11.75 The assessment is based on a worst-case scenario, as a detailed construction programme will not be finalised until prior to construction (post consent). In line with good construction practice, good site

practices will be implemented to minimise the potential effects. Although not required (as not significant effects are predicted), Section 8 of BS 5228-1: 2009+A1:2014 recommends a number of simple control measures as summarised below which will be implemented.

General good practice during Construction

11.76 Generally, proposed construction activities would be confined to the periods 07:00 to 19:00 weekdays and Saturdays 07:00 to 13:00. However, there may be the requirement for extended operating hours to minimise traffic disruptions during the movement of abnormal loads and during large concrete pours and also during the lifting of the turbine rotors. The principal contractor would:

- keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern;
- ensure site work continuing throughout 24 hours of a day shall be programmed, when appropriate, so that haulage vehicles will not arrive at or leave the Development Area between 19.00 and 07.00 hours, with the exception of abnormal loads that will be scheduled to avoid significant traffic flows;
- ensure all vehicles and mechanical plant are fitted with effective exhaust silencers and 'smart' reversing alarms and are subject to programmed maintenance;
- select inherently quiet plant where appropriate and feasible - major compressors will be 'sound reduced' models fitted, where appropriate and feasible, with properly lined and sealed acoustic covers, which will be kept closed whenever the machines are in use;
- review the options to utilise close temporary boarded fencing as acoustic screens whenever works are in close proximity to dwellings;
- ensure all ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
- instruct that machines will be shut down between work periods or throttled down to a minimum;
- ensure regular maintenance of all equipment used onsite, including maintenance related to noise emissions;
- ensure that vehicles are loaded carefully to ensure minimal drop heights so as to minimise noise during this operation; and
- ensure all ancillary plant such as generators and pumps will be positioned so as to cause minimum noise disturbance and if necessary, temporary acoustic screens or enclosures should be provided.

Residual Construction Effects

11.77 Due to the low background noise levels, elements of construction noise may be audible at the closest residential receptors for certain periods during the construction phase. However, application of the good practice construction mitigation measures outlined above (although not required specifically to mitigate effects), there will be no significant residual effects.

Operational Effects

Predicted Operational Effects

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

11.78 Based on the prevailing background noise levels, the Total ETSU-R-97 Noise Limits (applicable to all windfarms in the area i.e. cumulatively) have been established for each of the NALs as detailed in **Table 11.7** and **Table 11.8** below, based on a lower fixed minimum of 35dB (daytime) or background plus 5dB and 43dB (night-time) or background plus 5dB. Where the occupiers of a receptor have a financial interest with the Development the limits have been increased to 45dB or background plus 5dB for the daytime and night time periods, as is detailed in ETSU-R-97. Although currently unoccupied, Muirhead (Noise Assessment Location 4) will have financial involvement in the project if it becomes occupied during operation. It is within the ownership of Buccleuch and therefore considered financially involved.

11.79 The property Clackleith is located within the Development Area and is owned by Buccleuch Estates. The property is currently uninhabitable and it will remain unoccupied for the duration of the operation of the Development and as such it has not been considered in the assessment.

Table 11.7: Total ETSU-R-97 Noise Limits Daytime

NAL	Wind Speed (ms ⁻¹) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 – Corsebank	38.8	39.3	39.8	40.5	41.2	42.1	43	44	45.1	46.2	47.4	47.4
NAL2 – Spango Bank	35	35	35	35	35	35	36.6	38.6	40.5	42.2	43.4	43.4
NAL3 – Meadowfoot	35	35	35	35	35	35	35.5	36.4	37.5	39	39	39
NAL4 – Muirhead*	45	45	45	45	45	45	45	45	45	47.3	50.7	50.7
NAL5 – Howatsburnfoot	36.2	36.7	37.1	37.6	38	38.5	38.9	39.4	39.8	40.3	40.3	40.3
NAL6 – Brandleys Farm	35	35	35	35	35	35.8	38	40	41.8	43.1	43.1	43.1
NAL7 – Clenries Farm	35	35	35	35	35.7	37.4	39.3	41.5	43.9	46.4	46.4	46.4
NAL8 – Nether Cog	35.9	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44	44
NAL9 – Spango Bridge	35	35	35	35	35	35	36.6	38.6	40.5	42.2	43.4	43.4
NAL10 – Glenanners	38.8	39.3	39.8	40.5	41.2	42.1	43	44	45.1	46.2	47.4	47.4
NAL11 – Snar Farm	35	35	35	35	35	35	35.5	36.4	37.5	39	39	39
NAL12 – New Glendorch**	38.9	38.9	38.9	38.9	39.2	39.5	39.9	40.2	40.5	40.8	41.2	41.5
NAL13 – Leadhills**	40	40	40	40	40	40	40	40	41.5	43.9	46	47.7
NAL14 – Glenim Cottage	36.2	36.7	37.1	37.6	38	38.5	38.9	39.4	39.8	40.3	40.3	40.3
NAL15 – Brandleys Cottage	35	35	35	35	35	35.8	38	40	41.8	43.1	43.1	43.1
NAL16 – Mossend	35	35	35	35	35.7	37.4	39.3	41.5	43.9	46.4	46.4	46.4
NAL17 – Spoth	35.9	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44	44
NAL18 – Carco	35.9	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44	44
NAL19 – Meikle Carco	35.9	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44	44
NAL20 – Orchard	35.9	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44	44
NAL21 – Carcoside	35	35	35	35	35	35	35.5	36.4	37.5	39	39	39
NAL22 – Towerhill Cottage	35	35	35	35	35	35	35.5	36.4	37.5	39	39	39
NAL23 – Sunnyside	35	35	35	35	35	35	35.5	36.4	37.5	39	39	39
NAL24 – Duntercleuch*	45	45	45	45	45	45	45	45	45	45	45	45

*assumes FI with the Development

** derived using baseline noise data collected as part of the noise assessment undertaken for Harryburn Wind Farm and assuming a 40dB or background plus 5dB fixed minimum limit at Leadhills.

Table 11.8: Total ETSU-R-97 Noise Limits 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 – Corsebank	43	43	43	43	43	43	43	43	43.3	44.9	46.7	48.9	51.4			
NAL2 – Spango Bank	43	43	43	43	43	43	43	43	43	43	43	48.2	56.4	56.4		
NAL3 – Meadowfoot	43	43	43	43	43	43	43	43	43	43	43	43	43	43		
NAL4 – Muirhead*	45	45	45	45	45	45	45	45	45	45	45	47.7	47.7	47.7		
NAL5 – Howatsburnfoot	43	43	43	43	43	43	43	43	43	43	43	43	43	43		
NAL6 – Brandleys Farm	43	43	43	43	43	43	43	43	43	43	43	44.8	44.8	44.8		
NAL7 – Clenries Farm	43	43	43	43	43	43	43	43	43	43	43	47	47	47		
NAL8 – Nether Cog	43	43	43	43	43	43	43	43	43	43	43	43	43.1	43.1		
NAL9 – Spango Bridge	43	43	43	43	43	43	43	43	43	43	43	48.2	56.4	56.4		
NAL10 – Glenanners	43	43	43	43	43	43	43	43	43	43	43	43.3	44.9	46.7	48.9	51.4
NAL11 – Snar Farm	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
NAL12 – New Glendorch**	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
NAL13 – Leadhills**	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
NAL14 – Glenim Cottage	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
NAL15 – Brandleys Cottage	43	43	43	43	43	43	43	43	43	43	43	43	43	44.8	44.8	44.8
NAL16 – Mossend	43	43	43	43	43	43	43	43	43	43	43	43	43	47	47	47
NAL17 – Spoth	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43.1	43.1
NAL18 – Carco	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43.1	43.1
NAL19 – Meikle Carco	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43.1	43.1
NAL20 – Orchard	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43.1	43.1
NAL21 – Carcoside	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
NAL22 – Towerhill Cottage	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
NAL23 – Sunnyside	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
NAL24 – Duntercleuch*	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45

*assumes FI with the Development

** derived using baseline noise data collected as part of the noise assessment undertaken for Harryburn Wind Farm

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

- 11.80 A comparison has been undertaken of the predicted wind turbine noise immission levels from the Development and all other schemes at each of the identified NALs in order to determine whether predictions are within 10dB of each other. As is detailed in Sections 5.1.4 and 5.1.5 of the IOA GPG where noise immission levels are greater than 10dB apart then a cumulative noise assessment is not required. This is because the addition of a new noise source which is at least 10dB quieter than the existing noise level will have a negligible impact on overall noise levels. Where predictions are found to be within 10dB of each other, then a cumulative assessment is required. It was found that a likely cumulative noise assessment is required at seven noise sensitive receptors as is detailed in **Tables 11.9** and **11.10**. Further details can be found in Annex 8 of **Technical Appendix 11.2**.
- 11.81 **Tables 11.9** and **11.10** detail the Total ETSU-R-97 Noise Limits and predicted cumulative wind turbine noise levels for ETSU-R-97 daytime hours and ETSU-R-97 night-time hours. The tables also show the exceedance level which is the difference between the predicted cumulative turbine noise level and noise criterion at a given wind speed. A negative exceedance level indicates satisfaction of the noise criteria.
- 11.82 **Tables 11.9** and **11.10** show that no excess of the Total ETSU-R-97 Noise Limit is predicted to occur from the cumulative operation of the Development and other windfarm developments (Sunnyside and Harryburn).

Table 11.9: Compliance Table - Likely Cumulative Noise - Daytime

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
New Glendorch (NAL12)	Total ETSU-R-97 Noise Limit	38.9	38.9	38.9	38.9	39.2	39.5	39.9	40.2	40.5	40.8	41.2	41.5
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	30.7	34.5	36.2	36.2	36.2	36.2	36.2	36.2
	Exceedance Level L _{A90}	-	-	-	-	-8.5	-5	-3.7	-4	-4.3	-4.6	-5	-5.3
Leadhills (NAL13)	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40	40	41.5	43.9	46	47.7
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	26	29.8	31.5	31.6	31.6	31.6	31.6	31.6
	Exceedance Level L _{A90}	-	-	-	-	-14	-10.2	-8.5	-8.4	-9.9	-12.3	-14.4	-16.1
Meikle Carco (NAL19)	Total ETSU-R-97 Noise Limit	36.8	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44	44
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	24.1	27.8	29.7	29.8	29.9	29.9	29.9	29.9
	Exceedance Level L _{A90}	-	-	-	-	-15.3	-12.4	-11.4	-12	-12.7	-13.4	-14.1	-14.1
Orchard (NAL20)	Total ETSU-R-97 Noise Limit	36.8	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44	44
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	22.4	26.1	28	28.1	28.2	28.2	28.2	28.2
	Exceedance Level L _{A90}	-	-	-	-	-17	-14.1	-13.1	-13.7	-14.4	-15.1	-15.8	-15.8
Carcoside (NAL21)	Total ETSU-R-97 Noise Limit	35	35	35	35	35	35	35.5	36.4	37.5	39	39	39
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	27.8	30.3	32	32.9	33.3	33.3	33.3	33.3
	Exceedance Level L _{A90}	-	-	-	-	-7.2	-4.7	-3.5	-3.5	-4.2	-5.7	-5.7	-5.7

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
Towerhill Cottage (NAL22)	Total ETSU-R-97 Noise Limit	35	35	35	35	35	35	35.5	36.4	37.5	39	39	39
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	28.2	30.7	32.3	33.2	33.6	33.7	33.7	33.7
	Exceedance Level L _{A90}	-	-	-	-	-6.8	-4.3	-3.2	-3.2	-3.9	-5.3	-5.3	-5.3
Sunnyside (NAL23)	Total ETSU-R-97 Noise Limit	35	35	35	35	35	35	35.5	36.4	37.5	39	39	39
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	30.2	32.6	34.2	35.2	35.6	35.7	35.7	35.7
	Exceedance Level L _{A90}	-	-	-	-	-4.8	-2.4	-1.3	-1.2	-1.9	-3.3	-3.3	-3.3

Table 11.10: Compliance Table - Likely Cumulative Noise – Night time

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
New Glendorch (NAL12)	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	30.7	34.5	36.2	36.2	36.2	36.2	36.2	36.2
	Exceedance Level L _{A90}	-	-	-	-	-12.3	-8.5	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8
Leadhills (NAL13)	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	26	29.8	31.5	31.6	31.6	31.6	31.6	31.6
	Exceedance Level L _{A90}	-	-	-	-	-17	-13.2	-11.5	-11.4	-11.4	-11.4	-11.4	-11.4
Meikle Carco (NAL19)	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43	43.1	43.1
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	24.1	27.8	29.7	29.8	29.9	29.9	29.9	29.9
	Exceedance Level L _{A90}	-	-	-	-	-18.9	-15.2	-13.3	-13.2	-13.1	-13.1	-13.2	-13.2
Orchard (NAL20)	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43	43.1	43.1
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	22.4	26.1	28	28.1	28.2	28.2	28.2	28.2
	Exceedance Level L _{A90}	-	-	-	-	-20.6	-16.9	-15	-14.9	-14.8	-14.8	-14.9	-14.9
Carcoside (NAL21)	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	27.8	30.3	32	32.9	33.3	33.3	33.3	33.3
	Exceedance Level L _{A90}	-	-	-	-	-15.2	-12.7	-11	-10.1	-9.7	-9.7	-9.7	-9.7

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
Towerhill Cottage NAL22	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	28.2	30.7	32.3	33.2	33.6	33.7	33.7	33.7
	Exceedance Level L _{A90}	-	-	-	-	-14.8	-12.3	-10.7	-9.8	-9.4	-9.3	-9.3	-9.3
Sunnyside NAL23	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L _{A90}	-	-	-	-	30.2	32.6	34.2	35.2	35.6	35.7	35.7	35.7
	Exceedance Level L _{A90}	-	-	-	-	-12.8	-10.4	-8.8	-7.8	-7.4	-7.3	-7.3	-7.3

11.83 For completeness, cumulative noise predictions have been provided in Annex 8 (**Technical Appendix 11.2**) for the 16 noise sensitive receptors scoped out of the main assessment (where the cumulative predictions were greater than 10dB apart). Figures A1.4a-A1.4x (**Annex 1, Technical Appendix 11.2**) show predictions from the Development and 'all other schemes' against the 'Total ETSU-R-97 Noise Limits' at all receptors.

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

11.84 Site specific noise limits have been derived for each of the noise sensitive receptors considered within the **Tables 11.9** and **11.10** above. **Table 11.11** summarises the approach adopted at each NAL in order to derive the site specific noise limits for the Development.

Table 11.11: Limit Derivation Strategy

NAL	Limit Derivation Strategy
NAL1-11, 14-18, 24	Predictions from other schemes were not found to be within 10dB of the Total ETSU-R-97 Noise Limits. As such, the entire noise limit (Total) has been allocated to the Development.
NAL 12 - New Glendorch	Whilst the proposed Development's predictions are within 10dB of predictions of other schemes, it is more than 10dB below the Total ETSU-R-97 Noise Limits and so will not require a share of the limits. This location will subsequently not be assessed further.
NAL 13 - Leadhills	The only windfarm within 10dB of the predictions of the Development is the proposed Harryburn Windfarm. The likely cumulative noise assessment (shown in A1.4m included within Annex 1 of Technical Appendix 11.2 , shows that predicted noise is well within the proposed noise limits). A Total ETSU-R-97 Noise Limit of 40dB(A) or background plus 5dB has been assumed for Leadhills as per the noise assessment for Harryburn. For the purpose of this assessment the Total ETSU-R-97 Noise Limits have been split equally between the schemes by subtracting 3dB from the Total ETSU-R-97 Noise Limits. Given that this would result in a daytime limit of 37dB at the lower windspeeds the limits for the Development have been based on the apportioned limit but this is reduced to be set at 35db or background plus 5db at lower windspeeds as appropriate. For the night time periods the Total ETSU-R-97 Noise Limits have been shared equally between the two schemes by subtracting 3dB of the Total ETSU-R-97 Noise Limits.
NAL 19 - Meikle Carco	Whilst cumulative predictions are within 10dB of predictions of the Development, they are more than 10dB below the Total ETSU-R-97 Noise Limits. Therefore, due to the unlikelihood of the other schemes requiring a share of the Total ETSU-R-97 Noise limits, the whole limit has been allocated to the Development.
NAL20 - Orchard	Whilst cumulative predictions are within 10dB of predictions of the Development, they are more than 10dB below the Total ETSU-R-97 Noise Limits. Therefore, due to the unlikelihood of the other schemes requiring a share of the Total ETSU-R-97 Noise, the whole limit has been allocated to the Development.
NAL21 - Carcoside	As detailed in Sections 6.6.2 - 6.6.5 (Technical Appendix 11.2) the TNEI

NAL	Limit Derivation Strategy
NAL 22 - Towerhill Cottage	interpreted Sunnyside Limits will be subtracted from the 'Total ETSU Limit' which will result in the Development's Site Specific Noise Limits for these noise assessment locations.
NAL 23 - Sunnyside	

11.85 As summarised in **Table 11.11**, it is proposed that the Total ETSU-R-97 noise limits be allocated to the Development at 19 of the 24 noise assessment locations, due to demonstration that either the Development, or the other schemes will not need a portion of the limit. For three noise assessment locations (NAL's 21-24) apportionment is required to allow the Development and the other wind turbine development to co-exist to within the 'Total ETSU-R-97 Noise Limits'.

11.86 The Development Site Specific Noise Limits are compared to the predictions of the Development operating on its own and the results are summarised in **Table 11.12** and **11.13** below.

11.87 **Tables 11.12** and **11.13** detail the Site Specific Noise Limits required to ensure that the Development can operate within the overall cumulative Total ETSU-R-97 Noise Limit (as set out in **Table 11.7** and **Table 11.8**). **Table 11.12** and **11.13** set out the predicted wind turbine noise levels for the Development for ETSU-R-97 daytime hours and ETSU-R-97 night-time hours. The tables also show the exceedance level, which is the difference between the predicted turbine noise levels and noise criterion at a given wind speed. A negative exceedance level indicates satisfaction of the noise criteria. The Site Specific Noise Limits and predictions are also shown on Figures A1.5a-A1.5x included within Annex 1 of **Technical Appendix 11.2**.

11.88 **Tables 11.12** and **11.13** show that no excess of the derived Site Specific Noise Limits is predicted to occur from the Development.

Table 11.12: Compliance Table - Site Specific Noise Limits Daytime

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
Corsebank (NAL1)	Site Specific ETSU-R-97 Noise Limit	39.3	39.3	39.8	40.5	41.2	42.1	43.0	44.0	45.1	46.2	47.4	47.4
	Predicted Wind Turbine Noise L _{A90}	-	21.4	22.2	24.7	29.2	33.0	34.9	35.0	35.0	35.0	35.0	35.0
	Exceedance Level L _{A90}	-	-17.9	-17.6	-15.8	-12.0	-9.1	-8.1	-9.0	-10.1	-11.2	-12.4	-12.4
Spango Bank (NAL2)	Site Specific ETSU-R-97 Noise Limit	35.0	35.0	35.0	35.0	35.0	35.0	36.6	38.6	40.5	42.2	43.4	43.4
	Predicted Wind Turbine Noise L _{A90}	-	21.0	21.8	24.3	28.8	32.6	34.5	34.6	34.6	34.6	34.6	34.6
	Exceedance Level L _{A90}	-	-14.0	-13.2	-10.7	-6.2	-2.4	-2.1	-4.0	-5.9	-7.6	-8.8	-8.8
Meadowfoot (NAL3)	Site Specific ETSU-R-97 Noise Limit	35.0	35.0	35.0	35.0	35.0	35.0	35.5	36.4	37.5	39.0	39.0	39.0
	Predicted Wind Turbine Noise L _{A90}	-	20.8	21.6	24.1	28.6	32.4	34.3	34.4	34.4	34.4	34.4	34.4
	Exceedance Level L _{A90}	-	-14.2	-13.4	-10.9	-6.4	-2.6	-1.2	-2.0	-3.1	-4.6	-4.6	-4.6
Muirhead (NAL4)	Site Specific ETSU-R-97 Noise Limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	47.3	50.7	50.7
	Predicted Wind Turbine Noise L _{A90}	-	23.2	24.0	26.5	31.0	34.8	36.7	36.8	36.8	36.8	36.8	36.8
	Exceedance Level L _{A90}	-	-21.8	-21.0	-18.5	-14.0	-10.2	-8.3	-8.2	-8.2	-10.5	-13.9	-13.9
Howatsburnfoot (NAL5)	Site Specific ETSU-R-97 Noise Limit	36.7	36.7	37.1	37.6	38.0	38.5	38.9	39.4	39.8	40.3	40.3	40.3
	Predicted Wind Turbine Noise L _{A90}	-	20.4	21.2	23.7	28.2	32.0	33.9	34.0	34.0	34.0	34.0	34.0
	Exceedance Level L _{A90}	-	-16.3	-15.9	-13.9	-9.8	-6.5	-5.0	-5.4	-5.8	-6.3	-6.3	-6.3

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
Brandleys Farm (NAL6)	Site Specific ETSU-R-97 Noise Limit	35.0	35.0	35.0	35.0	35.0	35.8	38.0	40.0	41.8	43.1	43.1	43.1
	Predicted Wind Turbine Noise L _{A90}	-	22.4	23.2	25.7	30.2	34.0	35.9	36.0	36.0	36.0	36.0	36.0
	Exceedance Level L _{A90}	-	-12.6	-11.8	-9.3	-4.8	-1.8	-2.1	-4.0	-5.8	-7.1	-7.1	-7.1
Clenries Farm (NAL7)	Site Specific ETSU-R-97 Noise Limit	35.0	35.0	35.0	35.0	35.7	37.4	39.3	41.5	43.9	46.4	46.4	46.4
	Predicted Wind Turbine Noise L _{A90}	-	23.8	24.6	27.1	31.6	35.4	37.3	37.4	37.4	37.4	37.4	37.4
	Exceedance Level L _{A90}	-	-11.2	-10.4	-7.9	-4.1	-2.0	-2.0	-4.1	-6.5	-9.0	-9.0	-9.0
Nether Clog (NAL8)	Site Specific ETSU-R-97 Noise Limit	36.8	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44.0	44.0
	Predicted Wind Turbine Noise L _{A90}	-	24.1	24.9	27.4	31.9	35.7	37.6	37.7	37.7	37.7	37.7	37.7
	Exceedance Level L _{A90}	-	-12.7	-12.8	-11.1	-7.5	-4.5	-3.5	-4.1	-4.9	-5.6	-6.3	-6.3
Spango Bridge (NAL9)	Site Specific ETSU-R-97 Noise Limit	35.0	35.0	35.0	35.0	35.0	35.0	36.6	38.6	40.5	42.2	43.4	43.4
	Predicted Wind Turbine Noise L _{A90}	-	23.0	23.8	26.3	30.8	34.6	36.5	36.6	36.6	36.6	36.6	36.6
	Exceedance Level L _{A90}	-	-12.0	-11.2	-8.7	-4.2	-0.4	-0.1	-2.0	-3.9	-5.6	-6.8	-6.8
Glenanners (NAL10)	Site Specific ETSU-R-97 Noise Limit	39.3	39.3	39.8	40.5	41.2	42.1	43.0	44.0	45.1	46.2	47.4	47.4
	Predicted Wind Turbine Noise L _{A90}	-	21.0	21.8	24.3	28.8	32.6	34.5	34.6	34.6	34.6	34.6	34.6
	Exceedance Level L _{A90}	-	-18.3	-18.0	-16.2	-12.4	-9.5	-8.5	-9.4	-10.5	-11.6	-12.8	-12.8
Snar Farm (NAL11)	Site Specific ETSU-R-97 Noise Limit	35.0	35.0	35.0	35.0	35.0	35.0	35.5	36.4	37.5	39.0	39.0	39.0
	Predicted Wind Turbine Noise L _{A90}	-	14.7	15.5	18.0	22.5	26.3	28.2	28.3	28.3	28.3	28.3	28.3
	Exceedance Level L _{A90}	-	-20.3	-19.5	-17.0	-12.5	-8.7	-7.3	-8.1	-9.2	-10.7	-10.7	-10.7
New Glendorch (NAL12)	As detailed in Table 11.11 above, predictions at this noise assessment location are more than 10dB below the Total ETSU-R-97 Noise Limits and so will not require a share of the limits.												
Leadhills (NAL13)	Site Specific ETSU-R-97 Noise Limit	35.0	35.0	35.0	35.0	35.0	36.0	37.0	37.0	38.5	40.9	43	44.7
	Predicted Wind Turbine Noise L _{A90}	-	15.1	15.9	18.4	22.9	26.7	28.6	28.7	28.7	28.7	28.7	28.7
	Exceedance Level L _{A90}	-	-19.9	-19.1	-16.6	-12.1	-9.3	-8.4	-8.3	-9.8	-12.2	-14.3	-16
Glenim Cottage (NAL14)	Site Specific ETSU-R-97 Noise Limit	36.2	36.7	37.1	37.6	38.0	38.5	38.9	39.4	39.8	40.3	40.3	40.3
	Predicted Wind Turbine Noise L _{A90}	-	22.5	23.3	25.8	30.3	34.1	36.0	36.1	36.1	36.1	36.1	36.1
	Exceedance Level L _{A90}	-	-14.2	-13.8	-11.8	-7.7	-4.4	-2.9	-3.3	-3.7	-4.2	-4.2	-4.2

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
Brandleys Cottage (NAL15)	Site Specific ETSU-R-97 Noise Limit	35.0	35.0	35.0	35.0	35.0	35.8	38.0	40.0	41.8	43.1	43.1	43.1
	Predicted Wind Turbine Noise L _{A90}	-	22.7	23.5	26.0	30.5	34.3	36.2	36.3	36.3	36.3	36.3	36.3
	Exceedance Level L _{A90}	-	-12.3	-11.5	-9.0	-4.5	-1.5	-1.8	-3.7	-5.5	-6.8	-6.8	-6.8
Mossend (NAL16)	Site Specific ETSU-R-97 Noise Limit	35.0	35.0	35.0	35.0	35.7	37.4	39.3	41.5	43.9	46.4	46.4	46.4
	Predicted Wind Turbine Noise L _{A90}	-	23.7	24.5	27.0	31.5	35.3	37.2	37.3	37.3	37.3	37.3	37.3
	Exceedance Level L _{A90}	-	-11.3	-10.5	-8.0	-4.2	-2.1	-2.1	-4.2	-6.6	-9.1	-9.1	-9.1
Spath (NAL17)	Site Specific ETSU-R-97 Noise Limit	36.8	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44.0	44.0
	Predicted Wind Turbine Noise L _{A90}	-	20.2	21.0	23.5	28.0	31.8	33.7	33.8	33.8	33.8	33.8	33.8
	Exceedance Level L _{A90}	-	-16.6	-16.7	-15.0	-11.4	-8.4	-7.4	-8.0	-8.8	-9.5	-10.2	-10.2
Carco (NAL18)	Site Specific ETSU-R-97 Noise Limit	36.8	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44.0	44.0
	Predicted Wind Turbine Noise L _{A90}	-	17.6	18.4	20.9	25.4	29.2	31.1	31.2	31.2	31.2	31.2	31.2
	Exceedance Level L _{A90}	-	-19.2	-19.3	-17.6	-14.0	-11.0	-10.0	-10.6	-11.4	-12.1	-12.8	-12.8
Meikle Carco (NAL19)	Site Specific ETSU-R-97 Noise Limit	36.8	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44.0	44.0
	Predicted Wind Turbine Noise L _{A90}	-	16.0	16.8	19.3	23.8	27.6	29.5	29.6	29.6	29.6	29.6	29.6
	Exceedance Level L _{A90}	-	-20.8	-20.9	-19.2	-15.6	-12.6	-11.6	-12.2	-13.0	-13.7	-14.4	-14.4
Orchard (NAL20)	Site Specific ETSU-R-97 Noise Limit	36.8	36.8	37.7	38.5	39.4	40.2	41.1	41.8	42.6	43.3	44.0	44.0
	Predicted Wind Turbine Noise L _{A90}	-	14.2	15.0	17.5	22.0	25.8	27.7	27.8	27.8	27.8	27.8	27.8
	Exceedance Level L _{A90}	-	-22.6	-22.7	-21.0	-17.4	-14.4	-13.4	-14.0	-14.8	-15.5	-16.2	-16.2
Carcoside (NAL21)	Site Specific ETSU-R-97 Noise Limit	33.2	33.2	32.7	32.3	31.8	31.0	31.2	32.1	33.2	34.7	34.7	34.7
	Predicted Wind Turbine Noise L _{A90}	-	16.0	16.8	19.3	23.8	27.6	29.5	29.6	29.6	29.6	29.6	29.6
	Exceedance Level L _{A90}	-	-17.2	-15.9	-13.0	-8.0	-3.4	-1.7	-2.5	-3.6	-5.1	-5.1	-5.1
Towerhill Cottage (NAL22)	Site Specific ETSU-R-97 Noise Limit	33.2	33.2	32.7	32.3	31.8	31.0	31.2	32.1	33.2	34.7	34.7	34.7
	Predicted Wind Turbine Noise L _{A90}	-	12.9	13.7	16.2	20.7	24.5	26.4	26.5	26.5	26.5	26.5	26.5
	Exceedance Level L _{A90}	-	-20.3	-19.0	-16.1	-11.1	-6.5	-4.8	-5.6	-6.7	-8.2	-8.2	-8.2
Sunnyside (NAL23)	Site Specific ETSU-R-97 Noise Limit	33.2	33.2	32.7	32.3	31.8	31.0	31.2	32.1	33.2	34.7	34.7	34.7
	Predicted Wind Turbine Noise L _{A90}	-	13.1	13.9	16.4	20.9	24.7	26.6	26.7	26.7	26.7	26.7	26.7
	Exceedance Level L _{A90}	-	-20.1	-18.8	-15.9	-10.9	-6.3	-4.6	-5.4	-6.5	-8.0	-8.0	-8.0
Dunt Derle (NAL24)	Site Specific ETSU-R-97 Noise Limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
	Predicted Wind Turbine Noise L _{A90}	-	-	30.2	32.7	37.2	41	42.9	43.0	43.0	43.0	43.0	43.0
	Exceedance Level L _{A90}	-	-	-14.8	-12.3	-7.8	-4	-2.1	-2	-2	-2	-2	-2

Table 11.13: Compliance Table - Site Specific Noise Limits Night time

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
Corebank (NAL1)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	44.9	46.7	48.9	51.4
	Predicted Wind Turbine Noise L _{A90}	-	21.4	22.2	24.7	29.2	33.0	34.9	35.0	35.0	35.0	35.0	35.0
	Exceedance Level L _{A90}	-	-21.6	-20.8	-18.3	-13.8	-10.0	-8.1	-8.3	-9.9	-11.7	-13.9	-16.4
Spango Bank (NAL2)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	48.2	56.4	56.4
	Predicted Wind Turbine Noise L _{A90}	-	21.0	21.8	24.3	28.8	32.6	34.5	34.6	34.6	34.6	34.6	34.6
	Exceedance Level L _{A90}	-	-22.0	-21.2	-18.7	-14.2	-10.4	-8.5	-8.4	-8.4	-13.6	-21.8	-21.8
Meadowfoot (NAL3)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Wind Turbine Noise L _{A90}	-	20.8	21.6	24.1	28.6	32.4	34.3	34.4	34.4	34.4	34.4	34.4
	Exceedance Level L _{A90}	-	-22.2	-21.4	-18.9	-14.4	-10.6	-8.7	-8.6	-8.6	-8.6	-8.6	-8.6
Muirhead (NAL4)	Site Specific ETSU-R-97 Noise Limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	47.7	47.7	47.7
	Predicted Wind Turbine Noise L _{A90}	-	23.2	24.0	26.5	31.0	34.8	36.7	36.8	36.8	36.8	36.8	36.8
	Exceedance Level L _{A90}	-	-21.8	-21.0	-18.5	-14.0	-10.2	-8.3	-8.2	-8.2	-10.9	-10.9	-10.9
Howatsburnfoot (NAL5)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Wind Turbine Noise L _{A90}	-	20.4	21.2	23.7	28.2	32.0	33.9	34.0	34.0	34.0	34.0	34.0
	Exceedance Level L _{A90}	-	-22.6	-21.8	-19.3	-14.8	-11.0	-9.1	-9.0	-9.0	-9.0	-9.0	-9.0
Brandleys Farm (NAL6)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.8	44.8	44.8
	Predicted Wind Turbine Noise L _{A90}	-	22.4	23.2	25.7	30.2	34.0	35.9	36.0	36.0	36.0	36.0	36.0
	Exceedance Level L _{A90}	-	-20.6	-19.8	-17.3	-12.8	-9.0	-7.1	-7.0	-7.0	-8.8	-8.8	-8.8
Clonries Farm (NAL7)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	47.0	47.0	47.0
	Predicted Wind Turbine Noise L _{A90}	-	23.8	24.6	27.1	31.6	35.4	37.3	37.4	37.4	37.4	37.4	37.4
	Exceedance Level L _{A90}	-	-19.2	-18.4	-15.9	-11.4	-7.6	-5.7	-5.6	-5.6	-9.6	-9.6	-9.6
Clonries Farm (NAL8)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	43.1

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
	Predicted Wind Turbine Noise L _{A90}	-	24.1	24.9	27.4	31.9	35.7	37.6	37.7	37.7	37.7	37.7	37.7
	Exceedance Level L _{A90}	-	-18.9	-18.1	-15.6	-11.1	-7.3	-5.4	-5.3	-5.3	-5.3	-5.4	-5.4
Spango Bridge (NAL9)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	48.2	56.4	56.4
	Predicted Wind Turbine Noise L _{A90}	-	23.0	23.8	26.3	30.8	34.6	36.5	36.6	36.6	36.6	36.6	36.6
	Exceedance Level L _{A90}	-	-20.0	-19.2	-16.7	-12.2	-8.4	-6.5	-6.4	-6.4	-11.6	-19.8	-19.8
Glenanthers (NAL10)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	44.9	46.7	48.9	51.4
	Predicted Wind Turbine Noise L _{A90}	-	21.0	21.8	24.3	28.8	32.6	34.5	34.6	34.6	34.6	34.6	34.6
	Exceedance Level L _{A90}	-	-22.0	-21.2	-18.7	-14.2	-10.4	-8.5	-8.7	-10.3	-12.1	-14.3	-16.8
Snar Farm (NAL11)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Wind Turbine Noise L _{A90}	-	14.7	15.5	18.0	22.5	26.3	28.2	28.3	28.3	28.3	28.3	28.3
	Exceedance Level L _{A90}	-	-28.3	-27.5	-25.0	-20.5	-16.7	-14.8	-14.7	-14.7	-14.7	-14.7	-14.7
New Glendorch (NAL12)	As detailed in Table 11.11 above, predictions at this noise assessment location are more than 10dB below the Total ETSU-R-97 Noise Limits and so will not require a share of the limits.												
	Site Specific ETSU-R-97 Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Leadhills (NAL13)	Predicted Wind Turbine Noise L _{A90}	-	15.1	15.9	18.4	22.9	26.7	28.6	28.7	28.7	28.7	28.7	28.7
	Exceedance Level L _{A90}	-	-24.9	-24.1	-21.6	-17.1	-13.3	-11.4	-11.3	-11.3	-11.3	-11.3	-11.3
	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Glenim Cottage (NAL14)	Predicted Wind Turbine Noise L _{A90}	-	22.5	23.3	25.8	30.3	34.1	36.0	36.1	36.1	36.1	36.1	36.1
	Exceedance Level L _{A90}	-	-20.5	-19.7	-17.2	-12.7	-8.9	-7.0	-6.9	-6.9	-6.9	-6.9	-6.9
	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.8	44.8	44.8
Brandleys Cottage (NAL15)	Predicted Wind Turbine Noise L _{A90}	-	22.7	23.5	26.0	30.5	34.3	36.2	36.3	36.3	36.3	36.3	36.3
	Exceedance Level L _{A90}	-	-20.3	-19.5	-17.0	-12.5	-8.7	-6.8	-6.7	-6.7	-8.5	-8.5	-8.5
	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	47.0	47.0	47.0
Mosseed (NAL16)	Predicted Wind Turbine Noise L _{A90}	-	23.7	24.5	27.0	31.5	35.3	37.2	37.3	37.3	37.3	37.3	37.3
	Exceedance Level L _{A90}	-	-19.3	-18.5	-16.0	-11.5	-7.7	-5.8	-5.7	-5.7	-9.7	-9.7	-9.7
	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	43.1

Location		Wind Speed (ms ⁻¹) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
	Predicted Wind Turbine Noise L _{A90}	-	20.2	21.0	23.5	28.0	31.8	33.7	33.8	33.8	33.8	33.8	33.8
	Exceedance Level L _{A90}	-	-22.8	-22.0	-19.5	-15.0	-11.2	-9.3	-9.2	-9.2	-9.2	-9.3	-9.3
Carco (NAL18)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	43.1
	Predicted Wind Turbine Noise L _{A90}	-	17.6	18.4	20.9	25.4	29.2	31.1	31.2	31.2	31.2	31.2	31.2
	Exceedance Level L _{A90}	-	-25.4	-24.6	-22.1	-17.6	-13.8	-11.9	-11.8	-11.8	-11.8	-11.9	-11.9
Meikle Carco (NAL19)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	43.1
	Predicted Wind Turbine Noise L _{A90}	-	16.0	16.8	19.3	23.8	27.6	29.5	29.6	29.6	29.6	29.6	29.6
	Exceedance Level L _{A90}	-	-27.0	-26.2	-23.7	-19.2	-15.4	-13.5	-13.4	-13.4	-13.4	-13.5	-13.5
Orchard (NAL20)	Site Specific ETSU-R-97 Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	43.1
	Predicted Wind Turbine Noise L _{A90}	-	14.2	15.0	17.5	22.0	25.8	27.7	27.8	27.8	27.8	27.8	27.8
	Exceedance Level L _{A90}	-	-28.8	-28.0	-25.5	-21.0	-17.2	-15.3	-15.2	-15.2	-15.2	-15.3	-15.3
Carcoside (NAL21)	Site Specific ETSU-R-97 Noise Limit	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0
	Predicted Wind Turbine Noise L _{A90}	-	16.0	16.8	19.3	23.8	27.6	29.5	29.6	29.6	29.6	29.6	29.6
	Exceedance Level L _{A90}	-	-26.0	-25.2	-22.7	-18.2	-14.4	-12.5	-12.4	-12.4	-12.4	-12.4	-12.4
Towerhill Cottage (NAL22)	Site Specific ETSU-R-97 Noise Limit	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0
	Predicted Wind Turbine Noise L _{A90}	-	12.9	13.7	16.2	20.7	24.5	26.4	26.5	26.5	26.5	26.5	26.5
	Exceedance Level L _{A90}	-	-29.1	-28.3	-25.8	-21.3	-17.5	-15.6	-15.5	-15.5	-15.5	-15.5	-15.5
Sunnyside (NAL23)	Site Specific ETSU-R-97 Noise Limit	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0
	Predicted Wind Turbine Noise L _{A90}	-	13.1	13.9	16.4	20.9	24.7	26.6	26.7	26.7	26.7	26.7	26.7
	Exceedance Level L _{A90}	-	-28.9	-28.1	-25.6	-21.1	-17.3	-15.4	-15.3	-15.3	-15.3	-15.3	-15.3
Duntercleuch (NAL24)	Site Specific ETSU-R-97 Noise Limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	Predicted Wind Turbine Noise L _{A90}	-	-	30.2	32.7	37.2	41	42.9	43.0	43.0	43.0	43.0	43.0
	Exceedance Level L _{A90}	-	-	-14.8	-12.3	-7.8	-4	-2.1	-2	-2	-2	-2	-2

11.89 An assessment has also been undertaken to assess the operational noise effects from the electrical plant located at the substation. The noise emissions from the plant are expected to reduce by approximately 60dB over a distance of 300m from the substation which would equal to a residual noise emission level of approximately 14dB(A) at 300m (closest property, NAL 2 – Spango Farm, is approximately 1,720m to the substation). This level will be below the typical measurement threshold of a Type 1 sound level meter and as such it is expected that the noise associated with the substation will not be audible above background noise levels. The effect will therefore not be significant. Further information on the assessment is included within Section 6.3 of **Technical Appendix 11.2**.

Proposed Mitigation

11.90 As is discussed in detail in **Chapter 3**, throughout the design process the layout of the Development was iteratively reviewed to optimise turbine numbers and locations, subject to a wide range of constraints identified, including noise. The design process therefore satisfactorily minimised any increase in ambient noise levels at two levels: firstly through several iterations of design process (embedded mitigation) and secondly, through the use of ETSU-R-97 noise limits which will apply to the Development regardless of the final chosen turbine. On this basis, no further mitigation is proposed.

11.91 Should any post-consent micro-siting be required, the Development will be required to comply with the Site Specific Noise Limits.

Residual Operational Effects

11.92 Predicted windfarm operational noise levels at all the noise assessment locations lie below the Site Specific ETSU-R-97 daytime and night-time Noise Limits. In addition the cumulative noise predictions from the Development and other operational and proposed windfarms lie below the Total ETSU-R-97 Noise Limits. At some locations, under some wind conditions and for a certain proportion of the time windfarm noise may be audible; however, it will be at an acceptable level in relation to the ETSU-R-97 guidelines. There will be no significant residual effects.

Cumulative Construction Effects

Predicted Cumulative Effects during Construction

11.93 There is the potential for Harryburn Windfarm to be under construction at the same time as the Development (should they both be consented), therefore there is the potential for cumulative construction noise effects to occur. However, there are a number of factors that would result in limited interaction between the Development and Harryburn, such as the likely difference in construction traffic routes (Harryburn construction traffic is likely to access their site via the B797 and B7040).

11.94 For the Development, all noise levels during all phases of work are at least 10dB below the 65dB Weekday threshold, which indicates that regardless of any other noise sources, the construction noise from the proposed Harryburn Windfarm will not be a contributing factor leading to a potential breach of the 65dB threshold, (due to the logarithmic way in which decibels are added, if an additional noise source is 10dBA lower than an existing noise source it will have a negligible impact upon the total noise level e.g. 65dBA + 55dBA ≈ 65dBA). Therefore, noise levels are considered unlikely to cause any significant effects at any of the surrounding noise sensitive receptors.

Proposed Mitigation

11.95 No additional mitigation is proposed at this stage. The general good practice measures detailed above in Section 11.73 will apply.

Residual Cumulative Effects during Construction

11.96 Due to the low background noise levels, elements of construction noise from the Development may be audible at the closest residential receptors for certain periods during the construction phase. However, with or without the good practice construction mitigation measures outlined above, there will be no significant residual effects.

Cumulative Operational Effects

Predicted Cumulative Effects during Operation

11.97 An assessment of the potential cumulative effects has been undertaken and the results are summarised in Sections 11.75-11.78 above.

11.98 Figures A1.4a-A1.4x included within Annex 1 of **Technical Appendix 11.2** show the cumulative wind turbine noise immission levels for all receptors against the Total ETSU-R-97 Noise Limits.

Proposed Mitigation

11.99 Based on the candidate turbine modelled in the assessment for the Development, no mitigation is required and there is no need to assess alternative scenarios using different candidate turbines. There are a number of wind turbine makes and models that may be suitable for the Development. Should the proposal receive consent, the final choice of turbine will be subject to a competitive tendering process. The final choice of turbine will, however, have to meet the noise limits determined and contained within any condition attached to the Consent.

Residual Cumulative Effects during Operation

11.100 At some locations, under some wind conditions and for a certain proportion of the time windfarm noise may be audible; however, it will be at an acceptable level in relation to the ETSU-R-97 guidelines. There will be no significant residual effects.

Summary of Significant Effects

11.101 The findings of the construction assessment demonstrate that due to the low background noise levels, elements of construction noise may be audible at the closest residential receptors for certain periods during the construction phase. However, on the basis of application of good practice construction mitigation measures there will be no significant construction noise effects, including cumulatively with other developments.

The findings of the operational assessment demonstrate that at some locations, under some wind conditions and for a certain proportion of the time windfarm noise may be audible; however, it will be at an acceptable level in relation to the ETSU-R-97 guidelines. On this basis, there will be no significant operational noise effects, including cumulatively with other developments.

ⁱ The Scottish Government, 2011. Planning Advice Note PAN 1/2011: Planning and Noise

ⁱⁱ The Scottish Government, Web Based Renewables Advice: 'Onshore Wind Turbines' – updated May 28th 2014

ⁱⁱⁱ The Working Group on Noise from Wind Turbines (1996) ETSU-R-97 The Assessment and Rating of Noise from Wind Farms', ETSU for the DTI (Department of Trade and Industry)

^{iv} International Standards Organisation, ISO9613: 1996 'Acoustics - Attenuation of sound during propagation outdoors' -Part 2: General method of calculation

^v Institute of Acoustics (2013) 'Good Practice Guidance on the application of ETSU-R-97 for wind turbine noise assessment'

^{vi} British Standard BS5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' – Part 1: Noise

^{vii} British Standard BS 5228-1:1997 Noise and vibration control on construction and open sites. Code of practice for basic information and procedures for noise and vibration control

^{viii} Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000