CONTENTS

TABLES

FIGURES

TECHNICAL APPENDICES

INTRODUCTION

14.1 This Chapter considers the noise effects arising from the proposed Clashindarroch II Wind Farm (the proposed development), including construction, operational and decommissioning phases.

14.2 The following terms and definitions are used throughout this Chapter:

- emission refers to the noise level generated by a source of noise, expressed as either a sound power level or a sound pressure level;
- immission refers to the sound pressure level at the identified receptors;
- SWL indicates sound power level in decibels (dB);
- SPL indicates sound pressure level in decibels (dB);
- Noise Sensitive Receptors (NSRs) are properties which are potentially sensitive to noise and, as such, require protection from nearby noise sources;
- study area is the area surrounding the proposed development within a radius of 5km; and
- noise-control-property, is the nearest representative property likely to be most affected by wind turbine noise emission.

14.3 The assessment of construction (and decommissioning) noise has been undertaken in accordance with the calculation and assessment methodologies contained within BS5228-1:2009+A1:2014, *Code of Practice for Noise and Vibration Control on Construction and Open Sites: Part 1 – Noise* (Ref. 14.1).

14.4 An assessment of vehicles associated with the construction phase of the proposed development has been undertaken based on the results of the Transport Assessment – Chapter 13: Highways Traffic and Transport, and with reference to the *Design Manual for Roads and Bridges* (DMRB; Ref. 14.2).

14.5 The assessment of operational and cumulative noise has been undertaken in accordance with the Energy Technology Support Unit (ETSU) report, *The Assessment and Rating of Noise from Wind Farms* (Ref. 14.3). The ETSU report (ETSU-R-97) provides guidance on noise limits for wind turbine developments which are considered to *"offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development"*.

14.6 According to the ETSU-R-97:

"The Noise Working Group is of the opinion that absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area contributing to the noise received at the properties in question. It is clearly unreasonable to suggest that, because a wind farm has been constructed in the vicinity in the past which resulted in increased noise levels at some properties, the residents of these properties are now able to tolerate higher noise levels still. The existing wind farm should not be considered as part of the prevailing background noise".

14.7 Therefore, the cumulative noise impact assessment has been based on the background noise survey undertaken by Hayes McKenzie (HM) to support Clashindarroch Wind Farm planning application (Ref. 14.4), which is understood to be the first implemented wind farm within the study area.

14.8 However, the nearest NSR to be considered as the noise-control-property for the proposed development noise impact assessment are not the same as the nearest noise-control-property for Clashindarroch Wind Farm, and therefore it was agreed with a representative of Aberdeenshire Council that a background noise survey would also be carried out at the nearest NSR to the proposed development.

LEGISLATION, PLANNING POLICY AND GUIDANCE

The Control of Pollution Act 1974

14.9 Noise from construction sites is controlled by means of The Control of Pollution Act 1974 (CoPA). Under Section 60 of the CoPA the local authority may improve requirements as to the way in which works are carried out. The local authority may specify plant or machinery which is or not to be used, hours of work, permitted noise levels, and provide for a change in circumstances. Section 61 of the CoPA allows an operator to apply to the Local Planning Authority (LPA) for prior consent to carry out construction activities. The application should specify works to be carried out and best practicable means that will be implemented to minimise noise levels where significant impacts are likely to occur.

The Environmental Protection Act 1990

14.10 The Environmental Protection Act 1990 (EPA) requires that Local Authorities carry out appropriate inspections/assessments to identify statutory nuisance, as defined within the CoPA. Furthermore, the Local Authority should serve abatement notices where statutory nuisance occurs. Procedures are also specified with regards to complaints from persons affected by a statutory nuisance.

Scottish Planning Policy

14.11 Scottish Planning Policy (SPP; Ref. 14.5) states (at paragraph 170) that *"wind farms should be sited and designed to ensure impacts are minimised and to protect an acceptable level of amenity for adjacent communities".* The SPP states that noise should be one of the environmental criteria considered when assessing effects on communities and individual dwellings (paragraph 169).

Planning Advice Note (PAN) 1/2011

14.12 PAN 1/2011, *Planning and Noise*, (Ref. 14.6) states that there are two sources of noise from wind turbines, the mechanical noise from the turbines and the aerodynamic noise from the blades: - *"good acoustical design and siting of turbines is essential to minimise the potential to generate noise"*.

14.13 The document (at paragraph 29) refers to web-based Scottish Government planning advice on renewable technologies for onshore wind turbines; however, no other guidance or reference to wind turbine noise is made within PAN 1/2011.

Onshore Wind Turbines Scottish Government Planning Advice

14.14 The web-based Scottish Government planning advice for onshore wind turbines (last updated 28th May 2014, Ref. 14.7) states:

"The Report, 'The Assessment and Rating of Noise from Wind Turbines' (Final Report, Sept 1996, DTI) (ETSU-R-97) describes a framework for the measurement of wind farm noise, which 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. This gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable burden on wind farm developers, and suggest appropriate noise conditions".

14.15 The web-based guidance also refers to the Institute of Acoustics (IOA) 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (hereafter referred to as the IOA GPG; Ref. 14.8), stating that *"the Scottish Government accepts that the guide represents current industry good practice".*

Aberdeenshire Council – Wind Turbine Development Submission Guidance Note

14.16 Aberdeenshire Council issued a Submission Guidance Note (SGN) in February 2015 (Ref. 14.9) on the *Information required for an Assessment of the Noise Impact of Proposed Wind Turbine Developments to be undertaken in Connection with a Planning Application*. This guidance note states that a noise impact assessment for a proposed wind turbine development should be undertaken in accordance with ETSU-R-97 and the IOA GPG.

14.17 The SGN goes on to state (in Section A) that *"a desk-top site-specific noise impact assessment is acceptable in circumstances where it is expected that the fixed limit of 35dB $L_{A90,10min}$ for all wind speeds up to 10m/s can be meet by the proposed turbine(s), including any cumulative impacts. Where this fixed limit cannot be met, a background noise survey will be required to be undertaken and a detailed site-specific noise impact assessment submitted".*

14.18 With respect to cumulative impacts, the guidance from Aberdeenshire Council states the presence of any turbine development within a search area of 5km should be established, and that once this turbine development has been identified, *"cumulative noise impacts must be considered where the proposed turbine produces noise levels within 10dB of the noise levels of any turbines existing, consented or in the planning process at the same receptor locations"*. This guidance correlates with that provided within Section 5 of the IOA GPG.

14.19 Furthermore, Aberdeenshire Council *"expects that existing and consented wind turbine developments will be operating to full capacity of their consented noise limits"*; however, they state that alternative approaches may also be appropriate.

14.20 This guidance note may be reissued by Aberdeenshire Council in the near future; however, it is understood that only the publication date is likely to change, not the content of the note itself.

Institute for Environmental Management and Assessment (IEMA) Guidelines

14.21 The noise assessment in this Chapter has also been undertaken with reference to the *Guidelines for Environmental Noise Impact Assessment* (Ref. 14.10), produced by IEMA (see paragraph 14.49).

Construction Noise and Vibration Guidance

BS5228-1:2009+A1:2014 and BS5228-2:2009+A1:2014

14.22 Planning Advice Note PAN50 'Controlling the Environmental Effects of Surface Mineral Workings' (Ref. 14.11) gives guidance on the environmental effects of mineral working. The main document summarises the key issues with regard to various environmental impacts relating to surface mineral extraction and processing such as road traffic, blasting, noise, dust, visual intrusion etc. In addition, several annexes to the main document have been published which consider specific aspects in more detail: Annex A, 'The Control of Noise at Surface Mineral Workings' and Annex D 'The Control of Blasting at Surface Mineral Workings'. BS 5228-1 and BS 5228-2 also provide guidance relating to surface mineral extraction including the assessment of noise and vibration effects associated with quarry blasting.BS5228-1:2009+A1:2014 sets out a methodology for predicting noise levels arising from a wide variety of construction activities and it contains tables of sound power levels generated by mobile and fixed plant.

14.23 Annex E of BS5228-1:2009+A1:2014 gives several examples of acceptable limits for construction noise, the most simplistic being based upon the exceedance of fixed noise limits. In this respect, Section E.2 of the standard states: *"Noise from construction sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut"*.

14.24 The assessment of construction noise associated with the proposed development is based on the following fixed limit from BS5228-1:2009+A1:2014:

- noise levels, between 07:00 and 19:00 hours, outside the nearest window of the occupied room closest to the Site boundary, should not exceed 70dB(A)[1].

14.25 BS 5228-2 provides general guidance on legislation, prediction, control and assessment criteria for construction vibration. It explains that, for general construction activities, PPV vibration levels of around 0.3mm/s may just be perceptible in residential environments, and that levels of around 1mm/s may cause complaints unless prior warning and explanation has been given to residents: this may therefore represent a moderate impact, unless suitable engagement is undertaken (in which case it would represent a minor impact). Sustained vibration at 10mm/s would be likely to be intolerable, representing a major impact. The standard also explains that structural or cosmetic damage to buildings is unlikely at levels below 15mm/s.

Construction Traffic Noise Guidance

Design Manual for Roads and Bridges

14.26 Noise generated by construction traffic is assessed following the guidance within Part 7 of DMRB. DMRB states that *"a change in noise level of 1dB is equivalent to a 25% increase or 20% decrease in traffic flows, assuming all other factors remain unchanged"*.

14.27 DMRB also provides advice on the magnitude of effects associated with increases in total traffic flows and associated noise levels. Paragraph 3.37 of DMRB states that *"a change in road traffic of*

[1] Applicable in rural, suburban and urban areas away from main road traffic and industrial noise; for daytime working outside living rooms and offices

1dB $L_{A10,18h}$ in the short term (e.g. when a project is opened) is the smallest that is considered perceptible".

Operational Noise Guidance

ETSU-R-97

14.28 ETSU-R-97 sets out the findings of the Working Group on Noise from Wind Turbines, which was set up in 1993 by the (former) Department of Trade and Industry (DTI) to consider the available methods of noise assessment for wind farms and to derive a method and criteria suitable for future assessments.

14.29 ETSU-R-97 recommends that acceptability of wind farm noise should be assessed relative to existing background noise levels, so that both the outdoor amenity and the sleep of local residents are protected. It suggests that noise from wind turbines should be limited to 5dB above the background noise (L_{A90}) at all times. It does however also suggest absolute lower fixed limits of between 35 and 40dB L_{A90} for daytime (07.00 – 23.00) and 43dB L_{A90} for night-time (23.00 – 07.00). The absolute lower night-time fixed limit of 43dB L_{A90} is derived from the sleep disturbance criteria referred to in (the now superseded) PPG 24 (Ref. 14.12), with an allowance of 10dB for attenuation through an open window and a 2dB correction to convert an L_{Aeq} value to L_{A90}.

14.30 An increased noise limit of 45dB L_{A90} (or background noise plus 5dB) is suggested for both daytime and night-time periods for properties where the occupier has financial involvement in the wind farm.

14.31 The limits are derived by plotting a best fit line through a graph of the measured background noise levels and the corresponding average wind speeds. The ETSU-R-97 limits are then defined as 5dB above the average background noise level at each wind speed (as defined by the best fit line), or the absolute lower fixed limit, whichever is the highest.

14.32 An additional *'simplified'* assessment is also presented within ETSU-R-97 (page 66), whereby if an appropriate fixed noise limit can be achieved regardless of the wind speed, then this is considered sufficient for the protection of residential amenity without the measurement of background noise levels. In this regard, ETSU-R-97 states the following:

"If the developer can demonstrate that noise conditions would be met even if there was no increase in background noise with speed until quite high wind speeds, then a simplified approach can be adopted. We are of the opinion that if the noise is limited to an $L_{A90,10min}$ of 35dB up to wind speeds of 10m/s at 10 height, then this condition alone would offer sufficient protection of amenity and background noise surveys would be unnecessary. We feel that, even in sheltered areas when the wind speed exceeds 10m/s on the wind farm site, some additional background noise will be generated which will increase background noise levels at the property."

14.33 All noise limits in ETSU-R-97 are expressed in terms of a 10-minute L_{A90} noise level. This approach has been adopted to avoid extraneous transitory events unduly affecting the noise generated by wind farms when attempting to measure their noise emission level. The guidance within ETSU-R-97 states that the $L_{A90,10min}$ noise level will be approximately 2dB lower than the equivalent $L_{Aeq,10min}$ noise level.

Institute of Acoustics' Good Practice Guide to ETSU-R-97

14.34 The Scottish Government has formally endorsed the IOA GPG and the current (web-based) Scottish planning advice recommends that it is used for the assessment of wind turbine noise.

14.35 The IOA GPG does not replace the limits within ETSU-R-97, but it does provide good practice guidance on the use of the ETSU document in relation to background noise surveys and on the prediction of wind turbine noise. This is on the proviso that the appropriate input parameters and correction factors are used for the prediction of wind turbine noise, as follows:

- downwind propagation;
- a receptor height of 4m;
- atmospheric conditions of 10°C and 70% humidity;
- a ground absorption factor of G = 0.5; and
- turbine noise emission levels which include a margin for uncertainty.

14.36 The IOA GPG recommends suitable noise monitoring equipment to be used for background noise surveys and the correct siting to achieve representative noise levels, i.e. away from extraneous noise sources. The IOA GPG also defines how survey data should be analysed in order to derive appropriate noise limits for the proposed development at the closest receptors. This includes correlating background noise levels to standardised wind speeds at a height of 10m.

ISO 9613-2:1996 Prediction Method

14.37 The noise generated by the operation of a wind farm is predicted in accordance with ISO 9613-2:1996 (Ref. 14.13), as recommended by the IOA GPG and as shown below:

$$\textbf{Predicted Octave Band Noise Level} = L_w - A_{geo} - A_{atm} - A_{gr} - A_{bar} - A_{misc}$$

(Where L_w is the octave band Sound Power Level (SWL) in decibels (dB) and A represents the various attenuation factors, also in dB)

14.38 The attenuation factors indicated in the above formula are detailed as follows:

14.39 $\mathbf{A_{geo}}$ is the attenuation due to geometric divergence. This is the reduction in noise levels caused by the spherical spreading of the noise over distance from the point source. The attenuation factor, therefore, increases as the distance from the noise source increases.

14.40 $\mathbf{A_{atm}}$ is the absorption of the noise by the atmosphere as sound energy is converted to heat. The level of absorption varies depending on the distance from the source and the atmospheric conditions (temperature and humidity). ISO 9613-1:1993 (Ref. 14.14) provides appropriate air attenuation factors for differing atmospheric conditions. In line with the IOA GPG, atmospheric conditions of 10°C and 70% humidity are used within the propagation model *"to represent a reasonably low level of air absorption"*.

14.41 $\mathbf{A_{gr}}$ is the ground factor and represents the reduction in noise levels due to the absorption of sound energy by ground cover. The level of reduction will vary significantly depending on the absorptive qualities of the ground cover. ISO 9613-1:1993 provides advice on appropriate attenuation factors

based on a range of cover from hard ground (G = 0) to soft absorbent ground (G = 1). A ground factor of 0.5 is assumed in the predictions of operational wind turbine noise. This is in accordance with the IOA GPG (paragraph 4.3.4), which recommends that a ground factor of 0.5 is used for turbines with warranted SWLs or with emission levels which include a margin for uncertainty.

14.42 **A_{bar}** relates to the attenuation due to the screening and reflection effects provided by obstacles between the source and receiver. The level of attenuation will vary depending on the degree by which the line of sight between source and receiver is affected and the frequency considered. In relation to wind farms, local topography will provide the largest influence on barrier effects; however, within the operational noise model, attenuation attributable to local topography is not included.

14.43 The predicted (L_{Aeq}) noise levels for all turbines are totalled to provide an overall A-weighted noise level. A further correction of 2dB is subtracted to convert the L_{Aeq} level to the L_{A90} as required for the ETSU-R-97 assessment. This is reiterated in the IOA GPG (at paragraph 4.25) which states:

"To obtain the L_{A90} parameter required by ETSU-R-97, it is necessary to apply a correction to the prediction results. Based on recent research, the assumption described in ETSU-R-97 in this regard continues to remain valid. A correction of -2dB is commonly applied."

14.44 In the interests of clarity, an overview of the key points in relation to the prediction and assessment of operational noise is provided in Technical Appendix 14.1: Noise Assessment Checklist. This *'checklist'* is referenced to Section 6.1 of the IOA GPG, which provides the key points which good practice suggests should be included in the assessment of operational noise from wind turbines.

SCOPE AND CONSULTATION

14.45 The formal scoping process is described in Chapter 6: Scoping and Consultation of this Environmental Impact Assessment Report (EIA Report) and Table 14-1 summarises the scoping response received from Aberdeenshire Council (Environmental Health) with respect to the noise assessment.

Table 14-1
Key Issues Raised During Scoping

Consultee	Summary of Key Issues	Response
Aberdeenshire Council – Environmental Health (Marr)	Chapter 11.0 of the draft scoping report submitted by the applicant details how operational (and construction) noise impacts of the proposed wind farm development will be considered. Early engagement with Environmental Health has been sought with a view to discuss background noise monitoring proposals and the approach to be taken in carrying out the noise impact assessment. New proposed layout and wind turbines model	Engagement with Aberdeenshire Council was undertaken (via email) during April – August 2017 to discuss the requirement for a background noise survey and the overall approach to the assessment. Confirmed general agreement with proposed methodology. Engagement and consultation with Aberdeenshire Council was undertaken (via email) during October 2018 to discuss the proposed new layout and project re-scoping.

Consultee	Summary of Key Issues	Response
	has been forward to the Council in October 2018. It is expected that the applicant ensures that all current and relevant best practice guidance is followed for the project's complete life cycle, i.e. from construction, operation and decommissioning phases.	Confirmed general agreement with proposed methodology. The cumulative noise impact has considered Clashindarroch Wind Farm operational 18 wind turbines together with the 14 proposed development wind turbines. The proposed development is not to be considered an extension of the operational Clashindarroch Wind Farm Additional background noise survey was carried out at two NSRs to evaluate the cumulative effect upon it. All aspects related to the potential noise impact has been assessed according to the best practice guidance and after discussion and agreement with Aberdeenshire Council.

Effects Scoped Out

14.46 Effects associated with vibration during the construction phase and the effects of operational traffic noise have been scoped out of the assessment. Considering the large distances between the proposed turbines and supporting infrastructure (>1.5km), vibration effects at the closest receptors are not likely to be significant.

14.47 It is anticipated that the proposed development would not generate significant volumes of traffic during its operation[2] and would be no greater than those expected and accounted for in background variations to the existing traffic flows. Therefore, the noise and vibration effects of operational traffic are scoped out.

14.48 Amplitude Modulation (AM) (as well as low frequency and tonal noise) has been scoped out of the noise impact assessment as recently published studies into these phenomena indicates that AM is site dependent and, can only be evaluated once the development is operational, as AM is directly related to the local meteorological factors interacting with the installed turbines' blades in addition to receptor's distance and orientation. In the rare event of AM related noise complaints, there are standard[3] means to identify, quantify and mitigate AM noise.

14.49 Therefore, reference is made to Section 7.2.1 of the GPG which states:

"The evidence in relation to 'Excess' or 'Other' Amplitude Modulation (AM) is still developing. At the

[2] As per Chapter 13: Highways, Traffic and Transport, the proposed development would generate no more than five trips in any one day and zero trips on most days. This would normally require light vans or similar vehicles only.

[3] Renewable UK research into aerodynamic modulation of wind turbine noise: wind turbine amplitude modulation, December 2013.

time of writing, current practice is not to assign a planning condition to deal with AM".

Assessment Methods

14.50 *The 'Guidelines for Environmental Noise Impact Assessment', produced* by IEMA, address the key principles of noise impact assessment and are applicable to all development proposals where noise effects are likely to occur. The guidelines state that *"much noise measurement and quantification is concerned with the effect of noise which varies significantly with time".* The guidelines go on to state:

"Measuring in decibels means that a 3dB change is a doubling of the sound energy and a 10dB change is a tenfold increase. For sounds which are very similar in all but magnitude, a change or difference of 1dB is just perceptible under laboratory conditions, 3dB is perceptible under most normal conditions and a 10dB increase appears to be twice as loud."

14.51 The guidelines also provide specific support on how noise impact assessments fit within the EIA process. They cover:

- how to scope a noise assessment;
- issues to be considered when defining the background noise environment;
- prediction of changes in noise levels as a result of implementing development proposals; and
- definition and evaluation of the significance of the effects of changes in noise levels.

14.52 The key terms within this assessment, which are relevant to the EIA process, are 'sensitivity' and 'significance'. In accordance with the IEMA guidelines, the noise impact, the noise effect and the significance of the effect must be determined.

Sensitivity of Receptor

14.53 The significance of the noise effect would depend on the receptor type and its sensitivity to the noise impact. All identified NSRs within this assessment are residential properties; therefore, the sensitivity of these receptors is considered to be 'High'.

Statement of Significance

14.54 The significance of effects from short-term construction noise is made as follows, with reference to the guidance of BS5228-1:2009+A1:2014:

- where construction noise levels at receptors are below the adopted daytime noise limit of 70dB L_{Aeq}, this is determined to be 'not significant'; and
- where construction noise levels at receptors are above the adopted daytime noise limit of 70dB L_{Aeq}, this is determined to be 'significant'.

14.55 The significance of effects from short-term construction traffic noise is made as follows, with reference to the guidance of DMRB:

- where the increase in existing noise levels (due to construction traffic) is predicted to be less

than 1dB, this is determined to be 'not significant'; and

- where the increase in existing noise levels (due to construction traffic) is predicted to be more than 3dB, this is determined to be 'significant'.

14.56 These adverse effects, while important at a local scale, are temporary and would only occur during the anticipated construction period.

14.57 The assessment of the significance of effects from operational and cumulative (wind turbine) noise is made as follows, with reference to ETSU-R-97 and the IOA GPG:

- where operational and/or cumulative noise levels at receptors are below the relevant ETSU-R-97 noise limits, this is determined to be 'not significant'; and
- where operational and/or cumulative noise levels at receptors are above the relevant ETSU-R-97 noise limits, this is determined to be 'significant'.

Assumptions, Limitations and Confidence

14.58 A number of good practice environmental measures are usually in-built into the design of a proposed development (i.e. embedded mitigation), and these are assumed to be in place prior to any assessment of effects. In relation to operational noise, adverse operational and cumulative noise effects were intrinsic considerations in the design of the proposed development to avoid any long-term effects that could affect the planning consent of the proposed development and/or nearby noise-sensitive receptors. The proposed development has therefore been designed to ensure that effects from operational noise are not significant, mainly through siting of the turbines.

14.59 The assessment of construction and operational noise has been based on available published data for the associated noise sources. The noise predictions in this assessment have been undertaken using the proprietary software-based noise model CadnaA®, which implements the full range of UK calculation methods including BS5228-1:2009+A1:2014 and ISO 9613-2:1996.

14.60 With respect to the latter, the IOA GPG comments on several recent studies on noise propagation and states (at paragraph 4.1.4), *"the outcome of this research has demonstrated that the ISO 9613-2 standard in particular, which is widely used in the UK, can be applied to obtain realistic predictions of noise from onshore wind turbines during the worst-case propagation conditions".* The ISO 9613-2:1996 prediction framework takes into account the distance between the sound sources and the closest receptors and the amount of attenuation due to atmospheric absorption. The methodology also assumes downwind propagation, i.e. a wind direction that assists the propagation of sound from the source to receiver.

BASELINE CONDITIONS

14.61 The Site is located within Clashindarroch Forest and is predominantly covered in commercial forestry, with some areas of open moorland and ancient woodland. It is located approximately 6km south-west of Huntly and the surrounding area is generally rural in nature, populated with residential properties and farmsteads.

14.62 The Clashindarroch Wind Farm consists of 18 turbines and located within the 5km radius of the

proposed development study area and therefore, is considered under the cumulative noise impact assessment.

Identified Nearest Noise Sensitive Receptors

14.63 The NSRs identified within this assessment are those residential properties within 5km of the proposed turbine locations. Noise levels are predicted to a location representative of each outdoor amenity area rather than the façade of the residential property. This is to ensure the continued protection of amenity of outdoor areas and in line with the IOA GPG which states (at paragraph 4.3.8) that *"calculations should be made at points representative of the relevant outdoor amenity area (as defined in ETSU-R-97) at locations nearest to the proposed wind farm development"*.

14.64 Table 14-2 details the identified NSRs for the assessment of construction, operational and cumulative noise.

Table 14-2
Noise Sensitive Receptors

NSR ID	NSR Name	Distance to Closest Turbine, km (Turbine ID)	Direction to Closest Turbine	OS Grid Coordinates (NGR)[4]	
				Easting	Northing
H1	Blackmiddens	6.0 (T2)	North	342580	826010
H2	Glack	4.4 (T5)	North	345655	827491
H3	Boganclogh Lodge	2.3 (T2)	North	343595	829381
H4	Boganclogh	2.5 (T2)	North	343608	829466
H5	Old Merdrum	3.2 (T14)	West	346707	829860
H6	Finglenny	1.9 (T5)	West	345668	830574
H7	Corrylair	1.7 (T6)	West	346337	834028
H8	Drumfergue	2.6 (T6)	West	347369	834017
H9	Wood of Drumfergue	3.3 (T6)	West	348109	834084
H10	Coynachie	4.4 (T6)	West	349056	834231
H11	Wester Tillathrowie	2.5 (T6)	West	346772	834733
H12	Tillathrowie	2.8 (T6)	West	347038	835093
H13	Whitestone of Tillathrowie	3.9 (T6)	West	347938	835441
H14	Bailiesward	4.5 (T6)	South	347037	837116
H15	Lower Gordonsburn	5.4 (T6)	South	347345	838141
H16	Cairnargat Steading	5.8 (T1)	South	345601	839285

[4] National Grid Reference, as used for the prediction of construction and operational noise.

NSR ID	NSR Name	Distance to Closest Turbine, km (Turbine ID)	Direction to Closest Turbine	OS Grid Coordinates (NGR)[4]	
				Easting	Northing
H17	Malach	5.5 (T1)	South	345380	838748
H18	Drumduan	4.9 (T1)	South	344376	838583
H19	Westerpark	4.6 (T1)	South	343739	838249
H20	Playlands	4.4 (T1)	South	343423	837990
H21	Netherton	4.3 (T1)	South	342993	837642
H22	Deveron Way	3.9 (T1)	South	342924	837352
H23	Auchinhandoch	3.5 (T1)	South	342581	836831
H24	Howemill	2.8 (T1)	South	342748	836149
H25	Succoth	2.3 (T1)	South	342798	835420
H26	Meikle Gouls	2.2 (T8)	South	341956	834795
H27	Tomnaven	2.8 (T12)	East	340488	833501
H28	Hillock of Echt	3.1 (T12)	North	339875	832440
H29	Oldtown of Corinacy	3.3 (T12)	North	339740	832440
H30	Pyke	3.7 (T12)	East	339280	831934
H31	Haddoch	5.9 (T12)	North	339410	827330
H32	Upper Howbog	6.3 (T13)	North	340237	826326
H33	Nether Howbog	6.9 (T2)	North	340480	825600
H34	Elrick	6.2 (T2)	North	342099	825843
H35	Broomhill Cottage	3.6 (T5)	North	344930	828155
H36	Bruntland	3.8 (T5)	North	345479	828149
H37	Brae of Essie	4.4 (T5)	North	346128	828183
H38	Milton of Lesmore	4.4 (T5)	North	346792	828637
H39	New Merdrum	3.5 (T5)	North	346167	828874
H40	Mytice	3.5 (T5)	West	347464	830991
H41	Clashindarroch	3.9 (T14)	West	348397	831687

Background Noise Monitoring Clashindarroch Wind Farm

14.65 Background noise monitoring, for the purposes of deriving the operational daytime and night-time noise limits for Clashindarroch Wind Farm was undertaken as part of the April 2009 planning application for that development[5]. These noise limits, as detailed in Condition 24 of the Clashindarroch Wind Farm extant planning permission (reference APP/2009/1380), are as follows:

"At wind speeds not exceeding 12m/s (as measured or calculated at a height of 10m above ground level, at the location of one of the turbines), the wind turbine noise level, when measured at any dwelling, shall not exceed:

During night hours, 38dB $L_{A90,10min}$ or the night hours $L_{A90,10min}$ background noise level plus 5dB(A), whichever is the greater.

During daytime hours, 35dB $L_{A90,10min}$ or the daytime hours $L_{A90,10min}$ background noise level plus 5dB(A), whichever is the greater."

Consented Operational Noise Limits

14.66 Based on the information provided on the measured background noise levels (as per Chapter 18 of the HM report), the consented daytime and night-time noise limits are as detailed in Table 14-3 for H3 (Boganclogh Lodge) and H4 (Boganclogh), which are considered to be representative of noise-control-properties as they are the nearest and most affected NSRs.

Table 14-3
Consented Noise Limits for Clashindarroch Wind Farm H3 and H4

	10m Height Wind Speed, m/s									
	3	4	5	6	7	8	9	10	11	12
Daytime										
Daytime Background Noise Level, L_{A90} *($y = -0.0004x^4 + 0.013x^3 – 0.0416x^2 – 0.1452x + 35.144$)*	34.7	34.6	34.8	35.1	35.6	36.3	37.3	38.5	40.0	41.6
Daytime Background Noise Level + 5dB	39.7	39.6	39.8	40.1	40.6	41.3	42.3	43.5	45.0	46.6
Derived Daytime Noise Limit, L_{A90} *35dB L_{A90} or Background Noise Level + 5dB*	39.6*	39.6	39.8	40.1	40.6	41.3	42.3	43.5	45.0	46.6
Night-time										
Night-time Background Noise Level, L_{A90} *($y = -0.0008x^4 + 0.0252x^3 –$*	33.4	33.4	33.5	33.9	34.5	35.4	36.7	38.2	40.0	42.0

[5] Undertaken by Hayes McKenzie Partnership Ltd

	10m Height Wind Speed, m/s									
	3	4	5	6	7	8	9	10	11	12
$0.144x^2 + 0.1913x + 33.482$)										
Night-time Background Noise Level + 5dB	38.4	38.4	38.5	38.9	39.5	40.4	41.7	43.2	45.0	47.0
Derived Night-time Noise Limit, L_{A90} *38dB L_{A90} or Background Noise Level + 5dB*	38.4	38.4	38.5	38.9	39.5	40.4	41.7	43.2	45.0	47.0
*Note that the limit for a lower wind speed was not increased even though a higher background was measured.										

14.67 The consented daytime and night-time noise limits as presented in Table 14-3 have been referenced for the assessment of the proposed development and the cumulative noise assessment. In accordance with Aberdeenshire Council's SGN, for the purposes of this assessment it has been assumed that the Clashindarroch Wind Farm operates at a noise level equal to these consented noise limits, i.e. *"operating to full capacity of their consented noise limits"*.

Background Noise Survey Clashindarroch II Wind Farm

14.68 Following preliminary consultation with Aberdeenshire Council, additional background noise monitoring was undertaken at two locations identified as the nearest NSR to the proposed development, during March and April 2019, to enable the cumulative noise impact assessment and compliance with the consented noise limits for the study area.

14.69 The additional survey locations are shown in Figure 14-1.

14.70 The two survey locations, survey periods and observations are described as follows:

- **Finglenny (H6)** – Noise levels were measured continuously from 11th March to 1st April 2019 within a garden area to the east of this property, where the background noise was observed to comprise birdsong within the nearfield, noise from a distant stream and some occasional vehicle movements from forestry operations. It is believed that due to its location, this receptor would record noise immission from Clashindarroch Wind Farm.

- **Corrylair (H7)** – Noise levels were measured continuously from 11th to 31st March 2019 within a rear garden area to the north of this property, where the background noise was observed to be low comprising of faint noise from a stream and birdsong. This receptor is believed to be well sheltered from Clashindarroch Wind Farm noise immission.

14.71 The approximate survey locations are presented in Figure 14.1 and the approximate grid reference in Table 14-4.

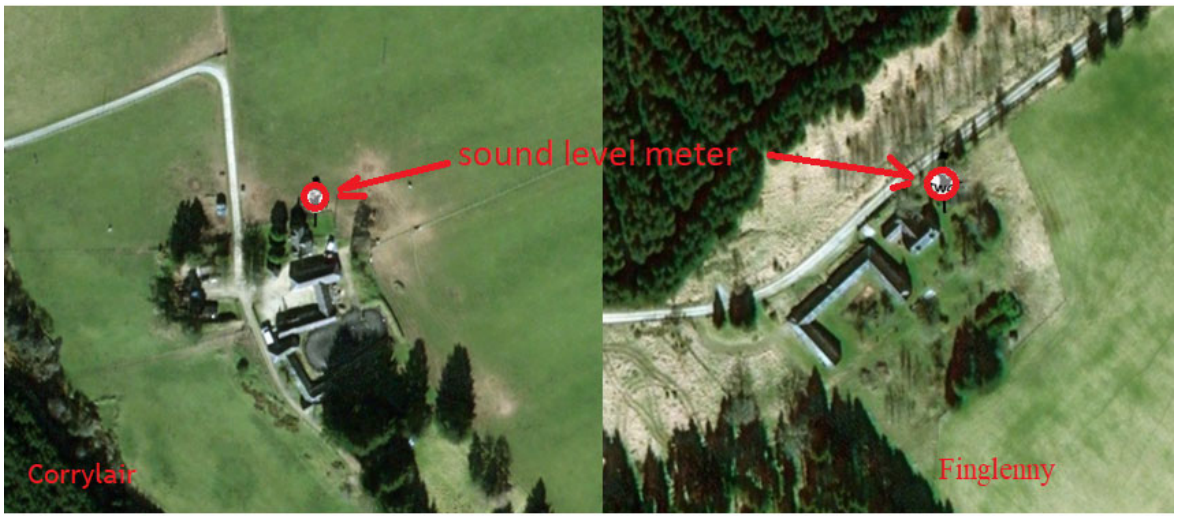

Figure 14-1
Survey Locations

Table 14-4
Approximate Background Noise Survey Locations

NSR ID	NSR Name	OS Grid Coordinates (NGR)[6]	
		Easting	Northing
H6	Finglenny	345673	830601
H7	Corrylair	346367	834139

14.72 The survey equipment (Rion NL-52 sound level meters and a Rion NC-74 calibrator) which has been used is categorised as Class 1, as specified in IEC 61672-1:2013. The sound level meters were calibrated before and after the survey period at each location, and no significant deviations were noted. The UKAS calibration certificates can be provided on request.

14.73 The sound level meters and enhanced outdoor kits were installed within an area representative of the garden (or equivalent amenity area) of each property. In accordance with paragraph 2.5.2 of the IOA GPG, each survey location reflected the *"typical"* or *"indicative"* levels of background noise for that property.

14.74 All measurements were made with the microphone mounted on a pole at approximately 1.5m above the ground, located more than 3.5m away from vertical reflecting surfaces, but still within 20m of the property. Each microphone was used with a Rion WS-10 windshield which maintains the Class 1 specifications when in place and minimises wind-induced turbulence at the microphone.

14.75 Rainfall was logged (in 10-minute periods) using a rain gauge which was located adjacent to the sound level meter at Corrylair (H7).

14.76 In order to correlate the background noise measurements with wind speed, as per the ETSU-R-97

[6] National Grid Reference, as used for the prediction of construction and operational noise.

guidance, meteorological data was obtained from an onsite mast. Wind speeds were measured at a height of 109m (close to the 110m proposed hub height), and this data was used to derive the standardised 10m height average 10-minute wind speeds, as per the guidance of the IOA GPG (paragraph 2.6.2).

14.77 The measured background noise levels are presented using a series of scatter graphs reproduced in the following Figure 14-2 to Figure 14-5. Each scatter graph for each location shows the background noise level (L_{A90}), logged in 10-minute periods, and the standardised 10m height wind speed for comparison.

14.78 An analysis of the measured background noise levels is required in order to derive the operational noise limits in accordance with ETSU-R-97 and the IOA GPG. The measured background noise is separated into amenity (or quiet daytime) hours and night-time hours. Amenity is defined as 18.00 to 23.00 hours on all weekdays, as well as 13.00 to 23.00 on Saturdays and 07.00 to 23.00 on Sundays. Night-time is defined as the period between 23.00 and 07.00 on all days.

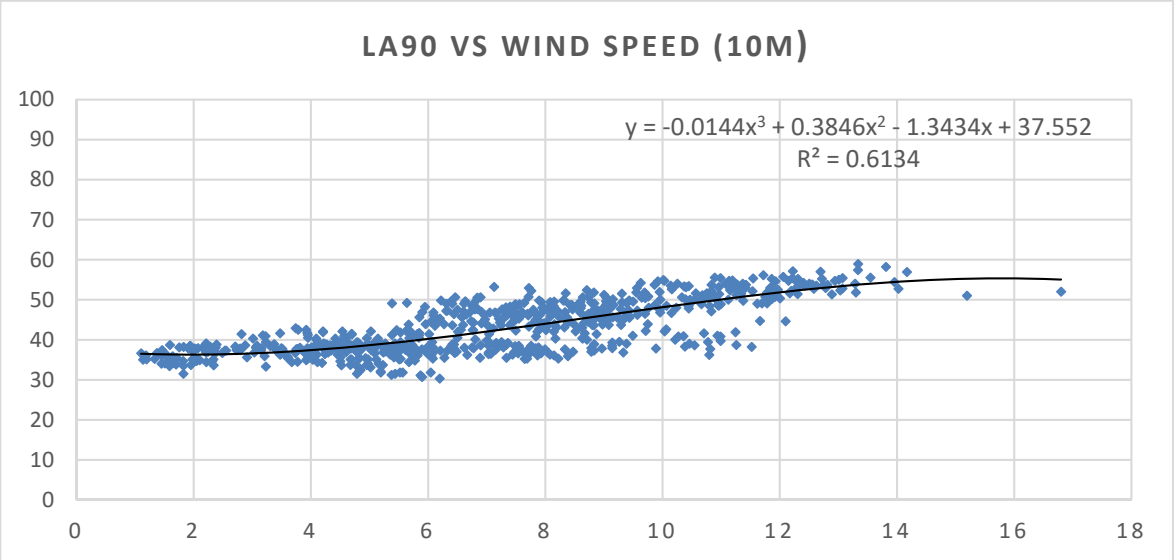

Figure 14-2
H6 - Finglenny daytime survey results

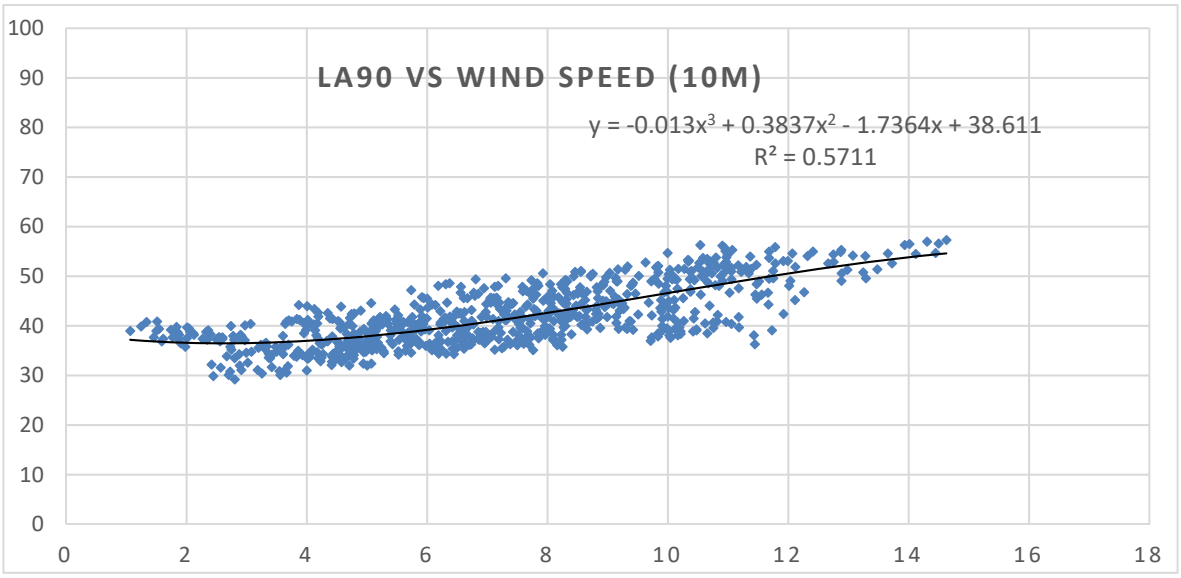

Figure 14-3
H6 - Finglenny Night-time Survey Results

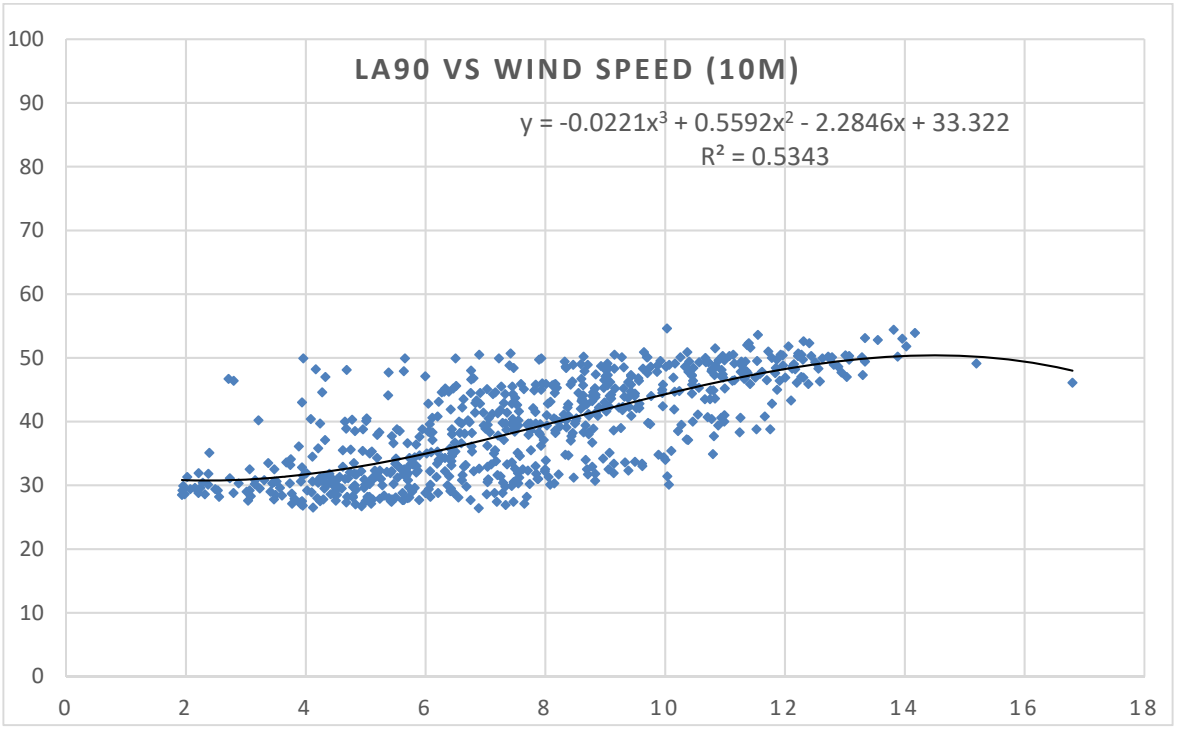

Figure 14-4
H7 - Corrylair Daytime Survey Results

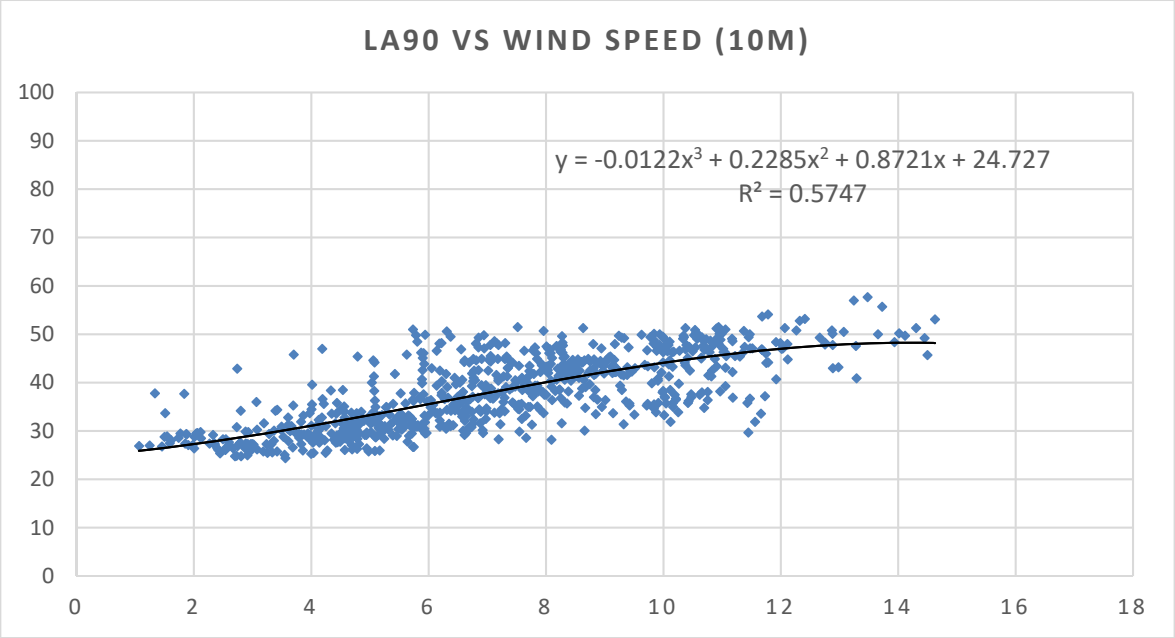

Figure 14-5
H7 - Corrylair Night-time Survey Results

14.79 For both survey locations, during the daytime and night-time hours, it is shown that the background noise rises with wind speed. This is expected for these locations, being within a rural area with minimum influence from extraneous noise sources. The regression analysis also shows similar background noise levels during both the daytime and night-time periods, again indicating a correlation with wind speeds and less influence from other noise sources.

14.80 The measured background noise from both locations contains a sufficient number of data points to establish noise limits between 3m/s and 12m/s, i.e. between cut-in and the speed at which the maximum sound power level is achieved. As per the IOA GPG (paragraph 2.9.5), the data contains *"no fewer than 200 data points for each of the amenity hours and night-time periods in the wind speed range required, and no fewer than five data points in each 1m/s wind speed 'bin' within this range"*.

14.81 Third order polynomials have been used for the data collected at both locations. As per the IOA GPG (paragraph 3.1.1.9), this *"should provide sufficient information to allow a reasonable representation of the prevailing background noise levels during the survey period"*.

14.82 Each of the two survey locations used are only representative of the residential property at that location. For the remaining NSRs shown in Table 14-10, a simplified noise limit of 35dB L_{A90} has been adopted in line with the ETSU-R-97 guidance, and no further evaluation is necessary.

Table 14-5
Measured Noise Levels at H6 (Finglenny)

	10m Height Wind Speed, m/s									
	3	4	5	6	7	8	9	10	11	12
Daytime										
Daytime Background Noise Level, L_{A90} *($y = -0.0144x^3 + 0.3846x^2 – 1.3434x + 37.552$)*	36.6	37.4	38.7	40.2	42.1	44.0	46.1	48.2	50.1	51.9
Night-time										
Night-time Background Noise Level, L_{A90} *($y = -0.013x^3 +0.3837x^2 – 1.7364x + 38.611$)*	36.5	37.0	37.9	39.2	40.8	42.6	44.6	46.6	48.6	50.6

Table 14-6
Measured Noise Levels at H7 (Corrylair)

	10m Height Wind Speed, m/s									
	3	4	5	6	7	8	9	10	11	12
Daytime										
Daytime Background Noise Level, L_{A90} *($y = -0.0221x^3 + 0.5592x^2 – 2.2846x + 33.3222$)*	30.9	31.7	33.1	35.0	37.2	39.5	41.9	44.3	46.4	48.2
Night-time										
Night-time Background Noise Level, L_{A90} *($y = -0.0122x^3 +0.2285x^2 + 0.8721x + 24.727$)*	29.1	31.1	33.3	35.6	37.8	40.1	42.2	44.1	45.7	47.0

14.83 The following tables presents the evaluation of the derived noise limit at H6 and H7.

Table 14-7
Derived Noise Levels at H6 receptor

	10m Height Wind Speed, m/s									
	3	4	5	6	7	8	9	10	11	12
Daytime										
Daytime Background Noise Level	36.6	37.4	38.7	40.2	42.1	44	46.1	48.2	50.1	51.9
Derived Daytime Noise Limit, L_{A90} *35dB L_{A90} or Background Noise Level + 5dB*	41.6	42.4	43.7	45.2	47.1	49	51.1	53.2	55.1	56.9
Night-time										
Night-time Background Noise Level, L_{A90}	36.5	37.0	37.9	39.2	40.8	42.6	44.6	46.6	48.6	50.6
Derived Night-time Noise Limit, L_{A90} *38dB L_{A90} or Background Noise Level + 5dB*	41.5	42.0	42.9	44.2	45.8	47.6	49.6	51.6	53.6	55.6

14.84 Receptor H6 is in relatively close proximity to receptors H3 and H4 (as shown in Figure 14-6), however the derived limit is considered significantly higher at this receptor compared with the consented noise limit for the Clashindarroch Wind Farm. It is considered that noise from the operation of Clashindarroch could have impacted on the measurement results.

14.85 Therefore, as a precautionary measure, the noise impact assessment carried out at H6 is based on the consented noise limits for the Clashindarroch Wind Farm.

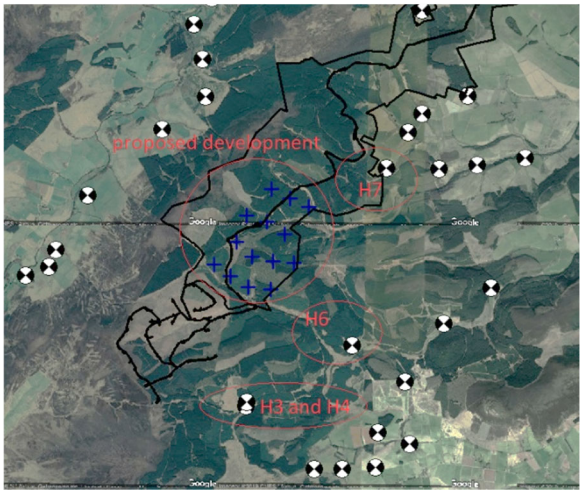

Figure 14-6
Identified NSRs

Table 14-8
Derived Noise Levels at H7 receptor

	10m Height Wind Speed, m/s									
	3	4	5	6	7	8	9	10	11	12
Daytime										
Daytime Background Noise Level, L_{A90}	30.9	31.7	33.1	35	37.2	39.5	41.9	44.3	46.4	48.2
Derived Daytime Noise Limit, L_{A90} *35dB L_{A90} or Background Noise Level + 5dB*	35.9	36.7	38.1	40.0	42.2	44.5	46.9	49.3	51.4	53.2
Night-time										
Night-time Background Noise Level, L_{A90}	29.1	31.1	33.3	35.6	37.8	40.1	42.2	44.1	45.7	47.0
Derived Night-time Noise Limit, L_{A90} *38dB L_{A90} or Background Noise Level + 5dB*	38.0	38.0	38.3	40.6	42.8	45.1	47.2	49.1	50.7	52.0

ASSESSMENT OF EFFECTS

Construction Work Effects

14.86 Any development of a nature such as the proposed development has the potential to generate noise during the construction phase, should appropriate mitigation not be employed. However, disruption due to construction noise is a localised phenomenon, and is both temporary and intermittent in nature.

14.87 The techniques available to predict the likely noise effects from construction are necessarily based on quite detailed information on the type and number of plant being used, their location within the Site and the length of time they are in operation. Based on available information at the time of the assessment and past experience of wind farm developments, the likely construction plant has been assumed for each task as detailed in Table 14-9. Predictions of construction noise have been based on the corresponding 10m Sound Pressure Levels (SPLs) listed in Annex C of BS5228-1:2009+A1:2014.

Table 14-9
Octave Band Noise Level Data for Construction Activities (SPL at 10m), dB

BS5228 Reference	Activity / Plant	Octave Band Frequency, Hz							
		63	125	250	500	1000	2000	4000	8000
Construction Compound									
C.4, 78	Diesel Generator	64	67	68	65	58	54	49	42
Concrete Batching									
C.2, 45	Water Pump	73	68	62	62	61	56	53	41
C.4, 22	Large Concrete Mixer	72	73	79	72	69	67	63	60
C.4, 29	Concrete Pump & Boom Arm	83	77	75	75	74	75	67	63
	All plant combined	**84**	**79**	**81**	**77**	**75**	**76**	**69**	**65**
Mobile Plant (5 movements per hour)									
C.2, 14	Tracked Excavator	85	78	77	77	73	71	68	63
C.9, 8	Wheeled Loader	89	88	85	83	82	81	73	67
	All plant combined	**90**	**88**	**85**	**83**	**82**	**81**	**73**	**67**
Base of Turbine & Battery Storage									
C.2, 11	Dozer	75	79	77	77	74	71	65	57
C.2, 14	Tracked Excavator	85	78	77	77	73	71	68	63
C.2, 31	Dump Truck	86	79	79	79	79	84	69	60
C.4, 27	Concrete Mixer Truck	84	74	74	73	73	75	65	59
C.4, 50	Mobile Crane	68	71	68	62	66	66	55	46
C.4, 52	Mobile Crane	73	71	66	67	74	66	58	49
	All plant combined	**90**	**84**	**83**	**83**	**82**	**85**	**73**	**66**
Borrow Pit									
C.1, 45	Tracked Crusher	93	86	79	81	75	71	66	59
C.2, 11	Dozer	75	79	77	77	74	71	65	57
C.2, 14	Tracked Excavator	85	78	77	77	73	71	68	63
C.2, 31	Dump Truck	86	79	79	79	79	84	69	60
	All plant combined	**94**	**88**	**84**	**85**	**82**	**85**	**73**	**66**

14.88 In order to model barrier attenuation from local topography, Ordnance Survey *'Terrain 5'* data has been incorporated into the noise model; however, barrier attenuation from man-made structures (i.e. buildings) has not been considered.

14.89 The predicted construction noise levels have assumed that all items of plant and all activities would

operate and occur simultaneously; however, it is likely that plant would operate for much shorter periods during the construction phase, resulting in lower noise levels.

14.90 Table 14-10 presents the maximum noise level expected from the simultaneous operation of all anticipated plant and construction activities, as well as those activities associated with the construction compound, battery storage and borrow pit.

Table 14-10
Predicted Construction Noise Levels, dB

NSR ID	NSR Name	Predicted Noise Level, L_{Aeq}
H1	Blackmiddens	20.5
H2	Glack	24.1
H3	Boganclogh Lodge	20.8
H4	Boganclogh	20.6
H5	Old Merdrum	30.0
H6	Finglenny	26.4
H7	Corrylair	44.8
H8	Drumfergue	30.7
H9	Wood of Drumfergue	27.3
H10	Coynachie	34.7
H11	Wester Tillathrowie	47.6
H12	Tillathrowie	42.5
H13	Whitestone of Tillathrowie	38.3
H14	Bailiesward	49.4
H15	Lower Gordonsburn	37.5
H16	Cairnargat Steading	28.5
H17	Malach	19.0
H18	Drumduan	19.7
H19	Westerpark	18.1
H20	Playlands	16.8
H21	Netherton	16.5
H22	Deveron Way	16.5
H23	Auchinhandoch	17.1
H24	Howemill	18.7

NSR ID	NSR Name	Predicted Noise Level, L_{Aeq}
H25	Succoth	20.5
H26	Meikle Gouls	19.6
H27	Tomnaven	17.2
H28	Hillock of Echt	16.8
H29	Oldtown of Corinacy	17.2
H30	Pyke	17.3
H31	Haddoch	18.2
H32	Upper Howbog	17.8
H33	Nether Howbog	14.9
H34	Elrick	19.5
H35	Broomhill Cottage	21.3
H36	Bruntland	23.3
H37	Brae of Essie	21.6
H38	Milton of Lesmore	21.4
H39	New Merdrum	25.0
H40	Mytice	20.3
H41	Clashindarroch	18.6

14.91 The predicted construction noise levels have been assessed against an external daytime criterion of 70dB L_{Aeq}. The predicted noise levels from all assumed construction plant and activities are shown to be comfortably below the adopted criterion of 70dB L_{Aeq} and therefore effects would be **Not Significant**. No further evaluation has been undertaken; however, the Best Practice Measures section presents the Best Practicable Means that should be adopted during construction and decommissioning work.

Best Practice Measures

14.92 The adoption of Best Practicable Means is the most effective means of controlling noise from construction sites. The precise noise mitigation measures to control noise from construction activities, with respect to the proposed development, may require agreement with the Aberdeenshire Council prior to the works starting. However, generic measures are provided below to illustrate the range of techniques available:

- all roads would be kept clean and maintained in a good state of repair to avoid unwanted rattle from vehicles;
- materials would be handled in a manner that minimises noise;

- all plant would have noise emission levels that comply with the limiting levels defined in EC Directive 2000/14/EC (Ref. 14.15) (and UK Statutory Instrument 2001/1701 (Ref. 14.16)), and any subsequent amendments;
- consideration would be given to the recommendations set out in Annex B of BS5228-1:2009+A1:2014 with respect to noise sources, remedies and their effectiveness;
- plant would be operated in a proper manner with respect to minimising noise emissions, i.e. minimisation of drop heights, no unnecessary revving of engines, etc.;
- plant would be started up sequentially rather than all at once;
- plant would be subject to regular maintenance and kept in good working order to meet manufacturers' noise rating levels;
- plant that is used intermittently would be shut down when not in use;
- vehicles would not wait or queue on the public highway with engines idling; and
- reversing alarms would incorporate one of the following features where practicable – directional sounders, broadband signals, self-adjusting sounders or flashing warning lights. Alternative and comparable systems could be used to minimise noise and nuisance from reversing alarms.

14.93 Experience from other sites has shown that by implementing these measures, typical noise levels from construction activities could be reduced by 5dB or more. Problems concerning noise from construction works can sometimes be avoided by taking a considerate and neighbourly approach to relations with local residents. Works should not be undertaken outside the hours agreed with the local authority.

14.94 The potential noise and vibration effects of blasting operations would be reduced according to the guidance set out in the relevant British Standards and PAN50 Annex D:

- blasting should take place under controlled conditions with the agreement of the relevant authorities, at regular times within the working week, that is, Mondays to Fridays, between the hours of 10:00 and 16:00. Blasting on Saturday mornings should be a matter for negotiation between the contractor and the council;
- blasting operations would need to adhere to good practice as set out in BS 5228-2, and in PAN50, Annex D, Paragraph 95 in order to control air overpressure; and
- a scheme would be submitted to the council, for approval of blasting details, which will outline the mitigation measures to be adopted.

Residual Effects

14.95 As construction works are temporary and noise levels have been predicted for a worst-case situation, no further mitigation measures are considered necessary. The predicted noise levels from all assumed construction plant and activities are shown to be below the adopted criterion of 70dB L_{Aeq}, and as such, the effect of construction noise is predicted to be **Not Significant**.

Construction Traffic Effects

14.96 Additional traffic generated during the construction phase is referred to in Chapter 13: Highways, Traffic and Transport. The traffic assessment relates to the two-way traffic generated along the proposed transport route required to deliver construction materials and turbine components and considers both the maximum and average trip generation expected over the construction period.

14.97 The daily (12-hour) traffic flows on each road section, for 'baseline' and 'baseline + development', are shown in Table 14-6. This shows the predicted increase in traffic flows (Heavy Goods Vehicles (HGVs) and total traffic) and the figures are referenced to Table 13-10 of Chapter 13: Highways, Traffic and Transport. The baseline traffic flows are those observed on an average weekday over a 12-hour period between 07.00 and 19.00 hours.

Table 14-11
Construction Traffic – 12 Hour Flows

Link & Road Section	Trip Case	Scenario	HGV	Total
1 – A920, east of Site	Maximum day	Baseline	283	1,943
		Baseline + Development	357	2,142
		Increase	**26%**	**10%**
	Average day	Baseline	283	1,943
		Baseline + Development	310	2,120
		Increase	**10%**	**9%**
2 – A96, north of A96/A920 junction	Maximum day	Baseline	1,120	7,007
		Baseline + Development	1,157	7,104
		Increase	**3%**	**1%**
	Average day	Baseline	1,120	7,007
		Baseline + Development	1,134	7,081
		Increase	**1%**	**1%**

14.98 According to DMRB, *"a change in noise level of 1dB is equivalent to a 25% increase or 20% decrease in traffic flow"*. This change in noise level, in accordance with the IEMA guidelines, equates to a difference which is just perceptible under laboratory conditions; however, a change or difference of 3dB is perceptible under most normal conditions.

14.99 By comparing the 'baseline' and 'baseline + development' flows, it can be seen that the increase in HGVs would generally be below 25%, except when maximum trip generation is expected during the construction period, corresponding to an increase in HGVs of 26% on the A920 east of the Site.

14.100 This predicted increase of 26% in HGVs (for maximum trip generation) is marginally in excess of the 25% threshold quoted in DMRB for a noise level change of 1dB. The maximum predicted increase in construction traffic is therefore likely to result in a noise level change marginally in excess of 1dB,

but lower than 3dB. A change of less than 3dB would not be perceptible under normal conditions[7] and therefore the effect of traffic associated with the construction period is predicted to be **Not Significant.**

Operational Effects

14.101 The proposed grid location of the turbines, as used within the CadnaA® noise model, are shown in Table 14-12.

Table 14-12
Proposed Development Turbine Locations

Turbine ID	OS Grid Coordinates (NGR)	
	Easting	Northing
T1	344086	833617
T2	343640	831705
T3	343415	832583
T4	344357	832735
T5	344076	831659
T6	344821	833268
T7	344002	832977
T8	343603	833107
T9	344460	833440
T10	344118	832206
T11	343713	832298
T12	342964	832151
T13	343286	831912
T14	344533	832177

Candidate Wind Turbine Model

14.102 The Nordex N133/4.8 wind turbine has been selected as the candidate turbine for the noise assessment and is considered a worst-case turbine in terms of noise levels produced by a turbine of the scale of that proposed for the wind farm. The turbine hub height used for the assessment is 110m.

[7] Reiterated in PAN 1/2011 (paragraph 5), where it states that *"for noise of a similar character, a change of 3dB(A) is the minimum perceptible under normal conditions".*

14.103 Noise emission data for this turbine model has been derived from a technical document[8] supplied by the manufacturer. A copy is provided in Technical Appendix 14.2: Candidate Turbine Data.

14.104 The noise emission data for the candidate turbine is available in octave band spectra analysis converted to the 10m height reference conditions, (roughness 0.05m) with wind speeds of 3m/s to 12m/s inclusive and corresponds to the turbine in its normal mode of operation, i.e. "Mode 0".

Candidate Wind Turbine Noise

14.105 The octave band sound power level data for the purposes of the operational noise propagation model is presented in Table 14-13, which includes a +2dB correction for measurement uncertainty. The overall broadband noise level is also shown for each integer wind speed.

Table 14-13
Standardised Octave Band and Broadband Noise Level Data for Nordex N133/4.8 turbine, (dBA)

Hub Height Wind Speed, m/s	Frequency, Hz								Overall Broadband Level*
	63	125	250	500	1000	2000	4000	8000	
3	78.5	85.5	90.0	91.3	91.1	88.6	82.9	71.8	97.0
4	80.0	87.0	91.5	92.8	92.6	90.1	84.4	73.3	98.5
5	84.0	91.1	95.9	98.3	98.9	96.4	88.9	76.6	104.0
6	88.2	95.3	100.1	102.5	103.1	100.6	93.1	80.8	108.2
7	89.5	96.6	101.4	103.8	104.4	101.9	94.4	82.1	109.5
8	91.0	96.8	100.0	102.4	104.3	103.4	98.0	84.2	109.5
9	91.0	96.8	100.0	102.4	104.3	103.4	98.0	84.2	109.5
10	91.0	96.8	100.0	102.4	104.3	103.4	98.0	84.2	109.5
11	91.0	96.8	100.0	102.4	104.3	103.4	98.0	84.2	109.5
12	91.0	96.8	100.0	102.4	104.3	103.4	98.0	84.2	109.5

*logarithmic sum of octave band data, corresponding to the published broadband noise level for each integer wind speed, including a +2dB correction for measurement uncertainty.

14.106 The assessment of operational noise has considered the effect of the intervening ground profile between the proposed turbines and each identified receptor, as per the IOA GPG, which states (at paragraph 4.3.9):

"A further correction of +3dB should be added to the calculated overall A-weighted noise level for propagation 'across a valley', i.e. a concave ground profile, or where the ground falls away significantly, between the turbine and receiver location.

[8] Nordex N133/4.8, Octave Sound Power Levels, Report F008_272_A14_EN Revision 01, 2018-07-24

The following criterion of application is recommended:

$$H_m \geq 1.5 \times (abs\ (h_s - h_r) / 2)$$

Where hm is the mean height above the ground of the direct line of sight from the receiver to the source, and h_s and h_r are the heights above local ground level of the source and receiver respectively."

14.107 Using topographic data at a resolution of 5m, along with the location of the proposed turbines and the identified receptors, it is found that the +3dB penalty is applicable for a number of turbines and receptors as detailed in Table 14-14.

Table 14-14
Requirement for +3dB Penalty for Individual Turbines at NSRs (indicated by x)

Turbine ID	H1 – Blackmiddens	H5 – Old Merdrum	H13 – Whitestone of Tillathrowie	H39 – New Merdrum
T1		x		
T2				
T3				
T4				
T5				
T6				
T7				
T8				
T9				
T10			x	
T11	x		x	x
T12		x		
T13		x		
T14			x	

14.108 In the assessment, all receptor heights were set to 4m, as recommended in the IOA GPG (paragraph 4.3.8) as "it has the effect of reducing the potential over-sensitivity of the calculation to the receiver region ground factor compared to lower receiver heights".

Proposed Development Predicted Operational Noise Levels

14.109 The predicted noise levels (L_{A90}) at the identified receptors due to the operation of the proposed development are presented numerically in Table 14-15. The predicted noise immission levels shown in Table 14-15 include the +3dB penalty for individual turbines where applicable.

Table 14-15
Predicted Operational Noise Levels, dB L_{A90}

NSR ID	NSR Name	10m Height Wind Speed, m/s									
		3	4	5	6	7	8	9	10	11	12
H1	Blackmiddens*	14	15.5	20	23.7	25.5	25.3	25.3	25.3	25.3	25.3
H2	Glack	13.9	15.4	20	23.8	25.5	25.1	25.1	25.1	25.1	25.1
H3	Boganclogh Lodge	20.9	22.4	27.3	31	32.8	32.1	32.1	32.1	32.1	32.1
H4	Boganclogh	21.3	22.8	27.7	31.4	33.2	32.5	32.5	32.5	32.5	32.5
H5	Old Merdrum*	20.9	22.4	27.1	31.1	32.6	32	32	32	32	32
H6	Finglenny	22.9	24.4	29.4	33.3	34.9	34.2	34.2	34.2	34.2	34.2
H7	Corrylair	22.8	24.3	29.4	33.4	34.9	34.1	34.1	34.1	34.1	34.1
H8	Drumfergue	18.7	20.2	25	29.1	30.5	29.9	29.9	29.9	29.9	29.9
H9	Wood of Drumfergue	16.4	17.9	22.6	26.6	28.1	27.5	27.5	27.5	27.5	27.5
H10	Coynachie	13.9	15.4	19.9	23.9	25.4	25	25	25	25	25
H11	Wester Tillathrowie	19.5	21	25.9	29.9	31.4	30.7	30.7	30.7	30.7	30.7
H12	Tillathrowie	17.9	19.4	24.2	28.3	29.7	29.1	29.1	29.1	29.1	29.1
H13	Whitestone of Tillathrowie*	18.1	19.6	24.3	28.3	29.8	29.3	29.3	29.3	29.3	29.3
H14	Bailiesward	13.7	15.2	19.8	23.8	25.3	24.9	24.9	24.9	24.9	24.9
H15	Lower Gordonsburn	11.4	12.9	17.4	21.4	22.9	22.6	22.6	22.6	22.6	22.6
H16	Cairnargat Steading	10.6	12.1	16.5	20.5	22	21.8	21.8	21.8	21.8	21.8
H17	Malach	11.7	13.2	17.7	21.7	23.2	23	23	23	23	23
H18	Drumduan	12.4	13.9	18.4	22.4	23.9	23.6	23.6	23.6	23.6	23.6
H19	Westerpark	13.2	14.7	19.2	23.2	24.7	24.3	24.3	24.3	24.3	24.3
H20	Playlands	13.7	15.2	19.8	23.8	25.3	24.9	24.9	24.9	24.9	24.9
H21	Netherton	14.4	15.9	20.5	24.5	26	25.5	25.5	25.5	25.5	25.5
H22	Deveron Way	15.1	16.6	21.2	25.2	26.7	26.2	26.2	26.2	26.2	26.2
H23	Auchinhandoch	16.2	17.7	22.4	26.4	27.9	27.3	27.3	27.3	27.3	27.3
H24	Howemill	18.3	19.8	24.7	28.7	30.2	29.5	29.5	29.5	29.5	29.5
H25	Succoth	21	22.5	27.5	31.5	33	32.3	32.3	32.3	32.3	32.3

NSR ID	NSR Name	10m Height Wind Speed, m/s									
		3	4	5	6	7	8	9	10	11	12
H26	Meikle Gouls	21.1	22.6	27.5	31.5	33	32.3	32.3	32.3	32.3	32.3
H27	Tomnaven	18.9	20.4	25.2	29	30.7	30	30	30	30	30
H28	Hillock of Echt	17.4	18.9	23.7	27.4	29.2	28.6	28.6	28.6	28.6	28.6
H29	Oldtown of Corinacy	17	18.5	23.2	26.9	28.7	28.1	28.1	28.1	28.1	28.1
H30	Pyke	15.6	17.1	21.8	25.5	27.3	26.7	26.7	26.7	26.7	26.7
H31	Haddoch	10.6	12.1	16.5	20.2	22	21.9	21.9	21.9	21.9	21.9
H32	Upper Howbog	10	11.5	15.9	19.6	21.4	21.2	21.2	21.2	21.2	21.2
H33	Nether Howbog	9	10.5	14.9	18.6	20.4	20.3	20.3	20.3	20.3	20.3
H34	Elrick	10.5	12	16.4	20.2	21.9	21.8	21.8	21.8	21.8	21.8
H35	Broomhill Cottage	16.1	17.6	22.3	26.1	27.8	27.3	27.3	27.3	27.3	27.3
H36	Bruntland	15.6	17.1	21.8	25.6	27.3	26.8	26.8	26.8	26.8	26.8
H37	Brae of Essie	15	16.5	21.1	25	26.6	26.2	26.2	26.2	26.2	26.2
H38	Milton of Lesmore	15.1	16.6	21.2	25.1	26.7	26.2	26.2	26.2	26.2	26.2
H39	New Merdrum*	19.6	21.1	25.8	29.7	31.3	30.7	30.7	30.7	30.7	30.7
H40	Mytice	17.8	19.3	24.1	28.1	29.6	29	29	29	29	29
H41	Clashindarroch	15.9	17.4	22	26	27.5	27	27	27	27	27
*penalty of +3dB applied for propagation 'across a valley' from individual turbines (as per Table 14-10)											

14.110 The summary of results indicates that the proposed development would comply with the simplified fixed 35dB noise limit at all identified receptors. However, further evaluation needs to be carried out to verify if the cumulative noise immission levels would still comply with the consented noise limit at H3, H4 and H6, the identified noise-control-properties for Clashindarroch Wind Farm, and the derived noise limits at H7.

Wind Farm Cumulative Noise Evaluation

14.111 In terms of cumulative effects, these are defined within the IEMA guidelines as *"those that result from additive impacts caused by other past, present or reasonably foreseeable actions together with the plan, programme or project itself and synergistic effects (in combination) which arise from the reaction between impacts or a development plan, programme or project on different aspects of the environment".*

14.112 ETSU-R-97 states the following in relation to cumulative noise at paragraph 16 of its Executive Summary:

"The Noise Working Group is of the opinion that absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area contributing to

the noise level received at the properties in question."

14.113 A cumulative operational noise assessment is therefore required where another wind turbine development could contribute to the noise level of the proposed wind farm, and the assessment should consider turbines which are operational, consented and/or within the planning application process. In this regard, the assessment has considered the cumulative effect of the proposed development when operating simultaneously with the operational Clashindarroch Wind Farm. Other proposed, consented and operational wind farms are located further away (i.e. at distances greater than 5km) and are therefore not considered to have a significant contribution to cumulative noise levels. A search radius of 5km is also in line with Aberdeenshire Council's SGN.

14.114 As per the IOA GPG (Section 5), and where appropriate, the cumulative noise assessment is based on daytime and night-time noise limits derived from measured background noise levels in accordance with ETSU-R-97, and these consented noise limits apply to all wind turbines operating cumulatively.

14.115 The IOA GPG goes on to state that if a proposed wind farm *"produces noise levels within 10dB of any existing wind farm(s) at the same receptor location, then a cumulative noise impact assessment is necessary"*. This is reiterated in the IOA GPG through reference to a report (Ref. 14.17) by Hayes McKenzie Partnership Ltd., whereby *"if an existing wind farm has permission to generate noise levels up to ETSU-R-97 limits, planning permission noise limits set at any future neighbouring wind farm would have to be at least 10dB lower than the limits set for the existing wind farm to ensure there is no potential for cumulative noise impacts to breach ETSU-R-97 limits (except in such cases where a higher fixed limit could be justified"*.

14.116 The following guidance is also provided in the IOA GPG with respect to the assessment of cumulative noise:

- *"In the first instance, the consented noise limits should be used within the cumulative noise impact calculations, unless otherwise agreed with the local authority"; and*
- *"It may be the case that the existing wind farm is not utilising the total ETSU-R-97 limits, and hence headroom might be present…for the development to proceed, the presented headroom needs to be maintained, permitted other mitigating factors such as critical controlling properties or significant separation distance are not relevant".*

14.117 The assessment of cumulative noise impact considers all proposed 14 turbines together with the 18 Clashindarroch Wind Farm turbines.

14.118 According to the ETSU-R-97, absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area contributing to the noise immission levels at the identified NSR. Therefore, the proposed 14 wind turbines, have been evaluated against the Clashindarroch Wind Farm consented noise limit at H3, H4 and H6. For H7 the derived noise limit has been utilised.

14.119 The locations of the Clashindarroch Wind Farm turbines are shown in Table 14-16.

Table 14-16
Clashindarroch Wind Farm – Turbine Locations

Turbine ID	OS Grid Coordinates (NGR)	
	Easting	Northing
T1	341828	829449
T2	341676	829803
T3	341421	830069
T4	341677	831253
T5	341648	830730
T6	341879	830337
T7	342096	829956
T8	342506	830261
T9	343016	830360
T10	342342	830618
T11	342141	830999
T12	342146	831465
T13	342875	830866
T14	342576	831261
T15	342973	831420
T16	342607	831729
T17	341281	830898
T18	341224	830424

14.120 As per Aberdeenshire Council's guidance, these turbines are assumed to be operating at a noise level equal to the consented noise limits derived from the measured daytime and night-time background noise (i.e. utilising the full ETSU-R-97 noise limits).

14.121 Table 14-17 reproduces the consented noise limits which are considered applicable to receptors H3, H4 and H6.

Table 14-17
Consented Derived Noise Limits for Clashindarroch Wind Farm

	10m Height Wind Speed, m/s									
	3	4	5	6	7	8	9	10	11	12
Daytime Noise Limit, L_{A90}	39.6	39.6	39.8	40.1	40.6	41.3	42.3	43.5	45.0	46.6
Night-time Noise Limit, L_{A90}	38.4	38.4	38.5	38.9	39.5	40.4	41.7	43.2	45.0	47.0

Cumulative Noise Impact Assessment

14.122 Table 14-18 presents the predicted cumulative daytime immission levels at the nearest identified properties to Clashindarroch Wind Farm and the proposed development, i.e. H3, H4, H6 and H7. The assessment is based on Clashindarroch operating at the consented limit and the predicted immission levels from the proposed development. It provides the likely margin above (+) or below (-) the consented operational noise limits.

Table 14-18
Margins Above (+) or Below (-) Consented Daytime Noise Limit, dB

NSR ID	NSR Name	10m Height Wind Speed, m/s									
		3	4	5	6	7	8	9	10	11	12
H3	**Boganclogh Lodge**										
	Proposed development	20.9	22.4	27.3	31	32.8	32.1	32.1	32.1	32.1	32.1
	Clashindarroch Wind Farm	39.6	39.6	39.8	40.1	40.6	41.3	42.3	43.5	45	46.6
	Cumulative Level	39.7	39.7	40.0	40.6	41.3	41.8	42.7	43.8	45.2	46.8
	Consented Noise Limit	39.6	39.6	39.8	40.1	40.6	41.3	42.3	43.5	45	46.6
	Difference	**0.1**	**0.1**	**0.2**	**0.5**	**0.7**	**0.5**	**0.4**	**0.3**	**0.2**	**0.2**
H4	**Boganclogh**										
	Proposed development	21.3	22.8	27.7	31.4	33.2	32.5	32.5	32.5	32.5	32.5
	Clashindarroch Wind Farm	39.6	39.6	39.8	40.1	40.6	41.3	42.3	43.5	45	46.6
	Cumulative Level	39.7	39.7	40.1	40.6	41.3	41.8	42.7	43.8	45.2	46.8
	Consented Noise Limit	39.6	39.6	39.8	40.1	40.6	41.3	42.3	43.5	45	46.6
	Difference	**0.1**	**0.1**	**0.3**	**0.5**	**0.7**	**0.5**	**0.4**	**0.3**	**0.2**	**0.2**

NSR ID	NSR Name	10m Height Wind Speed, m/s									
		3	4	5	6	7	8	9	10	11	12
H6	**Finglenny**										
	Proposed development	22.9	24.4	29.4	33.3	34.9	34.2	34.2	34.2	34.2	34.2
	Clashindarroch Wind Farm	39.6	39.6	39.8	40.1	40.6	41.3	42.3	43.5	45	46.6
	Cumulative Level	39.7	39.7	40.2	40.9	41.6	42.1	42.9	44.0	45.3	46.8
	Consented Noise Limit	39.6	39.6	39.8	40.1	40.6	41.3	42.3	43.5	45	46.6
	Difference	**0.1**	**0.1**	**0.4**	**0.8**	**1.0**	**0.8**	**0.6**	**0.5**	**0.3**	**0.2**
H7	**Corrylair**										
	Proposed development	22.8	24.3	29.4	33.4	34.9	34.1	34.1	34.1	34.1	34.1
	Clashindarroch Wind Farm	35.9	36.7	38.1	40	40.6	41.3	42.3	43.5	45	46.6
	Cumulative Level	36.1	36.9	38.6	40.9	41.6	42.1	42.9	44.0	45.3	46.8
	Derived Noise Limit	35.9	36.7	38.1	40	42.2	44.5	46.9	49.3	51.4	53.2
	Difference	**0.2**	**0.2**	**0.5**	**0.9**	**-0.6**	**-2.4**	**-4.0**	**-5.3**	**-6.1**	**-6.4**

14.123 The day-time assessment indicates that the cumulative noise immission level would exceed the derived or consented noise limits at all assessed locations by up to 1dB except at receptor H7 for wind speeds above 7m/s.

14.124 The assessment is based on the Clashindarroch Wind Farm operating at its consented noise limit at each of the assessment locations. However, a review of Chapter 18 of the Environmental Statement for the Clashindarroch Wind Farm indicates that predicted noise levels at Boganclough would be a minimum of 2.4dB below the lower day time limit (35dB LA90) during the daytime period and therefore not utilising the full ETSU-R-97 noise limits. As this is an operational wind farm it is considered reasonable to assume that this headroom would remain as it would be unlikely there would be a significant change in turbine model or layout.

14.125 For receptors H6 and H7, the noise immission levels from Clashindarroch Wind Farm would be controlled by receptors H3 and H4 resulting in significantly reduced levels at receptors H6 and H7. Furthermore, the predictions are based on downwind propagation from all wind turbines simultaneously. In reality this would not be the case based on turbine and receptor locations.

14.126 On this basis of the above, the actual noise immission levels at the receptors would be below that predicted. Notwithstanding this, there is headroom available for the proposed development to operate simultaneously with Clashindarroch Wind Farm within the consented noise limits.

14.127 Table 14-19 presents the predicted night-time immission levels at the nearest identified properties

to both wind farms, i.e. H3, H4, H6 and H7. It provides the likely margin above (+) or below (-) the consented operational noise limits.

Table 14-19
Margins Above (+) or Below (-) Consented Night-time Noise Limit, dB

NSR ID	NSR Name	10m Height Wind Speed, m/s									
		3	4	5	6	7	8	9	10	11	12
H3	**Boganclogh Lodge**										
	Proposed development	20.9	22.4	27.3	31	32.8	32.1	32.1	32.1	32.1	32.1
	Clashindarroch Wind Farm	38.4	38.4	38.5	38.9	39.5	40.4	41.7	43.2	45.0	47.0
	Cumulative Level	38.5	38.5	38.8	39.6	40.3	41.0	42.2	43.5	45.2	47.1
	Consented Noise Limit	38.4	38.4	38.5	38.9	39.5	40.4	41.7	43.2	45.0	47.0
	Difference	**0.1**	**0.1**	**0.3**	**0.7**	**0.8**	**0.6**	**0.5**	**0.3**	**0.2**	**0.1**
H4	**Boganclogh**										
	Proposed development	21.3	22.8	27.7	31.4	33.2	32.5	32.5	32.5	32.5	32.5
	Clashindarroch Wind Farm	38.4	38.4	38.5	38.9	39.5	40.4	41.7	43.2	45	47
	Cumulative Level	38.5	38.5	38.8	39.6	40.4	41.1	42.2	43.6	45.2	47.2
	Consented Noise Limit	38.4	38.4	38.5	38.9	39.5	40.4	41.7	43.2	45.0	47.0
	Difference	**0.1**	**0.1**	**0.3**	**0.7**	**0.9**	**0.7**	**0.5**	**0.4**	**0.2**	**0.2**
H6	**Finglenny**										
	Proposed development	22.9	24.4	29.4	33.3	34.9	34.2	34.2	34.2	34.2	34.2
	Clashindarroch Wind Farm	38.4	38.4	38.5	38.9	39.5	40.4	41.7	43.2	45	47
	Cumulative Level	38.5	38.6	39.0	40.0	40.8	41.3	42.4	43.7	45.3	47.2
	Consented Noise Limit	38.4	38.4	38.5	38.9	39.5	40.4	41.7	43.2	45.0	47.0
	Difference	**0.1**	**0.2**	**0.5**	**1.1**	**1.3**	**0.9**	**0.7**	**0.5**	**0.3**	**0.2**
H7	**Corrylair**										
	Proposed development	22.8	24.3	29.4	33.4	34.9	34.1	34.1	34.1	34.1	34.1
	Clashindarroch Wind Farm	38.0	38.0	38.3	38.9	39.5	40.4	41.7	43.2	45.0	47.0

NSR ID	NSR Name	10m Height Wind Speed, m/s									
		3	4	5	6	7	8	9	10	11	12
	Cumulative Level	38.1	38.2	38.8	40.0	40.8	41.3	42.4	43.7	45.3	47.2
	Derived Noise Limit	41.5	42.0	42.9	44.2	45.8	47.6	49.6	51.6	53.6	55.6
	Difference	**-3.4**	**-3.8**	**-4.1**	**-4.2**	**-5.0**	**-6.3**	**-7.2**	**-7.9**	**-8.3**	**-8.4**

14.128 The night-time assessment indicates that the cumulative noise immission level would meet the derived noise limit at receptor H7. However, there would be exceedances of the consented limit at receptors H3, H4 and H6 of up to 1.3dB.

14.129 The assessment is based on the Clashindarroch Wind Farm operating at its consented noise limit at each of the assessment locations. However, a review of Chapter 18 of the Environmental Statement for the Clashindarroch Wind Farm indicates that predicted noise levels at Boganclough would be a minimum of 4.1dB below consented noise limits during the night-time period and therefore not utilising the full ETSU-R-97 noise limits. As this is an operational wind farm it is considered reasonable to assume that this headroom would remain as it would be unlikely there would be a significant change in turbine model or layout.

14.130 For receptors H6 and H7, the noise immission levels from Clashindarroch Wind Farm would be controlled by receptors H3 and H4 resulting in significantly reduced levels at receptors H6 and H7. Furthermore, the predictions are based on downwind propagation from all wind turbines simultaneously. In reality this would not be the case based on turbine and receptor locations.

14.131 On this basis of the above, the actual noise immission levels at the receptors would be below that predicted. Notwithstanding this, there is headroom available for the proposed development to operate simultaneously with Clashindarroch Wind Farm within the consented noise limits.

14.132 On this basis there is headroom available for the proposed development to operate simultaneously with Clashindarroch Wind Farm within the consented noise limits. Furthermore, for receptor H7, the noise immission levels from Clashindarroch Wind Farm would be controlled by receptors H3 and H4 resulting in significantly reduced levels at this receptor.

14.133 The assessment of cumulative noise demonstrates compliance with ETSU-R-97 daytime and night-time noise limits for the identified receptors and across all assessed wind speeds. As such, the effect of cumulative noise is predicted to be not significant.

STATEMENT OF SIGNIFICANCE

14.134 The effect of construction and decommissioning noise, including construction traffic, is not predicted to be significant and no specific mitigation measures are considered necessary in addition to the best practice measures to be implemented during these phases.

14.135 The effect of operational and cumulative noise is also predicted to be not significant and no specific mitigation measures are considered necessary.

REFERENCES

Ref. 14.1: British Standards Institute (2014), British Standard (BS) 5228-1:2009+A1:2014, *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise*

Ref. 14.2: Highways Agency (2011), Design Manual for Roads and Bridges, Volume 11 *Environmental Assessment*, Section 3 *Environmental Assessmen*t Techniques, Part 7 Noise and Vibration

Ref. 14.3: The Working Group on Noise from Wind Farms (1996), ETSU-R-97, *The Assessment and Rating of Noise from Wind Farms*

Ref. 14.4 Clashindarroch Wind Farm (2009), Hayes McKenzie Report HM:2054, Chapter 18 Noise.

Ref. 14.5: Scottish Government (2014), *Scottish Planning Policy*

Ref. 14.6: Scottish Government (2011), Planning Advice Note PAN 1/2011, *Planning and Noise* and the associated *Technical Advice Note* (TAN)

Ref. 14.7: Scottish Government (2014). Onshore Wind Turbines: Planning Advice, 28 May 2014. Available at: https://www.gov.scot/publications/onshore-wind-turbines-planning-advice/ [Accessed 25/11/2019]

Ref. 14.8: Institute of Acoustics (2013), *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*

Ref. 14.9: Aberdeenshire Council (2015), *Wind Turbine Development – Submission Guidance Note on the Information required for an Assessment of the Noise Impact of Proposed Wind Turbine Developments to be undertaken in Connection with a Planning Application*. Available at: http://aberdeenshire.gov.uk/planning/plans-and-policies/planning-advice/ [Accessed 25/11/2019]

Ref. 14.10: The Institute of Environmental Management and Assessment (IEMA) (2014), *Guidelines for Environmental Noise Impact Assessment*

Ref. 14.11 Scottish Government (2014). Planning Advice Note PAN50 *Controlling the Environmental Effects of Surface Mineral Workings.*

Ref. 14.12: Department for Communities and Local Government (1994), *Planning Policy Guidance 24: Planning and Noise* [now withdrawn]

Ref. 14.13: International Organisation for Standardisation (1996), ISO9613-2, *Acoustics – Attenuation of Sound during Propagation Outdoors: Part 2 – General Method of Calculation*

Ref. 14.14: International Organisation for Standardisation (1993), ISO9613-1, *Acoustics – Attenuation of Sound during Propagation Outdoors: Part 1 – Calculation of the Absorption of Sound by the Atmosphere*

Ref. 14.15: European Communities, 2000/14/EC, *Directive 2000/14/EC of the European Parliament and of the Council of 8 May 2000 on the approximation of the laws of the Member States relating to*

the noise emission in the environment by equipment for use outdoors, Luxembourg: Office for Official Publications of the European Communities, 2000

Ref. 14.16 UK Statutory Instrument 2001/1701. The Noise Emission in the Environment by Equipment for use Outdoors Regulations.

Ref. 14.17: Hayes McKenzie Partnership Ltd (2011), Report on *Analysis of how noise impacts are considered in the determination of wind farm planning applications* (HM: 2293/R1).