Technical Appendix 11.2: Operational Noise Report

A specialist energy consultancy

Technical Appendix 11.2

Operational Noise Report

Artfield Forest Wind Farm

Artfield Forest Wind Farm Ltd

13865-004
17th February 2021

Statkraft

Quality Assurance

TNEI Services Ltd and TNEI Africa (Pty) Ltd. ("TNEI") operates an Integrated Management System and is registered with Ocean Certification Limited as being compliant with ISO 9001(Quality), ISO 14001 (Environmental) and OHSAS 18001 (Health and Safety).

Disclaimer

This document is issued for the sole use of the Customer as detailed on the front page of this document to whom the document is addressed and who entered into a written agreement with TNEI. All other use of this document is strictly prohibited and no other person or entity is permitted to use this report unless it has otherwise been agreed in writing by TNEI. This document must be read in its entirety and statements made within may be based on assumptions or the best information available at the time of producing the document and these may be subject to material change with either actual amounts differing substantially from those used in this document or other assumptions changing significantly. TNEI hereby expressly disclaims any and all liability for the consequences of any such changes. TNEI also accept no liability or responsibility for the consequences of this document being relied upon or being used for anything other than the specific purpose for which it is intended, or containing any error or omission which is due to an error or omission in data used in the document that has been provided by a third party.

Any information provided by third parties that is included in this report has not been independently verified by TNEI and as such TNEI accept no responsibility for its accuracy and completeness. The Customer should take appropriate steps to verify this information before placing any reliance on it.

Document Control

Revision	Status	Prepared by	Checked by	Approved by	Date
D1	DRAFT	GC / JB	JM	JM	29/10/2020
D2	SECOND DRAFT	JB	JM	JM	02/02/2021
R0	FINAL ISSUE	GC	JM	JM	17/02/2021

TNEI Services Ltd

Company Registration Number: 03891836 **VAT Registration Number: 239 0146 20**

Registered Address		
Bainbridge House	7th Floor	
86-90 London Road	West One	7th Floor
Manchester	Forth Banks	80 St. Vincent Street
M1 2PW	Newcastle upon Tyne	Glasgow
Tel:+44 (0)161 233 4800	NE1 3PA	G2 5UB
Fax:+44 (0)161 233 4801	Tel:+44 (0)191 211 1400	Tel: +44 (0)141 428 3180

TNEI Africa (Pty) Ltd

Registered: Mazars House, Rialto Rd, Grand Moorings Precinct, 7441 Century City, South Africa

Company Number: 2016/088929/07

1st Floor

Willowbridge Centre

Carl Cronje Drive

Cape Town

South Africa, 7530

Tel: +27 (0)21 974 6181

Executive Summary

TNEI Services was commissioned by Statkraft UK Ltd on behalf of Artfield Forest Wind Farm Ltd ('the Applicant') to undertake predictions of the wind turbine noise that would be emitted by the operation of the proposed Artfield Forest Wind Farm (hereinafter referred to as 'the Proposed Development'). The noise predictions were used to assess the potential impact of operational noise from the Proposed Development on the nearest noise sensitive receptors.

The Scottish Government's web based renewables advice on *'Onshore Wind Turbines'* states: *'The Report, "The Assessment and Rating of Noise from Wind Farms" (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 burdens on wind farm developers, and suggests appropriate noise conditions.'* Whilst the advice then goes on to state: *'The Institute of Acoustics (IOA) has since published Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* [IOA GPG]. *The document provides significant support on technical issues to all users of the ETSU-R-97 method for rating and assessing wind turbine noise, and should be used by all IOA members and those undertaking assessments to ETSU-R-97. The Scottish Government accepts that the guide represents current industry good practice.'* The guidance contained within ETSU-R-97 and current good practice has been used to assess the potential operational noise impact of the Proposed Development.

The noise assessment has been undertaken in three stages:

1) deriving the 'Total ETSU-R-97 Noise Limits' (which are applicable to noise from all wind turbines in the area operating concurrently) at noise sensitive receptors;
2) predicting the likely effects (undertaking a cumulative noise assessment where required) to determine whether noise immissions at noise sensitive receptors will meet the Total ETSU-R-97 Noise Limits; and
3) deriving 'Site Specific Noise Limits' for the Proposed Development (taking account of the noise limit that has already been allocated / could realistically be used by other cumulative schemes) and undertaking predictions against those limits.

There are a number of proposed / operational wind farms surrounding the Proposed Development; if additional background noise measurements were undertaken, then they could have been influenced by existing wind turbine noise. On that basis it was deemed appropriate to use the previously collected baseline data to derive the Total ETSU-R-97 Noise Limits. Following a review of where the baseline datasets were measured in the area, data collected as part of the Airies and Kilgallioch Wind Farm noise assessments was used.

A total of twenty four noise sensitive receptors were chosen as Noise Assessment Locations (NALs). The NALs were chosen to represent the noise sensitive receptors located closest to the Proposed Development and additional receptors were included to consider cumulative noise impacts. For the assessment locations where no background noise measurements were undertaken, noise data collected at proxy locations deemed representative of the expected background noise environment was used to assess the wind turbine noise impact at those receptors.

Having due regard to the guidance in ETSU-R-97 and to reflect the presence of the existing wind farms in the area, the daytime Total ETSU-R-97 Noise Limit was set at 40 dB(A) or background plus 5 dB whichever is the greater; this limit has already been conditioned for one of the operational schemes – Kilgallioch Wind Farm. The night time Total ETSU-R-97 Noise Limit has been set at 43 dB or background plus 5 dB whichever is the greater. The Site Specific daytime limit for noise associated with the Proposed Development has been set such that it never exceeds 35 dB(A) or background plus 5 dB, whichever is the greater. This represents the lower end of the daytime limits that can be applied under ETSU-R-97. The night time Site Specific Noise Limits have been set at 43 dB or background plus 5 dB whichever is the greater.

Predictions of wind turbine noise for the Proposed Development were made, based upon the sound power level data for a candidate wind turbine, the Vestas V150 5.6 MW. This wind turbine model has been chosen as it is considered to be representative of the type of turbine that could be installed at the site. Whatever the final turbine choice is, the Proposed Development would have to meet the noise limits determined and contained within any condition applied as part of its consent.

Modelling was undertaken using the ISO 9613: 1996 'Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation' noise prediction model which accords with current good practice and is considered to provide a realistic impact assessment. For the other schemes, predictions have been undertaken using sound power level data for the installed turbines, or a suitable candidate. The model of turbine was either identified through an online search, or through the use of Dumfries and Galloway Council's Planning Application Portal.

The likely cumulative assessment shows that there are predicted to be exceedances of the Total ETSU-R-97 Noise Limits at three NALs, but this is as a result of the predicted noise from other schemes in the area. The Proposed Development can operate concurrently with the proposed, consented and operational wind farms in the area, as its contribution is negligible. The other twenty-one NALs likely cumulative noise levels meet the Total ETSU-R-97 Noise Limits.

Site Specific Noise Limits have also been derived that take account of the other wind farm developments. Where wind turbine immissions from the other wind turbines at a given receptor were found to be at least 10 dB below the Total ETSU-R-97 Noise Limit, it is considered that they will be using a negligible proportion of the limit, as such it was considered appropriate to allocate the entire noise limit to the Proposed Development. For the receptors where turbine predictions were found to be within 10 dB of the Total ETSU-R-97 Noise Limit, apportionment of the Total ETSU-R-97 Noise Limits was undertaken in accordance with current good practice.

Predicted noise levels indicate that at all noise assessment locations wind turbine noise immissions were below the Site Specific Noise Limits when considering the Vestas V150 5.6 MW as a candidate turbine.

The use of Site Specific Noise Limits would ensure that the Proposed Development could operate concurrently with other proposed, consented or operational turbines in the area and would also ensure that the Proposed Development's individual contribution could be measured and enforced if required.

Should consent be granted for the Proposed Development it would be appropriate to include a set of noise related planning conditions, which detail the noise limits applicable to the Proposed Development.

Two occupiers of NALs have been highlighted by the Applicant as being financially involved in the Proposed Development. In addition, a further three occupiers of NALs assessed by other operational developments in the area are highlighted as being financially involved with their respective schemes (but not with the Proposed Development). The Total ETSU-R-97 Noise Limit for these NALs have therefore been increased to 45 dB or background + 5 dB for both the day time and night time periods, in accordance with guidance in ETSU-R-97.

There are a number of wind turbine makes and models that may be suitable for the Proposed Development. Should the Proposed Development receive consent the final choice of turbine would be subject to a competitive tendering process. As such, predictions of wind turbine noise are for information only. The final choice of turbine would, however, have to meet the noise limits determined and contained within any condition imposed.

Contents

TABLES

ANNEXES

1 Introduction

1.1 Brief

1.1.1 TNEI was commissioned by Statkraft UK Ltd on behalf of Artfield Forest Wind Farm Ltd ('the Applicant') to undertake an operational noise assessment for the proposed Artfield Forest Wind Farm (hereinafter referred to as 'the Proposed Development'). The following steps summarise the noise assessment process:

- Determine the Total ETSU-R-97 Noise Limits applicable to all wind farms in the area using the baseline noise levels reported in the consented, and now operational, wind farm EIA reports;
- Assess and undertake a cumulative noise assessment, where required, to take account of other proposed, consented or operational schemes near to the Proposed Development;
- Derive Site Specific Noise Limits for the Proposed Development, suitable for inclusion in the noise related planning condition should Scottish Ministers be minded to grant consent for the Proposed Development;
- Undertake predictions of the operational wind turbine noise immissions from the Proposed Development that will be incident at neighbouring noise sensitive receptors;
- Compare predictions of the operational wind turbine noise immissions from the Proposed Development against the Site Specific ETSU-R-97 Noise Limits that will be incident at neighbouring noise sensitive receptors; and
- Assess the impact of noise from the Proposed Development with reference to existing Government Guidance and the recommendations of the Department of Trade and Industry Noise Working Group on Noise from Wind Turbines, which are contained within ETSU-R-97 and the IOA GPG (current good practice).

1.2 Background

1.2.1 The Proposed Development is located approximately 8 km northwest of Kirkcowan and 15 km west of Newton Stewart in Dumfries and Galloway. The approximate OS Grid Reference for the centre if the site is 223675, 568343 and the proposed layout is shown on Figure A1.1a in Annex 1.

1.2.2 In the absence of a confirmed turbine model, this noise assessment models a candidate turbine, the Vestas V150 5.6 MW. This turbine has been selected as it is representative of the turbine type which could be installed at the site.

1.2.3 There are a number of proposed, consented and operational wind farm developments in proximity to the Proposed Development, which include the following:

- Artfield Fell Wind Farm (15 x SIEMENS-SWT 1.3-62 Turbines; Consented 2004, Operational);
- Balmurrie Fell Wind Farm (7 x SIEMENS-SWT 1.3-62 Turbines; Consented 25 November 2011, Operational);
- Carscreugh Wind Farm (18 x Gamesa G52 Turbines; Consented at appeal 21 March 2012, Operational);
- Glenchamber Wind Farm (11 x Nordex N100 2.5 MW Turbines; Consented at appeal 31 July 2012, Operational);
- Kilgallioch Wind Farm (94 x Gamesa G114 & 2 x Gamesa G90 Turbine; Consented 14 February 2013, Operational);
- Airies Wind Farm (14 x GE-2.85-103 Turbines; Consented 20 August 2013, Operational);
- Airies II Wind Farm (9 x Vestas-V150 5.6 MW Turbines; Scoping); and
- Kilgallioch Wind Farm Extension (11 x Vestas-V150 5.6 MW Turbine; In planning).

1.2.4 Figure A1.1b in Annex 1 shows the location of the above developments relative to the Proposed Development. For the consented / operational schemes noise related planning conditions have been set within the relevant Decision Notices, as detailed in Annex 2. Whilst consideration is not usually given to projects at the scoping stage (due to the uncertainty regarding scheme layout) Airies II Wind Farm has been included in the assessment. The layout for that scheme is based on the pre-application layout provided in September 2020[1]. The Site Specific Noise Limits presented in this report for the Proposed Development have taken account of the noise limits that have already allocated to, or could potentially be used by, the other schemes in the area (including Airies II).

1.2.5 For the purposes of assessing the above schemes in conjunction with the Proposed Development the following terms have been referred to throughout the assessment;

- 'Total ETSU-R-97 Noise Limits'; defined as being the limit that should not be exceeded from the cumulative operation of all wind farm developments, including the Proposed Development; and
- 'Site Specific Noise Limits'; defined as being the limit that is specific to the Proposed Development only, and derived through the apportionment (where required), of the 'Total ETSU-R-97 Noise Limits' in accordance with current good practice.

1.2.6 Note that in this report, the term 'noise emission' relates to the sound power level actually radiated from each wind turbine, whereas the term 'noise immission' relates

[1] It is noted that the Airies II developer confirmed that they had not yet reached design freeze at the time this data was provided and therefore the layout may change when an application is made. The Airies II developer has been provided with the final Proposed Development layout.

to the sound pressure level (the received noise) at any receptor location due to the operation of the wind turbines.

2 Noise Planning Policy and Guidance

2.1 Overview of Noise Planning Policy and Guidance

2.1.1 In assessing the potential noise impacts of the Proposed Development, the following guidance and policy documents have been considered:

- Local Policy;
- National Planning Policy [3];
- Web Based Renewables Advice: *'Onshore Wind Turbines'* [4];
- Planning Advice Note PAN 1/2011: *'Planning and Noise'* [5];
- ETSU-R-97 *'The Assessment and Rating of Noise from Wind Farms'*; and
- Institute of Acoustics *'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'* (IOA GPG) May 2013.

2.2 Local Policy

2.2.1 In determining an application for planning permission the 'starting point' for decision makers is to consider the compliance of a proposal against the proposed Development Plan taken as a whole. Plans often have policies tailored specifically to control certain kinds of proposed development and such policies should carry more weight and be more dominant in the minds of decision makers.

2.2.2 When considering planning applications, decision makers should have regard to any adopted Structure Plan Policies, Local Plan (or Local Development Plan) Policies and any accompanying Supplementary Planning Guidance. In determining planning applications due regard should be had to all other material considerations, including National Planning Policy.

Dumfries and Galloway Local Development Plan 2

2.2.3 The adopted Development Plan for the area comprises the Dumfries and Galloway Local Development Plan 2 (LDP2) which was adopted on 3 October 2019. The Local Plan sets out detailed policies and specific proposals for the development and use of land within Dumfries and Galloway.

2.2.4 The Plan contains a number of overarching polices, the aim of which is to deliver high standards of development. Policy OP1: Development Considerations. In relation to general amenity the policy states that: 'Development proposals should be compatible with the character and amenity of the area and should not conflict with nearby land uses.' It goes on to identify a number of issues which may result from development which will be in the consideration of proposals, including noise and vibration.

2.2.5 Policy IN1 covers the principle policy guidance in relation to renewable energy. It states:

'The Council will support development proposals for all renewable energy generation and/ or storage which are located, sited and designed appropriately. The acceptability of any proposed development will be assessed against the following considerations (inter alia):

- *Impact on local communities and individual dwellings, including visual impact, residential amenity, noise and shadow flicker.*

To enable this assessment sufficient detail should be submitted, to include the following as relevant to the scale and nature of the proposal (inter alia):

- *Environmental and other impacts associated with the construction and operational phases of the development including details of any visual impact, noise and odour issues.'*

2.2.6 Policy IN2 provides the principle policy guidance in relation to wind energy developments. It states that:

'The Council support wind energy proposals that are located, sited and designed appropriately. The acceptability of any proposed wind energy development will be assessed against the following considerations (inter alia):

The extent of any detrimental impact on communities, individual dwellings, residents and local amenity, including assessment of the impacts of noise, shadow flicker, visual dominance and the potential for associated mitigation.'

Dumfries and Galloway LDP2 Supplementary Guidance –Wind Energy Development: Development Management Considerations

2.2.7 The policy detailed above is supported by more detailed guidance contained within Supplementary Guidance - Wind Energy Development: Development Management Considerations. The guidance was adopted in February 2020 and is a material consideration as it forms part of the development plan and is afforded the same weight as the LDP.

2.2.8 The guidance provides more detail on each of the main development management considerations applicable when considering wind energy planning applications. With regards to amenity, the guidance states that:

'Each proposal will be assessed on a case by case basis against the relevant LDP2 policies'.

2.2.9 Further supporting text discusses the issue of noise in more detail:

'For all large and medium turbines a full site-specific noise impact assessment, following ETSU-R-97 and Institute of Acoustics methodology (or subsequent accepted national guidelines), which includes cumulative impact would be required for all appropriate noise sensitive properties as agreed with Environmental Health.'

2.3 National Planning Policy

2.3.1 Scottish Planning Policy (SPP) was published in 2014. It states (paragraph 169) that proposals for energy infrastructure should take account of spatial frameworks for wind farms (where relevant) and that considerations may include noise impacts on communities and individual dwellings.

2.4 Planning Advice Note PAN 1/2011: Planning and Noise

2.4.1 PAN 1/2011 provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. Paragraph 29 contains some specific information on noise from wind farms and states the following:

'There are two sources of noise from wind turbines - the mechanical noise from the turbines and the aerodynamic noise from the blades. Mechanical noise is related to engineering design. Aerodynamic noise varies with rotor design and wind speed, and is generally greatest at low speeds. Good acoustical design and siting of turbines is essential to minimise the potential to generate noise. Web based planning advice on renewable technologies for Onshore wind turbines provides advice on 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97) published by the former Department of Trade and Industry [DTI] and the findings of the Salford University report into Aerodynamic Modulation of Wind Turbine Noise.'

2.5 Web Based Planning Advice – Onshore Wind Turbines

2.5.1 The 'Onshore Wind Turbines' web-based document also describes the types of noise (mechanical and aerodynamic) that wind turbines generate. Mechanical noise is generated by the gearbox and generator and other parts of the drive train, which can be radiated as noise through the nacelle, gear box, tower and supporting structures, together with the aerodynamic noise generated by the action of the blades rotating through the air. The document states '*there has been significant reduction in the mechanical noise generated by wind turbines through improved turbine* design' and goes on to note:

'The Report, "The Assessment and Rating of Noise from Wind Farms" (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 burdens on wind farm developers, and suggests appropriate noise conditions.'

2.5.2 The web-based document then refers to the IOA GPG as a source, which provides:

'significant support on technical issues to all users of the ETSU-R-97 method for rating and assessing wind turbine noise, and should be used by all IOA members and those undertaking assessments to ETSU-R-97. The Scottish Government accepts that the guide represents current industry good practice.'

2.5.3 The document also refers to the role of PAN1/2011 'Planning and Noise' to:

'provide advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. The associated Technical Advice Note provides guidance which may assist in the technical evaluation of noise assessment.'

2.5.4 Examination of the Technical Advice Note [6] confirms it provides no further advice on wind farms other than referring to ETSU-R-97 and relevant parameters for modelling identified in the Institute of Acoustics Bulletin March 2009, on page 37. This has been superseded by the introduction of the IOA GPG in May 2013.

2.6 ETSU-R-97 The Assessment and Rating of Noise from Wind Farms

2.6.1 As wind farms started to be developed in the UK in the early 1990's, it became apparent that existing noise standards did not fully address the issues associated with the unique characteristics of wind farm developments and there was a need for an agreed methodology for defining acceptable noise limits for wind farm developments. This methodology was developed for the former Department of Trade and Industry (DTI) by the Working Group on Noise from Wind Turbines (WGNWT).

2.6.2 The WGNWT comprised a number of interested parties including, amongst others, Environmental Health Officers, wind farm operators, independent acoustic consultants and legal experts who:

'…between them have a breadth and depth of experience in assessing and controlling the environmental impact of noise from wind farms.'

2.6.3 In this way it represented the views of all the stakeholders that are involved in the assessment of noise impacts of wind farm developments. The recommendations of the WGNWT are presented in the DTI Report – ETSU-R-97 *'The Assessment and Rating of Noise from Wind Farms (1996).'*

2.6.4 The basic aim of the WGNWT in arriving at the recommendations was the intention to provide:

'Indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding to the costs and administrative burdens on wind farm developers or local authorities.'

2.6.5 ETSU-R-97 makes it clear from the outset that any noise restrictions placed on a wind farm must balance the environmental impact of the wind farm against the national

and global benefits that would arise through the development of renewable energy sources:

'The planning system must therefore seek to control the environmental impacts from a wind farm whilst at the same time recognising the national and global benefits that would arise through the development of renewable energy sources and not be so severe that wind farm development is unduly stifled.'

2.6.6 Where noise at the nearest noise sensitive receptors is limited to an $L_{A90,10min}$ of 35 dB(A) up to wind speeds of 10 ms^{-1} at a height of 10 m, then it does not need to be considered in the noise assessment, as protection of the amenity of these properties can be controlled through a simplified noise limit. In this regard ETSU-R-97 states that:

'For single turbines or wind farms with very large separation distances between the turbines and the nearest properties, a simplified noise condition may be suitable. If the noise is limited to an $L_{A90,10min}$ of 35 dB(A) up to wind speeds of 10 m/s at 10 m height, then this condition alone would offer sufficient protection of amenity, and background noise surveys would be unnecessary.'

2.6.7 The ETSU-R-97 assessment procedure specifies that where wind turbine noise is expected to be above the simplified limit of 35 dB L_{A90} noise limits should be set relative to existing background noise levels at the nearest receptors. These limits should reflect the variation in both turbine source noise and background noise with wind speed. Absolute lower limits, different for daytime and night time, are applied where low levels of background noise are measured. The wind speed range that should be considered ranges between the cut-in wind speed for the turbines (usually about 2 to 3 ms^{-1}) and up to 12 ms^{-1}, where all wind speeds are referenced to a 10 metre measurement height.

2.6.8 Separate noise limits apply for daytime and for night time. Daytime limits are chosen to protect a property's external amenity, and night time limits are chosen to prevent sleep disturbance indoors, with windows open.

2.6.9 The daytime noise limit is derived from background noise data measured during so-called 'quiet periods of the day', which comprise weekday evenings (18:00 to 23:00), Saturday afternoons and evenings (13:00 to 23:00) and all day and evening on Sundays (07:00 to 23:00). Multiple samples of 10 minute background noise levels using the $L_{A90,10min}$ measurement index are logged continuously over a range of wind speed conditions. These measured noise levels are then plotted against concurrent wind speed data and a 'best fit' curve is fitted to the data to establish the background noise level as a function of wind speed. The ETSU–R-97 daytime noise limit, sometimes referred to as a 'criterion curve', is then set at a level 5 dB(A) above the best fit curve over the desired wind speed range; subject to an appropriate daytime fixed minimum limit:

'For wind speeds where the best fit curve to the background noise data lies below a level of 30 - 35 dB(A) the criterion curve is set at a fixed level in the range 35 -

40 dB(A). The precise choice of criterion curve level within the range 35 - 40 dB(A) depends on a number of factors: the number of noise affected properties, the likely duration, the level of exposure and the potential impact on the power output of the wind farm. The quiet daytime limits have been set in ETSU-R-97 on the basis of protecting the amenity of residents whilst outside their dwellings in garden areas.'

2.6.10 The night time noise limit is derived from background noise data measured during the night time periods (23:00 to 07:00), with no differentiation being made between weekdays and weekends. The 10 minute L_{A90} noise levels measured over the night time periods are plotted against concurrent wind speed data and a 'best fit' correlation is established. The night time noise limit is also based on a level 5 dB(A) above the best fit curve over the 0 - 12 ms^{-1} wind speed range, with a fixed minimum limit of 43 dB L_{A90}.

2.6.11 The exception to the setting of both the daytime and night time fixed minimum limits occurs where a property occupier has a financial involvement in the wind farm development. Paragraph 24 of ETSU-R-97 states:

'The Noise Working Group recommends that both day and night time lower fixed limits can be increased to 45 dB(A) and that consideration should be given to increasing the permissible margin above background where the occupier of the property has some financial involvement in the wind farm.'

2.6.12 ETSU-R-97 provides a robust basis for determining the noise limits for wind turbine(s) and since its introduction has become the accepted standard for such developments across the UK.

2.7 Current Good Practice

A Good Practice Guide on the Application of ETSU-R-97

2.7.1 In May 2013, the Institute of Acoustics issued *'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'* (IOA GPG). The document provides guidance on background data collection, data analysis and limit derivation, noise predictions, cumulative issues, reporting requirements and other matters such as noise related planning conditions.

2.7.2 The Authors of the IOA GPG sets out the scope of the document in Section 1.2:

'This guide presents current good practice in the application of the ETSU-R-97 assessment methodology for all wind turbine developments above 50 kW, reflecting the original principles within ETSU-R-97, and the results of research carried out and experience gained since ETSU-R-97 was published. The noise limits in ETSU-R-97 have not been examined as these are a matter for Government.'

2.7.3 The guidance document was endorsed, on behalf of Scottish Government by the Cabinet Secretary for Finance, Employment and Sustainable Growth, Mr John Swinney MSP [7]). The recommendations included in the IOA GPG have been

considered and applied throughout this noise assessment for the Proposed Development.

2.7.4 The IOA GPG refers to six Supplementary Guidance Notes and where applicable these have also been considered in this report.

2.7.5 The guidance contained within ETSU-R-97 and the IOA GPG has therefore been used to assess and rate the operational noise emissions from the Proposed Development.

3 Potential Impacts

3.1 Operational Noise Sources

3.1.1 Wind turbines may emit two types of noise. Firstly, aerodynamic noise is a more natural sounding 'broad band' noise, albeit with a characteristic modulation, or 'swish', which is produced by the movement of the rotating blades through the air. Secondly, mechanical noise may emanate from components within the nacelle of a wind turbine. Potential sources of mechanical noise include gearboxes or generators.

3.1.2 Aerodynamic noise is usually perceived when the wind speeds are fairly low although at very low wind speeds the blades do not rotate, or rotate very slowly, and so negligible aerodynamic noise is generated. In higher winds aerodynamic noise may be masked by the normal sound of wind blowing through the trees and around buildings. The level of this natural 'masking' noise relative to the level of wind turbine noise is one of the several factors that determine the subjective audibility of the wind turbines [8].

3.2 Infrasound, Low Frequency Noise and Vibration

3.2.1 The term infrasound can be defined as the frequency range below 20 Hz, while low frequency noise (LFN) is typically in the frequency range 20 – 200 Hz [9]. An average young healthy adult has an audible range from 20 Hz to 20,000 Hz, although the sensitivity of the ear varies with frequency and is most sensitive to sounds with frequencies between 500 Hz and 4,000 Hz. Wind turbines do produce low frequency sounds [10], but our threshold of hearing at such low frequencies is relatively high and they therefore go unnoticed. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.

3.2.2 In 2004, the former DTI commissioned The Hayes McKenzie Partnership to report on claims that infrasound or LFN emitted by wind turbine generators (WTGs) were causing health effects. Of the 126 wind farms operating in the UK, five had reported LFN problems, therefore, such complaints are an exception, rather than a general problem that exists for all wind farms. Hayes McKenzie investigated the effects of infrasound and LFN at three wind farms for which complaints had been received and the results were reported in May 2006 [11]. The report concluded that:

- *'infrasound associated with modern wind turbines is not a source which will result in noise levels which may be injurious to the health of a wind farm neighbour;*
- *low frequency noise was measurable on a few occasions but below the existing permitted Night Time Noise Criterion. Wind turbine noise may result in internal noise levels within a dwelling that is just above the threshold of audibility, however at all sites it was always lower than that of local road traffic noise;*
- *that the common cause of complaint was not associated with LFN, but the occasional audible modulation of aerodynamic noise especially at night. Data collected showed that the internal noise levels were insufficient to wake up residents at these three sites. However once awoken, this noise can result in difficulties in returning to sleep.'*

3.2.3 The Applied and Environmental Geophysics Research Group at Keele University was commissioned by the Ministry of Defence (MOD), the DTI and the British Wind Energy Association (BWEA) to undertake microseismic and infrasound monitoring of LFN and vibrations from wind farms for the purposes of siting wind farms in the vicinity of Eskdalemuir in Scotland. Whilst the testing showed that vibration can be detected several kilometres away from wind turbines, the levels of vibration from wind turbines were so small that only the most sophisticated instrumentation can reveal their presence and they are almost impossible to detect. Nevertheless, the Renewable Energy Foundation alleged potential adverse health effects and when that story was picked up in the popular press, notably the Scotsman, the report's authors expressed concern over the way in which their work had been misinterpreted and issued a rebuttal statement [12] in August 2005:

'Vibrations at this level and in this frequency range will be available from all kinds of sources such as traffic and background noise – they are not confined to wind turbines. To put the level of vibration into context, they are ground vibrations with amplitudes of about one millionth of a millimetre. There is no possibility of humans sensing the vibration and absolutely no risk to human health.'

3.2.4 In response to concerns that wind turbines emit infrasound and cause associated health problems, Dr Geoff Leventhall, Consultant in Noise Vibration and Acoustics and author of the Defra Report on Low Frequency Noise and its Effects, said in the article in the Scotsman ('Wind farm noise rules 'dated'- James Reynolds, 5 August 2005'):

'I can state quite categorically that there is no significant infrasound from current designs of wind turbines.'

3.2.5 An article [13] published in the IOA Bulletin (March/April 2009) concluded that there is no robust evidence that either low frequency noise (including 'infrasound') or ground-borne vibration from wind farms, has an adverse effect on wind farm neighbours.

3.2.6 Work [14] by Dr Leventhall looked at infrasound levels within the ear compared to external sources and concluded:

'The conclusion is that the continuous inner ear infrasound levels due to internal sources, which are in the same frequency range as wind turbine rotational frequencies, are higher than the levels produced in the inner ear by wind turbines, making it unlikely that the wind turbine noise will affect the vestibular systems, contrary to suggestions made following the measurements at Shirley. The masking effect is similar to that in the abdomen (Leventhall 2009). The body, and vestibular systems, appear to be built to avoid disturbance from the high levels of infrasound which are produced internally from the heartbeat and other processes. In fact, the hearing mechanisms and the balance mechanisms, although in close proximity, have developed to minimise interaction (Carey and Amin 2006).'

3.2.7 More recently during a planning Appeal (PPA-310-2028, Clydeport Hunterston Terminal Facility, approximately 2.5 km south-west of Fairlie, 9 Jan 2018), the health impacts related to LFN associated with wind turbines were considered at length by the appointed Reporter (Mr M Croft). The Reporter considered evidence from Health Protection Scotland and the National Health Service. In addition, he also considered LFN surveys undertaken by the Appellant and the Local Authority, both of which demonstrated compliance with planning conditions and did not identify any problems attributable to the turbine operations; some periods with highest levels of low frequency noise were in fact recorded when the turbines were not operating.

3.2.8 The Reporter concluded that:

- The literature reviews by bodies with very significant responsibilities for the health of local people found insufficient evidence to confirm a causal relationship between wind turbine noise and the type of health complaints cited by some local residents;
- The NHS's assessment is that concerns about health impact are not supported by good quality research; and
- Although given the opportunity, the Community Council failed to provide evidence that can properly be set against the general tenor of the scientific evidence.

3.2.9 It is therefore not considered necessary to carry out specific assessments of LFN and it has not been considered further in the noise assessment.

3.3 Amplitude Modulation of Aerodynamic Noise (AM)

3.3.1 In the context of wind turbine noise amplitude modulation describes a variation in noise level over time; for example, observers may describe a 'whoosh whoosh' sound, which can be heard close to a wind turbine as the blades sweep past. Amplitude Modulation of aerodynamic noise is an inherent characteristic of wind turbine noise and was noted in ETSU-R-97, on page 68:

'The modulation or rhythmic swish emitted by wind turbines has been considered by some to have a characteristic that is irregular enough to attract attention. The level and depth of modulation of the blade noise is, to a degree, turbine-dependent and is dependent upon the position of the observer. Some wind turbines emit a greater level of modulation of the blade noise than others. Therefore, although some wind turbines might be considered to have a character that may attract one's attention, others have noise characteristics which are considerably less intrusive and unlikely to attract one's attention and be subject to any penalty.

This modulation of blade noise may result in a variation of the overall A-weighted noise level by as much as 3dBA (peak to trough) when measured close to a wind turbine. As distance from the wind turbine [or] wind farm increases, this depth of modulation would be expected to decrease as atmospheric absorption attenuates the high frequency energy radiated by the blade.'

3.3.2 In recent times the Acoustics community has sought to make a distinction between the AM discussed within ETSU-R-97, which is expected at most wind farms and as such may be considered as 'Normal Amplitude Modulation' (NAM), compared to the unusual AM that has sometimes been heard at some wind farms, hereinafter referred to as 'Other Amplitude Modulation' (OAM). The term OAM is used to describe an unusual feature of aerodynamic noise from wind turbines, where a greater than normal degree of regular fluctuation in sound level occurs at blade passing frequency, typically once per second. In some appeal decisions it may also be referred to as 'Excess Amplitude Modulation' (EAM). It should be noted that the noise assessment and rating procedure detailed in ETSU-R-97 fully takes into account the presence of the intrinsic level of NAM when setting acceptable noise limits for wind farms.

3.3.3 On 16 December 2013, RenewableUK (RUK) released six technical papers [15] on AM, which reflected the outcomes of research commissioned over the previous three years, together with a template planning condition. Whilst this research undoubtedly improved understanding of Other Amplitude Modulation (OAM) and its effects, it should be noted that at the time of writing it has not been endorsed by any relevant body such as the Institute of Acoustics (IOA).

3.3.4 On 22 January 2014, the IOA released a statement regarding the RUK research and the proposed planning condition to deal with the issue of amplitude modulation from a wind turbine and stated:

'This research is a significant step forward in understanding what causes amplitude modulation from a wind turbine, and how people react to it. The proposed planning condition, though, needs a period of testing and validation before it can be considered to be good practice. The IOA understands that RenewableUK will shortly be making the analysis tool publicly available on their website so that all interested parties can test the proposed condition, and the IOA will review the results later in the year. Until that time, the IOA cautions the use of the proposed planning condition.'

3.3.5 Research regarding amplitude modulation continued. In April 2015, the IOA issued a discussion document entitled *'Methods for Rating Amplitude Modulation in Wind Turbine Noise'*. The document presented three methods that can be used to quantify the level of AM at a given measurement location. After extensive consultation a preferred method of measuring OAM, which provides a framework for practitioners to measure and rate AM, was recommended by the IOA.

3.3.6 On 3 August 2015, the Department for Energy and Climate Change (DECC), now the Department for Business, Energy and Industrial Strategy (BEIS), commissioned independent consultants WSP Parsons Brinkerhoff to carry out a literature review on OAM (which they refer to simply as AM). The stated aims were as follows:

- *To review the available evidence on Amplitude Modulation (AM) in relation to wind turbines, including but not limited to the research commissioned and published by RenewableUK in December 2013;*
- *To work closely with the Institute of Acoustics' AM working group, who are expected to recommend a preferred metric and methodology for quantifying and assessing the level of AM in a sample of wind turbine noise data;*
- *To review the robustness of relevant dose response relationships, including the one developed by the University of Salford as part of the RenewableUK study, on which the correction (or penalty) for amplitude modulation proposed as part of its template planning condition is based;*
- *To consider how, in a policy context, the level(s) of AM in a sample of noise data should be interpreted, in particular determining at what point it causes a significant adverse impact;*
- *To recommend how excessive AM might be controlled through the use of an appropriate planning condition; and*
- *To consider the engineering/cost trade-offs of possible mitigation measures.*

3.3.7 Their report, which was released in October 2016, concluded that there is sufficient robust evidence that excessive AM leads to increased annoyance from wind turbine noise and recommended that excessive AM is controlled through a suitably worded planning condition, which will control it during periods of complaint. Those periods should be identified by measurement using the metric proposed by the work undertaken by the IOA, and enforcement action would rely upon professional judgement by Local Authority Environmental Health Officers based on the duration and frequency of occurrence.

3.3.8 It is not clear within the body of the report which evidence the authors relied upon to arrive at their conclusions, although the Executive Summary states (page 4);

"It is noted that none of the Category 1 or 2 papers have been designed to answer the main aim of the current review in its entirety. The Category 1 studies have limited representativeness due to sample constraints and the artificiality of laboratory environments, whereas the Category 2 studies generally do not directly address the issue of AM WTN exposure-response. A meta - analysis of the identified studies was not possible due to the incompatibility of the various methodologies employed.

Notwithstanding the limitations in the evidence, it was agreed with DECC that the factors to be included in a planning condition should be recommended based on the available evidence, and supplemented with professional experience".

3.3.9 The report [16] states that any planning condition must accord with existing planning guidance, and should be subject to legal advice on a case by case basis. Existing guidance would include compliance with the six tests of a planning condition embodied in Circular 4/98. The report's authors did not dictate a particular condition to be used but did suggest that any condition should include the following elements (p5):

- *"The AM condition should cover periods of complaints (due to unacceptable AM);*
- *The IoA-recommended metric should be used to quantify AM (being the most robust available objective metric);*
- *Analysis should be made using individual 10-minute periods, applying the appropriate decibel 'penalty' to each period, with subsequent analysis;*
- *The AM decibel penalty should be additional to any decibel penalty for tonality;* [tonality means mechanical sound already covered by ETSU noise limits]*; and*
- *An additional decibel penalty is proposed during the night time period to account for the current difference between the night and day limits on many sites to ensure the control method works during the most sensitive period of the day."*

3.3.10 At the time of writing there has been no official response to those recommendations from the IOA Noise Working Group and, as yet, no endorsement from any Scottish Government Minister or Department. The recommendation to impose a planning condition and the associated penalty scheme is at odds with the advice from the IOA GPG, which currently states (paragraph 7.2.10):

'7.2.1 The evidence in relation to "Excess" or "Other" Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM.'

3.3.11 On that basis Amplitude Modulation has not been considered further in this assessment.

4 Methodology

4.1 Assessing Operational Noise Impact

4.1.1 To undertake an assessment of the operational noise impact in accordance with the requirements of ETSU-R-97 and the IOA GPG, the following steps are required:

- Specify the location of the wind turbines for the Proposed Development;
- Review where background noise levels have previously been measured and reported at a selection of representative Noise Monitoring Locations (NML);
- Establish for each NML the 'Total ETSU-R-97 Noise Limits' based on the derived background noise trends;
- Where Total ETSU-R-97 Noise Limits have previously been set by a consented / operational wind farm, determine whether the fixed minimum limit (FML) should be increased (if applicable) considering the cumulative environment, and the FML awarded to other schemes in the vicinity;
- Identify the locations of all nearby noise sensitive receptors and select a sample of relevant Noise Assessment Locations (NAL). For each NAL, identify the most representative measured background noise data;
- Specify the likely noise emission characteristics of the wind turbines for the Proposed Development and all nearby cumulative wind turbines;
- Calculate the likely noise immission levels due to the cumulative operation of all relevant wind turbines and compare it to the Total ETSU-R-97 Limits;
- If required, determine the 'Site Specific Noise Limits' which take allowance of the noise immissions due to other schemes; and
- Calculate the likely noise immission levels due to the operation of the Proposed Development on its own and compare it to the Proposed Development's 'Site Specific Noise Limits'.

4.1.2 In order to consider the steps outlined above the assessment has been split into three separate stages:

- Stage 1 – determine the existing Total ETSU-R-97 Noise Limits already set for other wind farms within the vicinity of the Proposed Development at each NAL, or establish the Total ETSU-R-97 Limits for each NAL (where noise limits are not already set) based on the measured background noise levels. Consideration should be made to the FML to be assumed, accounting for the cumulative situation and what FML has already been consented in the area;
- Stage 2 – undertake a likely cumulative noise assessment to determine whether the Proposed Development can operate concurrently with other proposed, consented or operational wind farm developments; and

- Stage 3 – establish the Proposed Development's Site Specific Noise Limits (at levels below the Total ETSU-R-97 Noise Limits, where limit apportionment is required) and compare the noise predictions from the Proposed Development on its own against the proposed 'Site Specific Noise Limits'.

4.1.3 There are a range of turbine makes and models that may be appropriate for the Proposed Development. The final selection of turbine will follow a competitive tendering process and thus the final model of turbine may differ from those on which this assessment has been based. However, the final choice of turbine will comply with the noise limits which have been established for the site.

4.2 Consultation

Scoping Opinion (dated August 2020)

4.2.1 In the Scoping Opinion, the Dumfries and Galloway Council (THC) stated that;

'Environmental Health has advised that until a site-specific impact assessment has been carried out with regard to noise and potential for impact on private water supplies, they are unable to comment fully as to the expected impacts at this stage.'

4.2.2 In addition;

4.2.3 *'Environmental Health suggest that a method statement for the construction project should be provided within the EIA report for approval by Dumfries & Galloway Council. This should include an assessment of potentially noisy operations and outline the noise mitigation measures proposed. This will also include a programme and phases for each stage of work. Guidance as to construction noise prediction methodology may be found within BS5228:2009.'*

4.2.4 No mention of the methodology to be used for the operational noise assessment has been provided; the construction noise assessment has been undertaken as part of Technical Appendix 10.1.

4.2.5 The Scottish Government's Energy Consents Unit states that noise assessments should be carried out in line with relevant legislation and standards as detailed in Section 3.8 of the scoping report which refers to the use of ETSU-R-97 and the IOA GPG.'

4.2.6 The Scottish Ministers advise "the company to take note of Dumfries and Galloway Council's response which refers to noise." This is discussed further in Section 4.2.1 above.

Consultation with Dumfries and Galloway Council EHO (June 2020)

4.2.7 Prior to the commencement of the noise impact assessment for the Proposed Development, direct consultation was undertaken with the Environmental Health

Department at Dumfries and Galloway Council (DGC) in order to agree the approach to the noise assessment.

4.2.8 To date no response has been received from the Environmental Health Department at the Council.

4.2.9 A copy of the original consultation letter is included in Annex 3.

4.3 Setting the Total ETSU-R-97 noise limits (Stage 1)

Identify Existing Noise Limits

4.3.1 Noise limits have already been established at some of the closest receptors to the site as part of the planning conditions set for other consented schemes in the area.

4.3.2 The noise limits set at the operational schemes detailed in Section 1.2.3 above are based on fixed minimum limits (FML) of 35 dB or background +5 dB for the Daytime period, and 43 dB or background +5 dB for the Night-time period. The exception to this is the operational Kilgallioch Wind Farm which was consented with a higher 40 dB FML for the daytime period, and 43 dB or background +5 dB for the night time period. Where a property has financial involvement with a particular scheme, then noise limits are based on a higher FML of 45 dB or background + 5 dB for both daytime and night time periods.

4.3.3 Extracts of the Decision Notices containing the noise conditions are included in Annex 2.

Noise Impact Criteria in ETSU-R-97

4.3.4 The baseline noise environment has already been established as part of background noise surveys previously undertaken by, now consented and operational, wind farm applications in the area. These have been used to set, for each NAL, the daytime and night time Total ETSU-R-97 Noise Limits, and would apply for the cumulative operation of all wind turbines in the area. No further measurements were undertaken due to the potential for other cumulative noise schemes in the area to influence the measurements.

4.3.5 The Total ETSU-R-97 Noise Limits for the daytime has been set at 40 dB(A) or background plus 5 dB whichever is the greater; this is necessary as this limit has already been allocated to the operational Kilgallioch Wind Farm. The Total ETSU-R-97 Noise Limits at night time has been set at 43 dB(A) or background plus 5 dB whichever is the greater. This 'Total' limit relates to noise from all wind farm developments in the area. The limit was chosen with due regard to the guidance in ETSU-R-97 and following a review of the predicted levels for existing wind turbines in the area (and the noise limit that has effectively been allocated already to those consented developments).

4.3.6 As detailed in Section 2.6.9 above, ETSU-R-97 suggests that the daytime fixed minimum limit should be set somewhere in the range between 35 and 40 dB. The precise choice of criterion level within the range 35 - 40 dB(A) depends on a number of factors, including the number of dwellings in the neighbourhood of the wind farm, the effect of noise limits on the number of kWh generated and the duration and level of exposure to any noise. Site Specific Noise Limits have been derived such that they are always at or below the limit established using the lower fixed minimum limit of 35 dB.

4.3.7 The acceptable limits for wind turbine operational noise are clearly defined for all time periods by the application of the ETSU-R-97 methodology. Consequently, the test applied to operational noise is whether or not the predicted wind turbine noise immission levels at nearby noise sensitive properties lie below the ETSU-R-97 noise limits. Depending on the levels of background noise, the satisfaction of the ETSU-R-97 derived limits can lead to a situation whereby, at some locations under some wind conditions and for a certain proportion of the time, the wind turbine noise would be audible.

4.4 Assessment of likely effects and the requirement for a cumulative assessment (Stage 2)

4.4.1 A cumulative noise assessment has been undertaken to determine the likely impacts of the Proposed Development.

Noise Prediction / Propagation Model

4.4.2 The ISO 9613-2: 1996 *'Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation'* [17] model algorithm provides a robust prediction method for calculating the noise immission levels at the nearest receptors. A European Commission (EC) research project into wind farm noise propagation over large distances, published as 'Development of a Wind Farm Noise Prediction Model,' JOULE project JOR3-CT95-0051 in 1998, identified a simplified version of ISO 9613-2 as the most suitable at that time, but the full method has been used for this assessment.

4.4.3 The use of ISO 9613-2 is discussed in the IOA GPG which states, in Section 4.1.4:

'ISO 9613-2 standard in particular, which is widely used in the UK, can be applied to obtain realistic predictions of noise from on-shore wind turbines during worst case propagation conditions (i.e. sound speed gradients due to downwind conditions or temperature inversions), but only provided that the appropriate choice of input parameters and correction factors are made.'

4.4.4 There is currently no standard approach to specifying error bands on noise predictions. Table 5 of ISO 9613-2 suggests, at best, an estimated of accuracy of ± 3 dB(A). The work undertaken as part of the EC research study concluded that the

ISO 9613-2 algorithm reliably predicted noise levels that would generally occur under downwind propagation conditions.

4.4.5 The ISO 9613-2 model can take account of the following factors that influence sound propagation outdoors:

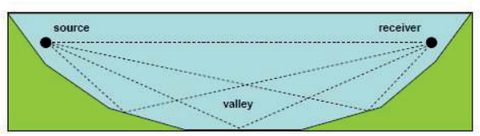
- Geometric divergence;
- Atmospheric absorption;
- Reflecting obstacles;
- Screening;
- Vegetation; and
- Ground attenuation.

4.4.6 The model uses as its acoustic input data the octave band sound power output of the turbine and calculates, on an octave band basis, attenuation due to the factors above, as appropriate.

4.4.7 The IOA GPG quotes a comparative study undertaken in Australia that indicated ISO 9613-2 can, in some conditions, under-predict ground attenuation effects and the potential for additional reflection paths 'across a valley', whilst slightly over-predicting on flat terrain. It should be noted, however, that the wind farm layouts studied were untypical for the UK, with rows of turbines spreading over 10 km on an elevated ridge. It also should be noted that no correction for background contribution was undertaken and the monitoring locations were located as far as 1.7 km from the nearest turbine, where turbine noise may be at similar levels to background noise and therefore difficult to differentiate. For the study's modelling work topographic height data was included as an input, which is consistent with ISO 9613-2 methodology generally, but use of topographic data is only used to consider the propagation path between source and receiver, and to test for topographic effects as detailed below in accordance with the IOA GPG.

4.4.8 The IOA GPG states that a *'further correction of +3 dB should be added to the calculated overall A-weighted level for propagation 'across a valley', i.e. a concave ground profile or where the ground falls away significantly between a turbine and the receiver location.'* The potential reflection paths are illustrated in Schematic 4.1 below.

Schematic 4.1: Multiple reflection paths for sound propagation across concave ground



Source: IOA GPG, page 21, Figure 5

4.4.9 A formula from the JOULE Project JOR3-CT95-0051 dated 1998 is suggested for determining whether a correction is required.

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

where h_m is the mean height above the ground of the direct line of sight from the receiver to the source (as defined in ISO 9613-2, Figure 3), and h_s and h_r are the heights above local ground level of the source and receiver respectively).

4.4.10 The calculation of h_m requires consideration of the digital terrain model and needs to be performed for each path between every turbine and every receiver. Interpretation of the results of the calculation above and the subsequent inclusion of a concave ground profile correction requires careful consideration with any topographical variation considered in the context of a site.

4.4.11 The IOA GPG also discusses the potential for topographical screening effects of the terrain surrounding a wind farm and the nearby noise sensitive receptors. Although barrier screening effects in ISO 9613-2 can make corrections of up to 15 dB, the IOA GPG states that where there is no line of sight between the highest point on the rotor and the receiver location a reduction of no more than 2 dB may be applied.

4.4.12 The modelling parameters used in this assessment are detailed in Section 6.3 below.

4.5 Setting the Site Specific Noise Limits (Stage 3)

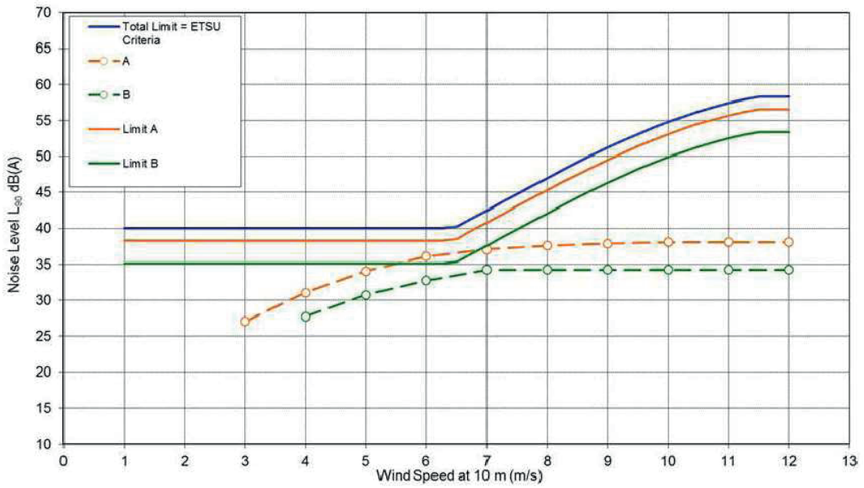
4.5.1 Summary Box 21 of the IOA GPG states:

'Whenever a cumulative situation is encountered, the noise limits for an individual wind farm should be determined in such a way that no cumulative excess of the total ETSU-R-97 noise limit would occur.'

4.5.2 In order to determine site specific noise limits at receptors in proximity to the Proposed Development (where required) limit apportionment has been undertaken. The limit apportionment has considered the noise limit already allocated to other wind farms in the area.

4.5.3 This approach is demonstrated in Graph 4.1 below. In this example the total limit (shown in blue) is shared between a consented wind farm (A) and a Proposed Development (B). The two noise limits for a given receptor (the solid orange and green lines) when added together equate to the Total ETSU-R-97 noise limit, and the predicted levels for each wind farm (the dashed lines) meet the specific limits established for consented wind farm and the Proposed Development.

Graph 4.1: Limit Apportionment Example



4.5.4 The limit derivation can also be undertaken with consideration to the amount of headroom between another schemes(s) predictions and the Total Noise Limit. With regard to this Section 5.4.11 of the IOA GPG states:

'In cases where there is significant headroom (e.g. 5 to 10 dB) between the predicted noise levels from the existing wind farm and the Total Noise Limits, where there would be no realistic prospect of the existing wind farm producing noise levels up to the Total Noise Limits, agreement could be sought with the LPA as to a suitable predicted noise level (including an appropriate margin to cover factors such as potential increases in noise) from the existing wind farm to be used to inform the available headroom for the cumulative assessment without the need for negotiation or cumulative conditioning. This may be the case particularly at low wind speeds.'

4.5.5 With this in mind, where appropriate, an additional 2 dB buffer has been added to the other schemes' turbine noise predictions. This is considered to be a suitable buffer in accordance with Section 5.4.11 of the IOA GPG and would represent a 60% increase in emitted noise levels from the other schemes.

4.5.6 Where predicted wind turbine noise levels from the individual wind farm/ turbine schemes are found to be >10 dB below the Total ETSU-R-97 Noise Limits then it has been deemed appropriate to allocate the entire noise limit to the Proposed Development. Further information on the approach to apportionment is provided in Section 6.6 below.

4.5.7 Where no significant headroom exists, and the entire noise limit is already being used up by other schemes in the area, then a Site Specific Noise Limit would be required to be set 10 dB below the Total ETSU-R-97 Noise Limits. Given the other schemes can realistically use this available budget allocated to them, this would ensure the

Proposed Development would have a negligible impact on other schemes ability to meet the Total ETSU-R-97 Noise Limits.

5 Baseline

5.1 Background Noise Monitoring

5.1.1 ETSU-R-97 and the IOA GPG make it clear that background noise levels should be established in the absence of noise from wind turbines. Due to the presence of a number of operational wind farms around the proposed development, noise monitoring undertaken to derive background noise levels could have been influenced by noise from existing operational turbines. In such circumstances the IOA GPG suggests four potential methods:

1. *"Switching off the existing wind farm during the background noise level survey (with associated significant cost implications);*
2. *Accounting for the contribution of the existing wind farm in the measurement data e.g. directional filtering (only including background data when it is not influenced by the existing turbines e.g. upwind of the receptor, but mindful of other extraneous noise sources e.g. motorways) or subtracting a prediction of noise from the existing wind farm from the measured noise levels;*
3. *Utilising an agreed proxy location removed from the area acoustically affected by the existing wind farm/s; or*
4. *Utilising background noise level data as presented within the Environmental Statement/s for the original wind farm/s (the suitability of the background noise level data should be established)."*

5.1.2 Following a review of the existing data available and potential monitoring locations around the Proposed Development, it was proposed that the original background noise measurements, used to inform the other consented and operational schemes, were used to derive the Total ETSU-R-97 Noise Limits. This approach was set out in the initial consultation undertaken with the Council (as detailed in Annex 3).

5.1.3 Background noise monitoring was undertaken at a number of Noise Monitoring Locations (NMLs) as part of the Airies and Kilgallioch wind farms applications. Table 5.1 below details the noise monitoring locations (NMLs) used for each scheme. The source of the data within their respective ES chapters is also detailed. The locations are shown on Figure A1.1a, Annex 1.

Table 5.1 Noise Monitoring Locations

NML	Receptor Name	Easting	Northing	Wind Farm
NML1	Kilquockadale	229258	567804	Airies*
NML2	Three Lochs Holiday Park	227216	565515	
NML3	Low Airies	226107	566542	
NML4	Gass Farm	224928	564021	

NML	Receptor Name	Easting	Northing	Wind Farm
NML5	Kilmacfadzean	220363	567523	Kilgallioch**
NML6	Quarter Farm	218645	568273	
NML7	Pultadie	218253	570027	
*ES Chapter 13 - Appendix 13.8 – Polynomial equations associated with graphs A13.1-A13.4				
**ES Chapter 13 - Table 13.3 – Prevailing Background Noise Levels				

5.1.4 Monitoring was also undertaken for the Glenchamber Wind Farm application, however wind speed measurements were undertaken using a 10 m high meteorological mast which would not accord with current good practice guidelines, therefore the baseline data has not been used in this assessment.

5.2 Prevailing Background Noise Level

5.2.1 Table 5.2 and 5.3 summarise the prevailing background noise levels measured at each of the noise monitoring locations.

Table 5.2 Summary of Prevailing Background Noise Levels during Quiet Daytime Periods (dB(A))

NML	Prevailing Background Noise Level $L_{A90,10\ min}$											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1 - Kilquockadale	25.1	24.3	24.4	25.5	27.6	30.6	34.6	39.5	45.3	45.3	45.3	45.3
NML2 - Three Lochs Holiday Park	18.8	21.4	23.9	26.3	28.7	31.0	33.2	35.4	37.5	37.5	37.5	37.5
NML3 - Low Airies	26.3	24.7	24.3	25.2	27.2	30.5	34.9	40.6	47.5	55.5	55.5	55.5
NML4 - Gass Farm	30.1	30.0	30.6	31.8	33.7	36.2	39.4	43.2	47.7	47.7	47.7	47.7
NML5 - Kilmacfadzean	17.6	18.9	20.6	22.4	24.4	26.9	29.9	33.6	37.7	41.5	41.5	41.5
NML6 - Quarter Farm	21.8	24.6	26.2	27.4	28.9	31.0	34.0	37.5	41.0	43.7	43.7	43.7
NML7 - Pultadie	25.3	26.0	26.5	27.1	28.2	30.2	33.3	37.1	41.0	43.5	43.5	43.5

Table 5.3 Summary of Prevailing Background Noise Levels during Night time Periods (dB(A))

NML	Prevailing Background Noise Level $L_{A90,10\ min}$											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1 - Kilquockadale	22.7	21.0	20.7	21.6	23.8	27.4	32.2	38.4	45.8	45.8	45.8	45.8
NML2 - Three Lochs Holiday Park	22.9	20.9	20.1	20.6	22.3	25.2	29.4	34.8	34.8	34.8	34.8	34.8
NML3 - Low Airies	22.6	20.9	20.5	21.7	24.2	28.2	33.6	40.4	48.7	58.4	58.4	58.4
NML4 - Gass Farm	25.2	22.8	22.2	23.4	26.3	30.9	37.3	45.5	55.4	55.4	55.4	55.4
NML5 - Kilmacfadzean	17.6	18.0	18.6	19.5	20.7	22.1	23.8	25.6	25.6	25.6	25.6	25.6
NML6 - Quarter Farm	22.7	23.6	24.7	26.0	27.5	29.2	31.0	32.9	32.9	32.9	32.9	32.9
NML7 - Pultadie	25.5	26.2	26.7	27.3	28.0	29.1	30.8	33.1	33.1	33.1	33.1	33.1

6 Noise Assessment Results

6.1 Noise Assessment Locations

6.1.1 Noise assessment locations (NAL) refer to the position on the curtilage denoted by the blue house symbol on Figure A1.1a (Annex 1). A total of twenty four noise sensitive receptors were chosen as representative NALs. The NALs chosen were the closest receptors to the Proposed Development and other wind farm developments. Predictions of wind turbine noise have been made at each of the NAL as detailed in Table 6.1.

6.1.2 This approach ensures that the report models the worst case (loudest) noise immission level expected at each group of noise sensitive receptors, as, generally speaking, sound levels decrease due to the attenuating factors described in Section 4.4.5 and thus the closer to a noise source, the higher the noise level. Table 6.1 details which NML has been used to set noise limits for each NAL – further justification of which NML has been used for each NAL is provided in Appendix 2 of the EHO consultation letter, within Annex 3 of this report.

Table 6.1 Noise Assessment Locations

Noise Assessment Location (NAL)	Easting (m)	Northing (m)	Elevation (m AOD)	Approximate Distance to Nearest Artfield Forest Turbine* (m)	Background Noise Data Used
NAL1 – Artfield**	223713	566158	163	1,476 (T11)	NML3
NAL2 - Low Airies***	226107	566542	147	1,609 (T12)	NML3
NAL3 – Glenchamber****	223793	563918	135	3604 (T11)	NML4
NAL4 - Torwood Bungalow 2	224358	563762	117	3712 (T11)	NML4
NAL5 - Torwood Bungalow*****	224426	563859	122	3615 (T11)	NML4
NAL6 - Torwood House Hotel	224466	564064	128	3411 (T11)	NML4
NAL7 - Torwood Two Dogs Lodge	224551	564121	126	3357 (T11)	NML4
NAL8 - Gass Farm*****	224928	564021	109	3459 (T12)	NML4
NAL9 - Scotts Corner	225033	564053	108	3,433 (T12)	NML4

Noise Assessment Location (NAL)	Easting (m)	Northing (m)	Elevation (m AOD)	Approximate Distance to Nearest Artfield Forest Turbine* (m)	Background Noise Data Used
NAL10 - Mark of Lochronald Bungalow	226031	564598	113	3132 (T12)	NML2
NAL11 - Mark of Lochronald	226093	564491	111	3,255 (T12)	NML2
NAL12 - Fell of Loch Ronald	227063	564387	115	3,831 (T12)	NML2
NAL13 - Balminnoch	226837	565411	124	2902 (T12)	NML2
NAL14 - The Old Schoolhouse	228677	566389	104	4029 (T12)	NML1
NAL15 - Kilquhockadale	229258	567804	115	4472 (T12)	NML1
NAL16 - Urrall	229275	569553	141	4935 (T12)	NML1
NAL17 - Tannielaggie	228748	572073	117	5972 (T2)	NML7
NAL18 - Kilmacfadzean	220363	567523	148	2362 (T5)	NML7
NAL19 - Quarter Farm	218645	568273	139	3,915 (T5)	NML8
NAL20 - Pultadie	218253	570027	145	4605 (T5)	NML9
NAL21 - Balmurrie	220495	566427	145	2850 (T5)	NML7
NAL22 - Dranigower	220128	565132	100	4068 (T5)	NML7
NAL23 - Garvilland	221583	561787	125	6337 (T11)	NML4
NAL24 - Carscreugh Croft	223200	562300	116	5307 (T11)	NML4

** Please note the distances to nearest turbines quoted above may differ from those reported elsewhere. Distances for the noise assessment are taken from the nearest turbine to the closest edge of the amenity area (usually the garden).*
*** the occupiers are financially involved with Artfield Fell/ Balmurrie*
**** the occupiers are financially involved with Airies*
***** the occupiers are financially involved with Glenchamber*
******the occupiers are financially involved with the Proposed Development.*

6.2 Noise Emission Characteristics of the Wind Turbines

6.2.1 There are a range of wind turbine models which may be suitable for installation at the Proposed Development. This assessment considers the Vestas V150 5.6 MW with serrated trailing edge blades.

6.2.2 For the cumulative assessment the turbines modelled are the Siemens SWT 62 (Artfield Fell/ Balmurrie), Gamesa G52 (Carscreugh), Nordex N100 (Glenchamber), GE 103 (Airies), Vestas V150 (Airies II), G114/G90 (Kilgallioch) and Vestas V150 (Kilgallioch Extension).

6.2.3 Due to the differences in the way in which levels are provided by the different manufacturers, TNEI has accounted for uncertainty using the guidance contained within Section 4.2 of the IOA GPG (2013). Details of the sound power level, octave data and measurement uncertainty used for the turbines considered in this assessment are available on request[2].

6.2.4 Manufacturer data is usually supplied based on a specific hub height whilst values are presented as standardised to 10 m height. The noise model used in this assessment alters turbine noise data to account for different hub heights, where applicable. The hub height modelled for the Proposed Development is 105 m. The hub heights considered for the other wind farm/turbine developments are summarised in Annex 4.

6.2.5 The location of the wind turbines are shown on Figure A1.1b and grid references are included in Annex 4.

6.3 Noise Propagation Parameters

6.3.1 As detailed in Section 4.4 above, the full version of the ISO 9613-2 model has been used to calculate the noise immission levels at the nearest receptors.

6.3.2 For the purposes of the present assessment, all noise level predictions have been undertaken using a receiver height of 4.0 m above local ground level, mixed ground (G=0.5) and air absorption co-efficients based on a temperature of 10 °C and 70 % relative humidity to provide a realistic impact assessment. The modelling parameters reflect current good practice as detailed within the IOA GPG.

6.3.3 The wind turbine noise immission levels are based on the $L_{A90,10\ minute}$ noise indicator in accordance with the recommendations in ETSU-R-97, which were obtained by subtracting 2dB(A) from the turbine sound power level data (L_{Aeq} indicator).

6.3.4 A topographical assessment has been undertaken between each noise sensitive receptor and wind turbine location to determine whether any concave ground profiles exist between the source and receiver (noise sensitive receptor). Analysis undertaken using a combination of CadnaA [(19)] and an Excel model found that if the formula in the IOA GPG is applied directly a +3 dB correction is required for some turbines at a number of receptors as summarised in Annex 4.

6.3.5 In addition, an assessment has been undertaken to determine whether any topographical screening effects of the terrain occur where there is no direct line of

[2] Noise data for the has not been included due to data confidentiality. Detailed noise data would be available upon request following the signing of the appropriate Non-Disclosure Agreement

site between the highest point on the turbine rotor and the receiver location. Upon analysis of each noise sensitive receptor it was found that a barrier correction of -2 dB could be applied for some turbines at a number of receptors as detailed in Annex 4. In reality, there is significant screening at some of the locations so more attenuation may occur in practice, the use of a 2 dB value is therefore considered to be conservative as it results in the highest predicted levels. All corrections have been applied, where necessary, in all of the Tables and Graphs in this report.

6.3.6 The need to include a concave ground/screening correction may change depending on the final location of the turbines (following micrositing) and the final turbine hub height. Nevertheless, turbine noise levels will have to meet the noise limits established in this report regardless of any increases in noise propagation caused by topography. Should planning permission be granted, the need to apply a concave slope correction will need to be considered by the Applicant prior to the final selection of a turbine model for the Proposed Development.

6.3.7 The cumulative assessment has taken into account directivity effects in line with good practice. The directivity of wind turbines has been recognised for some time. Building on earlier work by NASA, in 1988 Wyle Laboratories studied sound propagation using an omnidirectional loudspeaker source elevated 80 ft above ground, in upwind, downwind and cross wind situations, and in both flat and hilly terrain, then compared those measurements to measured data from actual wind turbines. Their study quantified directivity factors for a limited frequency range, but was unable to conclusively demonstrate the anticipated directivity effects on real wind turbines. It also highlighted, but was unable to explain, measured differences observed between flat and hilly terrain.

6.3.8 Hubbard (1990) described a number of factors believed to influence propagation and directivity, notably refraction caused by vertical wind and temperature gradients. In the downwind direction the wind gradient causes the sound rays to bend toward the ground, whereas in the upwind direction the rays curve upward away from the ground. Upwind of the turbine this results in a region of increased attenuation termed the 'shadow zone'. The excess attenuation is frequency dependent, with lowest frequencies least attenuated. Relating this to the earlier NASA studies, Hubbard noted that the distance from the source to the edge of the shadow zone is related to the wind speed gradient and the elevation of the source, which for a typical turbine source was calculated to be approximately 5 times the source height.

6.3.9 This observation was adopted in the IOA GPG, which states (4.4.2) 'Such reductions (due to "shadow zone" refraction effects) will in practice only progressively come into play at distances of between 5 and 10 turbine tip heights', while 4.4.3 provides graphical examples of increasing broadband directivity with increasing tip height scaling in both flat and hilly terrain, without qualifying either of those designations.

6.3.10 The IOA GPG recommends (4.4.1) that directivity attenuation factors adopted in any assessment should be clearly stated. The TNEI noise model can consider the effect of directivity, and in line with current good practice the attenuation values used are

in detailed in Table 6.2. These are based upon the examples given in the IOA GPG (4.4.2), using interpolation where required, and adopt a single attenuation value for receptors between located more than 5 tip heights from a receiver.

Table 6.2 Wind Directivity Attenuation Factors used in Modelling

Direction (º)	0	15	30	45	60	75	90	105	120	135	150	165
Attenuation dB(A))	-10	-9.9	-9.3	-8.3	-6.7	-4.6	-2	0	0	0	0	0
Direction (º)	180	195	210	225	240	255	270	285	300	315	330	345
Attenuation (dB(A))	0	0	0	0	0	0	-2	-4.6	-6.7	-8.3	-9.3	-9.9

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

6.4.1 The ETSU-R-97 noise limits are derived with relation to the background noise trends detailed in 5.2.1 above. These limits, sometimes referred to as the 'criterion curve', are based on a level 5 dB(A) above this best fit correlation curve, over a wind speed range from 0 to 12 ms^{-1}. Where the derived criterion curve for the daytime period lies below a fixed level in the range 35 – 40 dB(A) then ETSU-R-97 provides that the criterion curve may be set at an absolute level somewhere within that range.

6.4.2 When considering the cumulative impacts of the Proposed Development operating in conjunction with other operational, consented and proposed schemes a FML of 40 dB has been adopted to establish the daytime Total ETSU-R-97 Noise Limit. This limit was chosen following a review of the noise limits allocated or proposed for nearby wind farms and with due regard to the guidance in ETSU-R-97.

6.4.3 The only exception being where the occupiers are financially involved with the Proposed Development or another scheme where the Total ETSU-R-97 noise limits have been established based on a fixed minimum of 45dB(A) or background noise plus 5 dB whichever is the greater during the daytime and night time periods.

6.4.4 Whilst a cumulative daytime Total ETSU-R-97 Noise Limit of 40 dB (or background noise plus 5 dB) is proposed, the Proposed Developments Site Specific Noise Limit has been set such that it never exceeds 35 dB (or background noise plus 5 dB whichever is the greater); this represents the lower end of the daytime limit that can be applied under in ETSU-R-97.

6.4.5 The Total ETSU-R-97 noise limits have been established for each of the NALs as detailed in Table 6.3 and Table 6.4 below, based on a fixed minimum of 40dB(A) (daytime) or 43 dB(A) (Night time) or background plus 5 dB(A).

Table 6.3 Total ETSU-R-97 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
NAL1 - Artfield	45	45	45	45	45	45	45	45.6	52.5	60.5	60.5	60.5
NAL2 - Low Airies	45	45	45	45	45	45	45	45.6	52.5	60.5	60.5	60.5
NAL3 - Glenchamber	45	45	45	45	45	45	45	48.2	52.7	52.7	52.7	52.7
NAL4 - Torwood Bungalow 2	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
NAL5 - Torwood Bungalow	45	45	45	45	45	45	45	48.2	52.7	52.7	52.7	52.7
NAL6 - Torwood House Hotel	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
NAL7 - Torwood Two Dogs Lodge	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
NAL8 - Gass Farm	45	45	45	45	45	45	45	48.2	52.7	52.7	52.7	52.7
NAL9 - Scotts Corner	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
NAL10 - Mark of Lochronald Bungalow	40	40	40	40	40	40	40	40.4	42.5	42.5	42.5	42.5
NAL11 - Mark of Lochronald	40	40	40	40	40	40	40	40.4	42.5	42.5	42.5	42.5
NAL12 - Fell of Loch Ronald	40	40	40	40	40	40	40	40.4	42.5	42.5	42.5	42.5
NAL13 - Balminnoch	40	40	40	40	40	40	40	40.4	42.5	42.5	42.5	42.5
NAL14 - The Old Schoolhouse	40	40	40	40	40	40	40	44.5	50.3	50.3	50.3	50.3
NAL15 - Kilquhockadale	40	40	40	40	40	40	40	44.5	50.3	50.3	50.3	50.3
NAL16 - Urrall	40	40	40	40	40	40	40	44.5	50.3	50.3	50.3	50.3
NAL17 - Tannielaggie	40	40	40	40	40	40	40	40	42.7	46.5	46.5	46.5
NAL18 - Kilmacfadzean	40	40	40	40	40	40	40	40	42.7	46.5	46.5	46.5
NAL19 - Quarter Farm	40	40	40	40	40	40	40	42.5	46	48.7	48.7	48.7
NAL20 - Pultadie	40	40	40	40	40	40	40	42.1	46	48.5	48.5	48.5
NAL21 - Balmurrie	40	40	40	40	40	40	40	40	42.7	46.5	46.5	46.5
NAL22 - Dranigower	40	40	40	40	40	40	40	40	42.7	46.5	46.5	46.5
NAL23 - Garvilland	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
NAL24 - Carscreugh Croft	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7

Table 6.4 Total ETSU-R-97 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
NAL1 - Artfield	45	45	45	45	45	45	45	45.4	53.7	63.4	63.4	63.4
NAL2 - Low Airies	45	45	45	45	45	45	45	45.4	53.7	63.4	63.4	63.4
NAL3 - Glenchamber	45	45	45	45	45	45	45	50.5	60.4	60.4	60.4	60.4
NAL4 - Torwood Bungalow 2	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
NAL5 - Torwood Bungalow	45	45	45	45	45	45	45	50.5	60.4	60.4	60.4	60.4
NAL6 - Torwood House Hotel	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
NAL7 - Torwood Two Dogs Lodge	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
NAL8 - Gass Farm	45	45	45	45	45	45	45	50.5	60.4	60.4	60.4	60.4
NAL9 - Scotts Corner	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
NAL10 - Mark of Lochronald Bungalow	43	43	43	43	43	43	43	43	43	43	43	43
NAL11 - Mark of Lochronald	43	43	43	43	43	43	43	43	43	43	43	43
NAL12 - Fell of Loch Ronald	43	43	43	43	43	43	43	43	43	43	43	43
NAL13 - Balminnoch	43	43	43	43	43	43	43	43	43	43	43	43
NAL14 - The Old Schoolhouse	43	43	43	43	43	43	43	43.4	50.8	50.8	50.8	50.8
NAL15 - Kilquhockadale	43	43	43	43	43	43	43	43.4	50.8	50.8	50.8	50.8
NAL16 - Urrall	43	43	43	43	43	43	43	43.4	50.8	50.8	50.8	50.8
NAL17 - Tannielaggie	43	43	43	43	43	43	43	43	43	43	43	43
NAL18 - Kilmacfadzean	43	43	43	43	43	43	43	43	43	43	43	43
NAL19 - Quarter Farm	43	43	43	43	43	43	43	43	43	43	43	43
NAL20 - Pultadie	43	43	43	43	43	43	43	43	43	43	43	43
NAL21 - Balmurrie	43	43	43	43	43	43	43	43	43	43	43	43
NAL22 - Dranigower	43	43	43	43	43	43	43	43	43	43	43	43
NAL23 - Garvilland	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
NAL24 - Carscreugh Croft	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4

6.5 Predicting the likely effects and the requirement for a cumulative assessment (Stage 2)

6.5.1 A likely cumulative noise assessment was undertaken at all NALs detailed in Table 6.1. A detailed list of the wind farms considered in the assessment are included in Annex 4.

6.5.2 The result of the cumulative noise assessment is summarised in tabular form in Table 6.5 and Table 6.6 and show that the predicted cumulative wind turbine noise immission levels meet the 'Total ETSU-R-97 Noise limits' under all conditions for 21 of the NALs for both the daytime and night time periods. Exceedances (shown in **bold**) are predicted to occur at NALs 1, 2, and 18, however this is not as a result of any predicted contribution from the Proposed Development. Figures A1.2a-A1.2x (Annex 1) show predictions from the Proposed Development and 'all other schemes' against the 'Total ETSU-R-97 Noise Limits' at all receptors.

Table 6.5 ETSU-R-97 Compliance Table – Likely Cumulative Noise - Daytime

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Artfield	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	45.6	52.5	60.5	60.5	60.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	45.2	45.7	46.2	46.9	47.7	47.7	47.7
	Exceedance Level	-	-	-	-	-	**0.2**	**0.7**	**0.6**	-5.6	-12.8	-12.8	-12.8
NAL2 - Low Airies	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	45.6	52.5	60.5	60.5	60.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	50.9	51.6	52.2	52.2	52.2	52.2	52.2
	Exceedance Level	-	-	-	-	-	**5.9**	**6.6**	**6.6**	-0.3	-8.3	-8.3	-8.3
NAL3 - Glenchamber	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	48.2	52.7	52.7	52.7	52.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	40	41.4	41.9	42.1	42.3	42.3	42.3
	Exceedance Level	-	-	-	-	-	-5	-3.6	-6.3	-10.6	-10.4	-10.4	-10.4
NAL4 - Torwood Bungalow	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.8	38.2	38.9	39.1	39.3	39.3	39.3
	Exceedance Level	-	-	-	-	-	-4.4	-6.2	-9.3	-13.6	-13.4	-13.4	-13.4
NAL5 - Torwood Bungalow	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	48.2	52.7	52.7	52.7	52.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	37.3	38.6	39.3	39.5	39.8	39.8	39.8
	Exceedance Level	-	-	-	-	-	-7.7	-6.4	-8.9	-13.2	-12.9	-12.9	-12.9
NAL6 – Torwood House Hotel	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	37.8	39.1	39.7	40	40.3	40.3	40.3
	Exceedance Level	-	-	-	-	-	-3.4	-5.3	-8.5	-12.7	-12.4	-12.4	-12.4

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 – Torwood Two Dogs Lodge	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	37.6	38.8	39.3	39.5	39.8	39.8	39.8
	Exceedance Level	-	-	-	-	-	-3.6	-5.6	-8.9	-13.2	-12.9	-12.9	-12.9
NAL8 – Gass Farm	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	48.2	52.7	52.7	52.7	52.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.4	37.6	38.2	38.5	38.8	38.8	38.8
	Exceedance Level	-	-	-	-	-	-8.6	-7.4	-10	-14.2	-13.9	-13.9	-13.9
NAL9 – Scotts Corner	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.4	37.5	38.1	38.4	38.7	38.7	38.7
	Exceedance Level	-	-	-	-	-	-4.8	-6.9	-10.1	-14.3	-14	-14	-14
NAL10 – Mark of Lochronald Bungalow	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	40.4	42.5	42.5	42.5	42.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.5	37.6	38.1	38.3	38.6	38.6	38.6
	Exceedance Level	-	-	-	-	-	-3.5	-2.4	-2.3	-4.2	-3.9	-3.9	-3.9
NAL11 - Mark of Lochronald	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	40.4	42.5	42.5	42.5	42.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.2	37.2	37.8	38	38.3	38.3	38.3
	Exceedance Level	-	-	-	-	-	-3.8	-2.8	-2.6	-4.5	-4.2	-4.2	-4.2
NAL12 – Fell of Loch Ronald	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	40.4	42.5	42.5	42.5	42.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	34.7	35.8	36.3	36.5	36.8	36.8	36.8
	Exceedance Level	-	-	-	-	-	-5.3	-4.2	-4.1	-6	-5.7	-5.7	-5.7

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13-Ballminnoch	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	40.4	42.5	42.5	42.5	42.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	38.5	39.7	40.1	40.2	40.4	40.4	40.4
	Exceedance Level	-	-	-	-	-	-1.5	-0.3	-0.3	-2.3	-2.1	-2.1	-2.1
NAL14- The Old Schoolhouse	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	44.5	50.3	50.3	50.3	50.3
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	35.2	36.9	37.2	37.2	37.4	37.4	37.4
	Exceedance Level	-	-	-	-	-	-4.8	-3.1	-7.3	-13.1	-12.9	-12.9	-12.9
NAL15-Kilquhockadale	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	44.5	50.3	50.3	50.3	50.3
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	34.2	36	36.2	36.3	36.4	36.4	36.4
	Exceedance Level	-	-	-	-	-	-5.8	-4	-8.3	-14	-13.9	-13.9	-13.9
NAL16 – Urrall	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	44.5	50.3	50.3	50.3	50.3
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	31.9	33.5	33.7	33.8	33.8	33.8	33.8
	Exceedance Level	-	-	-	-	-	-8.1	-6.5	-10.8	-16.5	-16.5	-16.5	-16.5
NAL17– Tannielaggie	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	40	42.7	46.5	46.5	46.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	31.5	32.1	32.4	32.4	32.4	32.4	32.4
	Exceedance Level	-	-	-	-	-	-8.5	-7.9	-7.6	-10.3	-14.1	-14.1	-14.1
NAL18 – Kilmacfadzean	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	40	42.7	46.5	46.5	46.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	39.3	39.7	40.1	40.5	41.1	41.1	41.1
	Exceedance Level	-	-	-	-	-	-0.7	-0.3	**0.1**	-2.2	-5.4	-5.4	-5.4

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL19 – Quarter Farm	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	42.5	46	48.7	48.7	48.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	35.3	35.6	35.9	36.1	36.5	36.5	36.5
	Exceedance Level	-	-	-	-	-	-4.7	-4.4	-6.6	-9.9	-12.2	-12.2	-12.2
NAL20 – Pultadie	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	42.1	46	48.5	48.5	48.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	38.2	38.3	38.3	38.3	38.4	38.4	38.4
	Exceedance Level	-	-	-	-	-	-1.8	-1.7	-3.8	-7.7	-10.1	-10.1	-10.1
NAL21-Balmurrie	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	40	42.7	46.5	46.5	46.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	38.5	39	39.4	39.9	40.6	40.6	40.6
	Exceedance Level	-	-	-	-	-	-1.5	-1	-0.6	-2.8	-5.9	-5.9	-5.9
NAL22-Dranigower	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	40	40	40	42.7	46.5	46.5	46.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	35.7	36.7	37.1	37.3	37.7	37.7	37.7
	Exceedance Level	-	-	-	-	-	-4.3	-3.3	-2.9	-5.4	-8.8	-8.8	-8.8
NAL23 - Garvilland	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	38.1	41.5	43.8	44.2	44.2	44.2	44.2
	Exceedance Level	-	-	-	-	-	-3.1	-2.9	-4.4	-8.5	-8.5	-8.5	-8.5
NAL24 – Carscreugh Croft	Total Noise Limit: ETSU-R-97 L_{A90}	40	40	40	40	40	41.2	44.4	48.2	52.7	52.7	52.7	52.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.9	39.4	41.2	41.5	41.6	41.6	41.6
	Exceedance Level	-	-	-	-	-	-4.3	-5	-7	-11.2	-11.1	-11.1	-11.1

Table 6.6 ETSU-R-97 Compliance Table – Likely Cumulative Noise – Night time

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Artfield	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	45.4	53.7	63.4	63.4	63.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	45.2	45.7	46.2	46.9	47.7	47.7	47.7
	Exceedance Level	-	-	-	-	-	**0.2**	**0.7**	**0.8**	-6.8	-15.7	-15.7	-15.7
NAL2 - Low Airies	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	45.4	53.7	63.4	63.4	63.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	50.9	51.6	52.2	52.2	52.2	52.2	52.2
	Exceedance Level	-	-	-	-	-	**5.9**	**6.6**	**6.8**	-1.5	-11.2	-11.2	-11.2
NAL3 - Glenchamber	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	50.5	60.4	60.4	60.4	60.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	40	41.4	41.9	42.1	42.3	42.3	42.3
	Exceedance Level	-	-	-	-	-	-5	-3.6	-8.6	-18.3	-18.1	-18.1	-18.1
NAL4 - Torwood Bungalow	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.8	38.2	38.9	39.1	39.3	39.3	39.3
	Exceedance Level	-	-	-	-	-	-6.2	-4.8	-11.6	-21.3	-21.1	-21.1	-21.1
NAL5 - Torwood Bungalow	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	50.5	60.4	60.4	60.4	60.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	37.3	38.6	39.3	39.5	39.8	39.8	39.8
	Exceedance Level	-	-	-	-	-	-7.7	-6.4	-11.2	-20.9	-20.6	-20.6	-20.6
NAL6 – Torwood House Hotel	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	37.8	39.1	39.7	40	40.3	40.3	40.3
	Exceedance Level	-	-	-	-	-	-5.2	-3.9	-10.8	-20.4	-20.1	-20.1	-20.1

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 – Torwood Two Dogs Lodge	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	37.6	38.8	39.3	39.5	39.8	39.8	39.8
	Exceedance Level	-	-	-	-	-	-5.4	-4.2	-11.2	-20.9	-20.6	-20.6	-20.6
NAL8 – Gass Farm	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	45	45	45	45	45	50.5	60.4	60.4	60.4	60.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.4	37.6	38.2	38.5	38.8	38.8	38.8
	Exceedance Level	-	-	-	-	-	-8.6	-7.4	-12.3	-21.9	-21.6	-21.6	-21.6
NAL9 – Scotts Corner	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.4	37.5	38.1	38.4	38.7	38.7	38.7
	Exceedance Level	-	-	-	-	-	-6.6	-5.5	-12.4	-22	-21.7	-21.7	-21.7
NAL10 – Mark of Lochronald Bungalow	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.5	37.6	38.1	38.3	38.6	38.6	38.6
	Exceedance Level	-	-	-	-	-	-6.5	-5.4	-4.9	-4.7	-4.4	-4.4	-4.4
NAL11 - Mark of Lochronald	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.2	37.2	37.8	38	38.3	38.3	38.3
	Exceedance Level	-	-	-	-	-	-6.8	-5.8	-5.2	-5	-4.7	-4.7	-4.7
NAL12 – Fell of Loch Ronald	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	34.7	35.8	36.3	36.5	36.8	36.8	36.8
	Exceedance Level	-	-	-	-	-	-8.3	-7.2	-6.7	-6.5	-6.2	-6.2	-6.2

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13-Ballminnoch	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	38.5	39.7	40.1	40.2	40.4	40.4	40.4
	Exceedance Level	-	-	-	-	-	-4.5	-3.3	-2.9	-2.8	-2.6	-2.6	-2.6
NAL14- The Old Schoolhouse	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43.4	50.8	50.8	50.8	50.8
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	35.2	36.9	37.2	37.2	37.4	37.4	37.4
	Exceedance Level	-	-	-	-	-	-7.8	-6.1	-6.2	-13.6	-13.4	-13.4	-13.4
NAL15-Kilquhockadale	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43.4	50.8	50.8	50.8	50.8
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	34.2	36	36.2	36.3	36.4	36.4	36.4
	Exceedance Level	-	-	-	-	-	-8.8	-7	-7.2	-14.5	-14.4	-14.4	-14.4
NAL16 – Urrall	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43.4	50.8	50.8	50.8	50.8
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	31.9	33.5	33.7	33.8	33.8	33.8	33.8
	Exceedance Level	-	-	-	-	-	-11.1	-9.5	-9.7	-17	-17	-17	-17
NAL17– Tannielaggie	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	31.5	32.1	32.4	32.4	32.4	32.4	32.4
	Exceedance Level	-	-	-	-	-	-11.5	-10.9	-10.6	-10.6	-10.6	-10.6	-10.6
NAL18 – Kilmacfadzean	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	39.3	39.7	40.1	40.5	41.1	41.1	41.1
	Exceedance Level	-	-	-	-	-	-3.7	-3.3	-2.9	-2.5	-1.9	-1.9	-1.9

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL19 – Quarter Farm	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	35.3	35.6	35.9	36.1	36.5	36.5	36.5
	Exceedance Level	-	-	-	-	-	-7.7	-7.4	-7.1	-6.9	-6.5	-6.5	-6.5
NAL20 – Pultadie	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	38.2	38.3	38.3	38.3	38.4	38.4	38.4
	Exceedance Level	-	-	-	-	-	-4.8	-4.7	-4.7	-4.7	-4.6	-4.6	-4.6
NAL21-Balmurrie	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	38.5	39	39.4	39.9	40.6	40.6	40.6
	Exceedance Level	-	-	-	-	-	-4.5	-4	-3.6	-3.1	-2.4	-2.4	-2.4
NAL22-Dranigower	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	35.7	36.7	37.1	37.3	37.7	37.7	37.7
	Exceedance Level	-	-	-	-	-	-7.3	-6.3	-5.9	-5.7	-5.3	-5.3	-5.3
NAL23 - Garvilland	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	38.1	41.5	43.8	44.2	44.2	44.2	44.2
	Exceedance Level	-	-	-	-	-	-4.9	-1.5	-6.7	-16.2	-16.2	-16.2	-16.2
NAL24 – Carscreugh Croft	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	50.5	60.4	60.4	60.4	60.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	-	-	36.9	39.4	41.2	41.5	41.6	41.6	41.6
	Exceedance Level	-	-	-	-	-	-6.1	-3.6	-9.3	-18.9	-18.8	-18.8	-18.8

6.6 Derivation of Site Specific Noise Limits (Stage 3)

6.6.1 In order to protect residential amenity, the IOA GPG (2013) recommendations are that cumulatively, all schemes operate within the Total ETSU-R-97 Noise Limits. This can be found in summary box SB21 of the IOA GPG (2013) which states:

'Whenever a cumulative situation is encountered, the noise limits for an individual wind farm should be determined in such a way that no cumulative excess of the total ETSU-R-97 noise limit would occur.'

6.6.2 As detailed in Section 4.3.6 above, the daytime Site Specific Noise Limits have been derived based on the lower Fixed Minimum Noise Limits as detailed within ETSU-R-97. As detailed in Section 2.6.11 above, if the occupiers of a property are financially involved then both the day and night time fixed limits can be increased to 45 dB. Two occupiers of NALs have been highlighted by the Applicant as being financially involved in the Proposed Development. In addition, a further three occupiers of NALs assessed by other operational developments in the area are highlighted as being financially involved with their respective schemes.

6.6.3 Site Specific Noise Limits have been derived for each of the noise sensitive receptors considered within Table 6.1 above. Table 6.7 below summarises the approach adopted at each NAL in order to derive the Site Specific Noise Limits for the Proposed Development.

Table 6.7 Limit Derivation Strategy

NAL	Limit Derivation Strategy
NALs 1-4, 6-7, 10-11, 13-15, and 18-24	The Total ETSU-R-97 Noise Limit is being used in its entirety (or could realistically be used) by the proposed / operational schemes and therefore a Site Specific Noise Limit set 10 dB the Total ETSU-R-97 Noise Limits is required such that the proposed development would use negligible proportion of the overall noise limit.
NALs 5, 8-9, 12, 16-17	Significant headroom (>5dB) is present between the other proposed / operational schemes and the Total ETSU-R-97 Noise Limits. In accordance with Section 5.4.11 of the IOA GPG, a 2 dB buffer has been added to the turbine noise predictions for each of the other developments; this is considered to be a suitable buffer in accordance with the IOA GPG and would represent a 60% increase in emitted noise levels from the other schemes. The resulting cautious predictions of cumulative wind turbine noise have then been logarithmically subtracted from the Total ETSU-R-97 Noise Limit to determine the Site Specific Noise Limit for the proposed development. The day time Site Specific Noise Limits have been set such that they are always at or below limits set using background noise levels plus 5 dB with a fixed minimum limit of 35 dB.

6.6.4 As summarised in Table 6.7 above, for the majority of NALs (18 in total) the Total ETSU-R-97 Noise Limits are already being used (or could realistically be used) by the other schemes in the area, and no significant headroom exists. As such a limit 10dB

below the Total ETSU-R-97 Noise Limits has been adopted such that the Proposed Development would not be using a share of these noise limits. For the remaining 6 NALs apportionment was required in order to allow the Proposed Development and the other wind farm developments to co-exist to within the Total ETSU-R-97 Noise Limits.

6.6.5 Table 6.8 and Table 6.9 show the daytime and night time Site Specific Noise Limits, noise predictions for the Proposed Development and the exceedance level. A negative exceedence demonstrates compliance with the Site Specific Noise Limits.

6.6.6 The Tables show that the predicted wind turbine noise immission levels meet the Site Specific Noise Limits under all conditions and at all locations for both daytime and night time periods.

6.6.7 A series of graphs to show the predicted wind turbine noise from the Proposed Development compared to the Site Specific Noise Limits are included as Figures A1.3a - A1.3x (Annex 1). There is a set of graphs for each of the NAL, which show the Total ETSU-R-97 Noise Limit (solid red line), the prevailing background noise level (black line), the Site Specific Noise Limit (dashed red line with triangles) and the predicted wind turbine noise from the Proposed Development (solid green line).

Table 6.8 Site Specific Noise Limits Compliance Table – Daytime

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Artfield	Site Specific Noise Limit L_{A90}	35	35	35	35	35	35	35	35.6	42.5	50.5	50.5	50.5
	Predicted Wind Turbine Noise L_{A90}	-	21.7	23	26.7	31	34	34.6	35.3	35.3	35.3	35.3	35.3
	Exceedance Level	-	-13.3	-12	-8.3	-4	-1	-0.4	-0.3	-7.2	-15.2	-15.2	-15.2
NAL2 - Low Airies	Site Specific Noise Limit L_{A90}	35	35	35	35	35	35	35	35.6	42.5	50.5	50.5	50.5
	Predicted Wind Turbine Noise L_{A90}	-	19.1	20.4	24.1	28.4	31.4	32	32.7	32.7	32.7	32.7	32.7
	Exceedance Level	-	-15.9	-14.6	-10.9	-6.6	-3.6	-3	-2.9	-9.8	-17.8	-17.8	-17.8
NAL3 - Glenchamber	Site Specific Noise Limit L_{A90}	35	35	35	35	35	35	35	38.2	42.7	42.7	42.7	42.7
	Predicted Wind Turbine Noise L_{A90}	-	10.6	11.9	15.6	19.9	22.9	23.5	24.2	24.2	24.2	24.2	24.2
	Exceedance Level	-	-24.4	-23.1	-19.4	-15.1	-12.1	-11.5	-14	-18.5	-18.5	-18.5	-18.5
NAL4 - Torwood Bungalow	Site Specific Noise Limit L_{A90}	30	30	30	30	30	31.2	34.4	38.2	42.7	42.7	42.7	42.7
	Predicted Wind Turbine Noise L_{A90}	-	11.8	13.1	16.8	21.1	24.1	24.7	25.4	25.4	25.4	25.4	25.4
	Exceedance Level	-	-18.2	-16.9	-13.2	-8.9	-7.1	-9.7	-12.8	-17.3	-17.3	-17.3	-17.3
NAL5 - Torwood Bungalow	Site Specific Noise Limit L_{A90}	43.7	43.7	43.7	43.7	43.7	43.7	43.1	47.3	52.7	52.7	52.7	52.7
	Predicted Wind Turbine Noise L_{A90}	-	12.4	13.7	17.4	21.7	24.7	25.3	26	26	26	26	26
	Exceedance Level	-	-31.3	-30	-26.3	-22	-19	-17.8	-21.3	-26.7	-26.7	-26.7	-26.7
NAL6 – Torwood House Hotel	Site Specific Noise Limit L_{A90}	30	30	30	30	30	31.2	34.4	38.2	42.7	42.7	42.7	42.7
	Predicted Wind Turbine Noise L_{A90}	-	12.9	14.2	17.9	22.2	25.2	25.8	26.5	26.5	26.5	26.5	26.5
	Exceedance Level	-	-17.1	-15.8	-12.1	-7.8	-6	-8.6	-11.7	-16.2	-16.2	-16.2	-16.2

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 – Torwood Two Dogs Lodge	Site Specific Noise Limit L_{A90}	30	30	30	30	30	31.2	34.4	38.2	42.7	42.7	42.7	42.7
	Predicted Wind Turbine Noise L_{A90}	-	13.1	14.4	18.1	22.4	25.4	26	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-	-16.9	-15.6	-11.9	-7.6	-5.8	-8.4	-11.5	-16	-16	-16	-16
NAL8 – Gass Farm	Site Specific Noise Limit L_{A90}	44	44	44	44	44	44	43.6	48.2	52.7	52.7	52.7	52.7
	Predicted Wind Turbine Noise L_{A90}	-	12.6	13.9	17.6	21.9	24.9	25.5	26.2	26.2	26.2	26.2	26.2
	Exceedance Level	-	-31.4	-30.1	-26.4	-22.1	-19.1	-18.1	-22	-26.5	-26.5	-26.5	-26.5
NAL9 – Scotts Corner	Site Specific Noise Limit L_{A90}	35	35	35	35	35	38.4	42.8	48.2	52.7	52.7	52.7	52.7
	Predicted Wind Turbine Noise L_{A90}	-	12.6	13.9	17.6	21.9	24.9	25.5	26.2	26.2	26.2	26.2	26.2
	Exceedance Level	-	-22.4	-21.1	-17.4	-13.1	-13.5	-17.3	-22	-26.5	-26.5	-26.5	-26.5
NAL10 – Mark of Lochronald Bungalow	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	30.4	32.5	32.5	32.5	32.5
	Predicted Wind Turbine Noise L_{A90}	-	13.1	14.4	18.1	22.4	25.4	26	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-	-16.9	-15.6	-11.9	-7.6	-4.6	-4	-3.7	-5.8	-5.8	-5.8	-5.8
NAL11 - Mark of Lochronald	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	30.4	32.5	32.5	32.5	32.5
	Predicted Wind Turbine Noise L_{A90}	-	12.7	14	17.7	22	25	25.6	26.3	26.3	26.3	26.3	26.3
	Exceedance Level	-	-17.3	-16	-12.3	-8	-5	-4.4	-4.1	-6.2	-6.2	-6.2	-6.2
NAL12 – Fell of Loch Ronald	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	30.4	32.5	32.5	32.5	32.5
	Predicted Wind Turbine Noise L_{A90}	-	10.8	12.1	15.8	20.1	23.1	23.7	24.4	24.4	24.4	24.4	24.4
	Exceedance Level	-	-19.2	-17.9	-14.2	-9.9	-6.9	-6.3	-6	-8.1	-8.1	-8.1	-8.1

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13-Ballminnoch	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	30.4	32.5	32.5	32.5	32.5
	Predicted Wind Turbine Noise L_{A90}	-	13.5	14.8	18.5	22.8	25.8	26.4	27.1	27.1	27.1	27.1	27.1
	Exceedance Level	-	-16.5	-15.2	-11.5	-7.2	-4.2	-3.6	-3.3	-5.4	-5.4	-5.4	-5.4
NAL14- The Old Schoolhouse	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	34.5	40.3	40.3	40.3	40.3
	Predicted Wind Turbine Noise L_{A90}	-	10.3	11.6	15.3	19.6	22.6	23.2	23.9	23.9	23.9	23.9	23.9
	Exceedance Level	-	-19.7	-18.4	-14.7	-10.4	-7.4	-6.8	-10.6	-16.4	-16.4	-16.4	-16.4
NAL15-Kilquhockadale	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	34.5	40.3	40.3	40.3	40.3
	Predicted Wind Turbine Noise L_{A90}	-	9.2	10.5	14.2	18.5	21.5	22.1	22.8	22.8	22.8	22.8	22.8
	Exceedance Level	-	-20.8	-19.5	-15.8	-11.5	-8.5	-7.9	-11.7	-17.5	-17.5	-17.5	-17.5
NAL16 – Urrall	Site Specific Noise Limit L_{A90}	35	35	35	35	35	35.6	38.2	44.5	50.3	50.3	50.3	50.3
	Predicted Wind Turbine Noise L_{A90}	-	7.9	9.2	12.9	17.2	20.2	20.8	21.5	21.5	21.5	21.5	21.5
	Exceedance Level	-	-27.1	-25.8	-22.1	-17.8	-15.4	-17.4	-23	-28.8	-28.8	-28.8	-28.8
NAL17– Tannielaggie	Site Specific Noise Limit L_{A90}	35	35	35	35	35	35	35	38.6	42.7	46.5	46.5	46.5
	Predicted Wind Turbine Noise L_{A90}	-	5.4	6.7	10.4	14.7	17.7	18.3	19	19	19	19	19
	Exceedance Level	-	-29.6	-28.3	-24.6	-20.3	-17.3	-16.7	-19.6	-23.7	-27.5	-27.5	-27.5
NAL18 – Kilmacfadzean	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	30	32.7	36.5	36.5	36.5
	Predicted Wind Turbine Noise L_{A90}	-	15.5	16.8	20.5	24.8	27.8	28.4	29.1	29.1	29.1	29.1	29.1
	Exceedance Level	-	-14.5	-13.2	-9.5	-5.2	-2.2	-1.6	-0.9	-3.6	-7.4	-7.4	-7.4

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL19 – Quarter Farm	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	32.5	36	38.7	38.7	38.7
	Predicted Wind Turbine Noise L_{A90}	-	10.2	11.5	15.2	19.5	22.5	23.1	23.8	23.8	23.8	23.8	23.8
	Exceedance Level	-	-19.8	-18.5	-14.8	-10.5	-7.5	-6.9	-8.7	-12.2	-14.9	-14.9	-14.9
NAL20 – Pultadie	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	32.1	36	38.5	38.5	38.5
	Predicted Wind Turbine Noise L_{A90}	-	7.3	8.6	12.3	16.6	19.6	20.2	20.9	20.9	20.9	20.9	20.9
	Exceedance Level	-	-22.7	-21.4	-17.7	-13.4	-10.4	-9.8	-11.2	-15.1	-17.6	-17.6	-17.6
NAL21-Balmurrie	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	30	32.7	36.5	36.5	36.5
	Predicted Wind Turbine Noise L_{A90}	-	13.8	15.1	18.8	23.1	26.1	26.7	27.4	27.4	27.4	27.4	27.4
	Exceedance Level	-	-16.2	-14.9	-11.2	-6.9	-3.9	-3.3	-2.6	-5.3	-9.1	-9.1	-9.1
NAL22-Dranigower	Site Specific Noise Limit L_{A90}	30	30	30	30	30	30	30	30	32.7	36.5	36.5	36.5
	Predicted Wind Turbine Noise L_{A90}	-	9.6	10.9	14.6	18.9	21.9	22.5	23.2	23.2	23.2	23.2	23.2
	Exceedance Level	-	-20.4	-19.1	-15.4	-11.1	-8.1	-7.5	-6.8	-9.5	-13.3	-13.3	-13.3
NAL23 - Garvilland	Site Specific Noise Limit L_{A90}	30	30	30	30	30	31.2	34.4	38.2	42.7	42.7	42.7	42.7
	Predicted Wind Turbine Noise L_{A90}	-	5.2	6.5	10.2	14.5	17.5	18.1	18.8	18.8	18.8	18.8	18.8
	Exceedance Level	-	-24.8	-23.5	-19.8	-15.5	-13.7	-16.3	-19.4	-23.9	-23.9	-23.9	-23.9
NAL24 – Carscreugh Croft	Site Specific Noise Limit L_{A90}	30	30	30	30	30	31.2	34.4	38.2	42.7	42.7	42.7	42.7
	Predicted Wind Turbine Noise L_{A90}	-	8.3	9.6	13.3	17.6	20.6	21.2	21.9	21.9	21.9	21.9	21.9
	Exceedance Level	-	-21.7	-20.4	-16.7	-12.4	-10.6	-13.2	-16.3	-20.8	-20.8	-20.8	-20.8

Table 6.9 Site Specific Noise Limits Compliance Table – Night time

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Artfield	Site Specific Noise Limit L_{A90}	35	35	35	35	35	35	35	35.4	43.7	53.4	53.4	53.4
	Predicted Wind Turbine Noise L_{A90}	-	21.7	23	26.7	31	34	34.6	35.3	35.3	35.3	35.3	35.3
	Exceedance Level	-	-13.3	-12	-8.3	-4	-1	-0.4	-0.1	-8.4	-18.1	-18.1	-18.1
NAL2 - Low Airies	Site Specific Noise Limit L_{A90}	35	35	35	35	35	35	35	35.4	43.7	53.4	53.4	53.4
	Predicted Wind Turbine Noise L_{A90}	-	19.1	20.4	24.1	28.4	31.4	32	32.7	32.7	32.7	32.7	32.7
	Exceedance Level	-	-15.9	-14.6	-10.9	-6.6	-3.6	-3	-2.7	-11	-20.7	-20.7	-20.7
NAL3 - Glenchamber	Site Specific Noise Limit L_{A90}	35	35	35	35	35	35	35	40.5	50.4	50.4	50.4	50.4
	Predicted Wind Turbine Noise L_{A90}	-	10.6	11.9	15.6	19.9	22.9	23.5	24.2	24.2	24.2	24.2	24.2
	Exceedance Level	-	-24.4	-23.1	-19.4	-15.1	-12.1	-11.5	-16.3	-26.2	-26.2	-26.2	-26.2
NAL4 - Torwood Bungalow	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	40.5	50.4	50.4	50.4	50.4
	Predicted Wind Turbine Noise L_{A90}	-	11.8	13.1	16.8	21.1	24.1	24.7	25.4	25.4	25.4	25.4	25.4
	Exceedance Level	-	-21.2	-19.9	-16.2	-11.9	-8.9	-8.3	-15.1	-25	-25	-25	-25
NAL5 - Torwood Bungalow	Site Specific Noise Limit L_{A90}	43.7	43.7	43.7	43.7	43.7	43.7	43.1	50.5	60.4	60.4	60.4	60.4
	Predicted Wind Turbine Noise L_{A90}	-	12.4	13.7	17.4	21.7	24.7	25.3	26	26	26	26	26
	Exceedance Level	-	-31.3	-30	-26.3	-22	-19	-17.8	-24.5	-34.4	-34.4	-34.4	-34.4
NAL6 – Torwood House Hotel	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	40.5	50.4	50.4	50.4	50.4
	Predicted Wind Turbine Noise L_{A90}	-	12.9	14.2	17.9	22.2	25.2	25.8	26.5	26.5	26.5	26.5	26.5
	Exceedance Level	-	-20.1	-18.8	-15.1	-10.8	-7.8	-7.2	-14	-23.9	-23.9	-23.9	-23.9

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 – Torwood Two Dogs Lodge	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	40.5	50.4	50.4	50.4	50.4
	Predicted Wind Turbine Noise L_{A90}	-	13.1	14.4	18.1	22.4	25.4	26	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-	-19.9	-18.6	-14.9	-10.6	-7.6	-7	-13.8	-23.7	-23.7	-23.7	-23.7
NAL8 – Gass Farm	Site Specific Noise Limit L_{A90}	44	44	44	44	44	44	43.6	50.5	60.4	60.4	60.4	60.4
	Predicted Wind Turbine Noise L_{A90}	-	12.6	13.9	17.6	21.9	24.9	25.5	26.2	26.2	26.2	26.2	26.2
	Exceedance Level	-	-31.4	-30.1	-26.4	-22.1	-19.1	-18.1	-24.3	-34.2	-34.2	-34.2	-34.2
NAL9 – Scotts Corner	Site Specific Noise Limit L_{A90}	41.3	41.3	41.3	41.3	41.3	41.3	40.7	50.5	60.4	60.4	60.4	60.4
	Predicted Wind Turbine Noise L_{A90}	-	12.6	13.9	17.6	21.9	24.9	25.5	26.2	26.2	26.2	26.2	26.2
	Exceedance Level	-	-28.7	-27.4	-23.7	-19.4	-16.4	-15.2	-24.3	-34.2	-34.2	-34.2	-34.2
NAL10 – Mark of Lochronald Bungalow	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	33	33	33	33	33
	Predicted Wind Turbine Noise L_{A90}	-	13.1	14.4	18.1	22.4	25.4	26	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-	-19.9	-18.6	-14.9	-10.6	-7.6	-7	-6.3	-6.3	-6.3	-6.3	-6.3
NAL11 - Mark of Lochronald	Site Specific Noise Limit L_{A90}	41.4	41.4	41.4	41.4	41.4	41.4	40.9	40.4	40.3	40	40	40
	Predicted Wind Turbine Noise L_{A90}	-	12.7	14	17.7	22	25	25.6	26.3	26.3	26.3	26.3	26.3
	Exceedance Level	-	-28.7	-27.4	-23.7	-19.4	-16.4	-15.3	-14.1	-14	-13.7	-13.7	-13.7
NAL12 – Fell of Loch Ronald	Site Specific Noise Limit L_{A90}	42	42	42	42	42	42	41.5	41.3	41.3	41.1	41.1	41.1
	Predicted Wind Turbine Noise L_{A90}	-	10.8	12.1	15.8	20.1	23.1	23.7	24.4	24.4	24.4	24.4	24.4
	Exceedance Level	-	-31.2	-29.9	-26.2	-21.9	-18.9	-17.8	-16.9	-16.9	-16.7	-16.7	-16.7

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13-Ballminnoch	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	33	33	33	33	33
	Predicted Wind Turbine Noise L_{A90}	-	13.5	14.8	18.5	22.8	25.8	26.4	27.1	27.1	27.1	27.1	27.1
	Exceedance Level	-	-19.5	-18.2	-14.5	-10.2	-7.2	-6.6	-5.9	-5.9	-5.9	-5.9	-5.9
NAL14- The Old Schoolhouse	Site Specific Noise Limit L_{A90}	41.8	41.8	41.8	41.8	41.8	41.8	41	41.4	50.8	50.8	50.8	50.8
	Predicted Wind Turbine Noise L_{A90}	-	10.3	11.6	15.3	19.6	22.6	23.2	23.9	23.9	23.9	23.9	23.9
	Exceedance Level	-	-31.5	-30.2	-26.5	-22.2	-19.2	-17.8	-17.5	-26.9	-26.9	-26.9	-26.9
NAL15-Kilquhockadale	Site Specific Noise Limit L_{A90}	42.1	42.1	42.1	42.1	42.1	42.1	41.4	41.9	50.8	50.8	50.8	50.8
	Predicted Wind Turbine Noise L_{A90}	-	9.2	10.5	14.2	18.5	21.5	22.1	22.8	22.8	22.8	22.8	22.8
	Exceedance Level	-	-32.9	-31.6	-27.9	-23.6	-20.6	-19.3	-19.1	-28	-28	-28	-28
NAL16 – Urrall	Site Specific Noise Limit L_{A90}	43	43	43	43	43	43	42.2	42.6	50.8	50.8	50.8	50.8
	Predicted Wind Turbine Noise L_{A90}	-	7.9	9.2	12.9	17.2	20.2	20.8	21.5	21.5	21.5	21.5	21.5
	Exceedance Level	-	-35.1	-33.8	-30.1	-25.8	-22.8	-21.4	-21.1	-29.3	-29.3	-29.3	-29.3
NAL17– Tannielaggie	Site Specific Noise Limit L_{A90}	43	43	43	43	43	43	43	43	43	43	43	43
	Predicted Wind Turbine Noise L_{A90}	-	5.4	6.7	10.4	14.7	17.7	18.3	19	19	19	19	19
	Exceedance Level	-	-37.6	-36.3	-32.6	-28.3	-25.3	-24.7	-24	-24	-24	-24	-24
NAL18 – Kilmacfadzean	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	33	33	33	33	33
	Predicted Wind Turbine Noise L_{A90}	-	15.5	16.8	20.5	24.8	27.8	28.4	29.1	29.1	29.1	29.1	29.1
	Exceedance Level	-	-17.5	-16.2	-12.5	-8.2	-5.2	-4.6	-3.9	-3.9	-3.9	-3.9	-3.9

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL19 – Quarter Farm	Site Specific Noise Limit L_{A90}	41.7	41.7	41.7	41.7	41.7	41.7	41.6	41.5	41.4	41.2	41.2	41.2
	Predicted Wind Turbine Noise L_{A90}	-	10.2	11.5	15.2	19.5	22.5	23.1	23.8	23.8	23.8	23.8	23.8
	Exceedance Level	-	-31.5	-30.2	-26.5	-22.2	-19.2	-18.5	-17.7	-17.6	-17.4	-17.4	-17.4
NAL20 – Pultadie	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	33	33	33	33	33
	Predicted Wind Turbine Noise L_{A90}	-	7.3	8.6	12.3	16.6	19.6	20.2	20.9	20.9	20.9	20.9	20.9
	Exceedance Level	-	-25.7	-24.4	-20.7	-16.4	-13.4	-12.8	-12.1	-12.1	-12.1	-12.1	-12.1
NAL21-Balmurrie	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	33	33	33	33	33
	Predicted Wind Turbine Noise L_{A90}	-	13.8	15.1	18.8	23.1	26.1	26.7	27.4	27.4	27.4	27.4	27.4
	Exceedance Level	-	-19.2	-17.9	-14.2	-9.9	-6.9	-6.3	-5.6	-5.6	-5.6	-5.6	-5.6
NAL22-Dranigower	Site Specific Noise Limit L_{A90}	41.5	41.5	41.5	41.5	41.5	41.5	41.1	40.9	40.7	40.4	40.4	40.4
	Predicted Wind Turbine Noise L_{A90}	-	9.6	10.9	14.6	18.9	21.9	22.5	23.2	23.2	23.2	23.2	23.2
	Exceedance Level	-	-31.9	-30.6	-26.9	-22.6	-19.6	-18.6	-17.7	-17.5	-17.2	-17.2	-17.2
NAL23 - Garvilland	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	40.5	50.4	50.4	50.4	50.4
	Predicted Wind Turbine Noise L_{A90}	-	5.2	6.5	10.2	14.5	17.5	18.1	18.8	18.8	18.8	18.8	18.8
	Exceedance Level	-	-27.8	-26.5	-22.8	-18.5	-15.5	-14.9	-21.7	-31.6	-31.6	-31.6	-31.6
NAL24 – Carscreugh Croft	Site Specific Noise Limit L_{A90}	33	33	33	33	33	33	33	40.5	50.4	50.4	50.4	50.4
	Predicted Wind Turbine Noise L_{A90}	-	8.3	9.6	13.3	17.6	20.6	21.2	21.9	21.9	21.9	21.9	21.9
	Exceedance Level	-	-24.7	-23.4	-19.7	-15.4	-12.4	-11.8	-18.6	-28.5	-28.5	-28.5	-28.5

6.6.8 The assessment shows that the predicted wind turbine noise immission levels meet the Site Specific Noise Limits under all conditions and at all locations for both daytime and night time periods at all receptors.

6.6.9 In the event that consent is granted for the Proposed Development it would be appropriate to set noise limits equal to the Site Specific Noise Limits contained in Tables 6.8 and 6.9.

6.6.10 If consent is granted for the Proposed Development it would be appropriate to set noise limits equal to the Site Specific Noise Limits contained within Tables 6.8 and 6.9 which have been determined based on the use of a 40 dB daytime fixed minimum limit to set Total ETSU-R-97 Noise Limits and a 35 dB day time fixed minimum limit to set Site Specific Noise Limits.

6.7 Micrositing

6.7.1 It should be noted that the need to include a concave ground profile correction and/or barrier correction may change depending on the final location of the turbines (following micrositing) and the final turbine hub height. Nevertheless, turbine noise levels will have to meet the noise limits established in this report regardless of any increases and decreases in noise propagation caused by topography. Should consent be granted, the need to apply a concave ground profile/ barrier correction will need to be considered by the Applicant prior to the final selection of a turbine model for the site.

7 Conclusions

7.1.1 This report has assessed the potential impact of operational noise from the Proposed Development on the residents of nearby receptors. The guidance contained within ETSU-R-97 and current good practice (IOA GPG) has been used to assess the potential noise impact of the Proposed Development.

7.1.2 Background noise monitoring was undertaken as part of the EIA noise assessments for Airies Wind Farm and Kilgallioch Wind Farm, at seven noise sensitive receptors neighbouring the Proposed Development. A total of twenty four noise sensitive receptors were chosen as noise assessment locations. The assessment locations were chosen to represent the noise sensitive receptors located closest to the Proposed Development and other nearby wind farms. For the assessment locations where no background noise measurements were undertaken, noise data collected at proxy locations and as part of the noise assessments for other nearby schemes considered representative of the expected background noise environment was used to assess the noise impact at those receptors.

7.1.3 The background noise trends (as measured by the other nearby schemes) were used to establish the daytime and night time noise limits for each of the assessment locations. A 'Total ETSU-R-97 Noise Limit' of 40 dB(A) daytime or background plus 5dB (whichever is the greater) and 43 dB(A) night time or background plus 5dB (whichever is the greater) was used for this assessment.

7.1.4 There are a number of operational, consented and proposed wind farms in proximity to the Proposed Development. A cumulative assessment was undertaken at the noise sensitive receptors where predictions from the Proposed Development were found to be within 10 dB of the noise predictions from all other schemes. The cumulative assessment shows that there are predicted to be exceedances of the Total ETSU-R-97 Noise Limits at three NALs, but this is as a result of the predicted noise from other schemes in the area. For the other twenty-one NALs, likely cumulative noise levels meet the Total ETSU-R-97 Noise Limits. The Proposed Development can operate concurrently with the proposed, consented and operational wind farms in the area, as its contribution is negligible.

7.1.5 'Site Specific Noise Limits' have also been derived which take account (where required) of the other wind farms. Where no significant headroom exists between the predictions of the other cumulative schemes and the Total ETSU-R-97 Noise Limits, then the Site Specific Noise Limits for the Proposed Development have been set 10 dB below the Total ETSU-R-97 Noise Limits. This would ensure the Proposed Development would have a negligible impact on other schemes ability to meet the Total ETSU-R-97 Noise Limits.

7.1.6 Where immissions from other wind farms at a given receptor were found to be at least 10 dB below the 'Total ETSU-R-97 Noise Limit'; then the other wind farms would be using a negligible proportion of the limit. As such it is considered appropriate to

allocate the entire noise limit to the Proposed Development. For receptors where turbine predictions were found to be within 10dB of the Total ETSU-R-97 Noise Limits, apportionment of the Total ETSU-R-97 Noise Limits was undertaken.

7.1.7 An assessment was undertaken to determine whether the Proposed Development could operate within the 'Site Specific Noise Limits' and it was found that at all receptors wind turbine noise immissions were below the Site Specific Noise Limits when considering the Vestas V150 5.6 MW as a candidate turbine.

7.1.8 The Vestas turbine model was chosen as it is considered to be representative of the type of turbine that could be installed at the site. There are a number of wind turbine makes and models that may be suitable for the Proposed Development. Should the proposal receive planning permission, the final choice of turbine would be subject to a competitive tendering process. The final choice of turbine would, however, have to meet the noise limits determined and contained within any condition imposed.

8 Glossary of Terms

AOD: Above Ordnance Datum is the height above sea level.

Amplitude Modulation: a variation in noise level over time; for example observers may describe a 'whoosh whoosh' sound, which can be heard close to a wind turbine as the blades sweep past.

Attenuation: the reduction in level of a sound between the source and a receiver due to any combination of effects including: distance, atmospheric absorption, acoustic screening, the presence of a building façade, etc.

Background Noise: the noise level rarely fallen below in any given location over any given time period, often classed according to daytime, evening or night time periods. The L_{A90} indices (see below) is often used to represent the background noise level.

Bin: subset or group into which data can be sorted; in the case of wind speeds, bins are often centred on integer wind speeds with a width of 1 m/s. For example the 4 m/s bin would include all data with wind speeds of 3.5 to 4.5 m/s.

Dawn Chorus: noise due to birds which can occur at sunrise.

Broadband Noise: noise with components over a wide range of frequencies.

Decibel (dB): the ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. A logarithmic scale is used in noise level measurements because of this wide range. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound level.

dB(A): the ear has the ability to recognise a particular sound depending on its pitch or frequency. Microphones cannot differentiate noise in the same way as the ear, and to counter this weakness the noise measuring instrument applies a correction to correspond more closely to the frequency response of the human ear. The correction factor is called 'A Weighting' and the resulting measurements are written as dB(A). The dB(A) is internationally accepted and has been found to correspond well with people's subjective reaction to noise. Some typical subjective changes in noise levels are:

- a change of 3 dB(A) is just perceptible;
- a change of 5 dB(A) is clearly perceptible;
- a change of 10 dB(A) is twice (or half) as loud.

Directivity: the property of a sound source that causes more sound to be radiated in one direction than another.

Frequency: the pitch of a sound in Hz or kHz. See Hertz.

Ground Effects: the modification of sound at a receiver location due to the interaction of the sound wave with the ground along its propagation path from source to receiver. Described using the term 'G', and ranges between 0 (hard), 0.5 (mixed) and 1 (soft).

Hertz (Hz): sound frequency refers to how quickly the air vibrates, or how close the sound waves are to each other (in cycles per second, or Hertz (Hz)).

L_w: is the sound power level. It is a measure of the total noise energy radiated by a source of noise, and is used to calculate noise levels at a distant location. The L_{WA} is the A-weighted sound power level.

L_{eq}: is the equivalent continuous sound level, and is the sound level of a steady sound with the same energy as a fluctuating sound over the same period. It is possible to consider this level as the ambient noise encompassing all noise at a given time. The $LA_{eq,T}$ is the A-weighted equivalent continuous sound level over a given time period (T).

L_{90}: index represents the noise level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is often used to measure the background noise level. The $L_{A90,10min}$ is the A-weighted background noise level over a ten minute measurement sample.

Noise emission: the noise energy emitted by a source (e.g. a wind turbine).

Noise immission: the sound pressure level detected at a given location (e.g. the nearest dwelling).

Night Time Hours: ETSU-R-97 defines the night time hours as 23.00 to 07.00 every day.

Quiet Daytime Hours: ETSU-R-97 defines the amenity hours as 18.00 to 23.00 Monday to Friday, 13.00 to 23.00 on Saturdays and 07.00 to 23.00 on Sundays.

Sound Level Meter: an instrument for measuring sound pressure level.

Sound Power Level: the total sound power radiated by a source, in decibels.

Sound Pressure Level: a measure of the sound pressure at a point, in decibels**.**

Standardised Wind Speed: a wind speed measured at a height different than 10 m (generally measured at the turbine hub height) which is expressed to a reference height of 10 m using a roughness length of 0.05 for standardisation purpose (in accordance with the IEC 61400-11 standard).

Tonal Noise: noise which covers a very restricted range of frequencies (e.g. a range of ≤20 Hz). This noise can be more annoying than broadband noise.

Wind Shear: the increase of wind speed with height above the ground.

9 References

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

2. **Institute of Acoustics.** *Good Practice Guidance on the application of ETSU-R-97 for wind turbine noise assessment.* 2013.

3. **The Scottish Government.** Scottish Planning Policy (SPP) http://www.gov.scot/Publications/2014/06/5823. [Online] 2014.

4. **The Scottish Government.**. Web Based Renewables Advice: 'Onshore Wind Turbines' – http://www.scotland.gov.uk/Resource/0045/00451413.pdf. [Online] 28 May 2014.

5. **The Scottish Government.**. Planning Advice Note PAN 1/2011: Planning and Noise - http://www.scotland.gov.uk/Resource/Doc/343210/0114180.pdf. [Online] 2011.

6. **The Scottish Government.**. Technical Advice Note Assessment of Noise (http://www.scotland.gov.uk/Resource/Doc/343341/0114220.pdf). [Online]

7. **Letter John Swinney, MSP Cabinet Secretary for Finance, Employment and Sustainable Growth to Prof B Shield.** http://www.ioa.org.uk/pdf/scottish-government-endorsement-of-ioa-gpg.pdf. [Online]

8. *Visual and acoustic impact of wind turbine farms in residents Final report.* **Frits van den Berg et al.** s.l. : FP6-2005-Science-and-Society-20 Specific Support Action, 3 June 2008.

9. *Low frequency noise and annoyance .* **HG, Leventhall.** s.l. : Noise & Health Journal, 2004, Vol. 6.

10. *Do wind turbines produce significant low frequency sound levels? Conference paper 11th International Meeting on Low Frequency Noise and Vibration and its Control .* **Berg, G.P. van den.** Maastricht The Netherlands : s.n., 2004.

11. **Department of Trade and Industry.** *The Measurement of LFN at three UK Wind Farms .* 2006 : s.n.

12. **Keele University Rejects Renewable Energy Foundation.** http://archive.is/d3WB. *Low Frequency Noise Research Claims .* [Online]

13. **Institute of Acoustics Bulletin.** *Prediction and assessment of wind turbine noise.* 2009.

14. *Infrasound and the ear, 5th International conference on Wind Turbine Noise.* **Leventhall, G.** Denver : s.n., 2013.

15. **renewable UK.** http://www.renewableuk.com/search/all.asp?bst=amplitude+modulation. [Online]

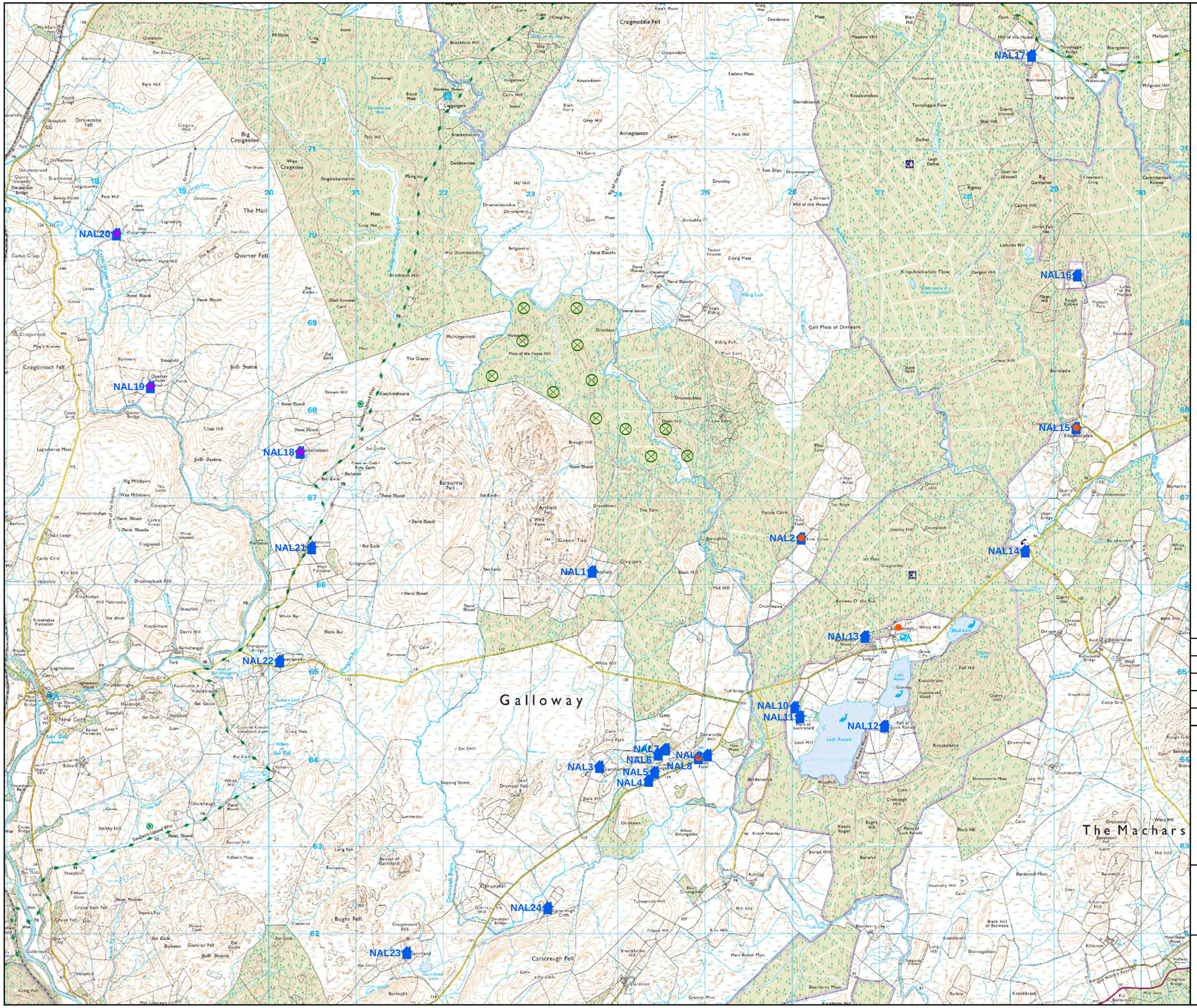
16. **Department of Energy & Climate Change.** *Wind Turbine AM Review Phase 2 Report.* 2016.

17. **International Standards Organisation.** *ISO9613:1996 'Acoustics – Attenuation of sound during propagation outdoors' – Part 2: General method of calculation.* 1996.

18. **ReSoft.** WindFarm, Version 4.2.2.1.

19. **DataKustik Gmbh.** CadnaA Version 4.4.

Annex 1 – Figures



Legend

- Proposed Turbine Location
- Noise Assessment Location (NAL)

Noise Monitoring Location (NML)

- Airies Wind Farm
- Kilgallioch Wind Farm

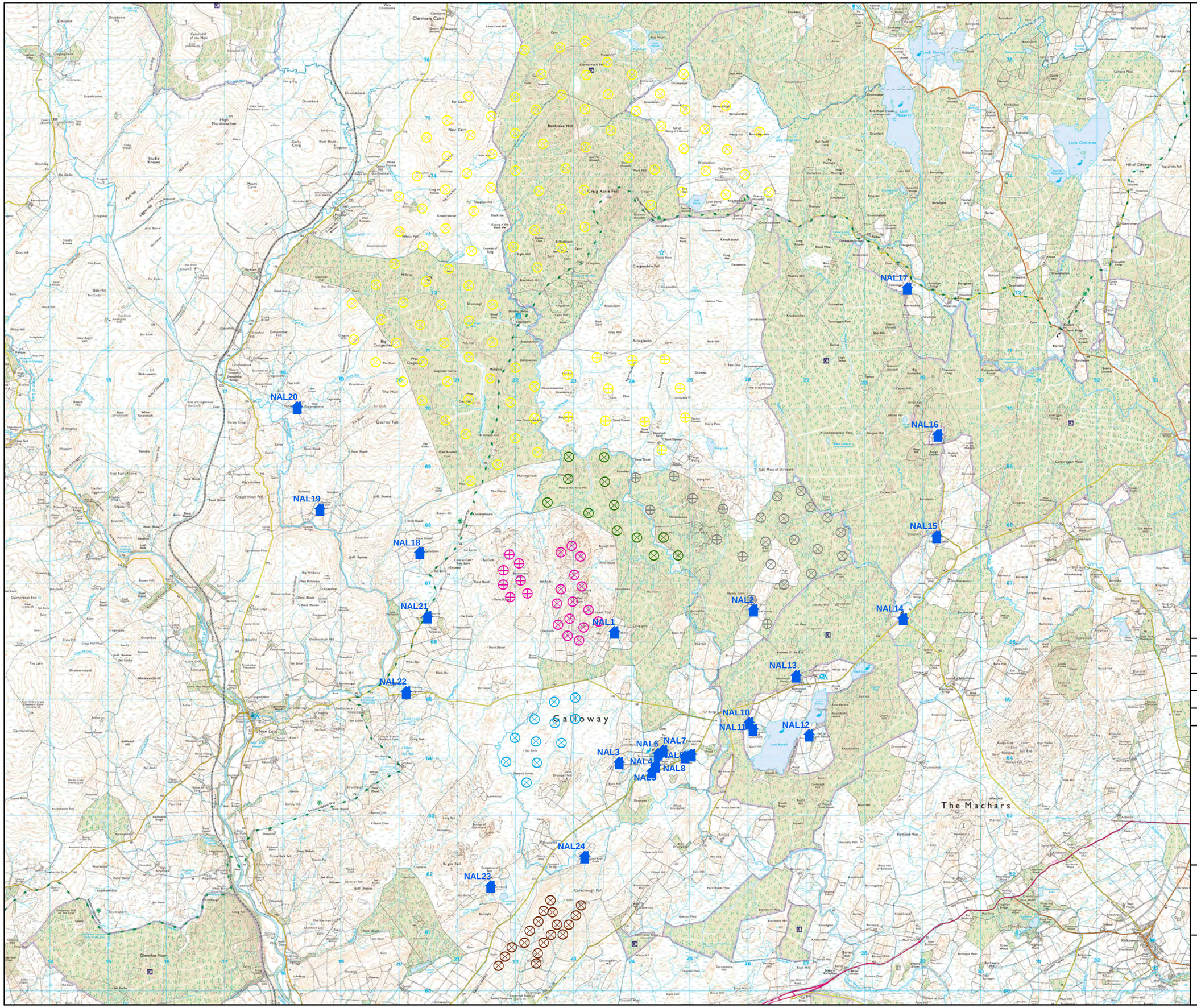
0 500 1,000 Metres

N

REV.	DETAILS	DRAWN	CHK'D	APP'D	DATE
R0	FIRST ISSUE	GC	JB	JB	21/10/2020

Project	Artfield Forest Wind Farm
Client	Artfield Forest Wind Farm Ltd
Title	Noise Monitoring and Assessment Locations
Figure No.	A1.1a
Scale	1:40,000 @A3
Doc. Ref.	13865-005

tnei



Legend

- Noise Assessment Location
- Artfield Forest Wind Farm
- Airies Wind Farm
- Airies II Wind Farm
- Artfield Fell Wind Farm
- Balmurrie Wind Farm
- Carscreugh Wind Farm
- Glenchamber Wind Farm
- Kilgallioch Wind Farm
- Kilgallioch Extension Wind Farm

0 1,000 2,000 Metres

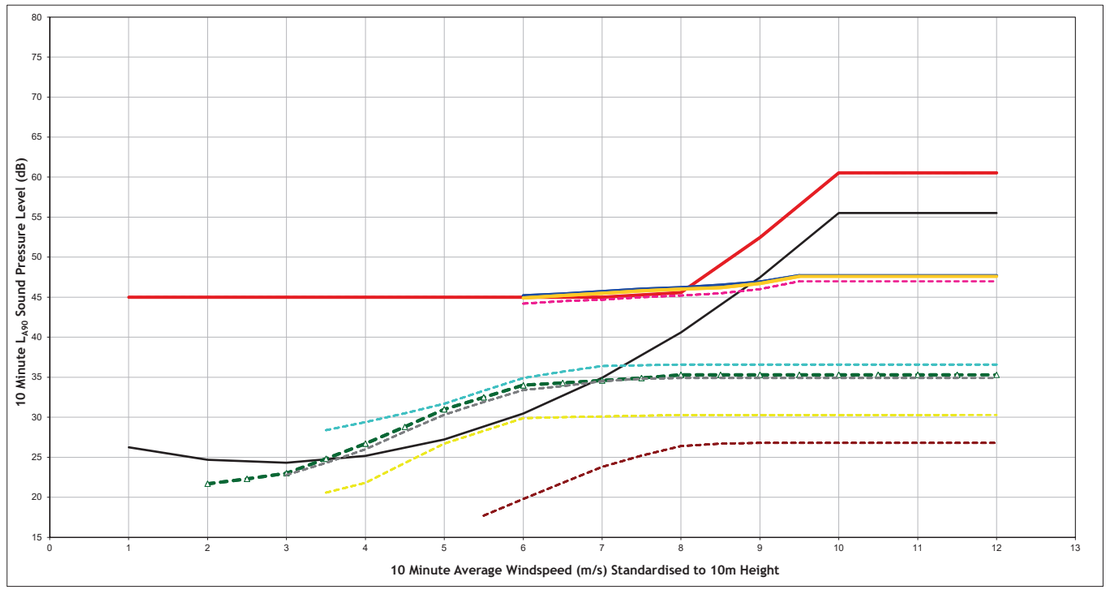
N

REV.	DETAILS	DRAWN	CHK'D	APP'D	DATE
R1	SECOND ISSUE	GC	JB	JB	01/02/2021
R0	FIRST ISSUE	GC	JB	JB	21/10/2020

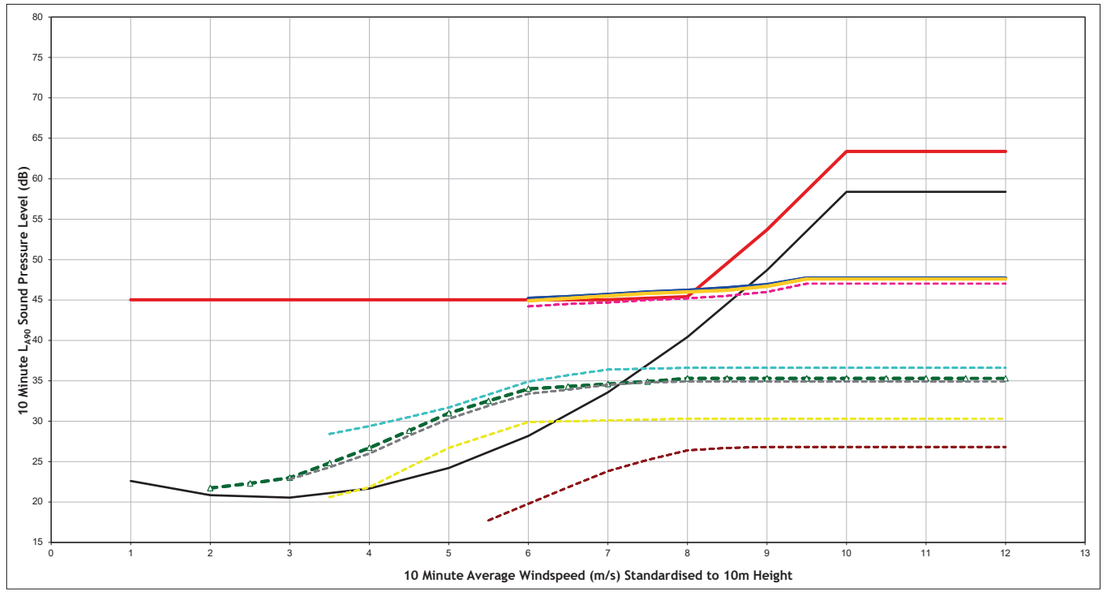
Project	Artfield Forest Wind Farm
Client	Artfield Forest Wind Farm Ltd
Title	Cumulative Wind Farm Locations
Figure No.	A1.1b
Scale	1:60,000 @A3
Doc. Ref.	13865-006

tnei

Quiet Daytime - Artfield (NAL1)



Night Time - Artfield (NAL1)



Legend:

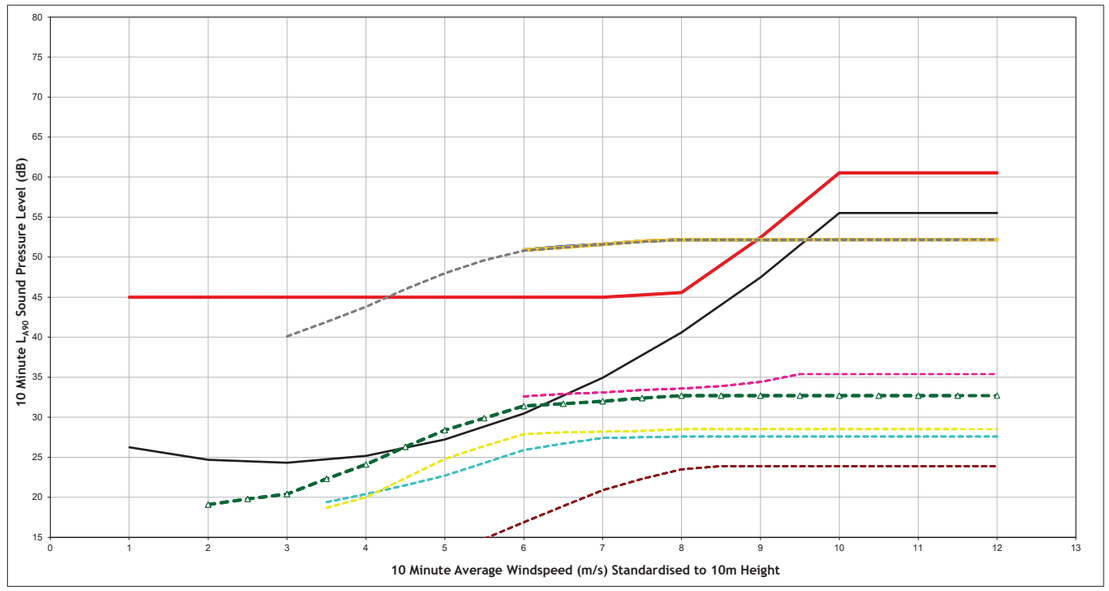
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Artfield (NAL1)
Figure Number	Figure A1.2a
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

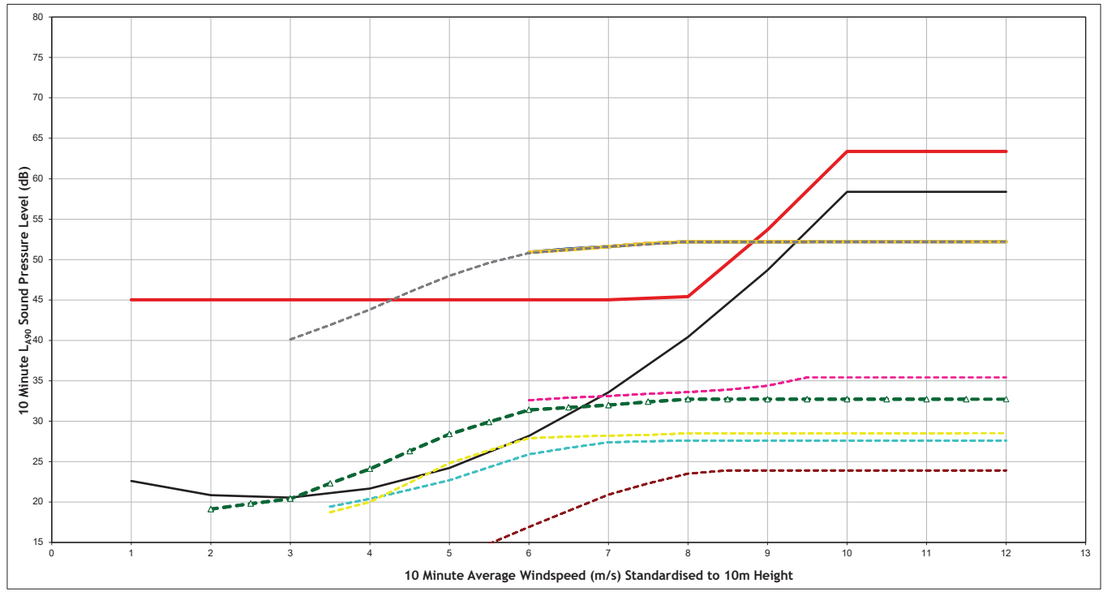
Statkraft

tnei

Quiet Daytime - Low Airies (NAL2)



Night Time - Low Airies (NAL2)



Legend:

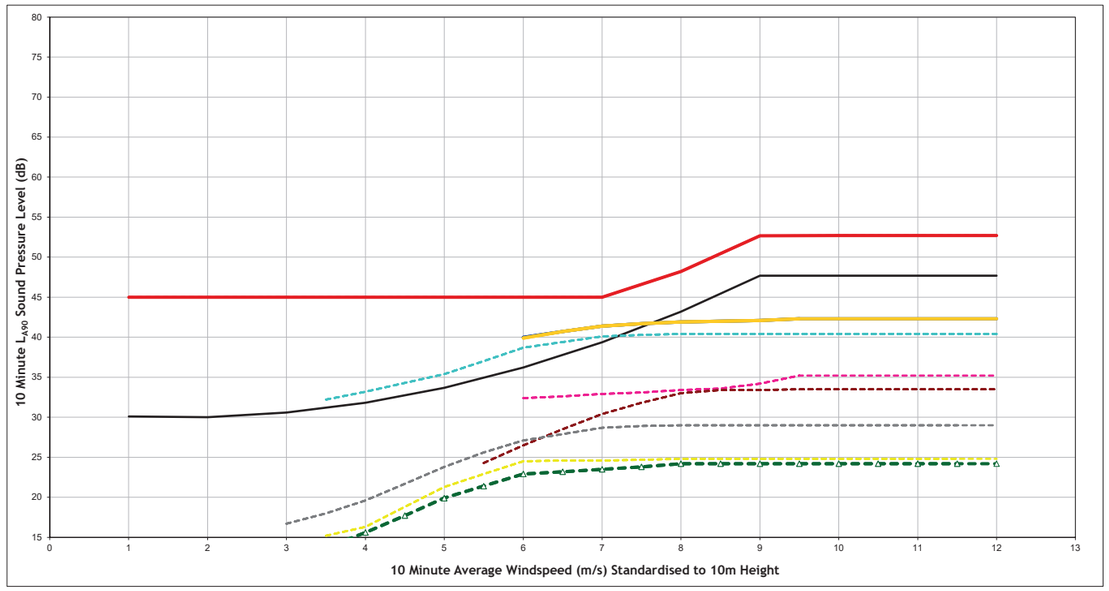
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Low Airies (NAL2)
Figure Number	Figure A1.2b
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

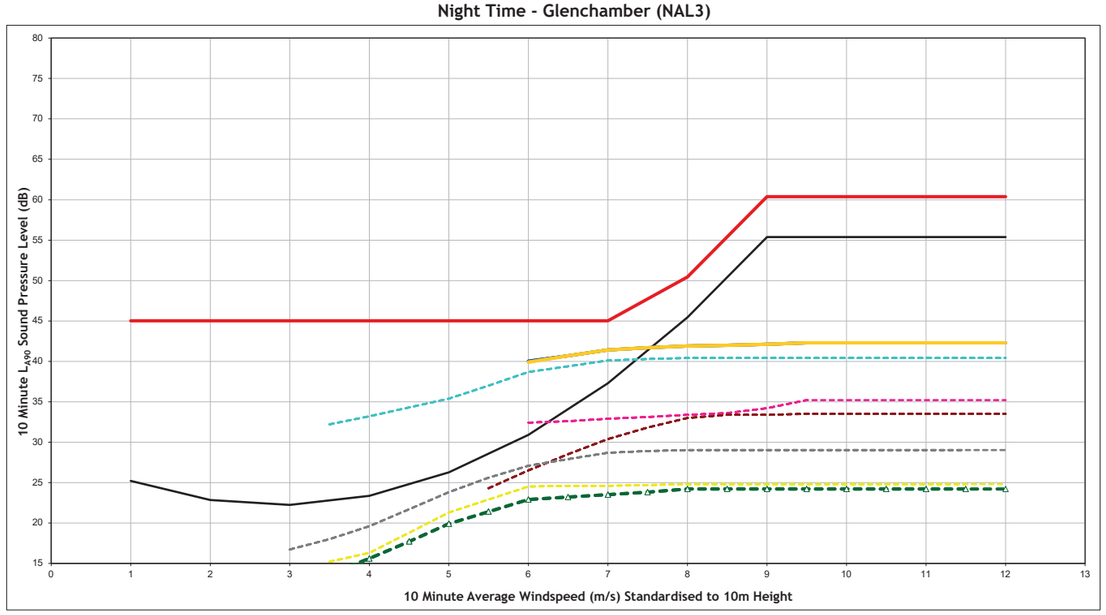
Statkraft

tnei

Quiet Daytime - Glenchamber (NAL3)



Night Time - Glenchamber (NAL3)

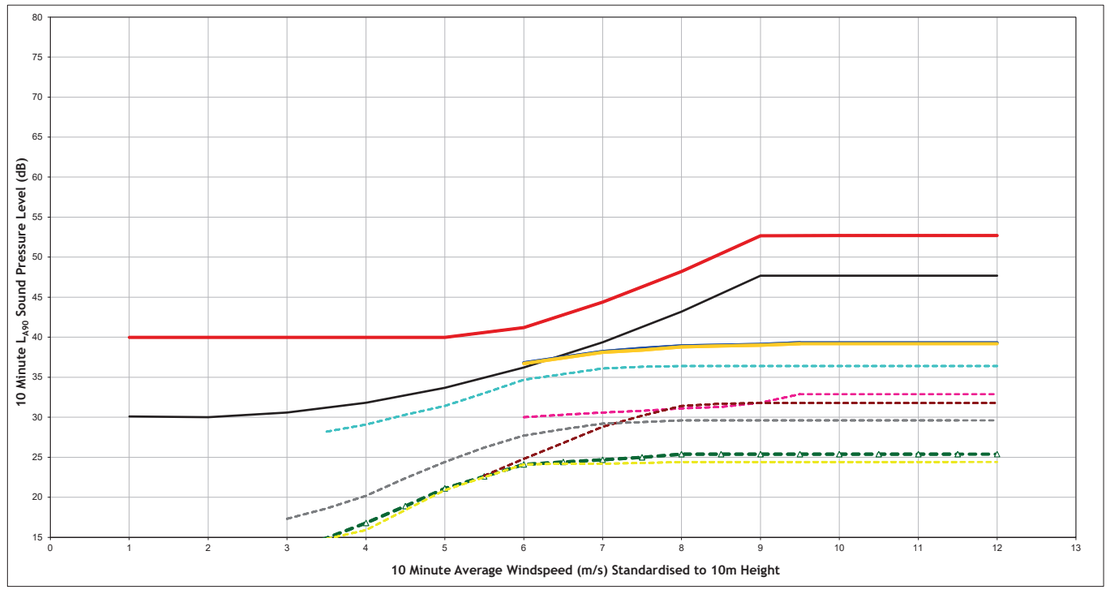


Legend:

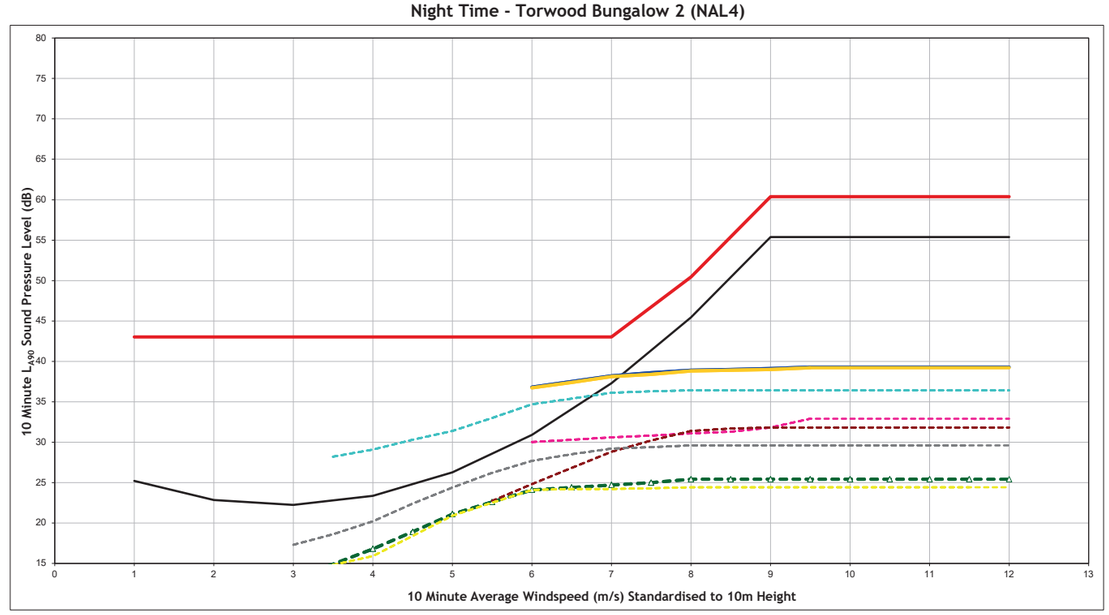
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Glenchamber (NAL3)
Figure Number	Figure A1.2c
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Torwood Bungalow 2 (NAL4)



Night Time - Torwood Bungalow 2 (NAL4)

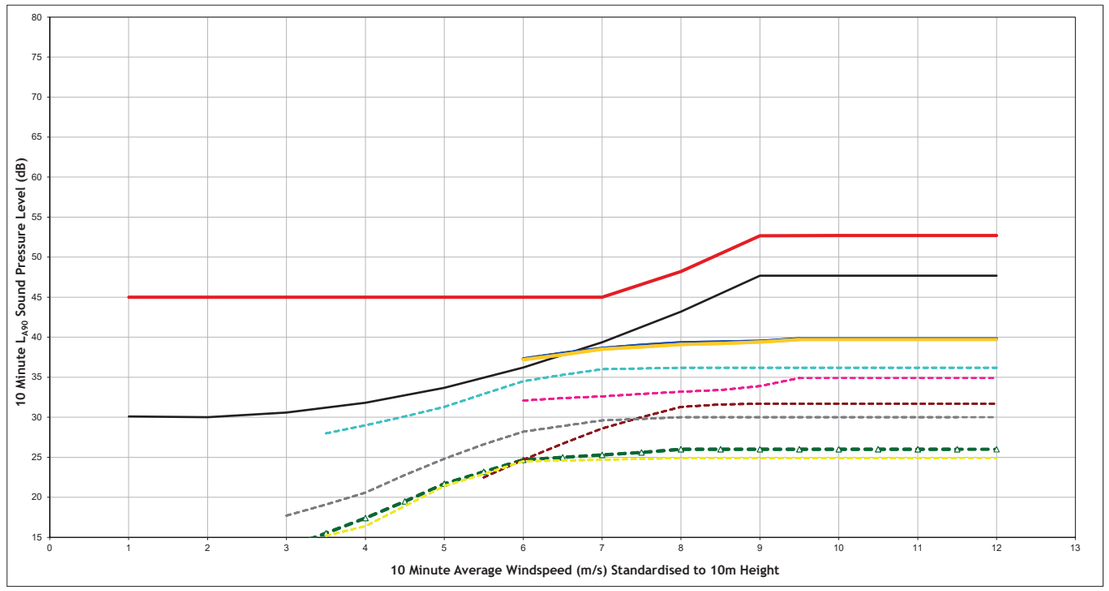


Legend:

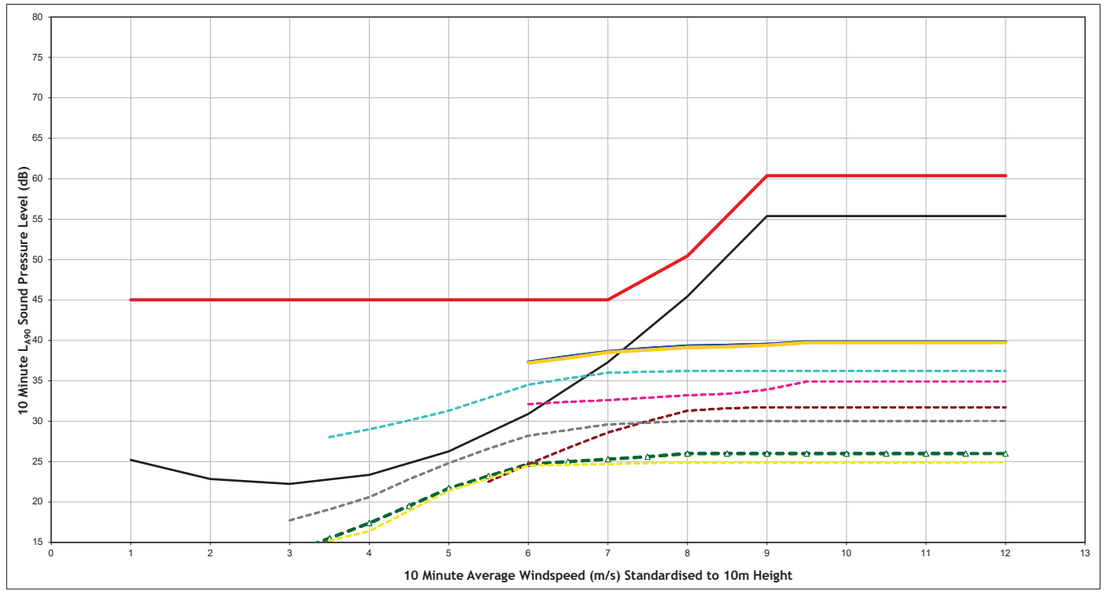
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Bungalow 2 (NAL4)
Figure Number	Figure A1.2d
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Torwood Bungalow (NAL5)



Night Time - Torwood Bungalow (NAL5)

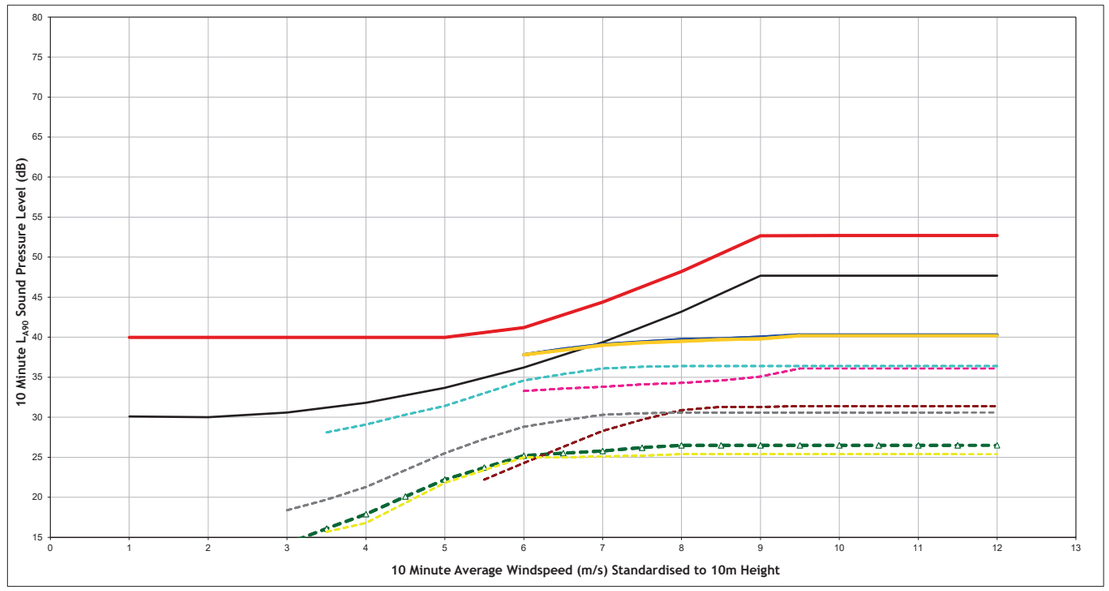


Legend:

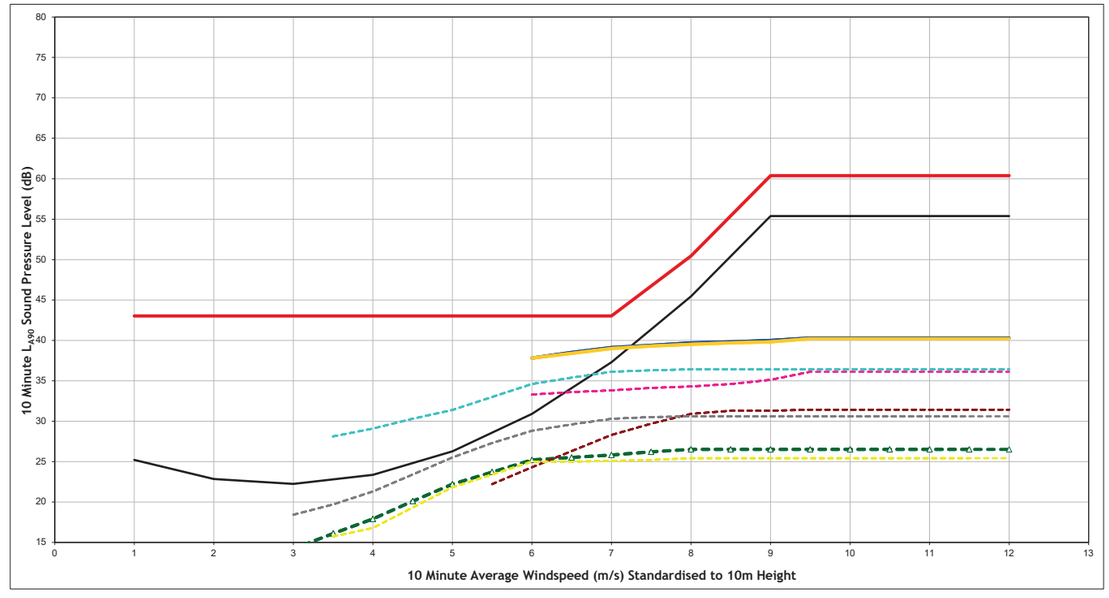
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Bungalow (NAL5)
Figure Number	Figure A1.2e
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Torwood House Hotel (NAL6)



Night Time - Torwood House Hotel (NAL6)

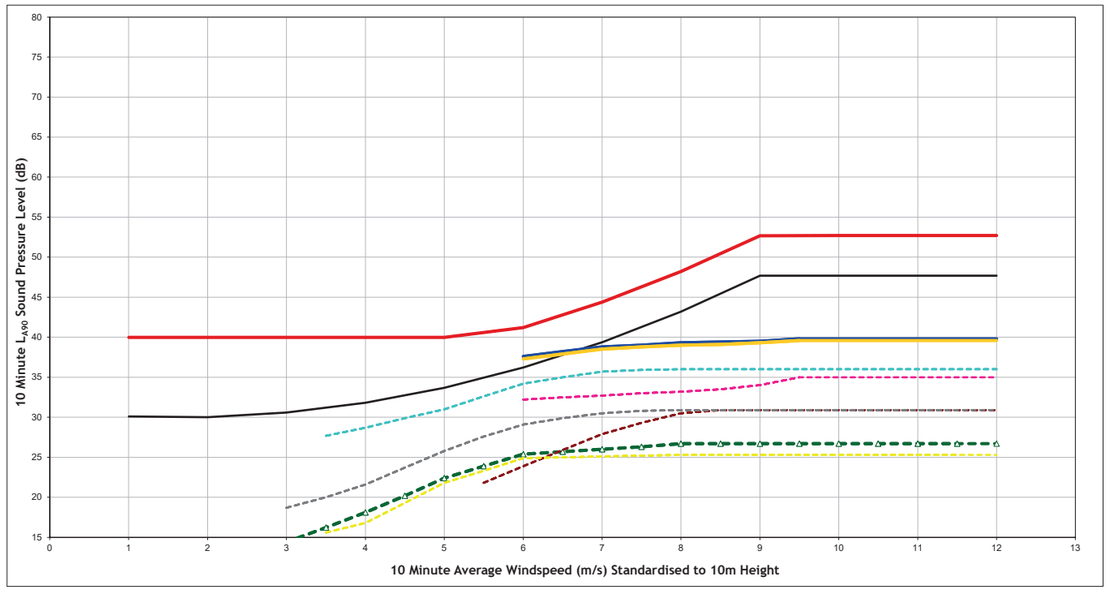


Legend:

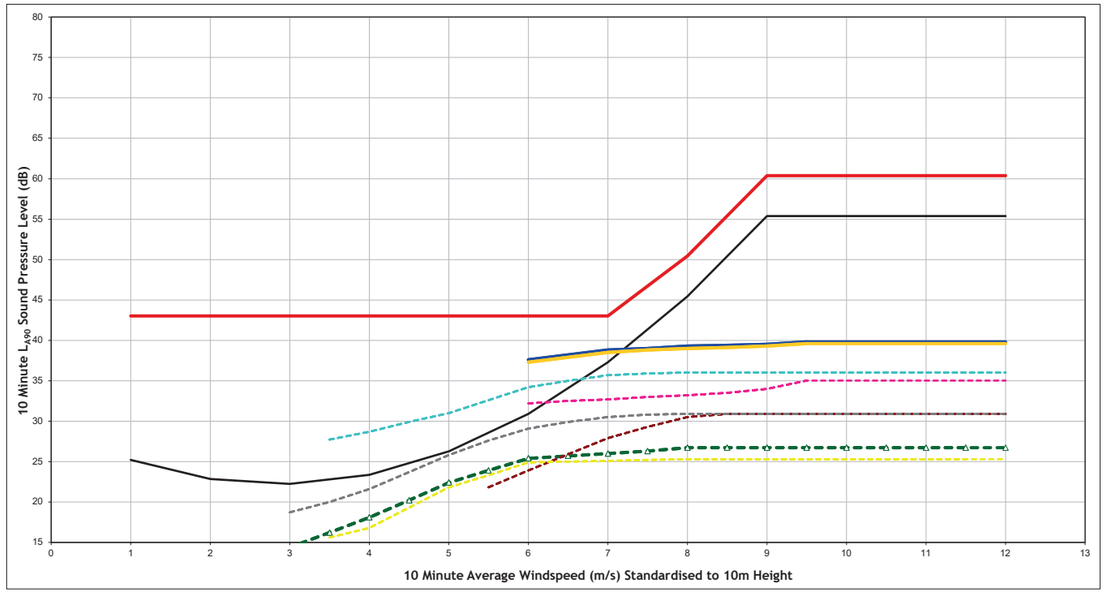
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood House Hotel (NAL6)
Figure Number	Figure A1.2f
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Torwood Two Dogs Lodge (NAL7)



Night Time - Torwood Two Dogs Lodge (NAL7)

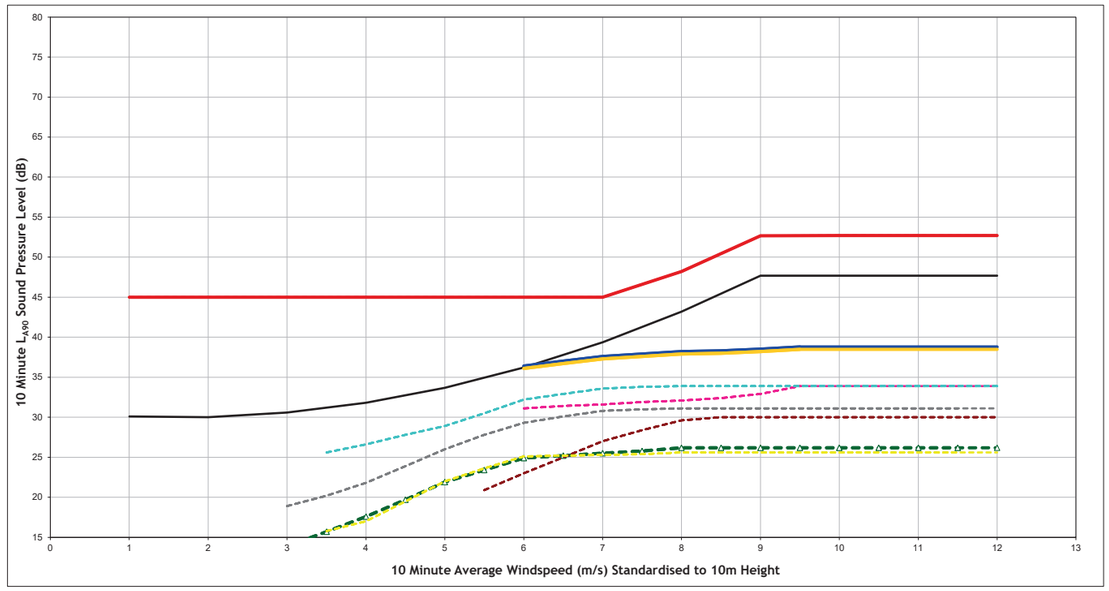


Legend:

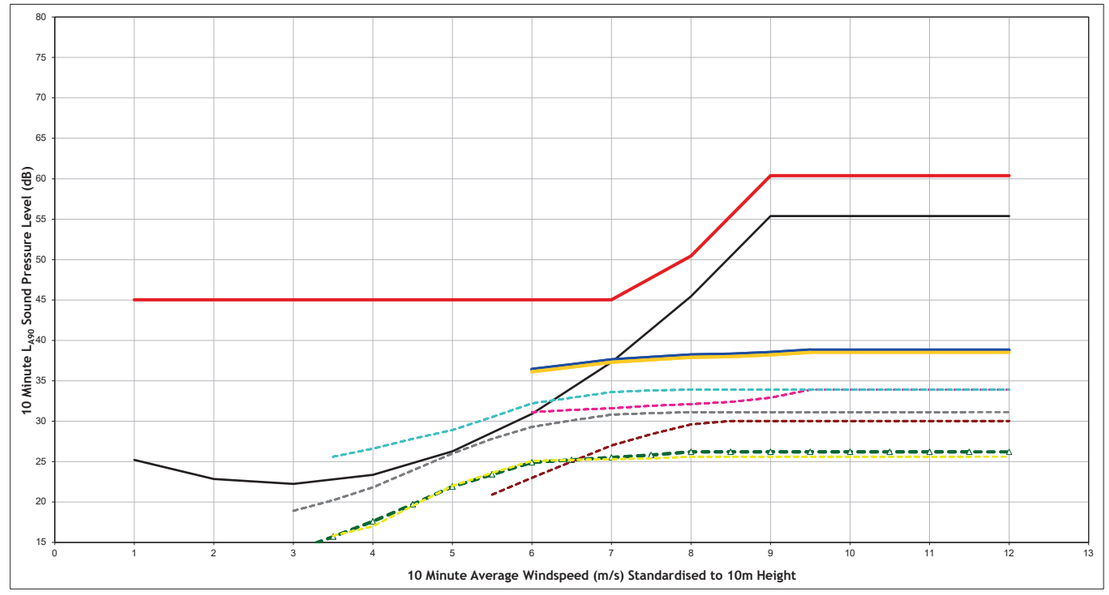
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Two Dogs Lodge (NAL7)
Figure Number	Figure A1.2g
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Gass Farm (NAL8)



Night Time - Gass Farm (NAL8)

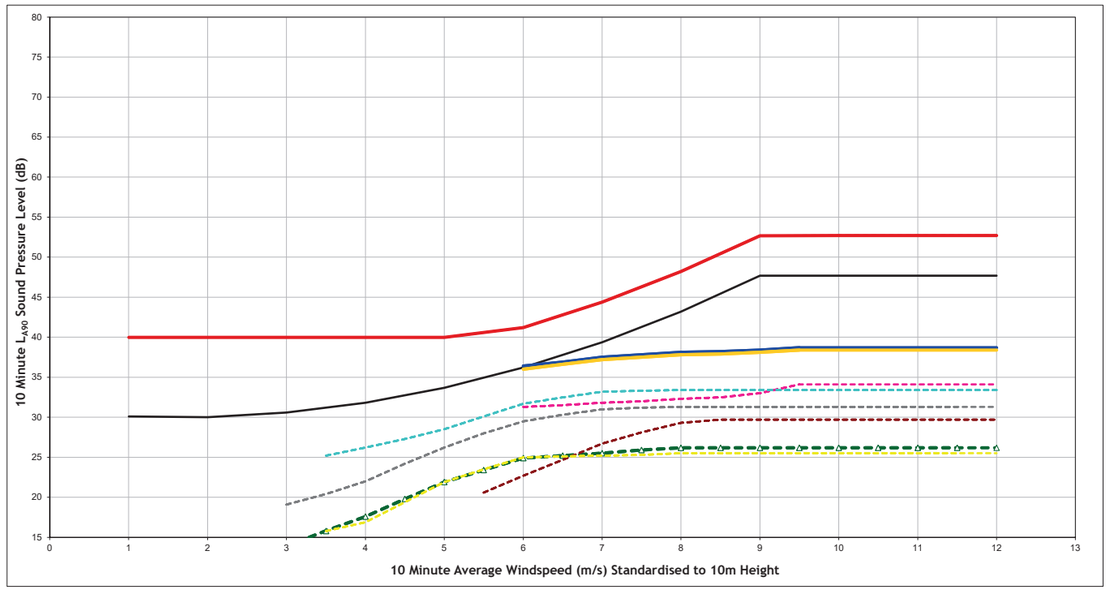


Legend:

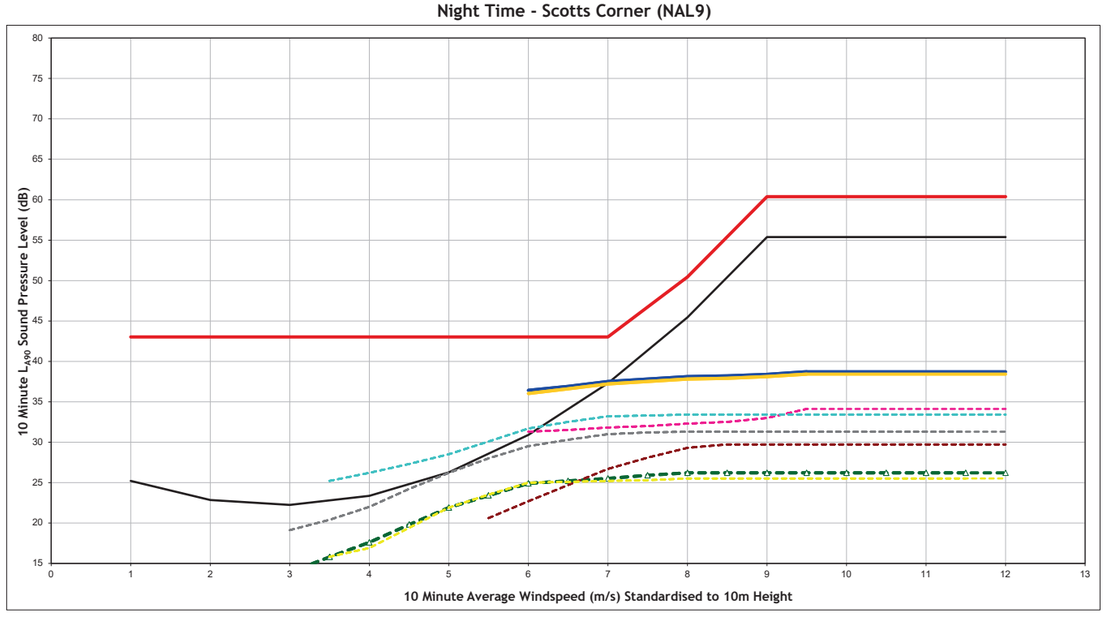
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Gass Farm (NAL8)
Figure Number	Figure A1.2h
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Scotts Corner (NAL9)



Night Time - Scotts Corner (NAL9)

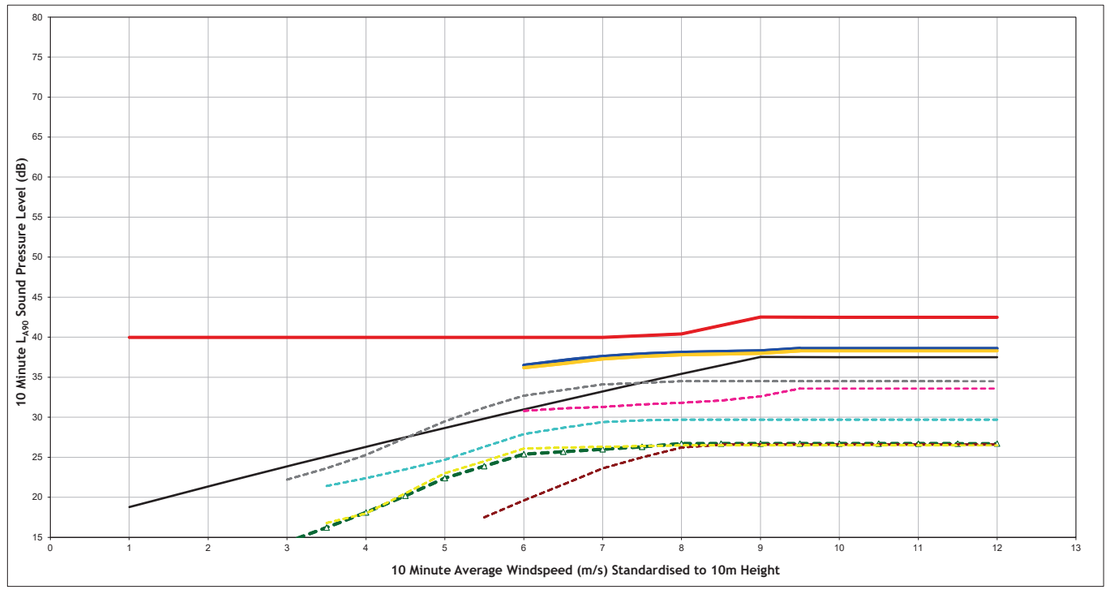


Legend:

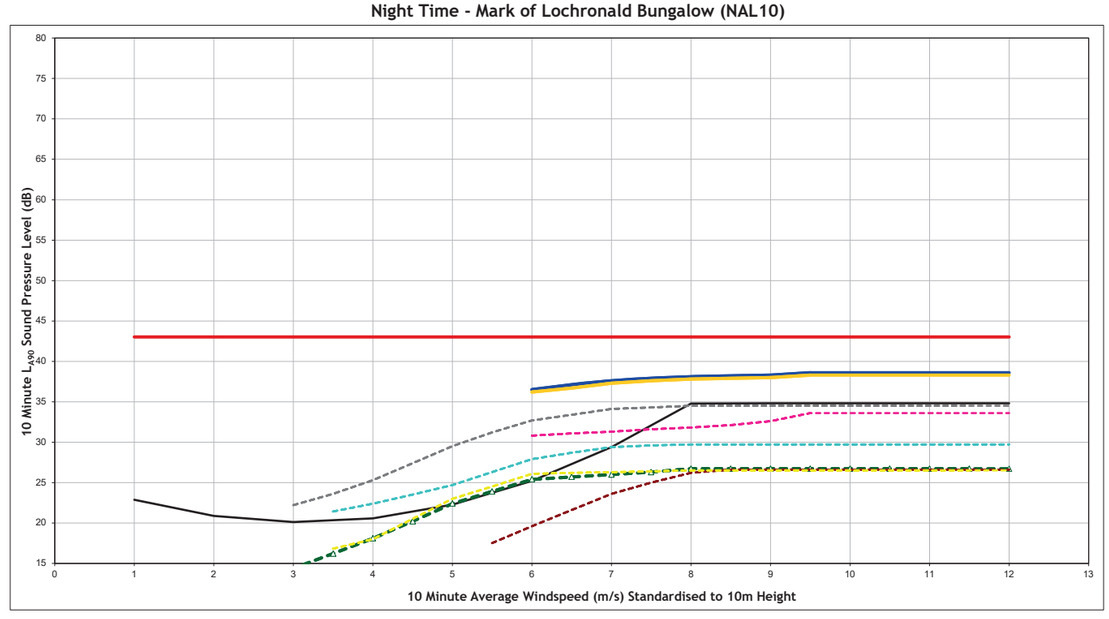
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Scotts Corner (NAL9)
Figure Number	Figure A1.2i
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Mark of Lochronald Bungalow (NAL10)



Night Time - Mark of Lochronald Bungalow (NAL10)

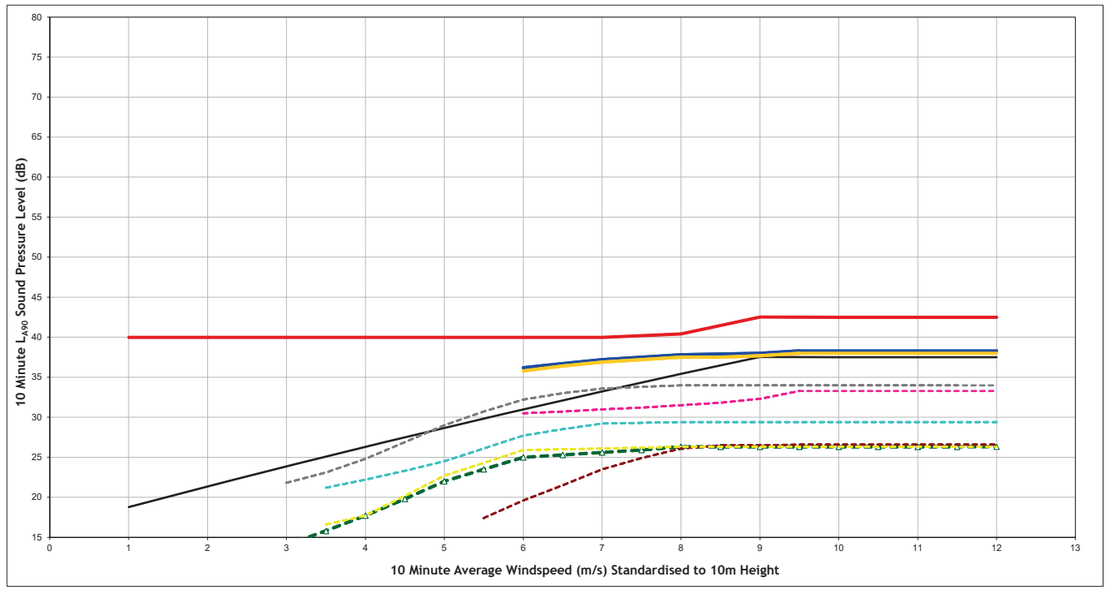


Legend:

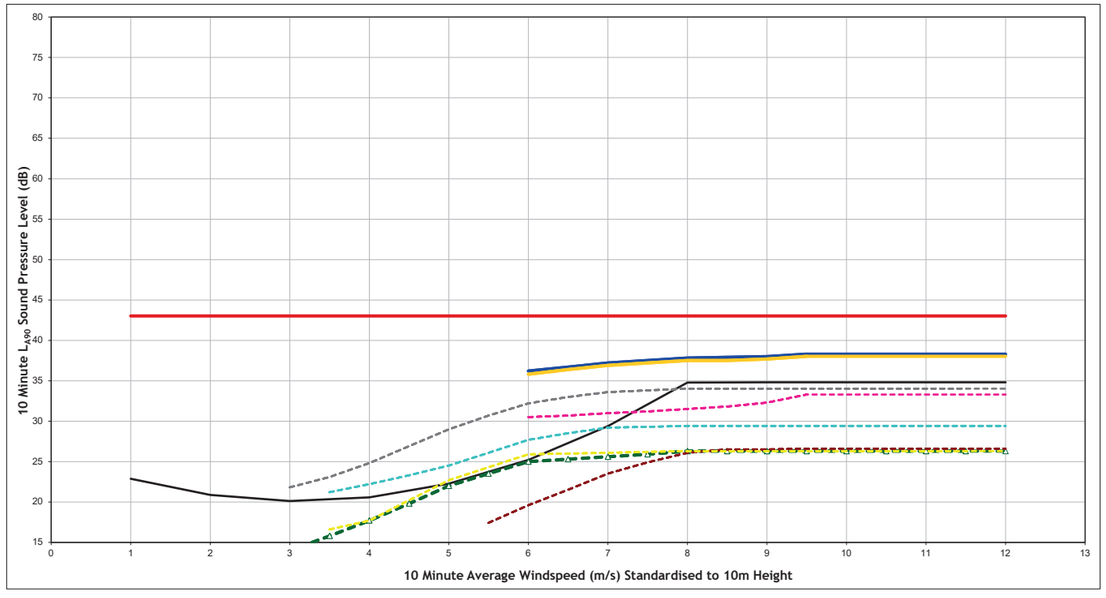
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Mark of Lochronald Bungalow (NAL10)
Figure Number	Figure A1.2j
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Mark of Lochronald (NAL11)



Night Time - Mark of Lochronald (NAL11)

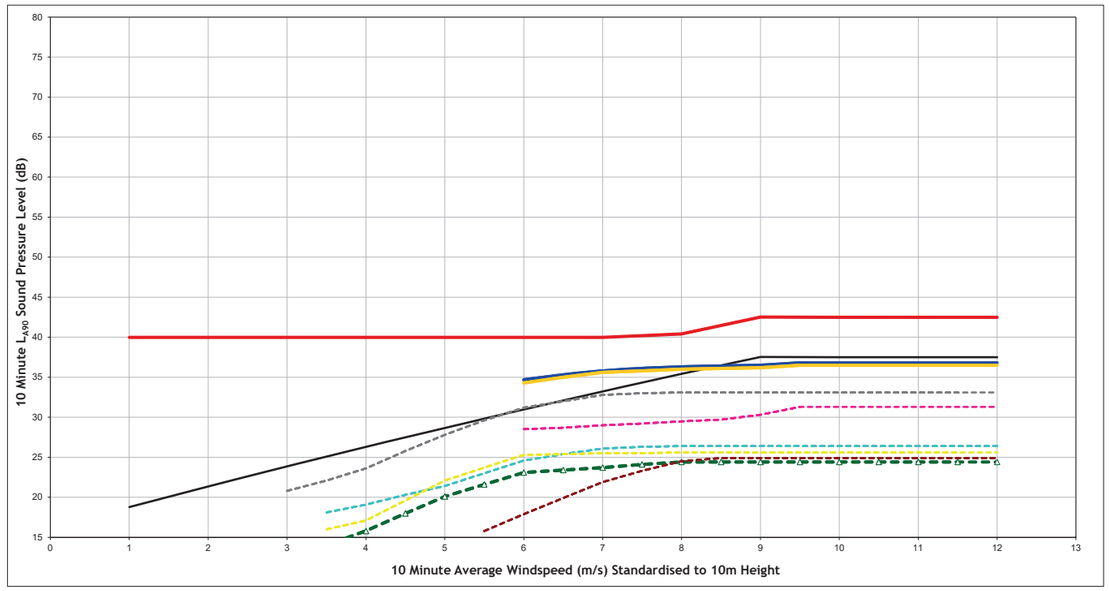


Legend:

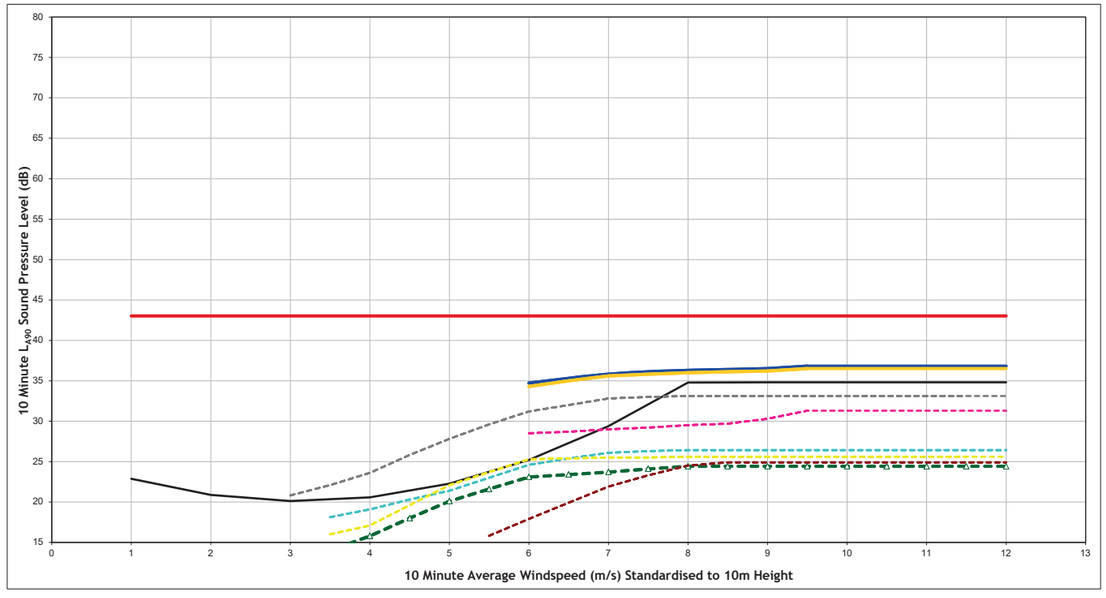
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Mark of Lochronald (NAL11)
Figure Number	Figure A1.2k
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Fell of Loch Ronald (NAL12)



Night Time - Fell of Loch Ronald (NAL12)

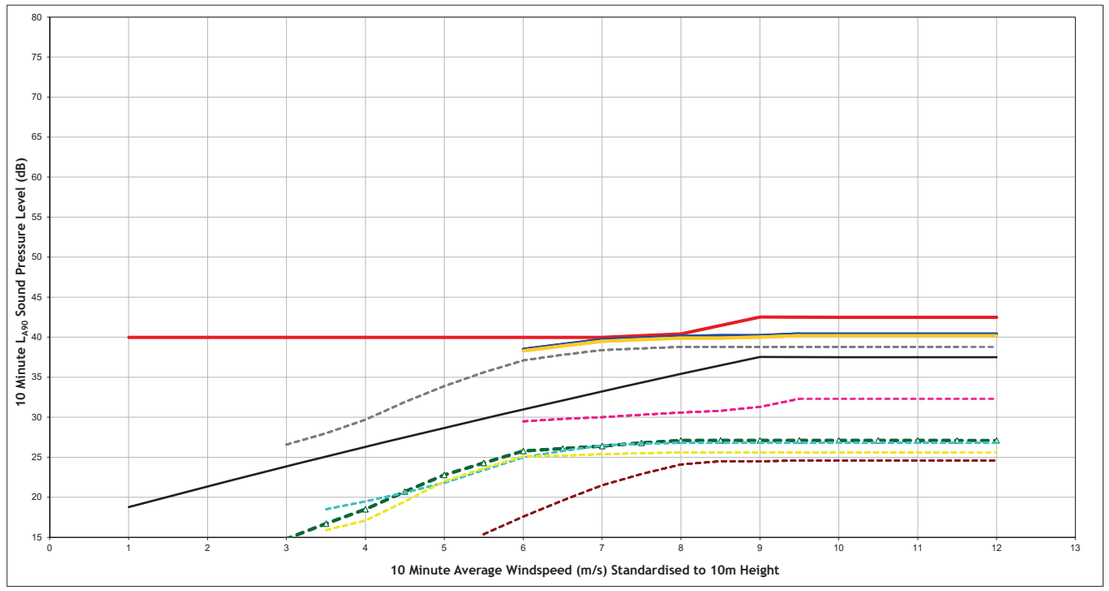


Legend:

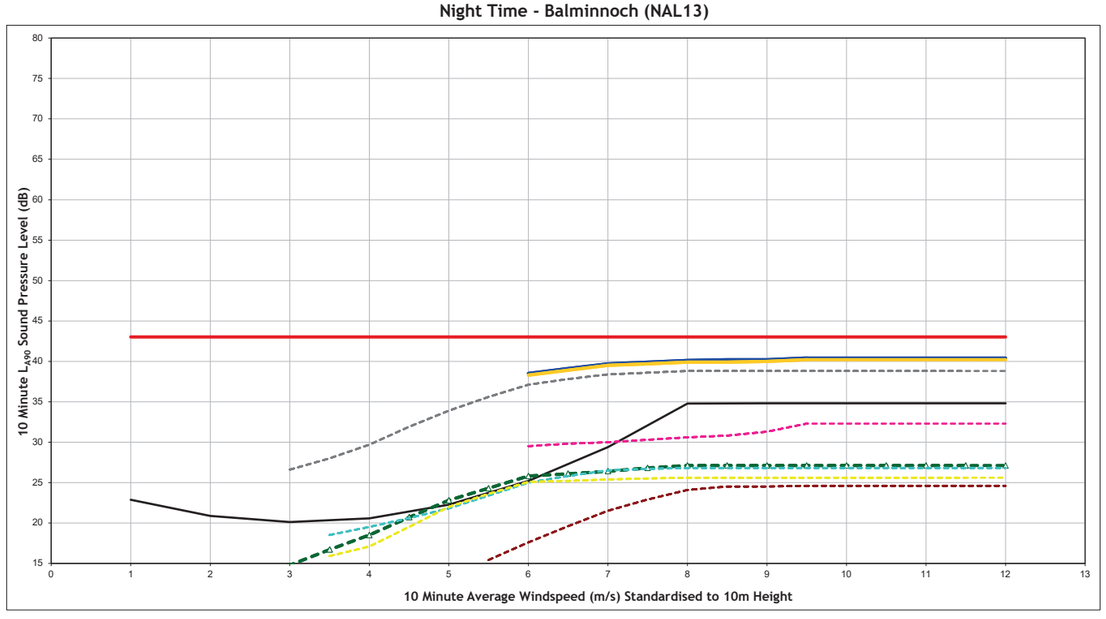
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Fell of Loch Ronald (NAL12)
Figure Number	Figure A1.2l
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Balminnoch (NAL13)



Night Time - Balminnoch (NAL13)

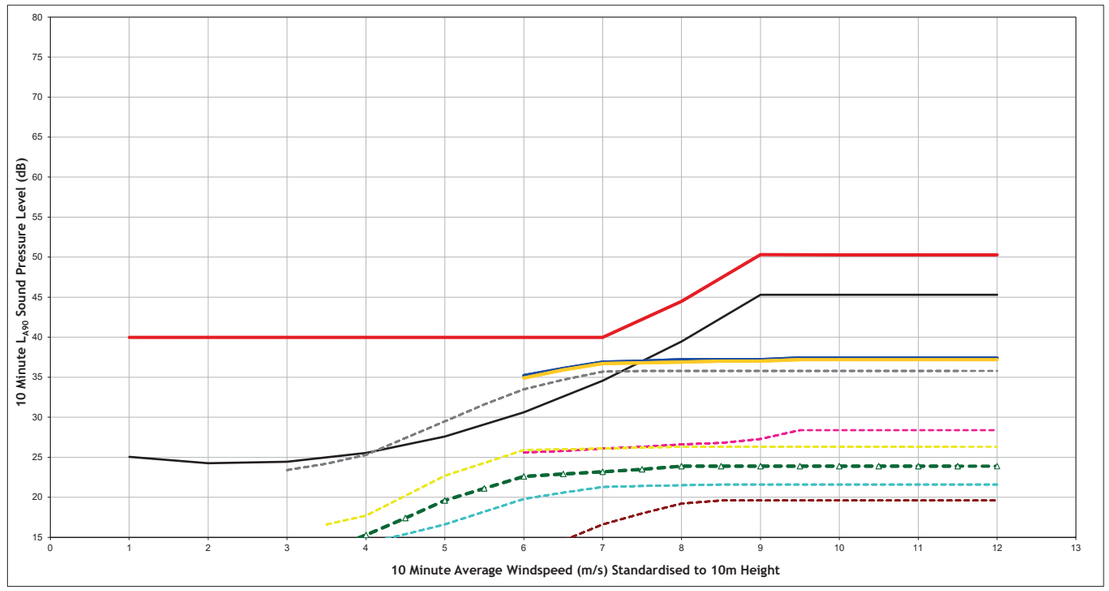


Legend:

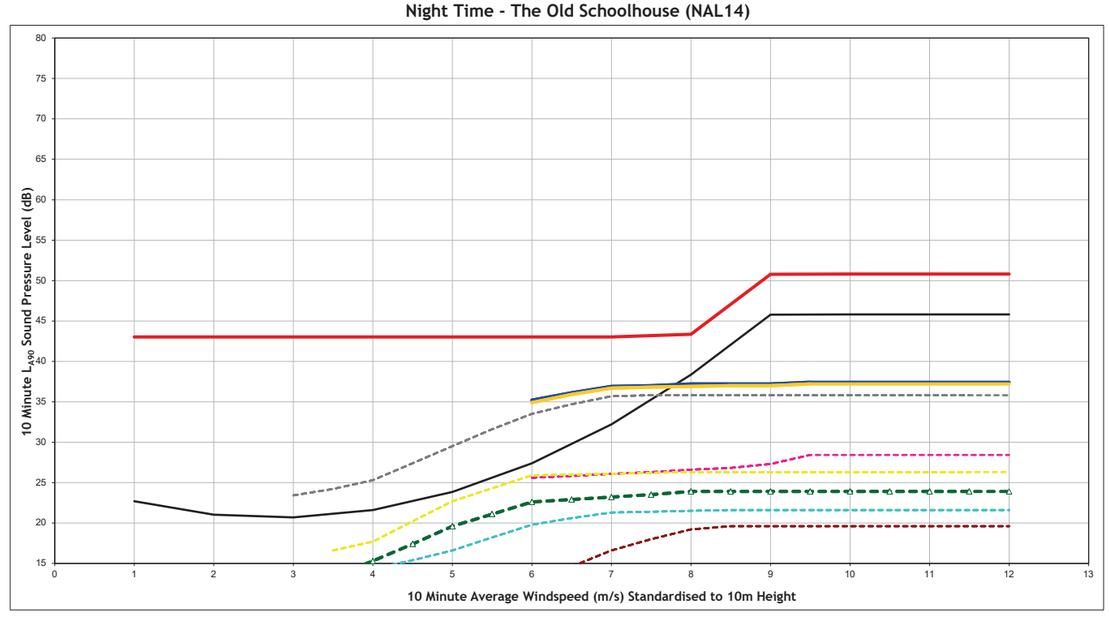
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Balminnoch (NAL13)
Figure Number	Figure A1.2m
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - The Old Schoolhouse (NAL14)



Night Time - The Old Schoolhouse (NAL14)

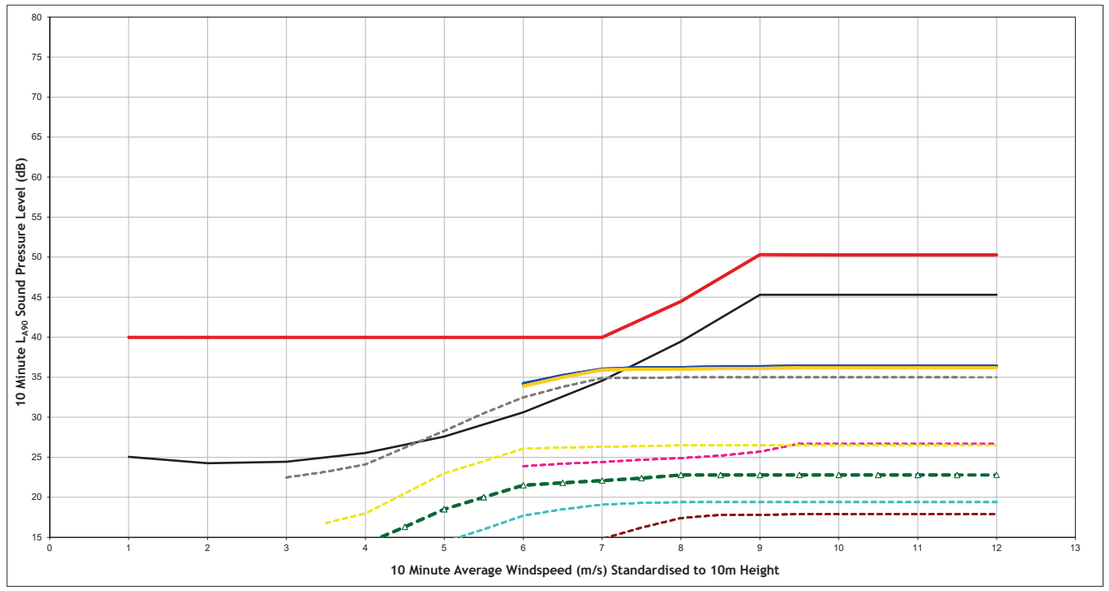


Legend:

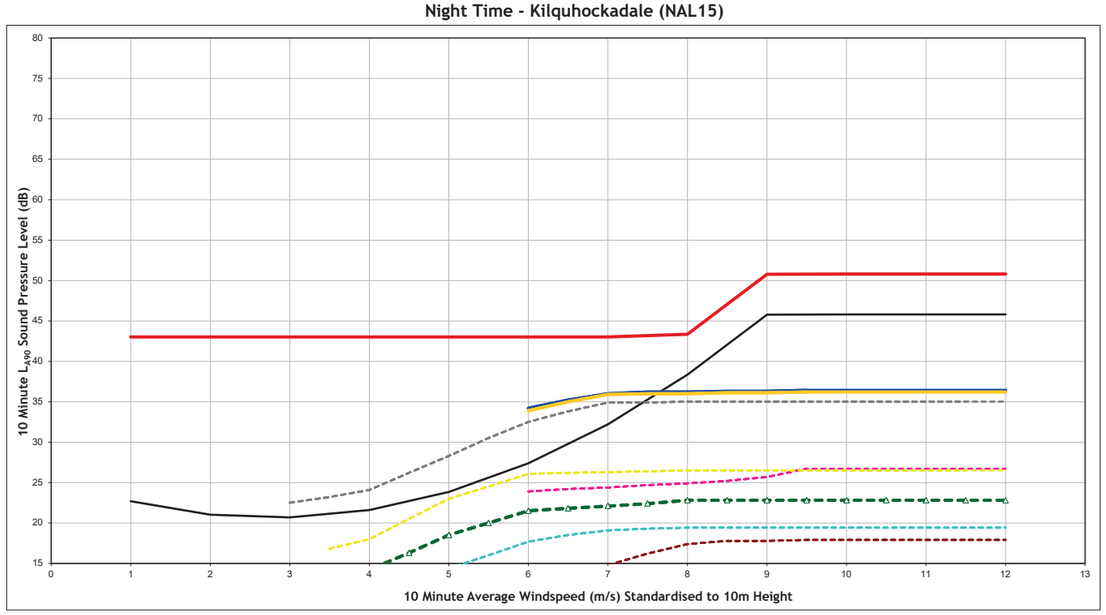
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment The Old Schoolhouse (NAL14)
Figure Number	Figure A1.2n
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Kilquhockadale (NAL15)



Night Time - Kilquhockadale (NAL15)

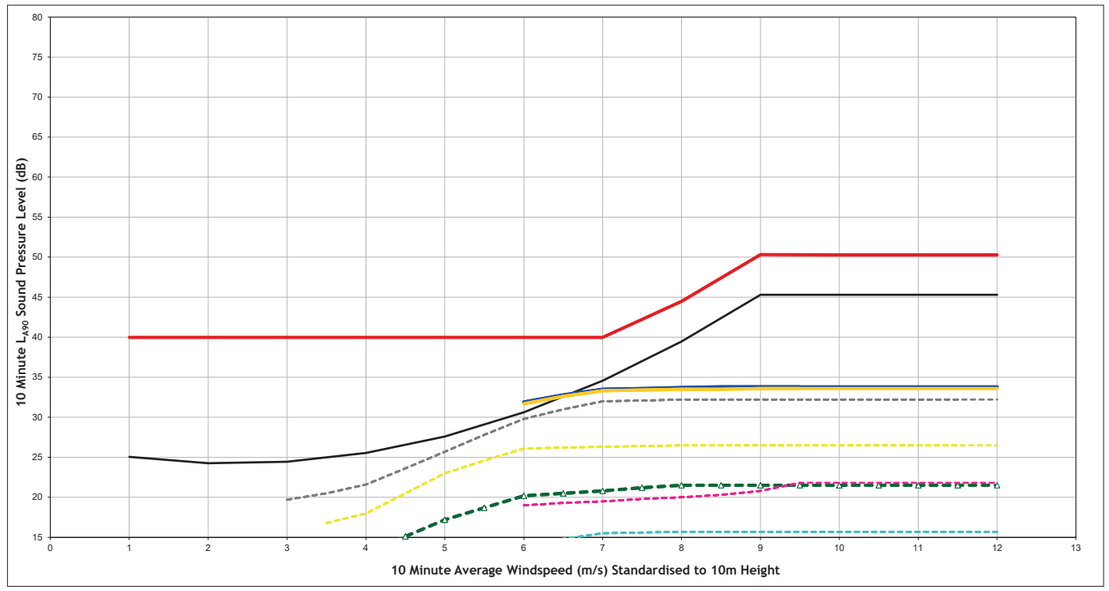


Legend:

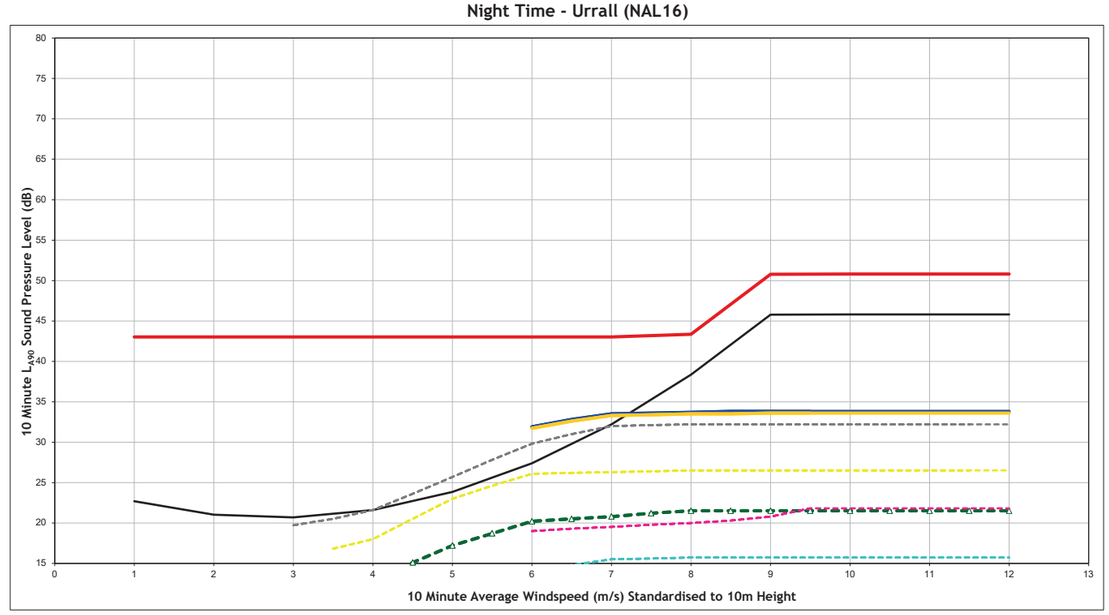
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Kilquhockadale (NAL15)
Figure Number	Figure A1.2o
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Urrall (NAL16)



Night Time - Urrall (NAL16)

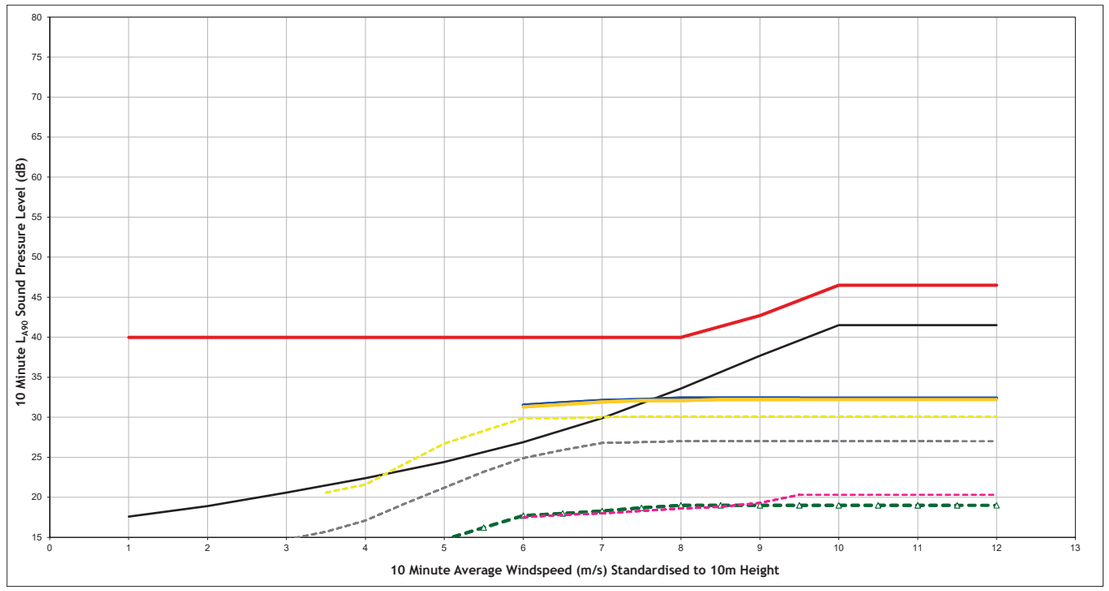


Legend:

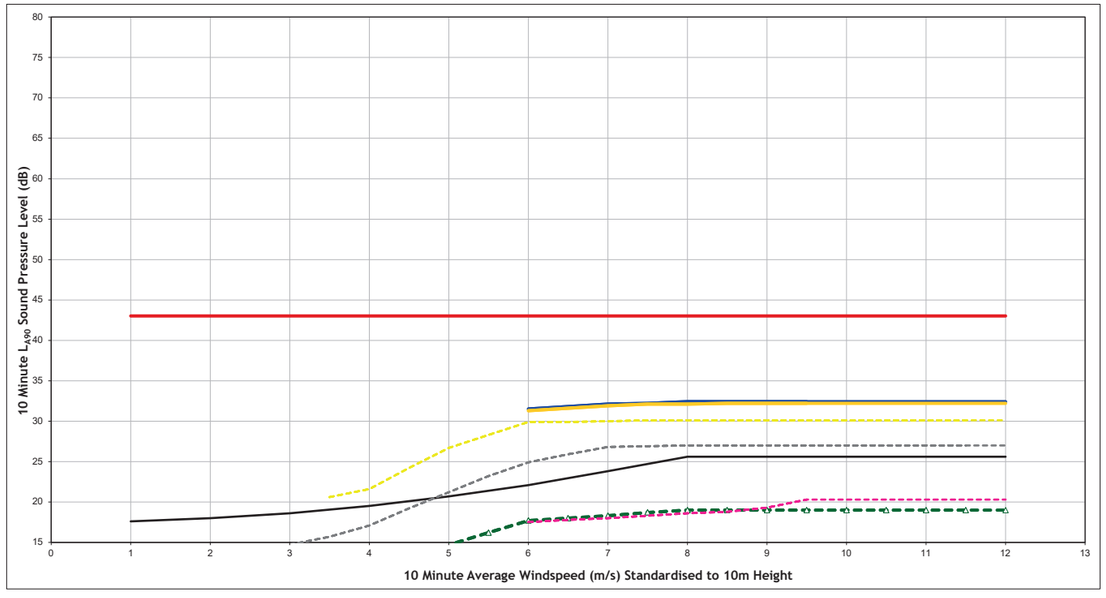
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Urrall (NAL16)
Figure Number	Figure A1.2p
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Tannielaggie (NAL17)



Night Time - Tannielaggie (NAL17)

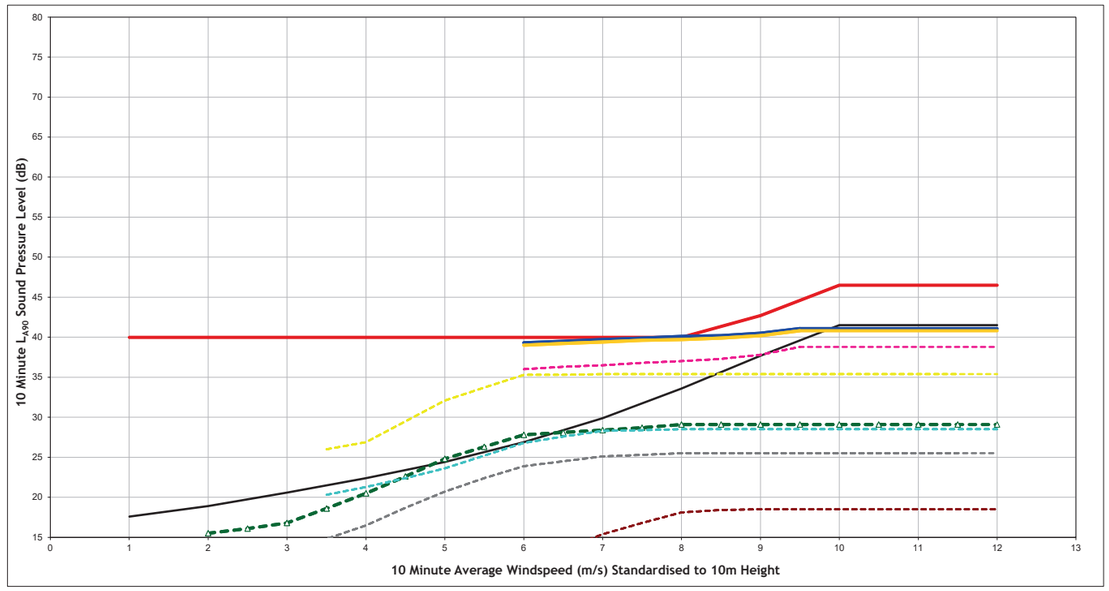


Legend:

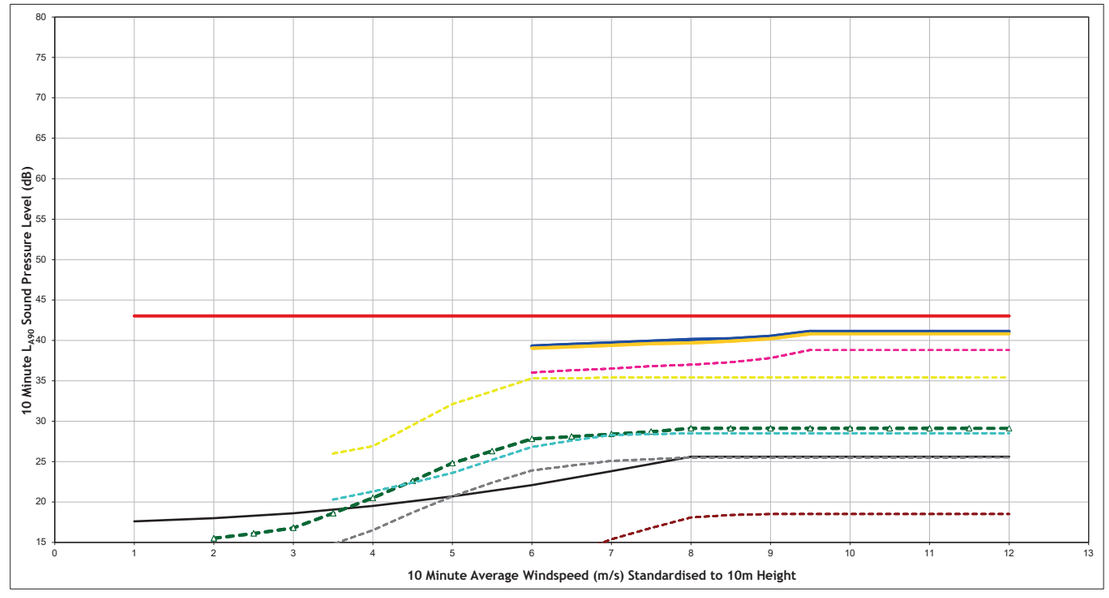
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Tannielaggie (NAL17)
Figure Number	Figure A1.2q
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Kilmacfadzean (NAL18)



Night Time - Kilmacfadzean (NAL18)

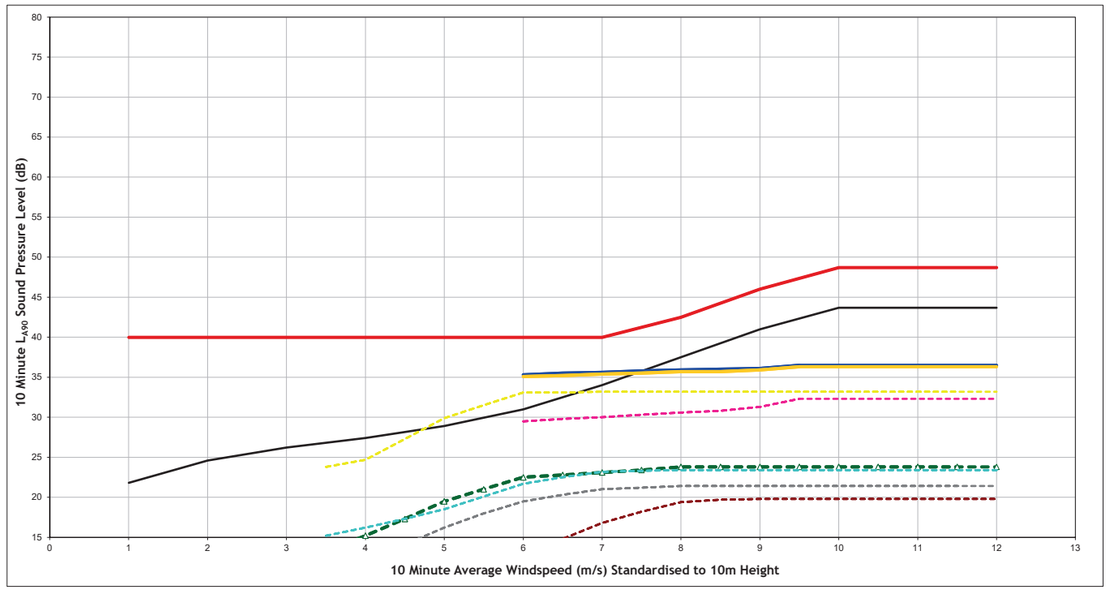


Legend:

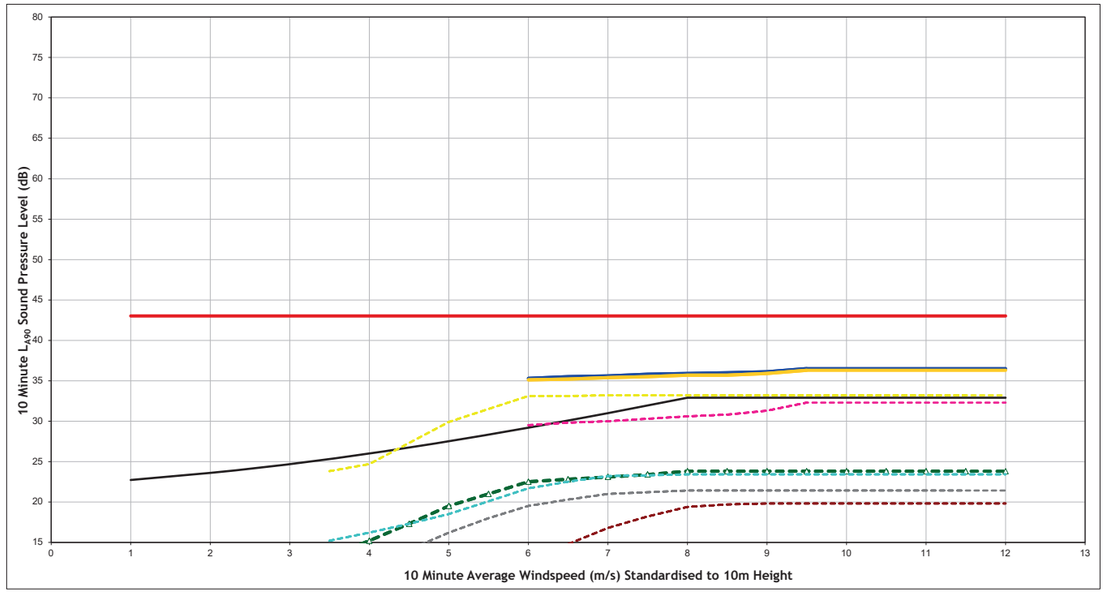
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Kilmacfadzean (NAL18)
Figure Number	Figure A1.2r
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Quarter Farm (NAL19)



Night Time - Quarter Farm (NAL19)

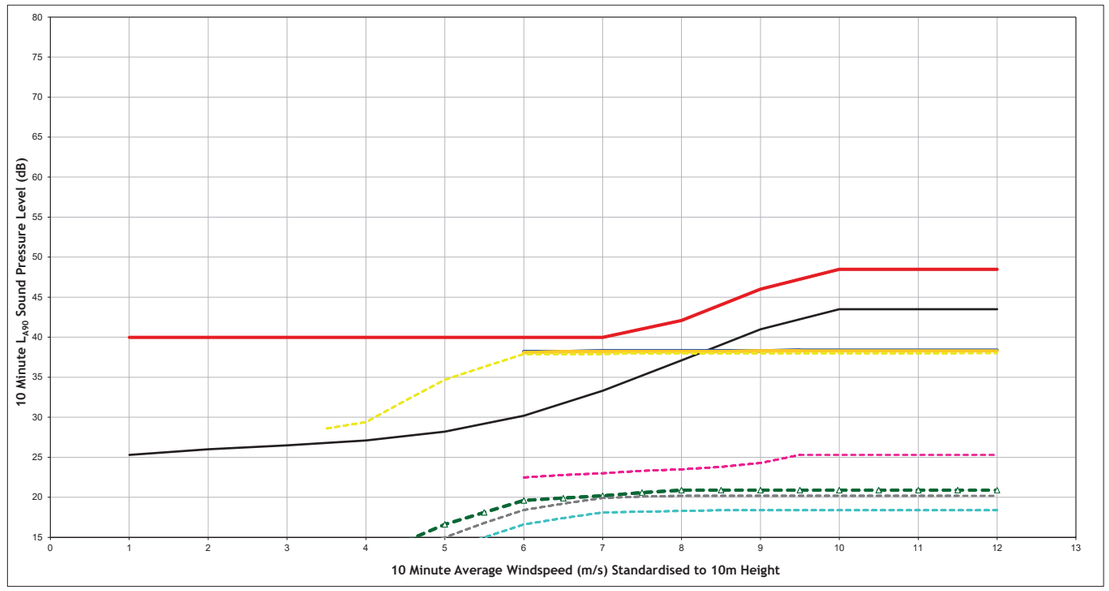


Legend:

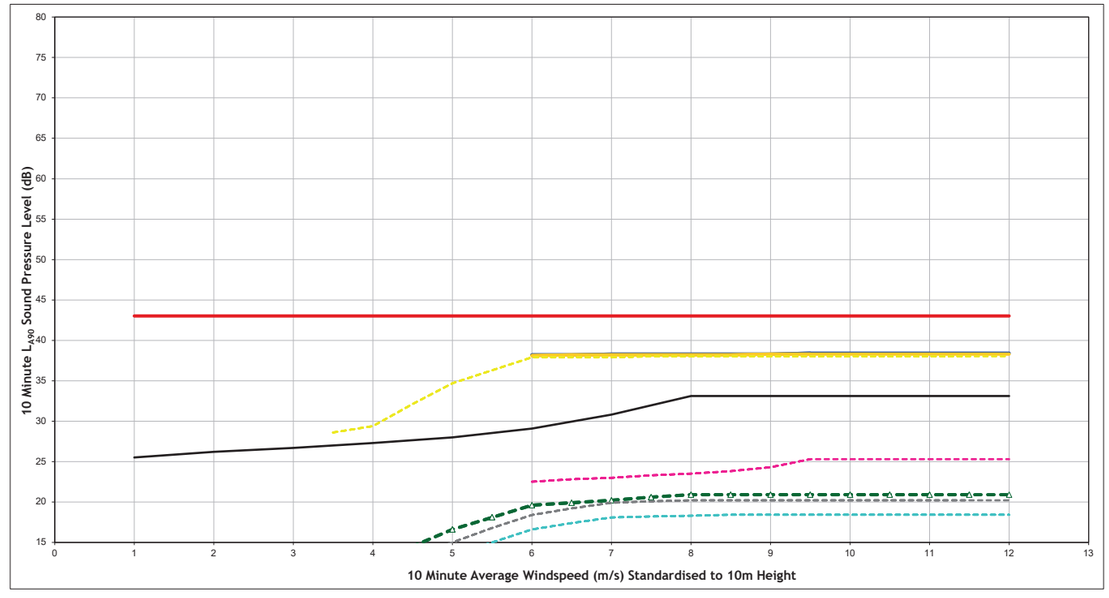
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Quarter Farm (NAL19)
Figure Number	Figure A1.2s
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Pultadie (NAL20)



Night Time - Pultadie (NAL20)

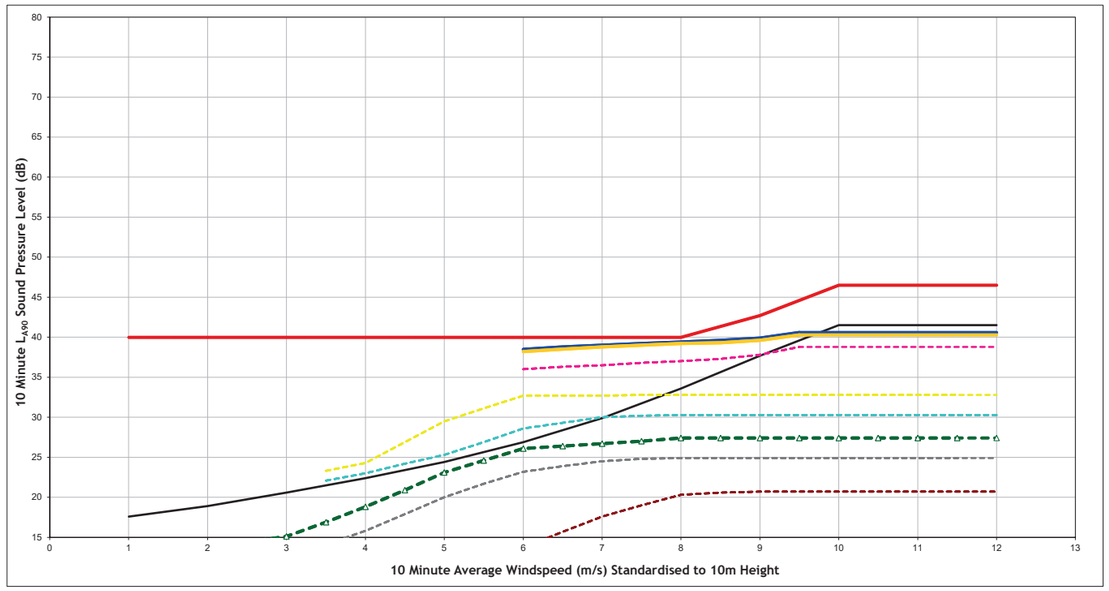


Legend:

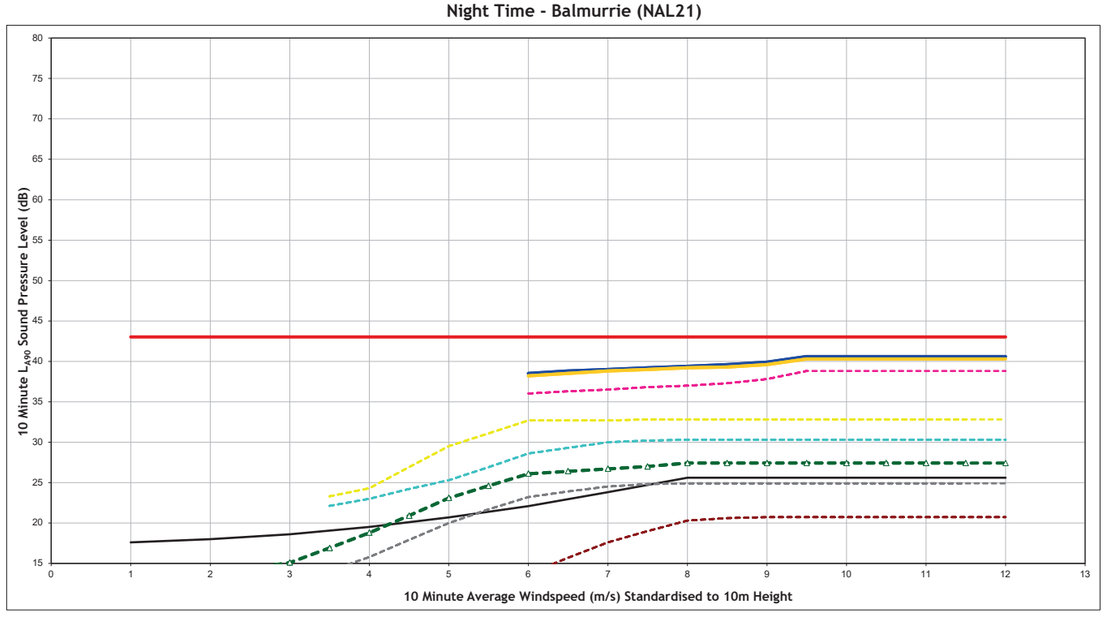
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Pultadie (NAL20)
Figure Number	Figure A1.2t
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Balmurrie (NAL21)



Night Time - Balmurrie (NAL21)

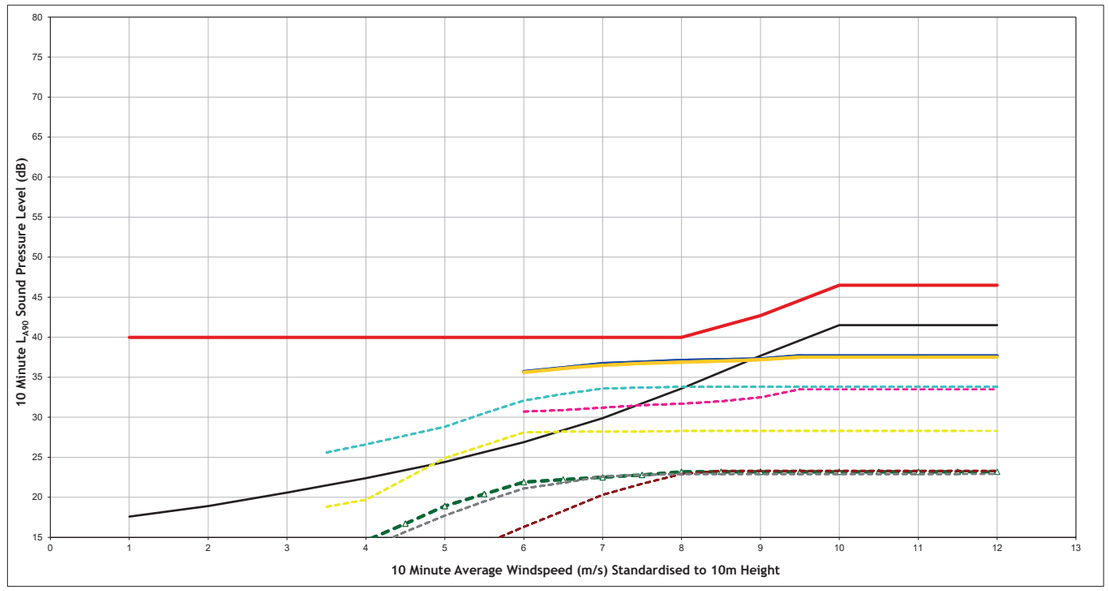


Legend:

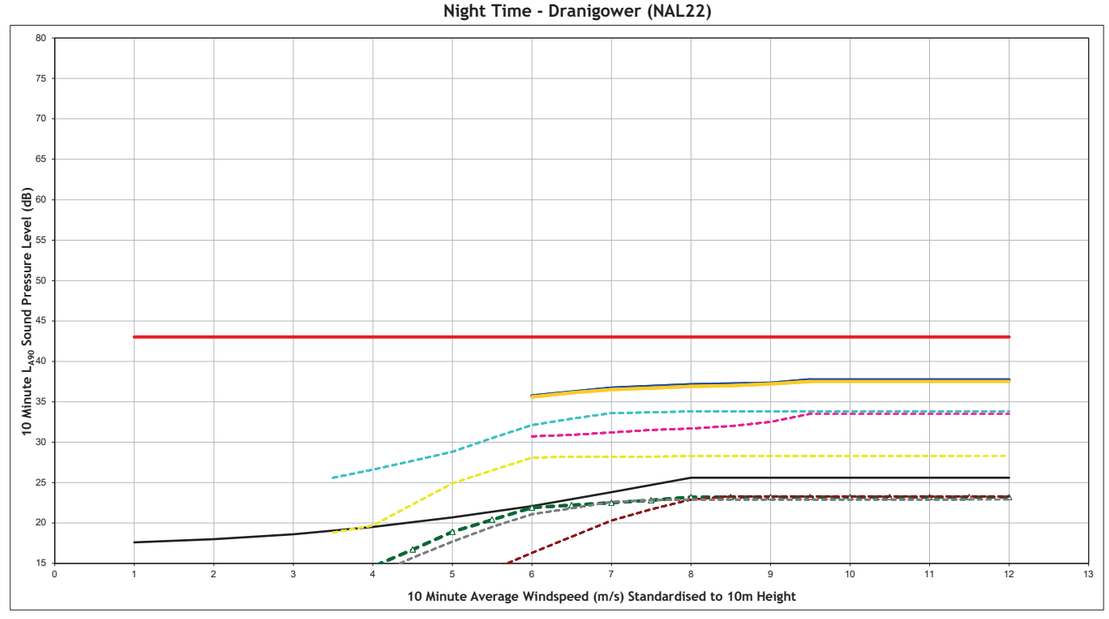
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Balmurrie (NAL21)
Figure Number	Figure A1.2u
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Dranigower (NAL22)



Night Time - Dranigower (NAL22)

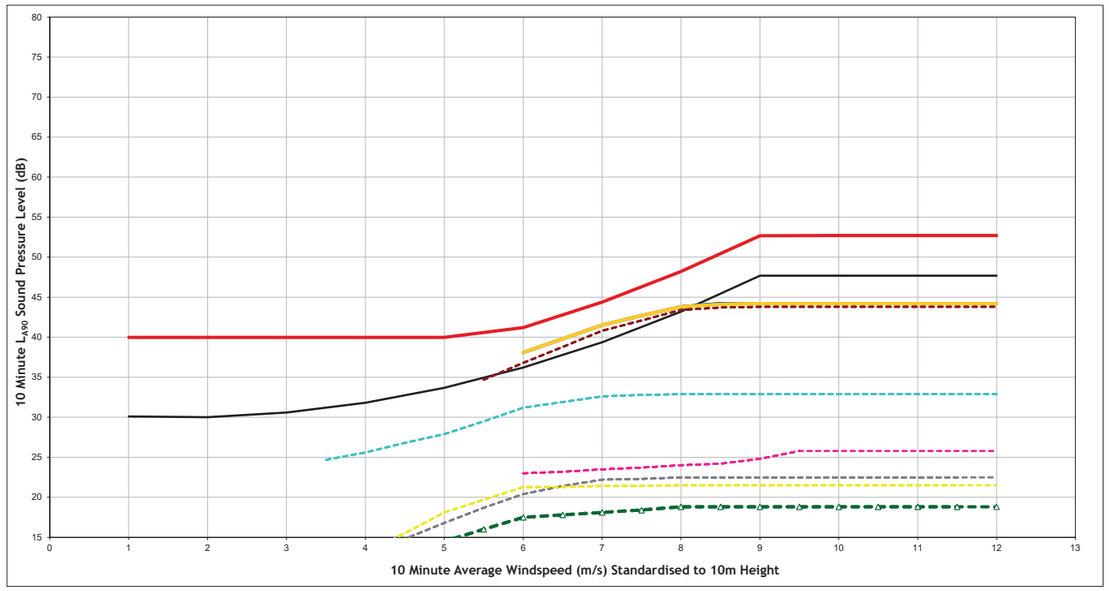


Legend:

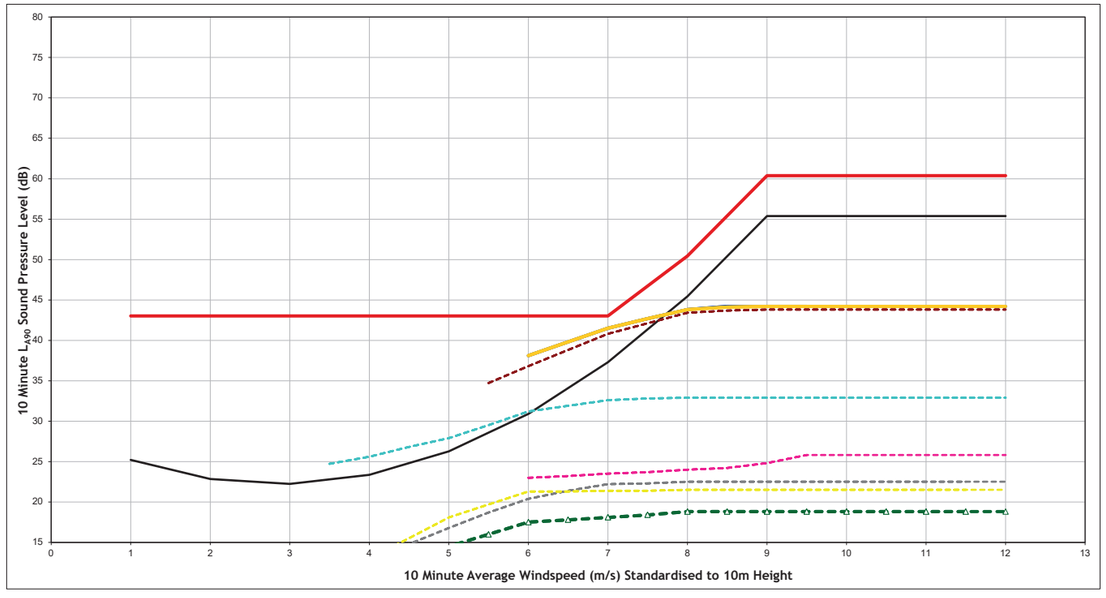
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Dranigower (NAL22)
Figure Number	Figure A1.2v
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Garvilland (NAL23)



Night Time - Garvilland (NAL23)

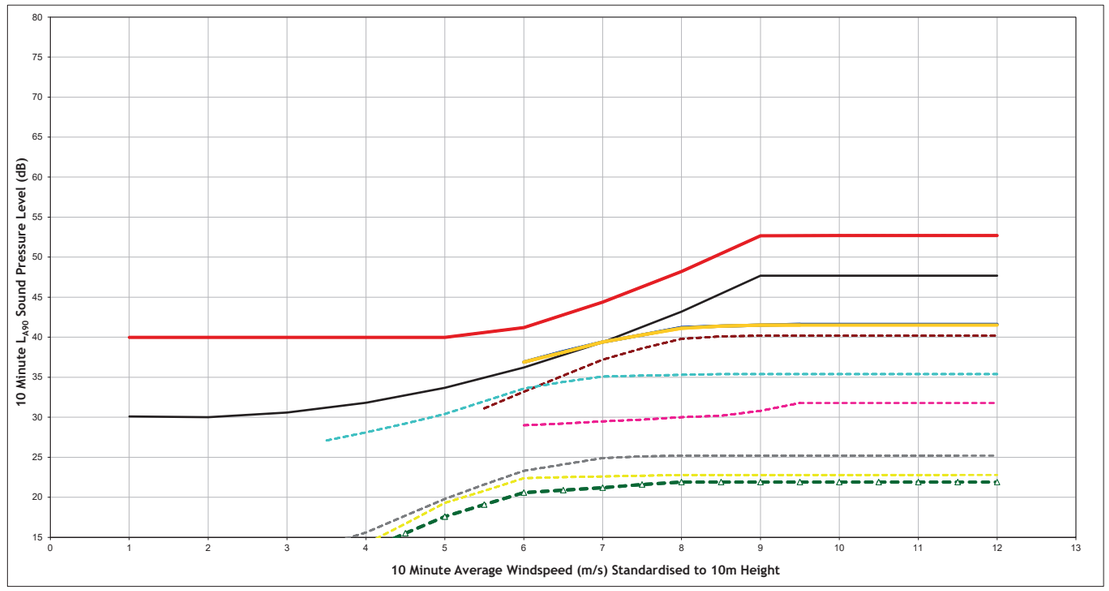


Legend:

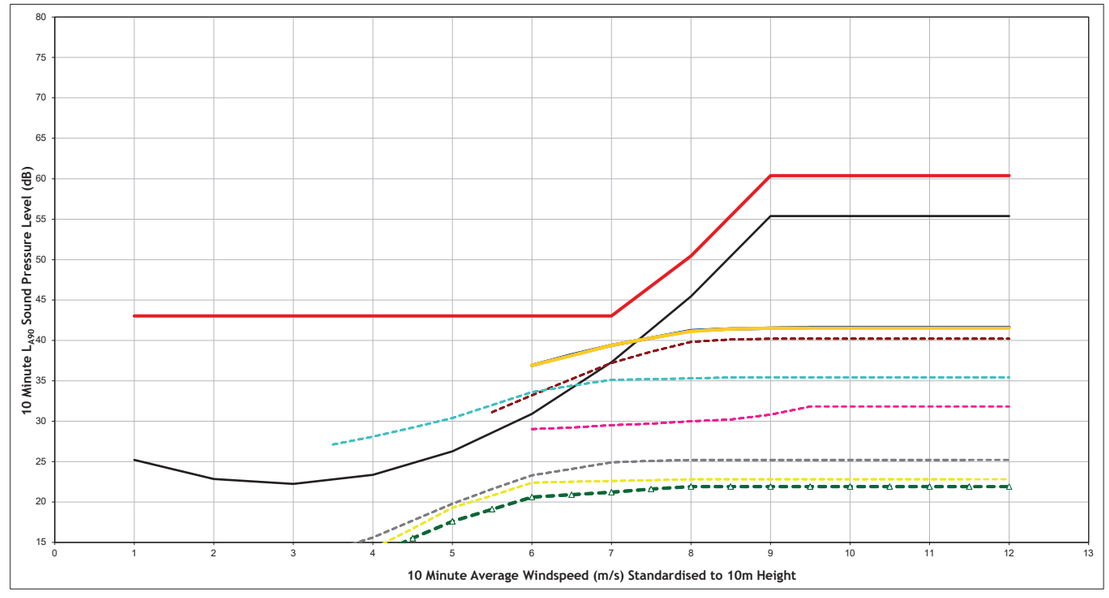
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Garvilland (NAL23)
Figure Number	Figure A1.2w
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Carscreugh Croft (NAL24)



Night Time - Carscreugh Croft (NAL24)

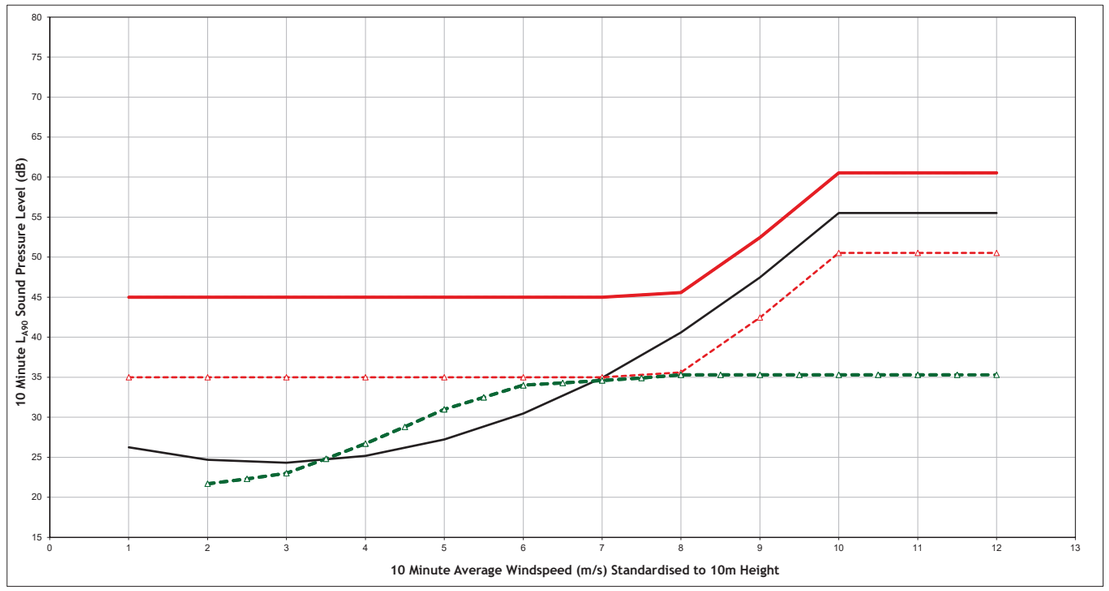


Legend:

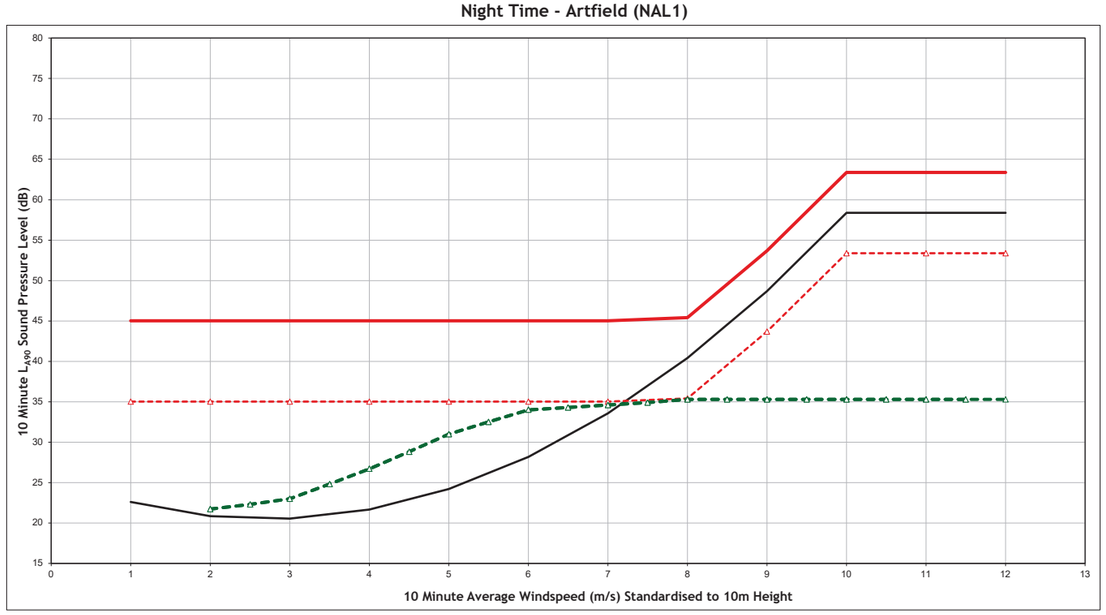
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies I & II
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Carscreugh Croft (NAL24)
Figure Number	Figure A1.2x
Scale	NTS
Drawn	JB
Checked	JM
Date	26/10/2020
Document Reference	13865-Models

Quiet Daytime - Artfield (NAL1)



Night Time - Artfield (NAL1)



Legend:

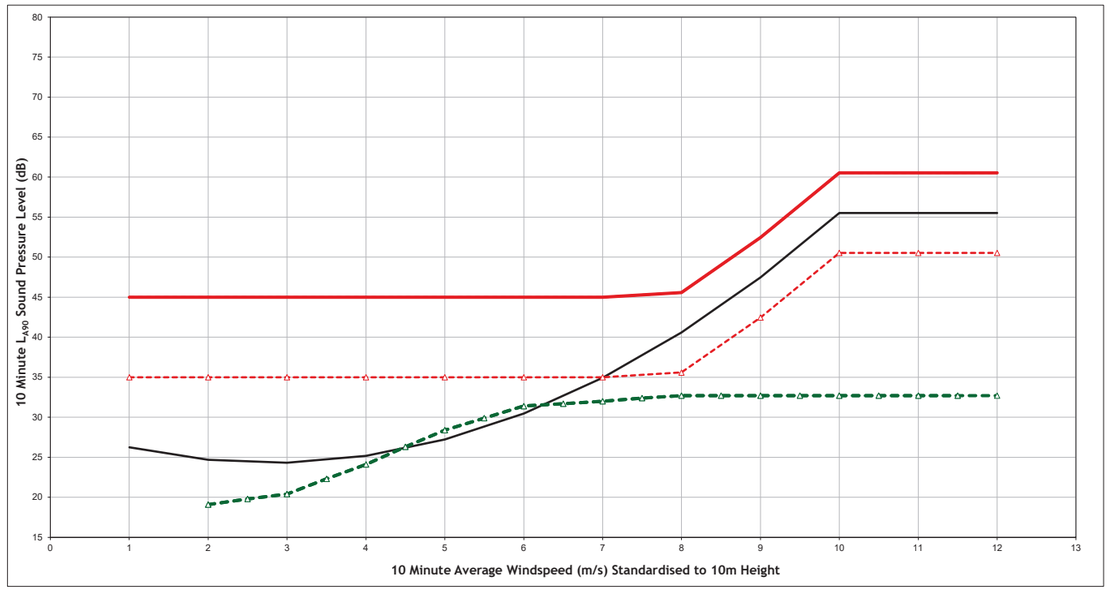
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Artfield (NAL1)
Figure Number	Figure A1.3a
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

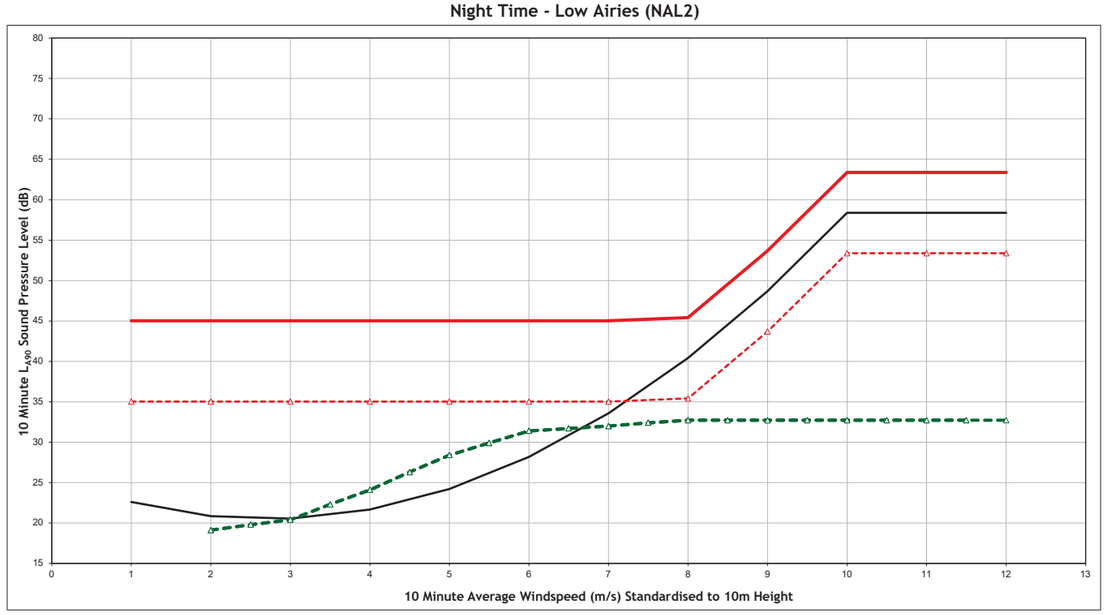
Statkraft

tnei

Quiet Daytime - Low Airies (NAL2)



Night Time - Low Airies (NAL2)



Legend:

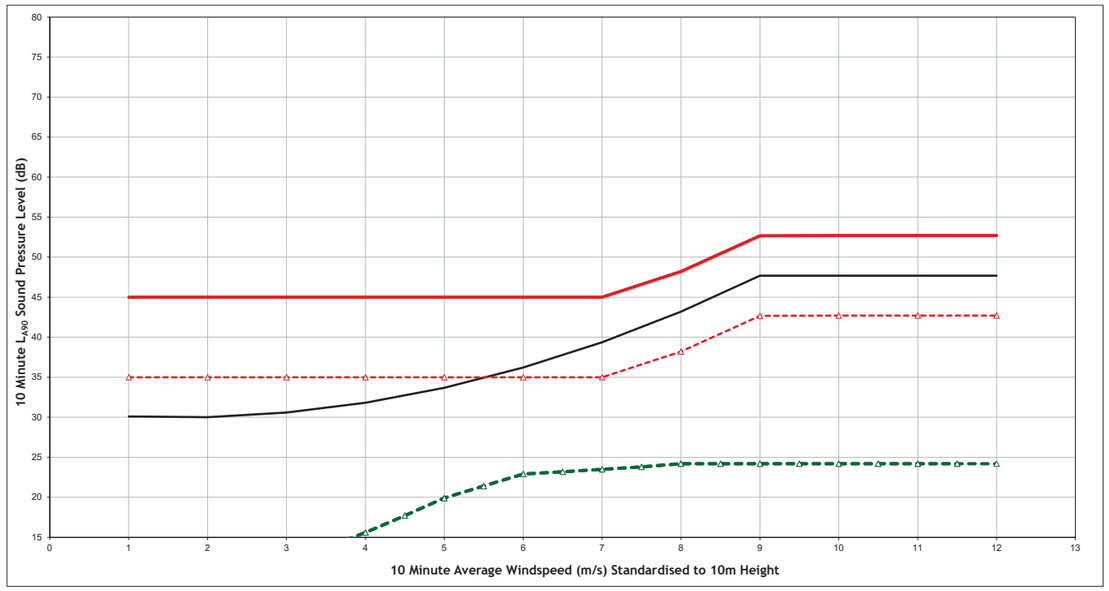
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Low Airies (NAL2)
Figure Number	Figure A1.3b
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

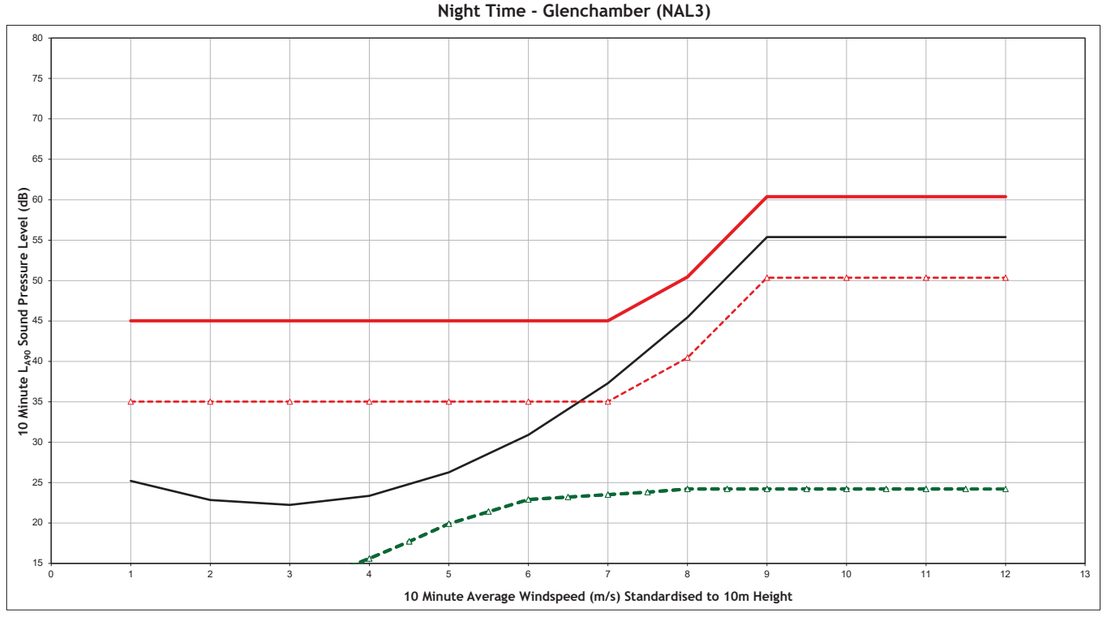
Statkraft

tnei

Quiet Daytime - Glenchamber (NAL3)



Night Time - Glenchamber (NAL3)

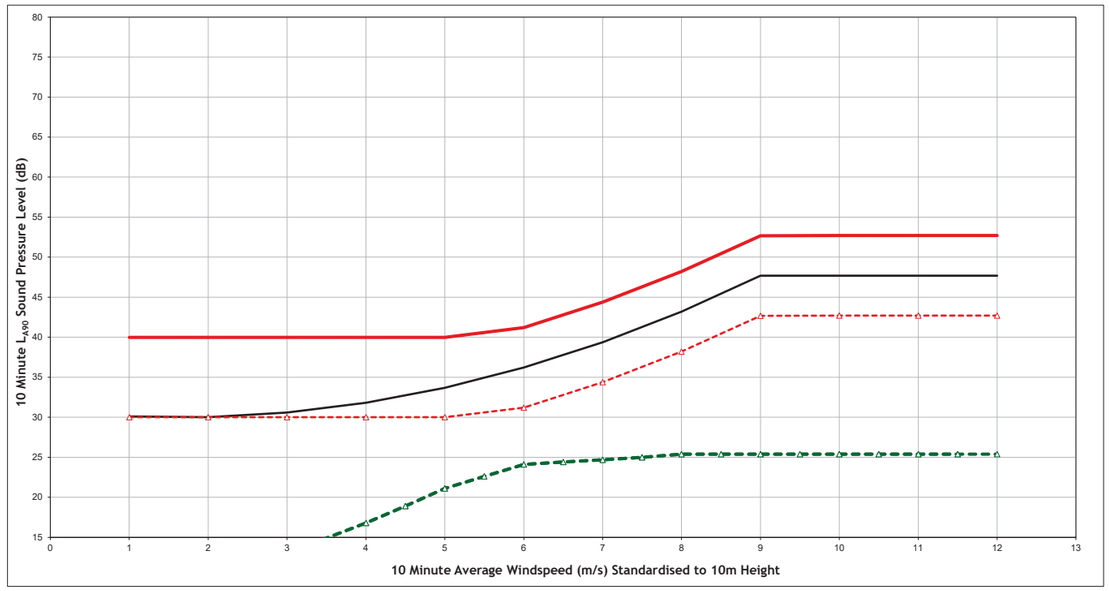


Legend:

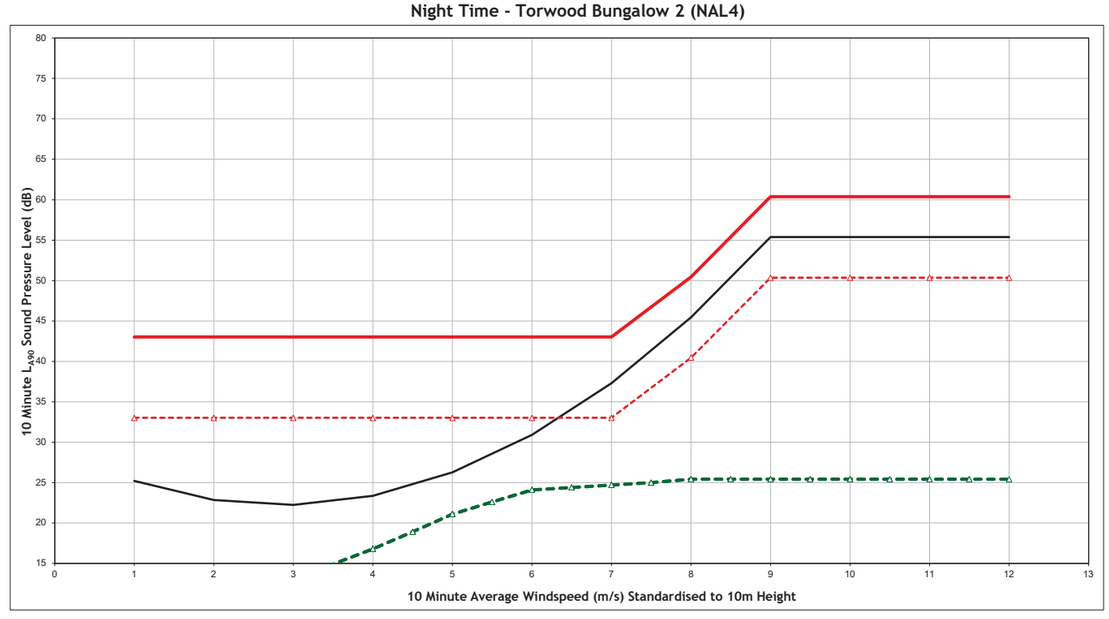
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Glenchamber (NAL3)
Figure Number	Figure A1.3c
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

Quiet Daytime - Torwood Bungalow 2 (NAL4)



Night Time - Torwood Bungalow 2 (NAL4)

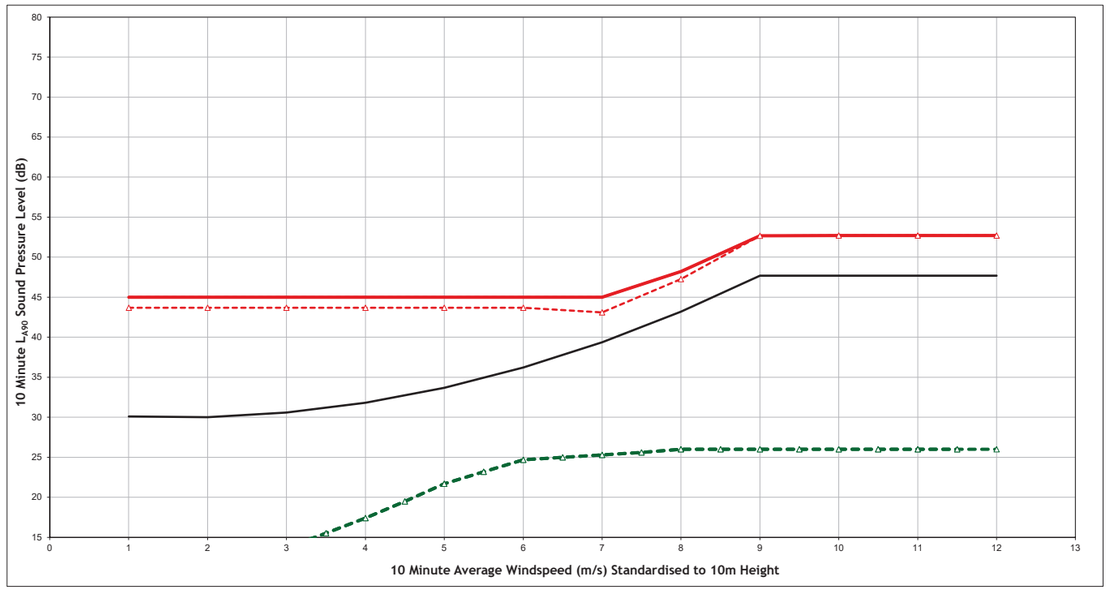


Legend:

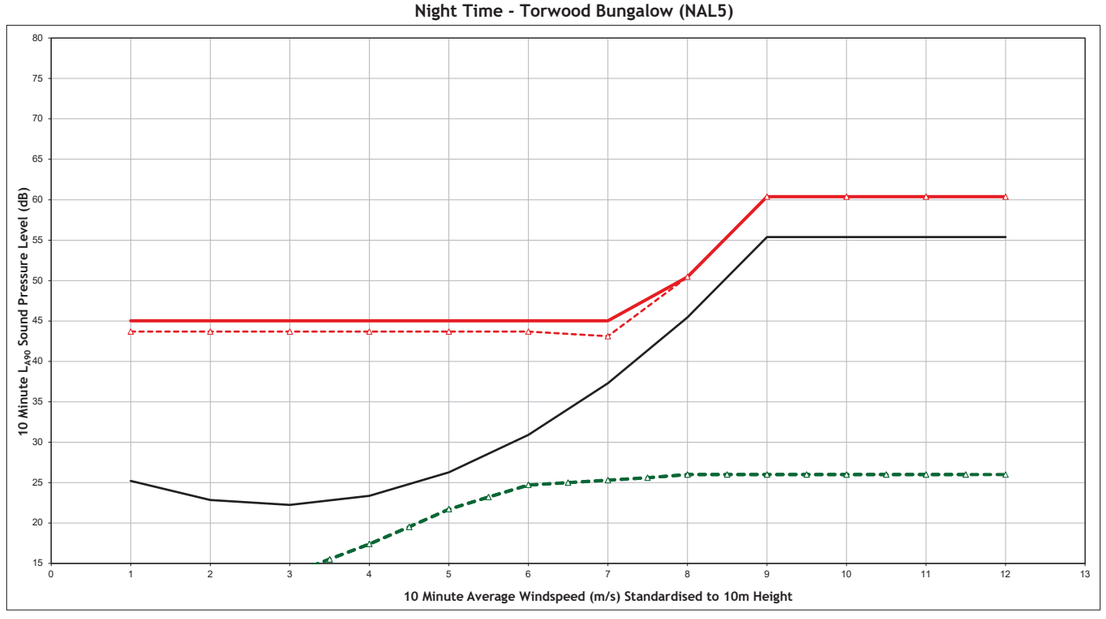
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Bungalow 2 (NAL4)
Figure Number	Figure A1.3d
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

Quiet Daytime - Torwood Bungalow (NAL5)



Night Time - Torwood Bungalow (NAL5)



Legend:

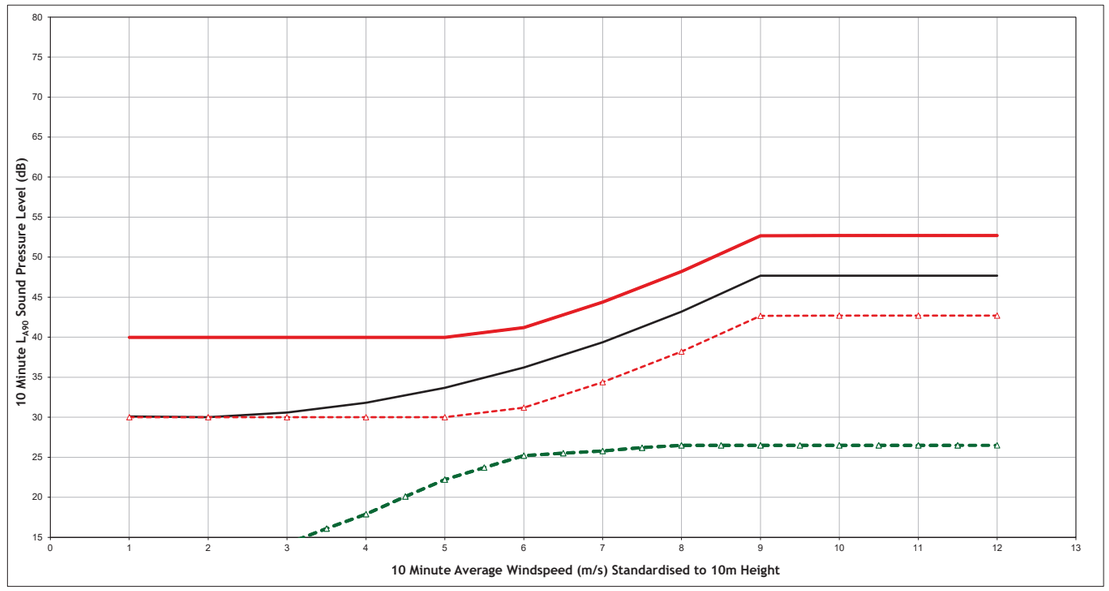
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Bungalow (NAL5)
Figure Number	Figure A1.3e
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

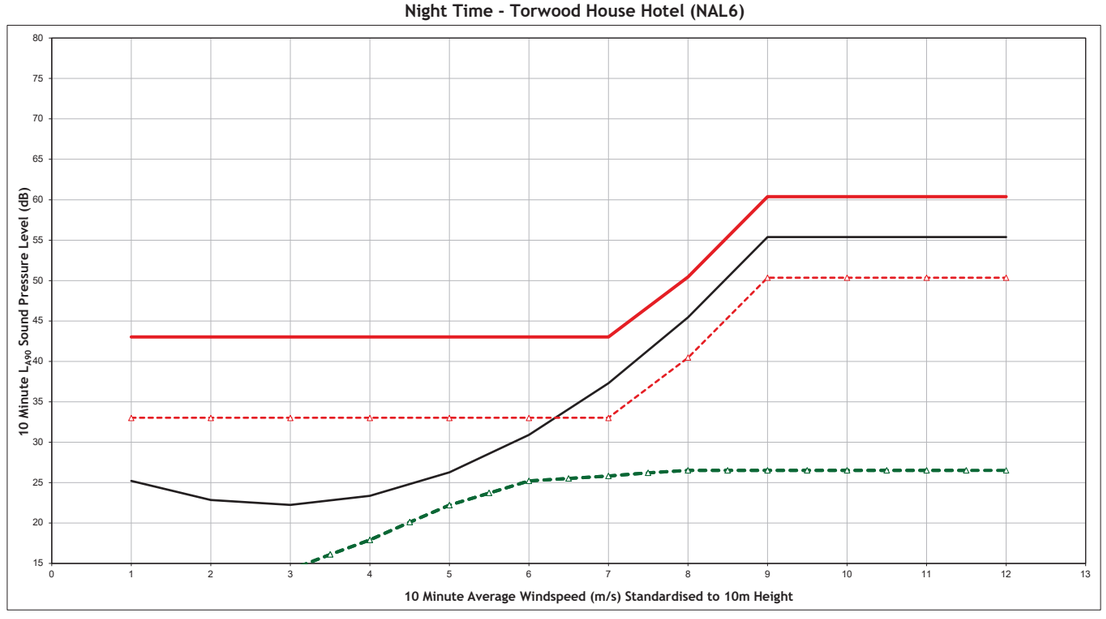
Statkraft

tnei

Quiet Daytime - Torwood House Hotel (NAL6)



Night Time - Torwood House Hotel (NAL6)



Legend:

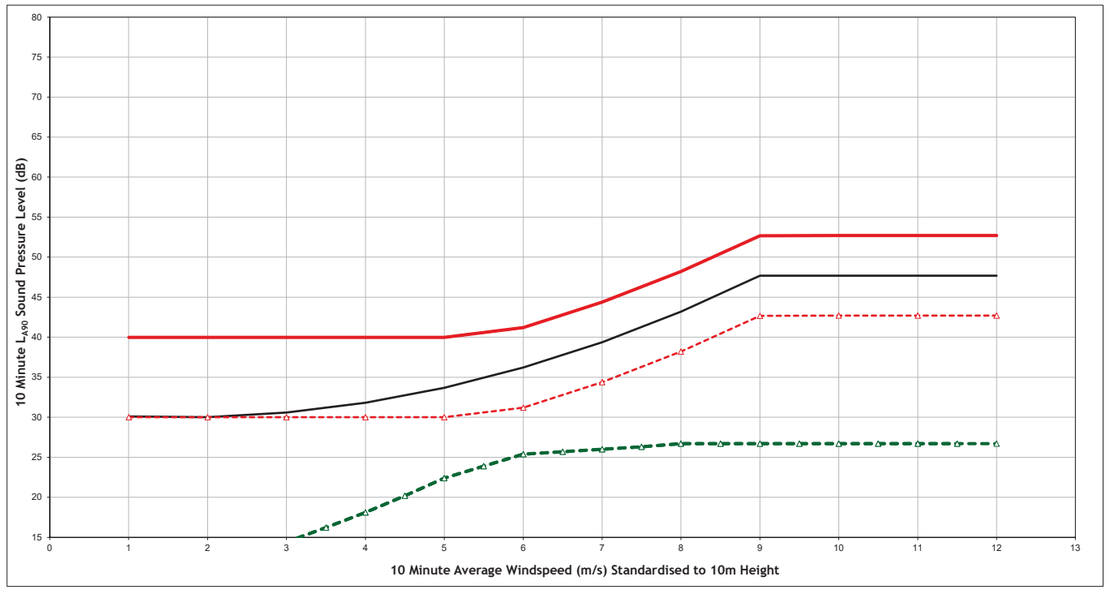
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood House Hotel (NAL6)
Figure Number	Figure A1.3f
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

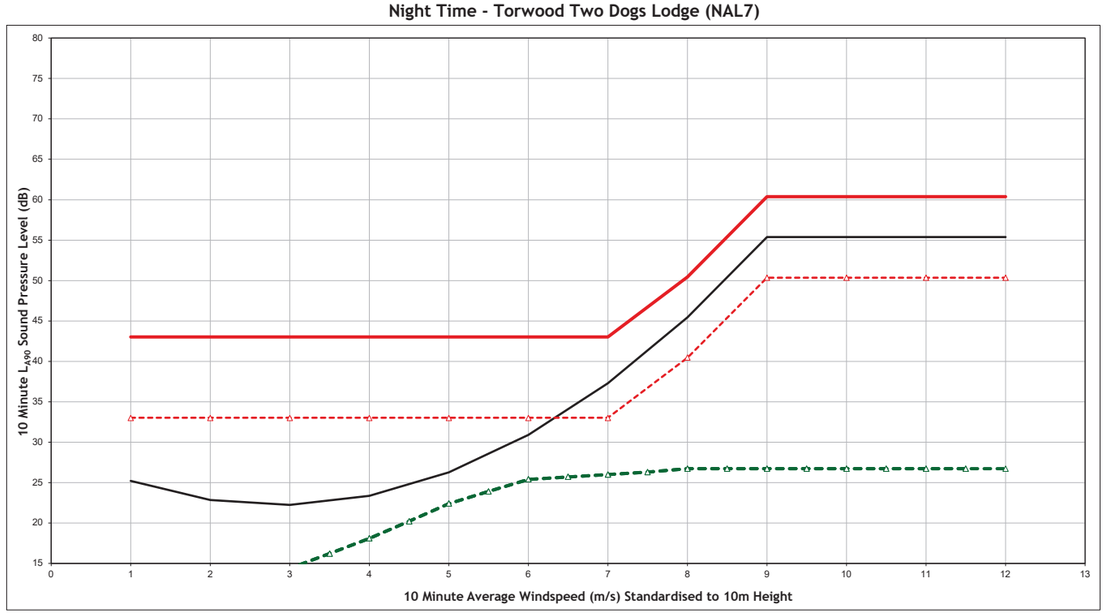
Statkraft

tnei

Quiet Daytime - Torwood Two Dogs Lodge (NAL7)



Night Time - Torwood Two Dogs Lodge (NAL7)

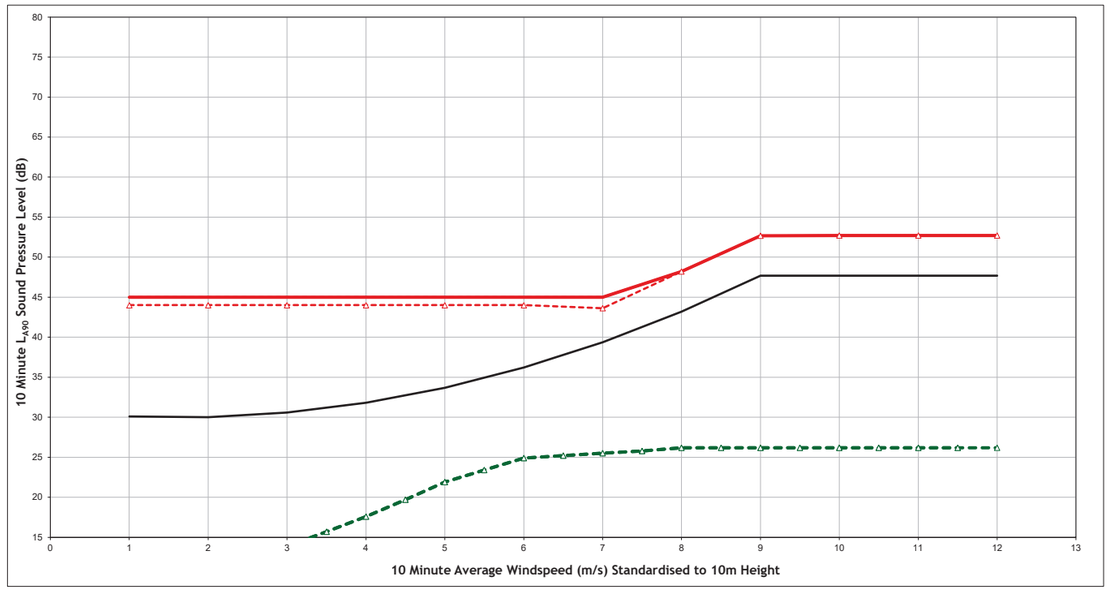


Legend:

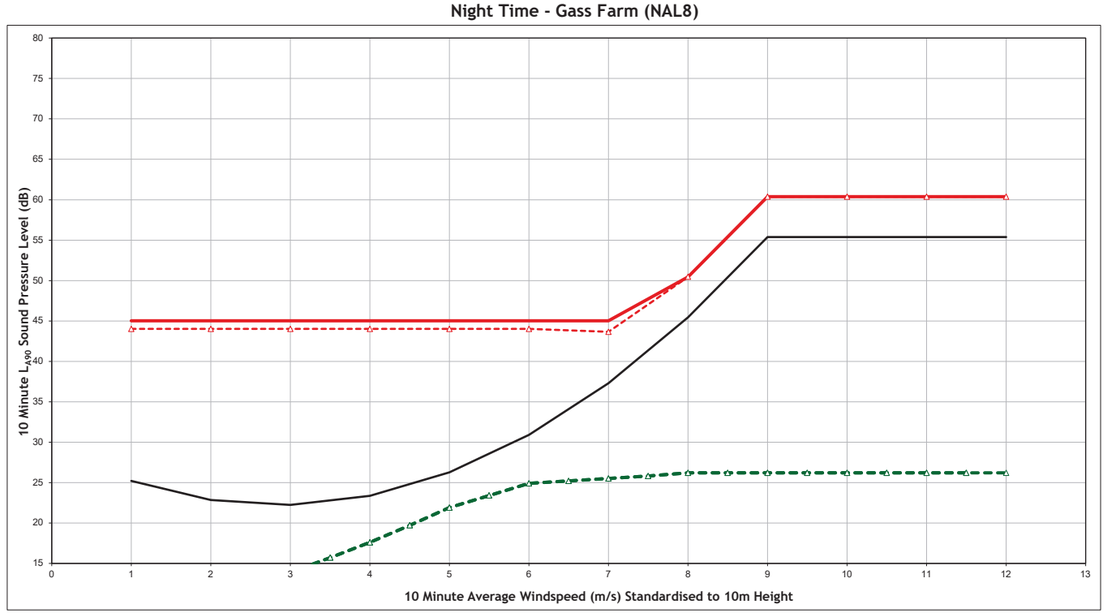
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment
	Torwood Two Dogs Lodge (NAL7)
Figure Number	Figure A1.3g
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

Quiet Daytime - Gass Farm (NAL8)



Night Time - Gass Farm (NAL8)

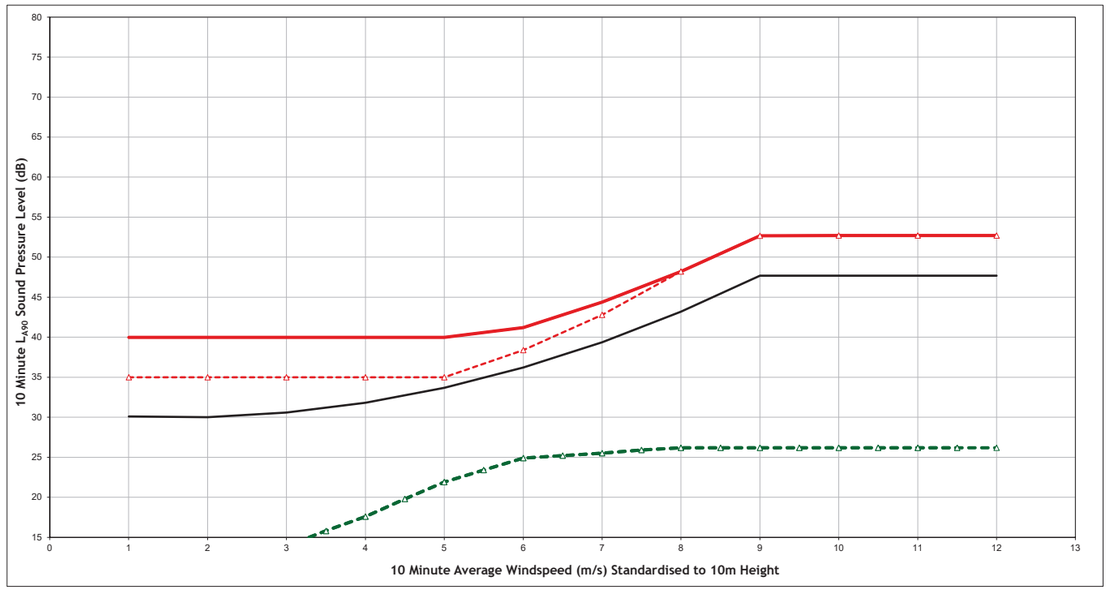


Legend:

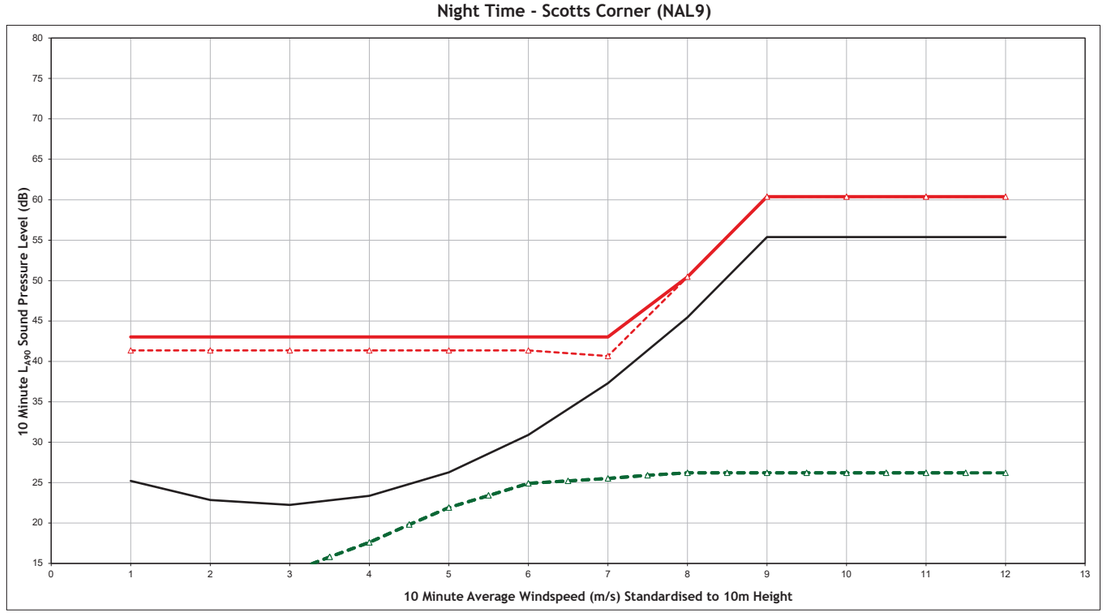
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment
	Gass Farm (NAL8)
Figure Number	Figure A1.3h
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

Quiet Daytime - Scotts Corner (NAL9)



Night Time - Scotts Corner (NAL9)



Legend:

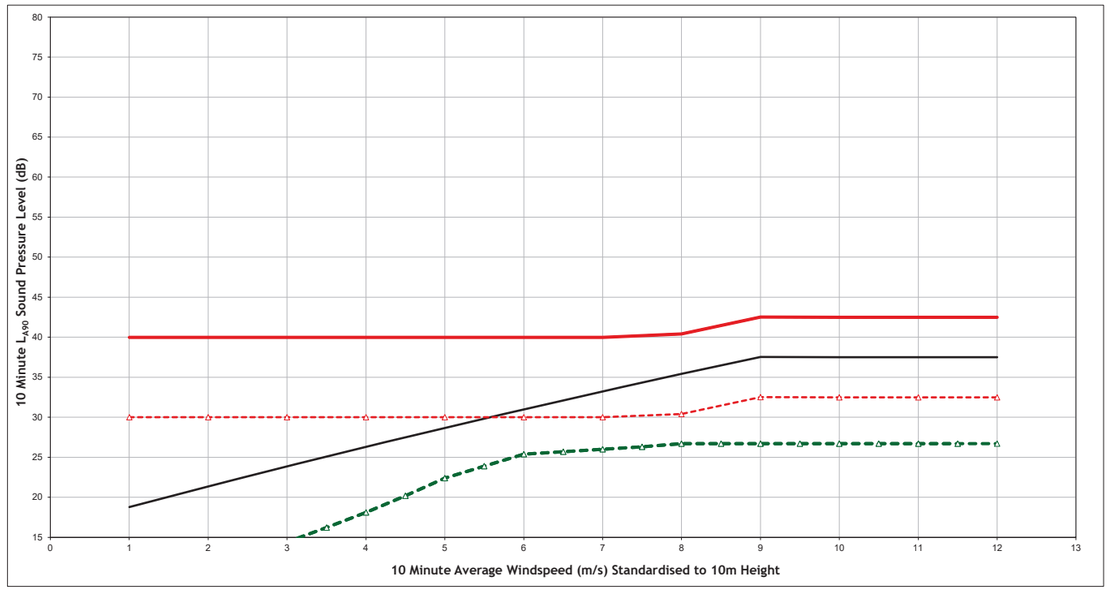
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Scotts Corner (NAL9)
Figure Number	Figure A1.3i
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

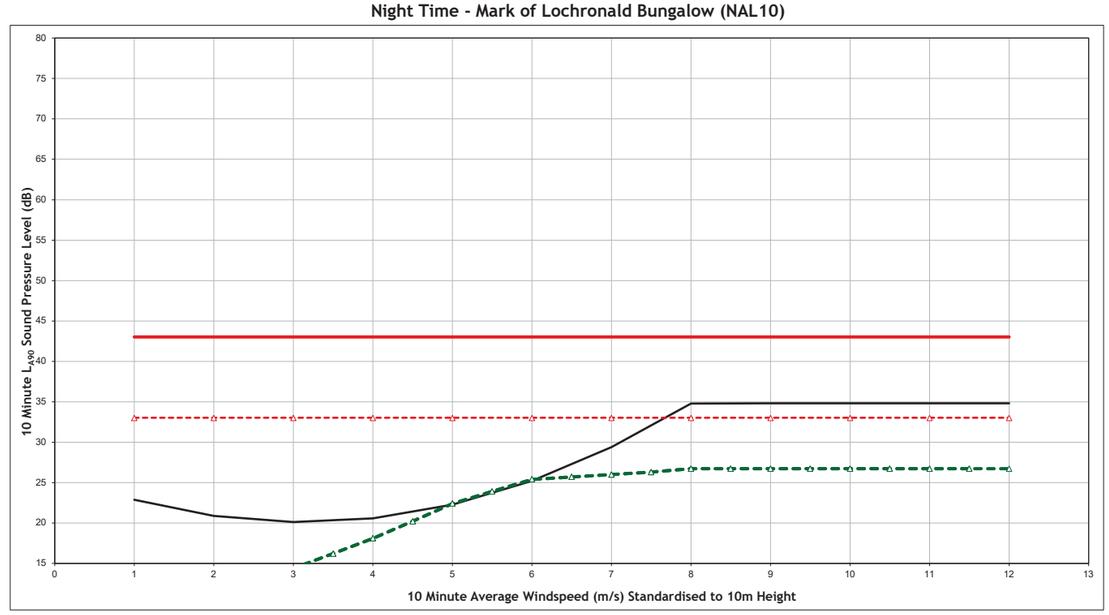
Statkraft

tnei

Quiet Daytime - Mark of Lochronald Bungalow (NAL10)



Night Time - Mark of Lochronald Bungalow (NAL10)



Legend:

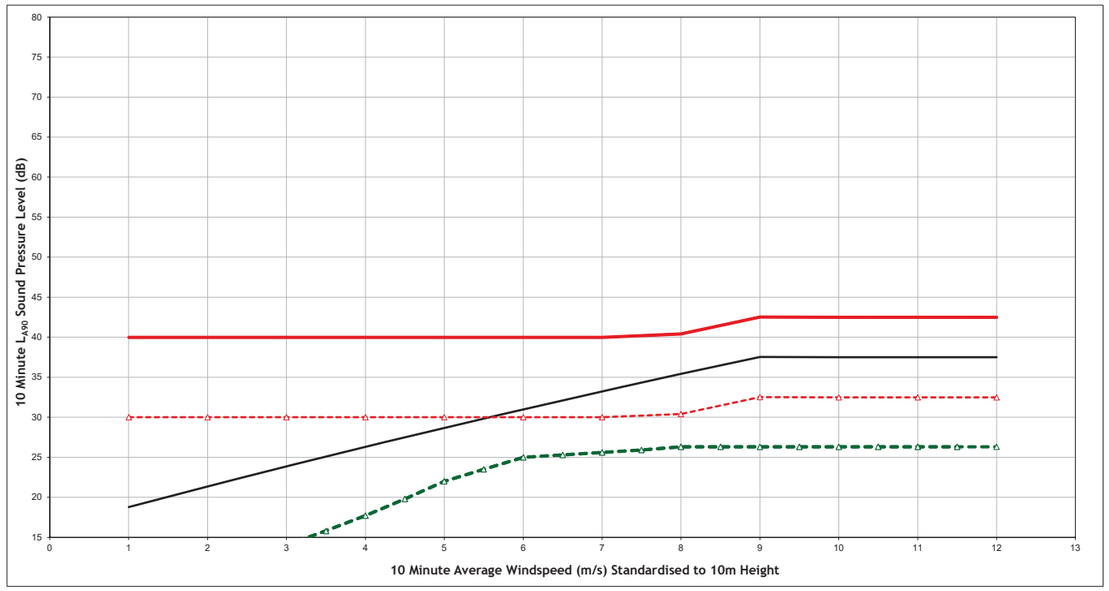
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Mark of Lochronald Bungalow (NAL10)
Figure Number	Figure A1.3j
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

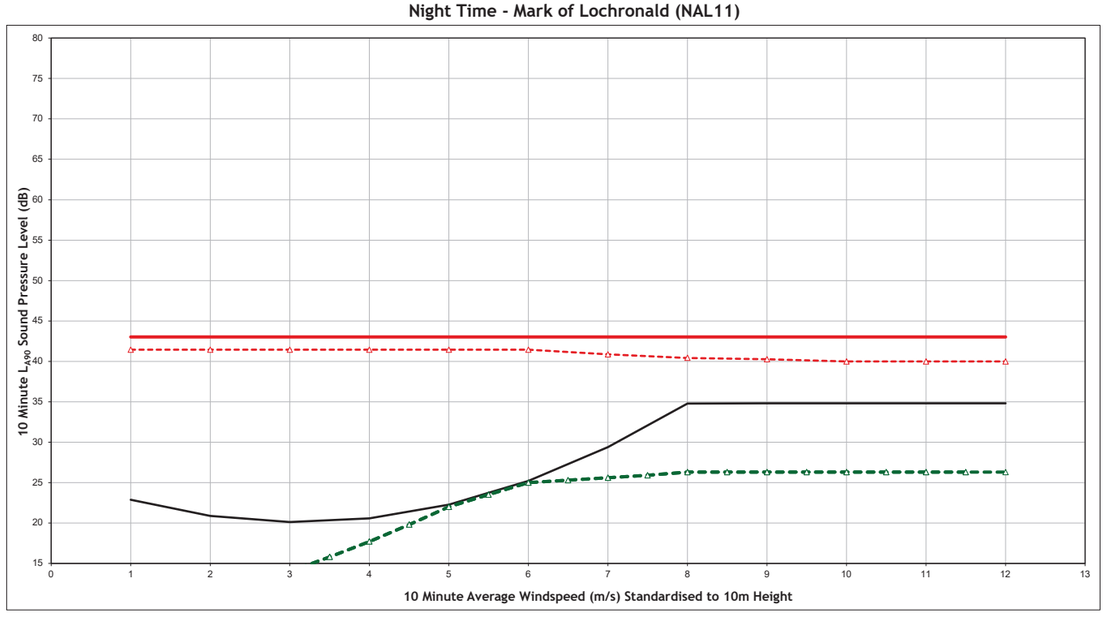
Statkraft

tnei

Quiet Daytime - Mark of Lochronald (NAL11)



Night Time - Mark of Lochronald (NAL11)



Legend:

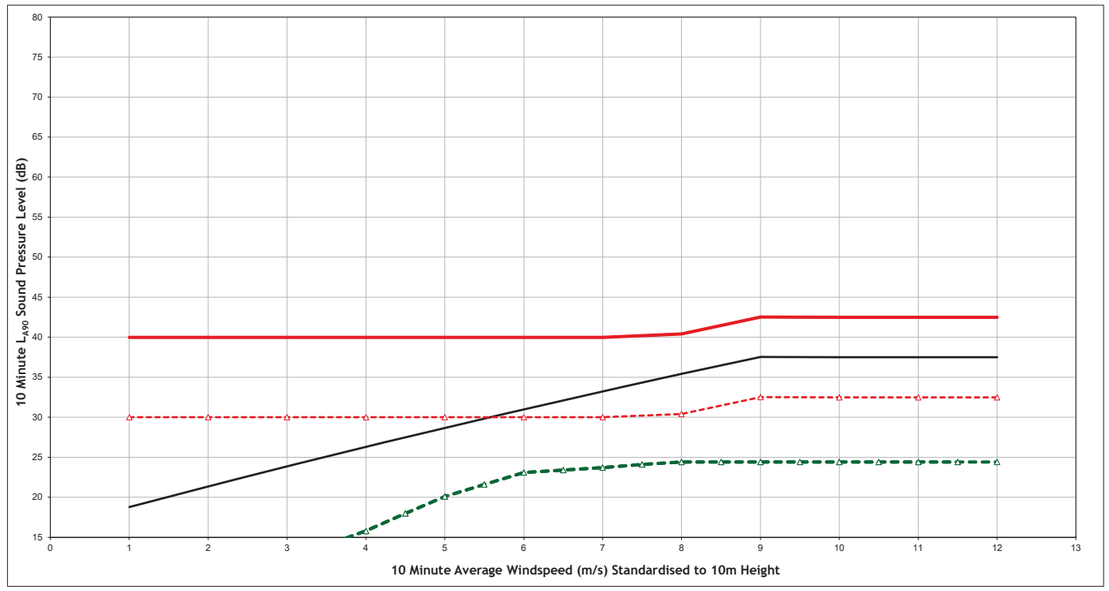
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Mark of Lochronald (NAL11)
Figure Number	Figure A1.3k
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

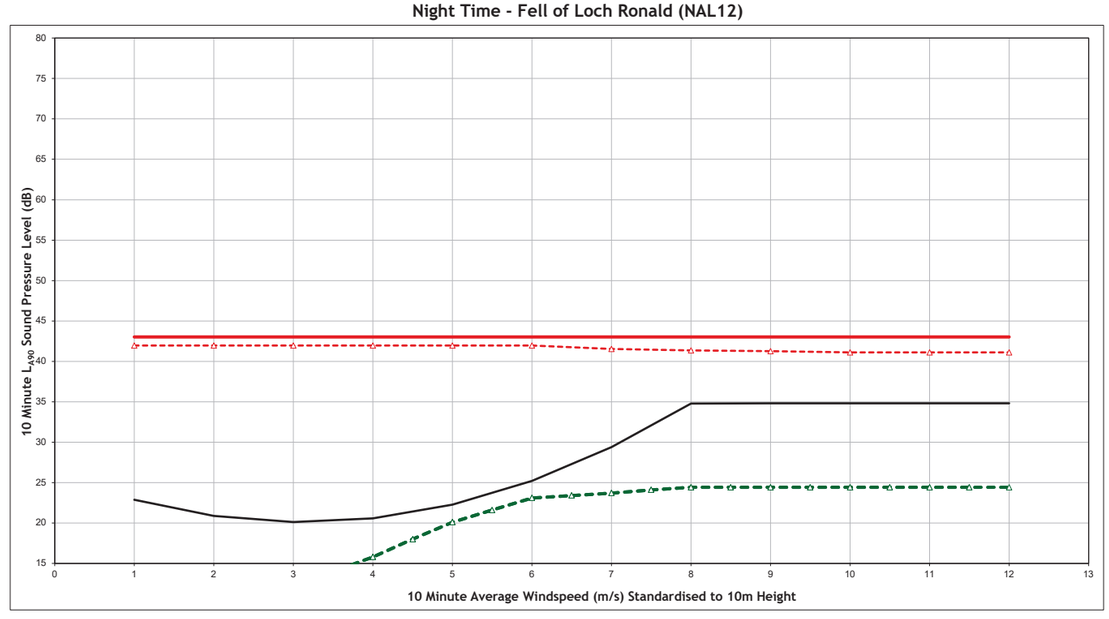
Statkraft

tnei

Quiet Daytime - Fell of Loch Ronald (NAL12)



Night Time - Fell of Loch Ronald (NAL12)



Legend:

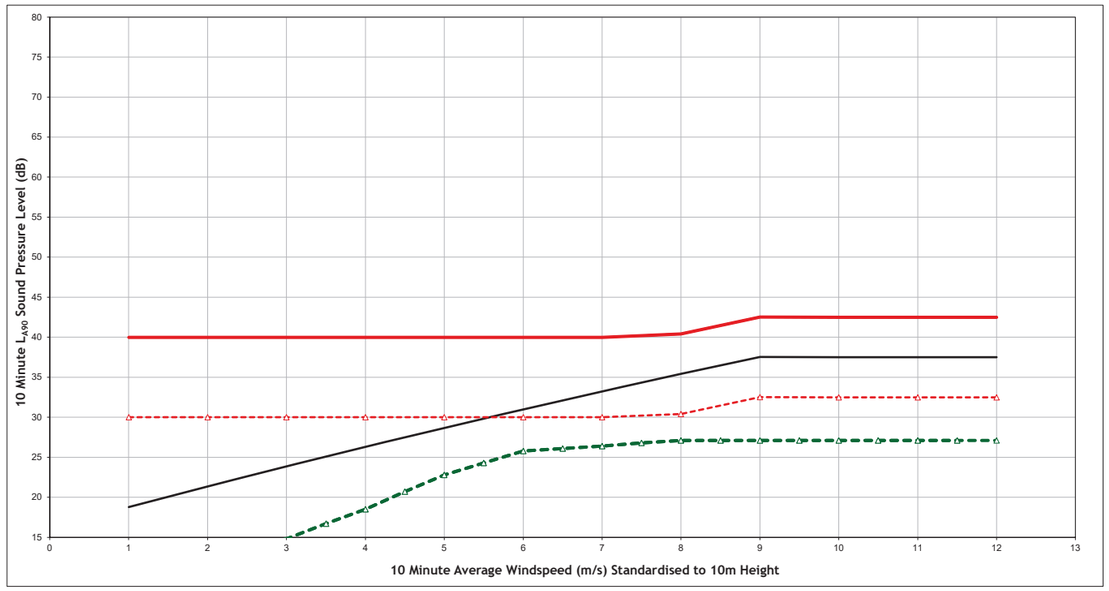
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Fell of Loch Ronald (NAL12)
Figure Number	Figure A1.3l
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

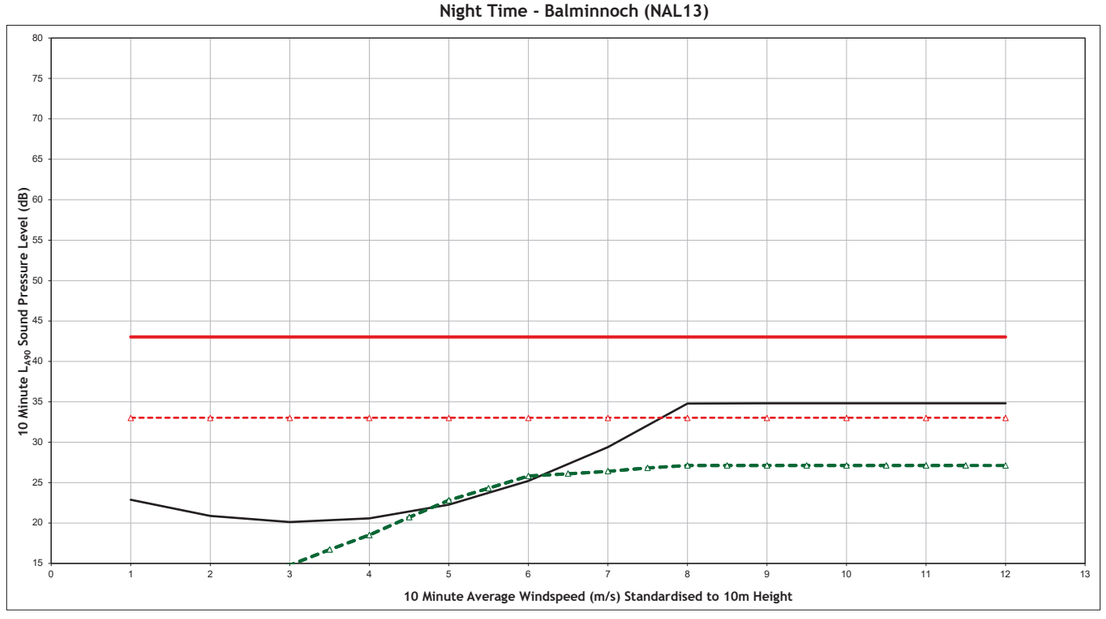
Statkraft

tnei

Quiet Daytime - Balminnoch (NAL13)



Night Time - Balminnoch (NAL13)



Legend:

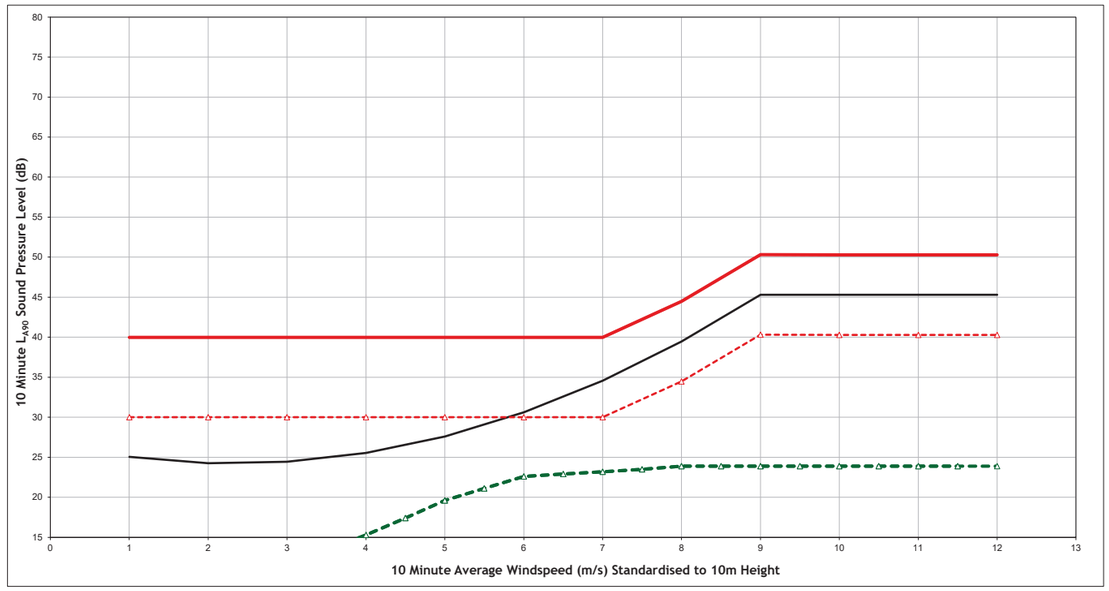
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Balminnoch (NAL13)
Figure Number	Figure A1.3m
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

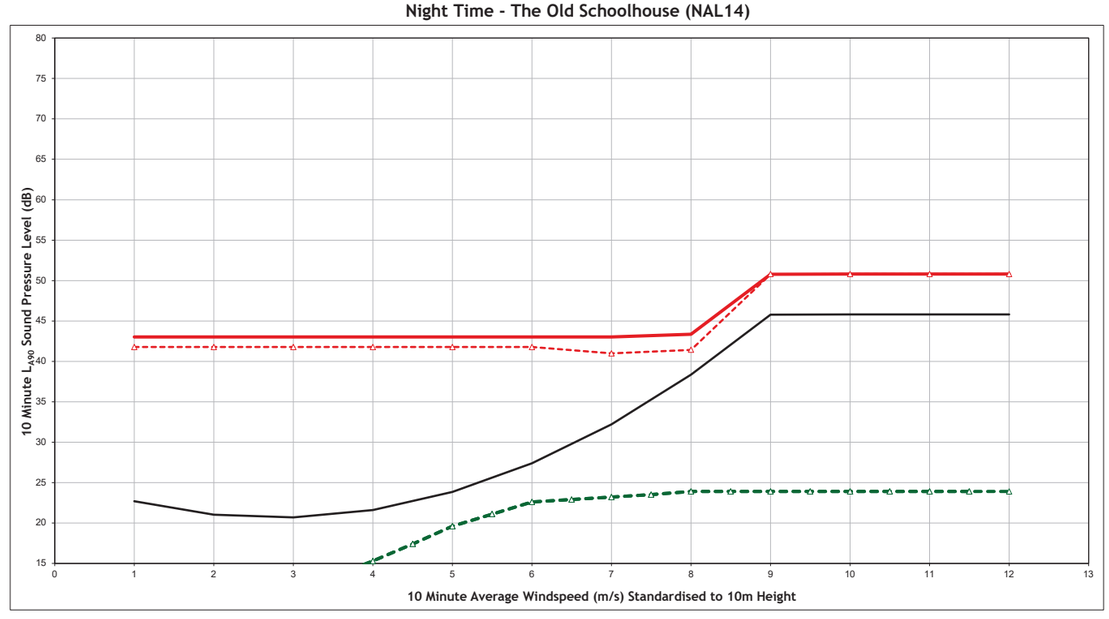
Statkraft

tnei

Quiet Daytime - The Old Schoolhouse (NAL14)



Night Time - The Old Schoolhouse (NAL14)



Legend:

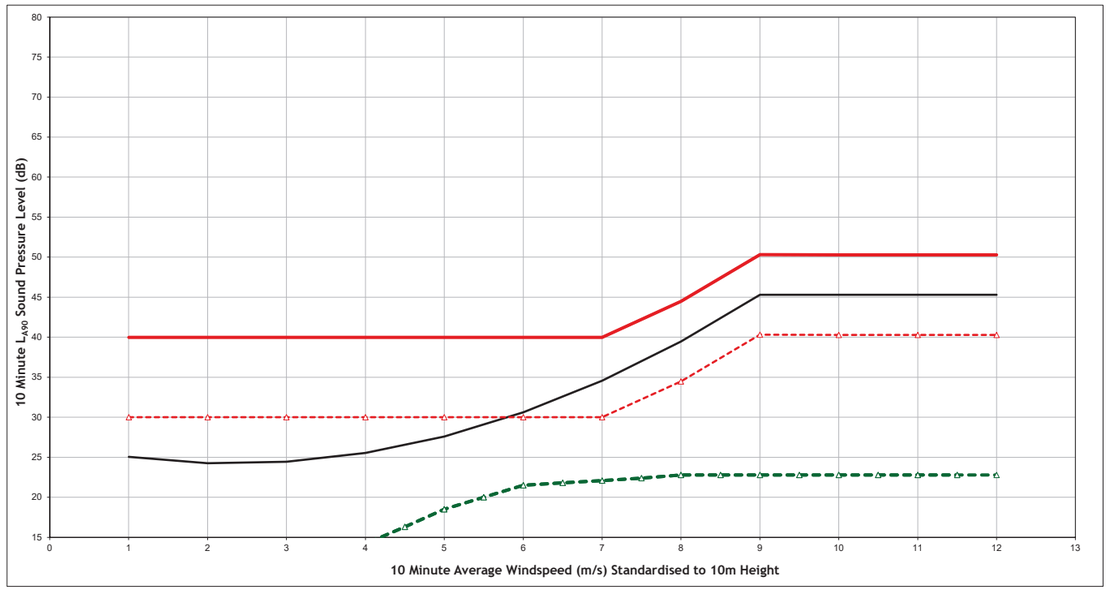
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment The Old Schoolhouse (NAL14)
Figure Number	Figure A1.3n
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

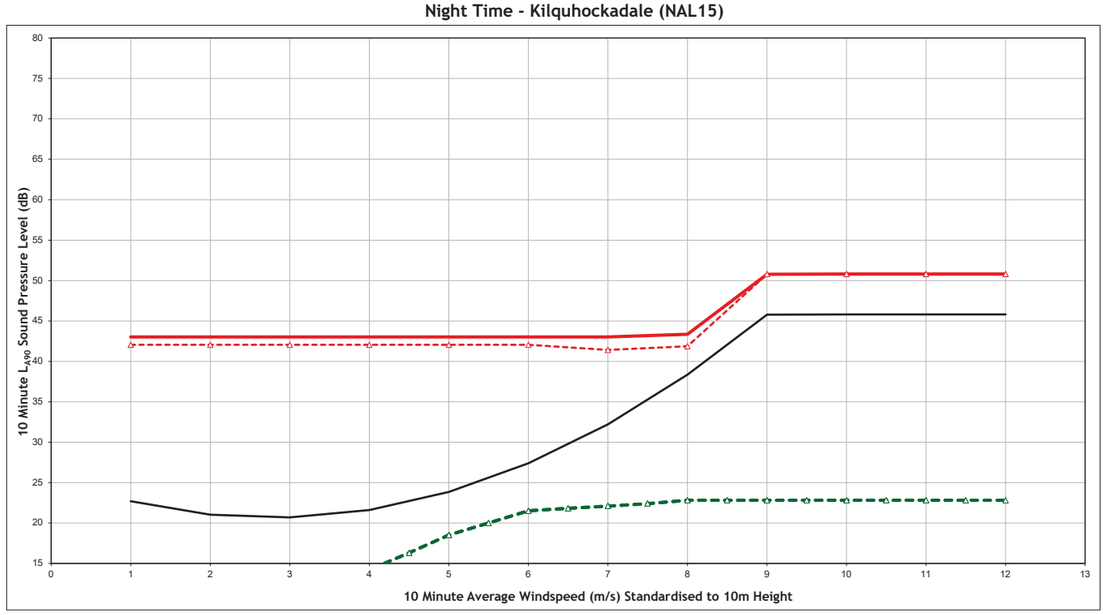
Statkraft

tnei

Quiet Daytime - Kilquhockadale (NAL15)



Night Time - Kilquhockadale (NAL15)



Legend:

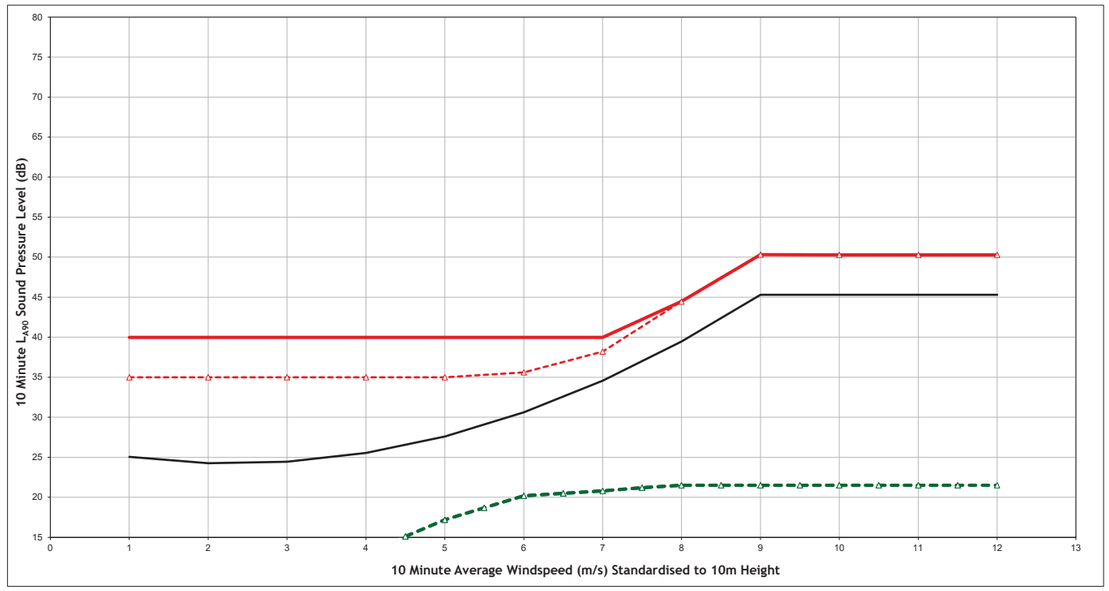
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Kilquhockadale (NAL15)
Figure Number	Figure A1.3o
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

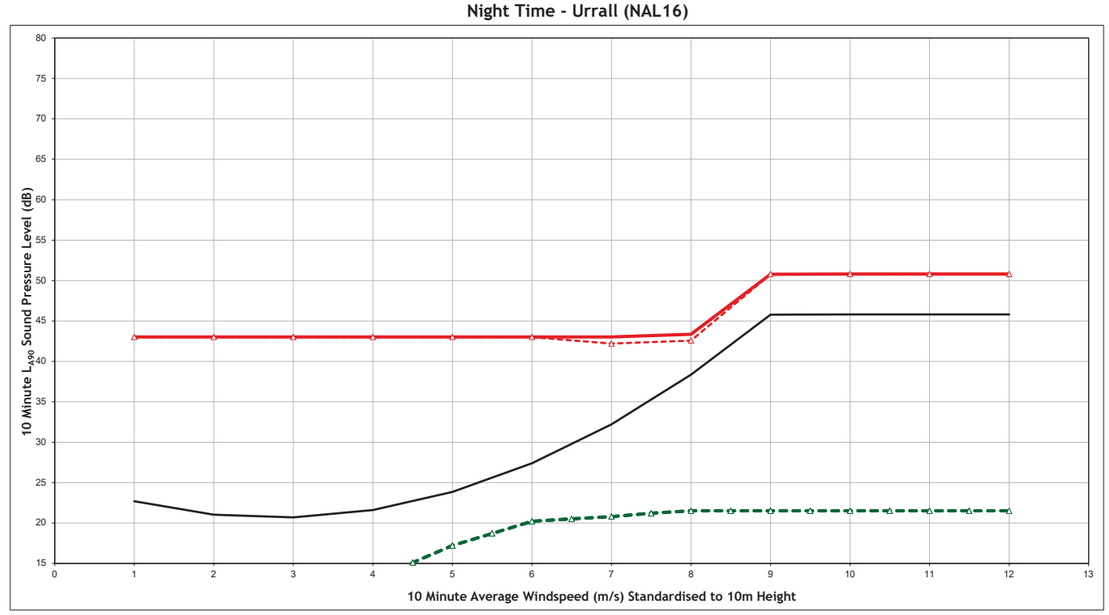
Statkraft

tnei

Quiet Daytime - Urrall (NAL16)



Night Time - Urrall (NAL16)



Legend:

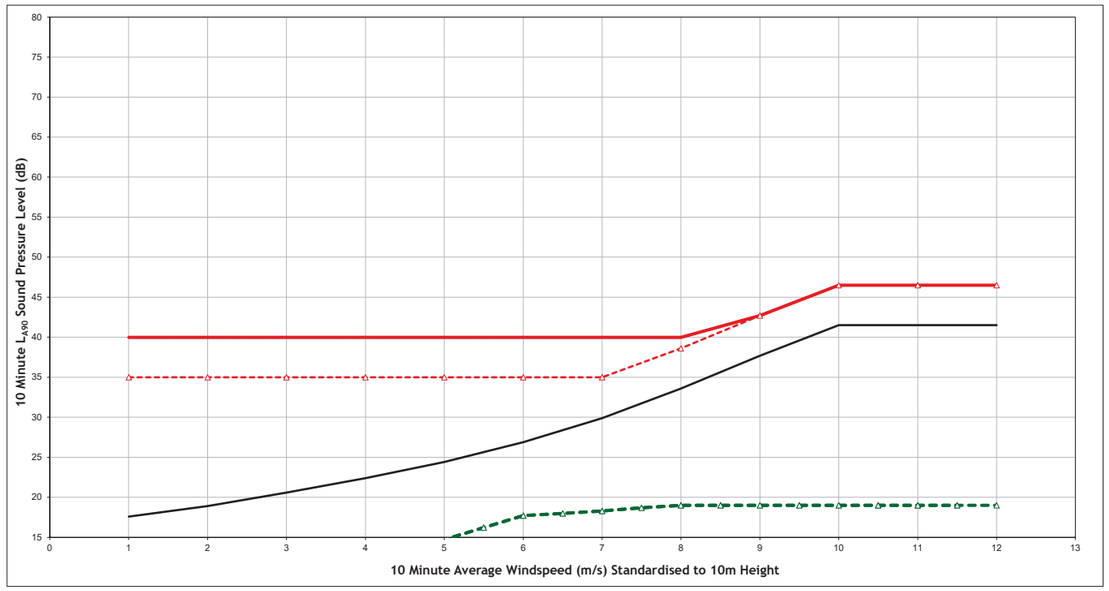
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Urrall (NAL16)
Figure Number	Figure A1.3p
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

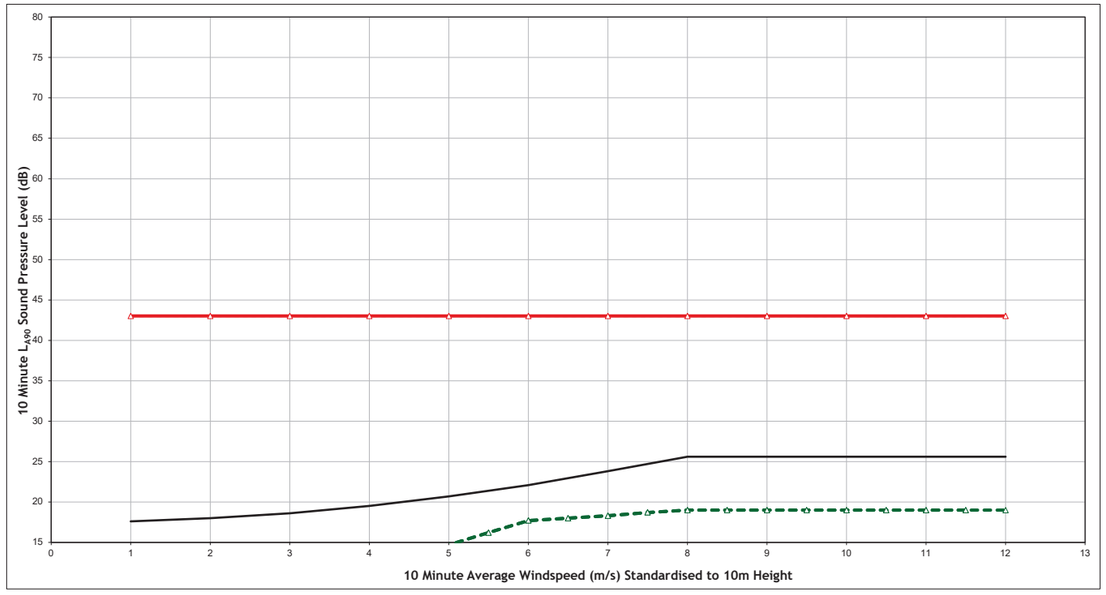
Statkraft

tnei

Quiet Daytime - Tannielaggie (NAL17)



Night Time - Tannielaggie (NAL17)



Legend:

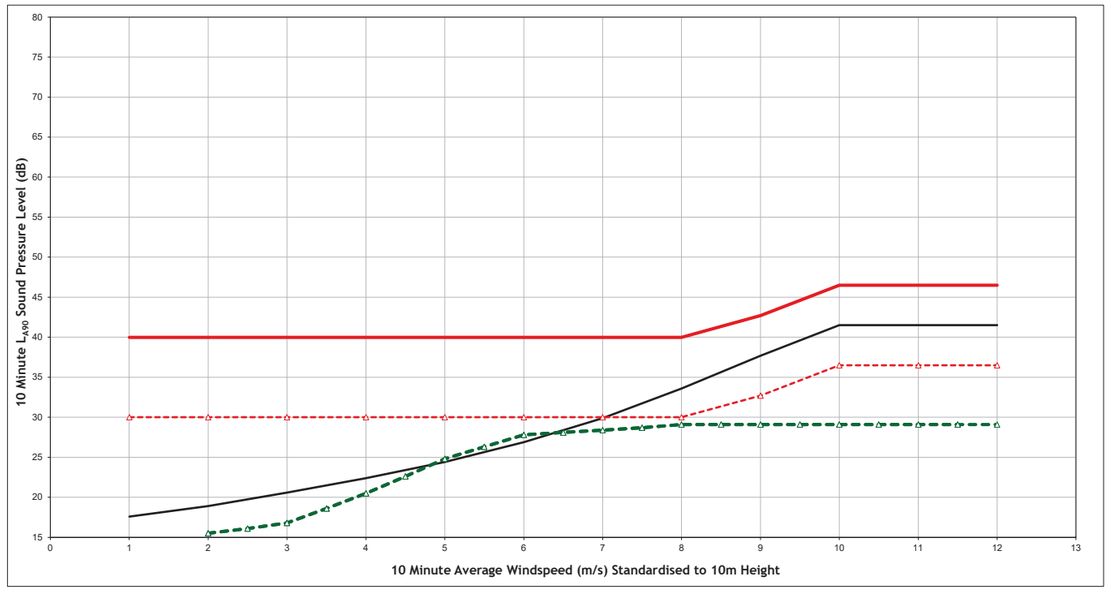
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Tannielaggie (NAL17)
Figure Number	Figure A1.3q
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

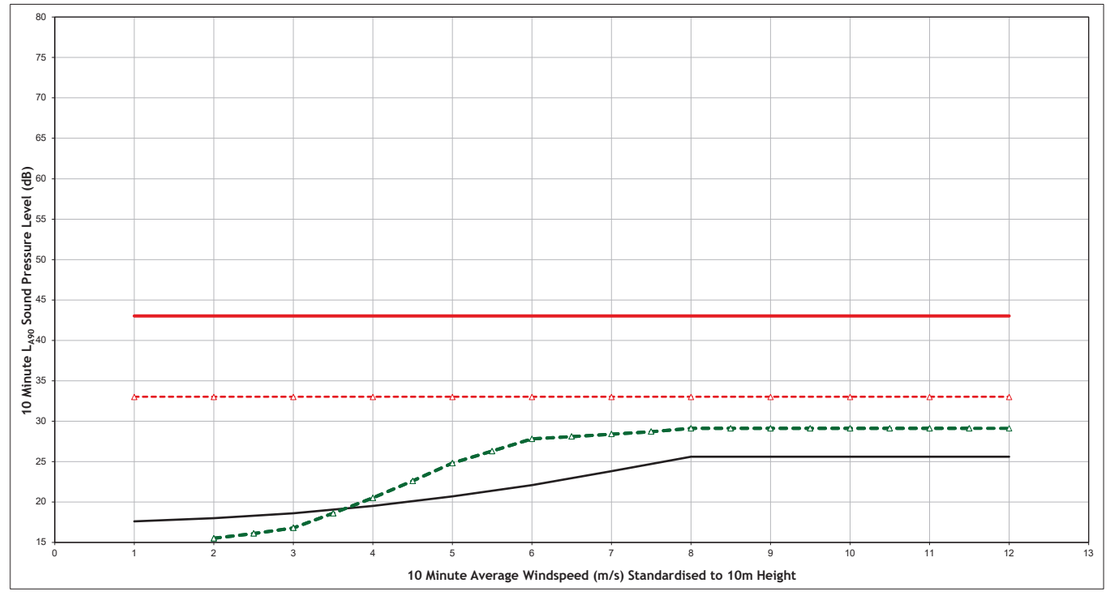
Statkraft

tnei

Quiet Daytime - Kilmacfadzean (NAL18)



Night Time - Kilmacfadzean (NAL18)



Legend:

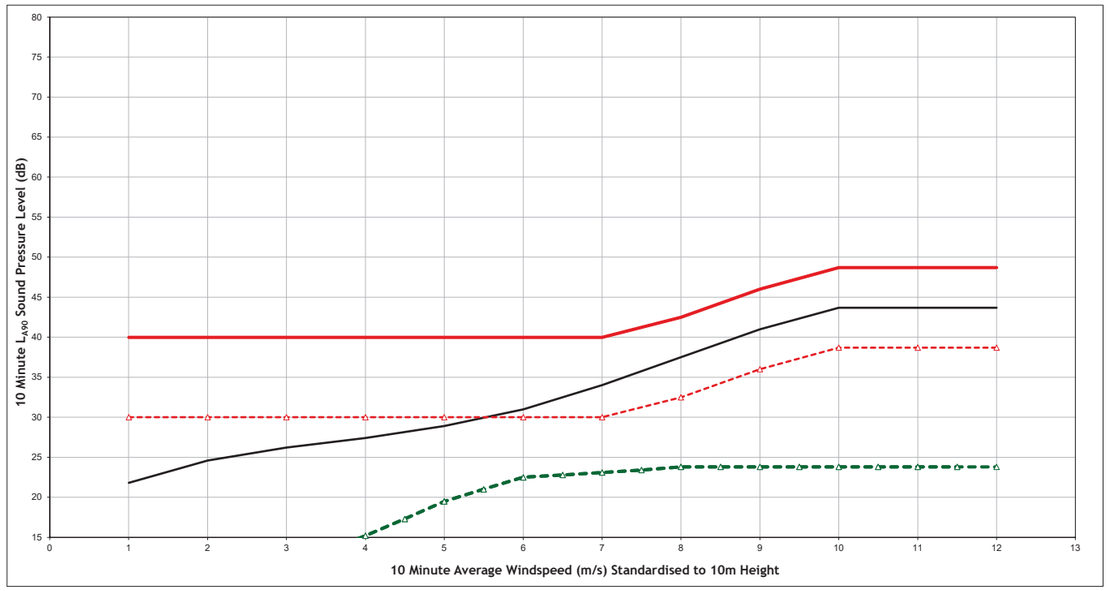
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Kilmacfadzean (NAL18)
Figure Number	Figure A1.3r
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

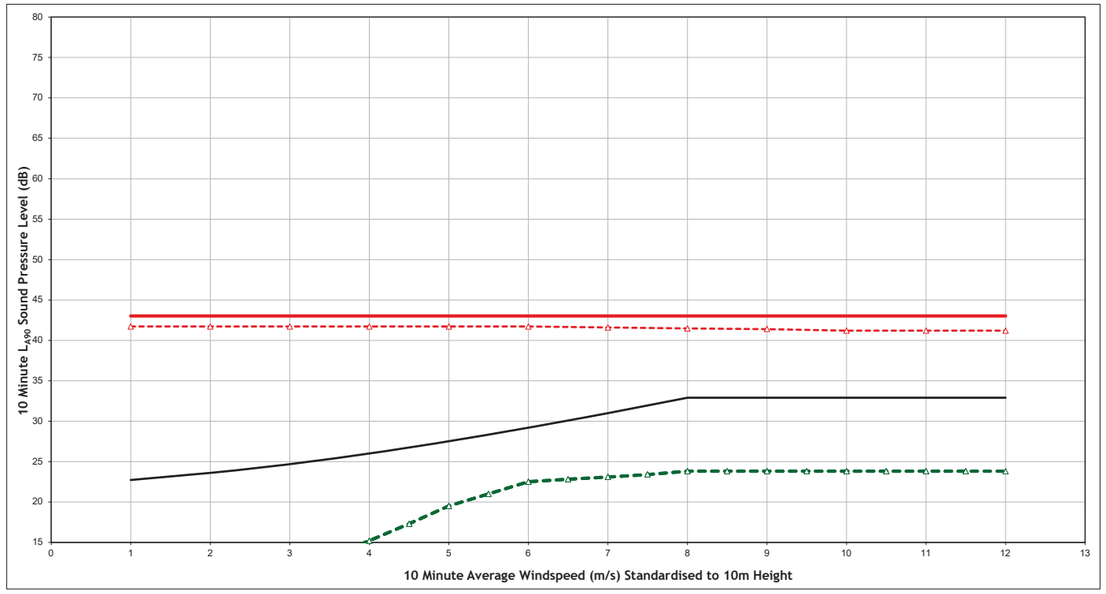
Statkraft

tnei

Quiet Daytime - Quarter Farm (NAL19)



Night Time - Quarter Farm (NAL19)



Legend:

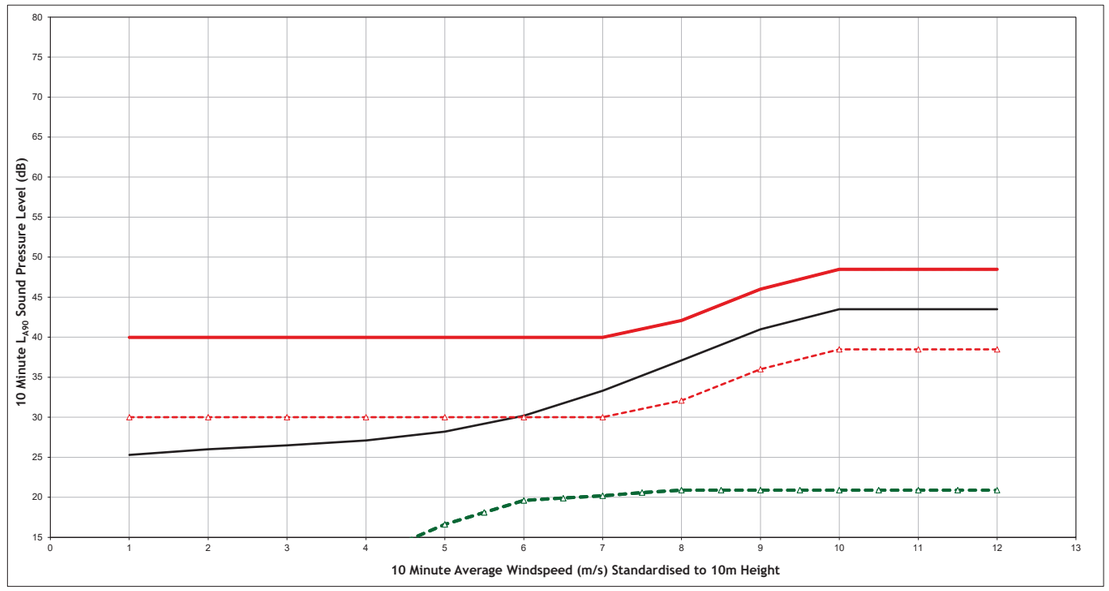
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Quarter Farm (NAL19)
Figure Number	Figure A1.3s
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

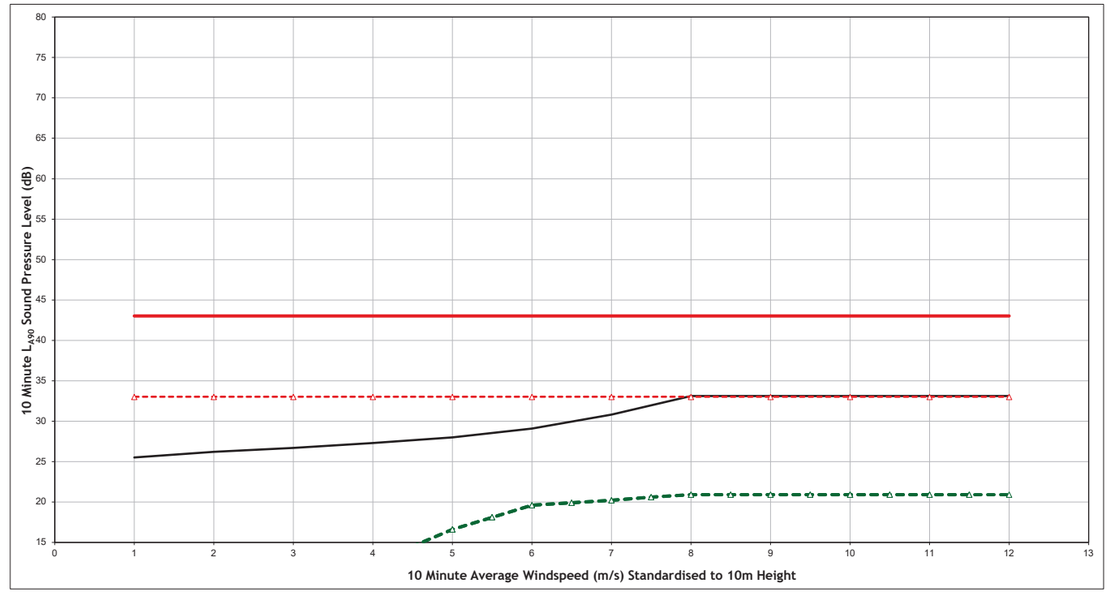
Statkraft

tnei

Quiet Daytime - Pultadie (NAL20)



Night Time - Pultadie (NAL20)



Legend:

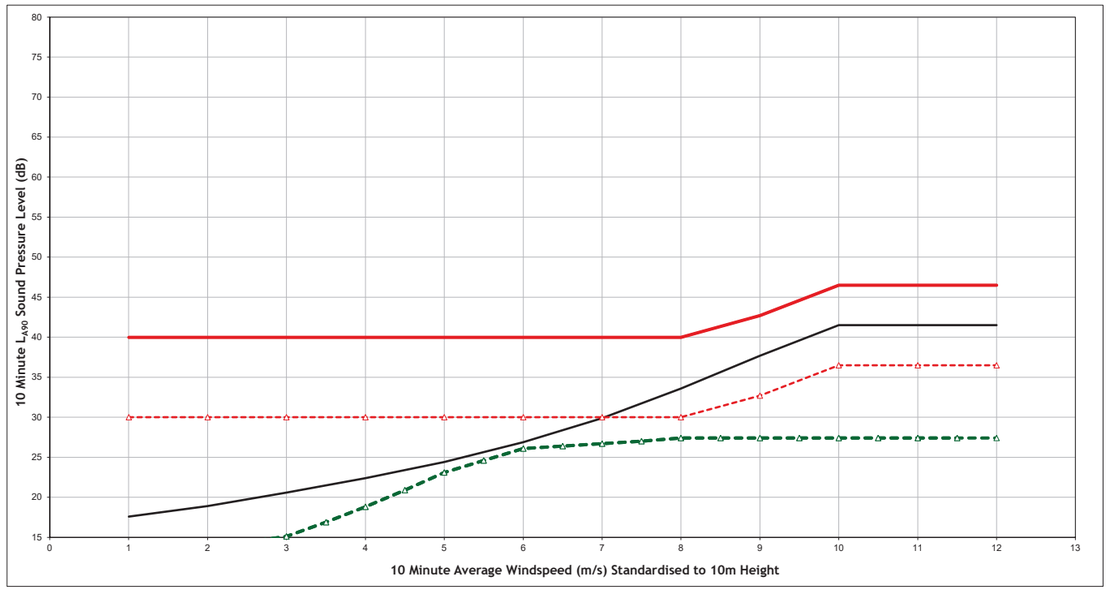
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Pultadie (NAL20)
Figure Number	Figure A1.3t
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

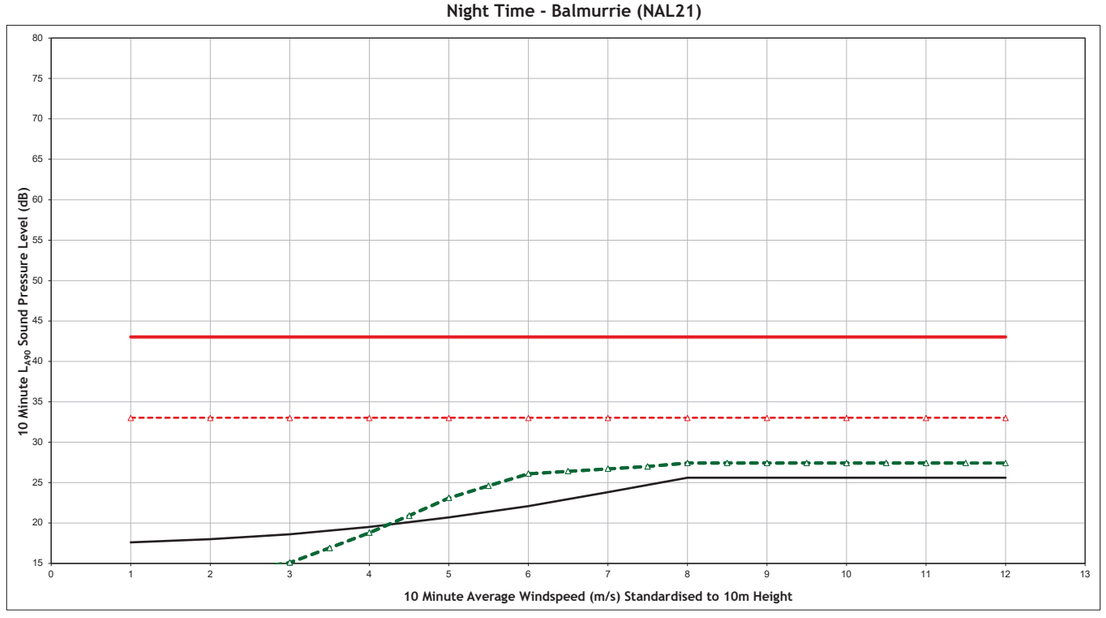
Statkraft

tnei

Quiet Daytime - Balmurrie (NAL21)



Night Time - Balmurrie (NAL21)



Legend:

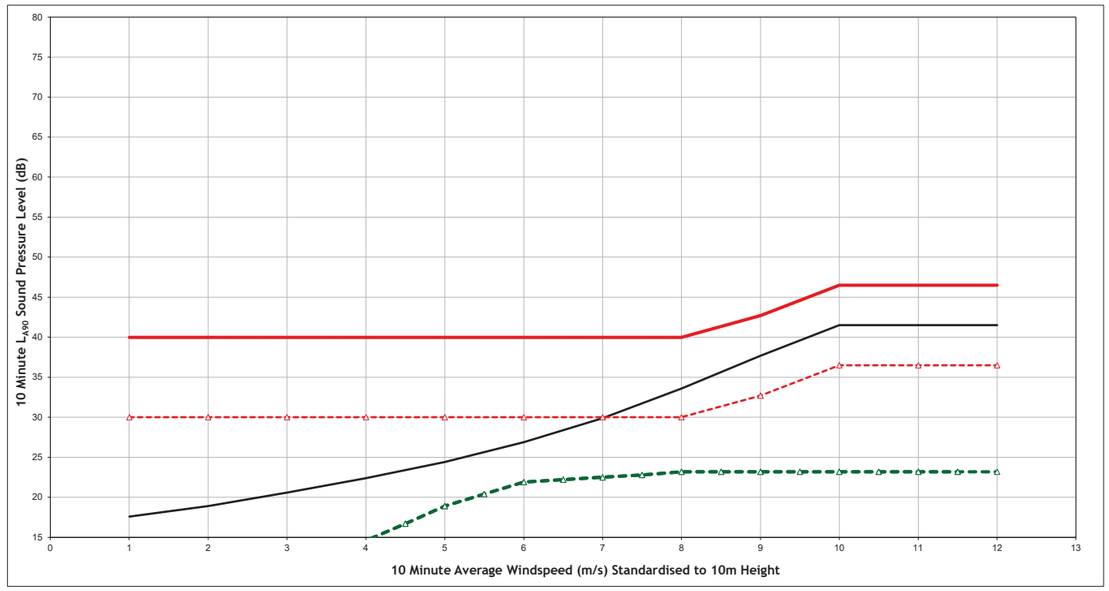
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Balmurrie (NAL21)
Figure Number	Figure A1.3u
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

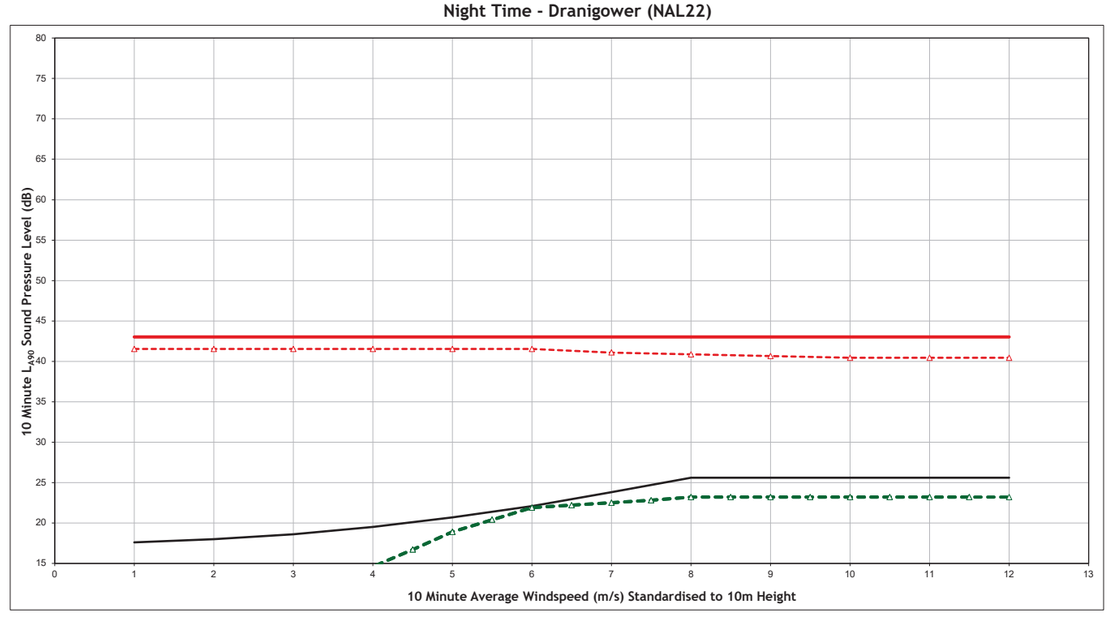
Statkraft

tnei

Quiet Daytime - Dranigower (NAL22)



Night Time - Dranigower (NAL22)



Legend:

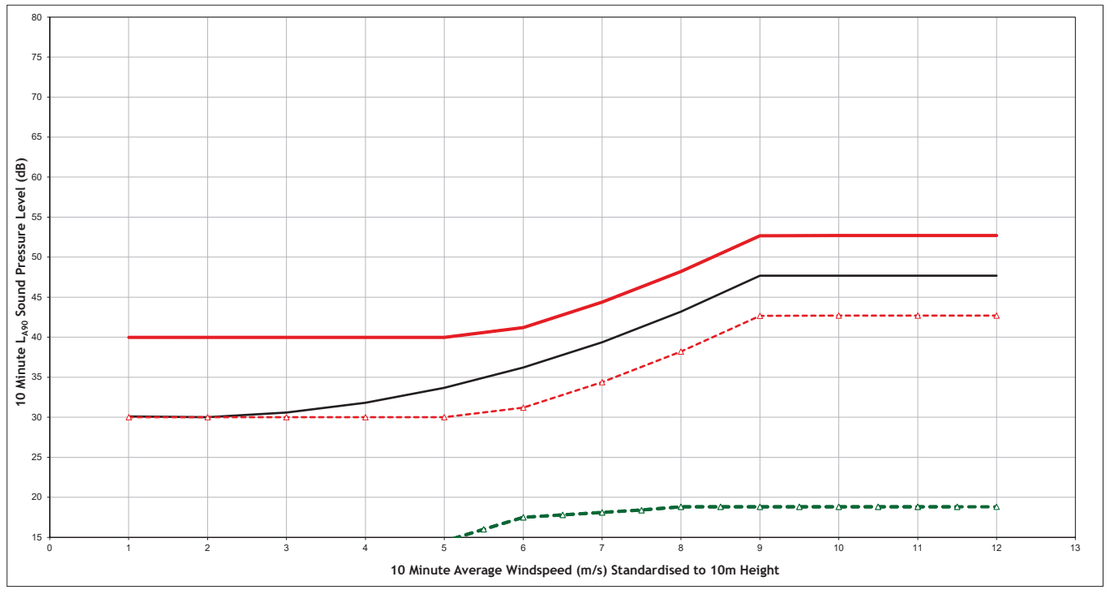
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Dranigower (NAL22)
Figure Number	Figure A1.3v
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

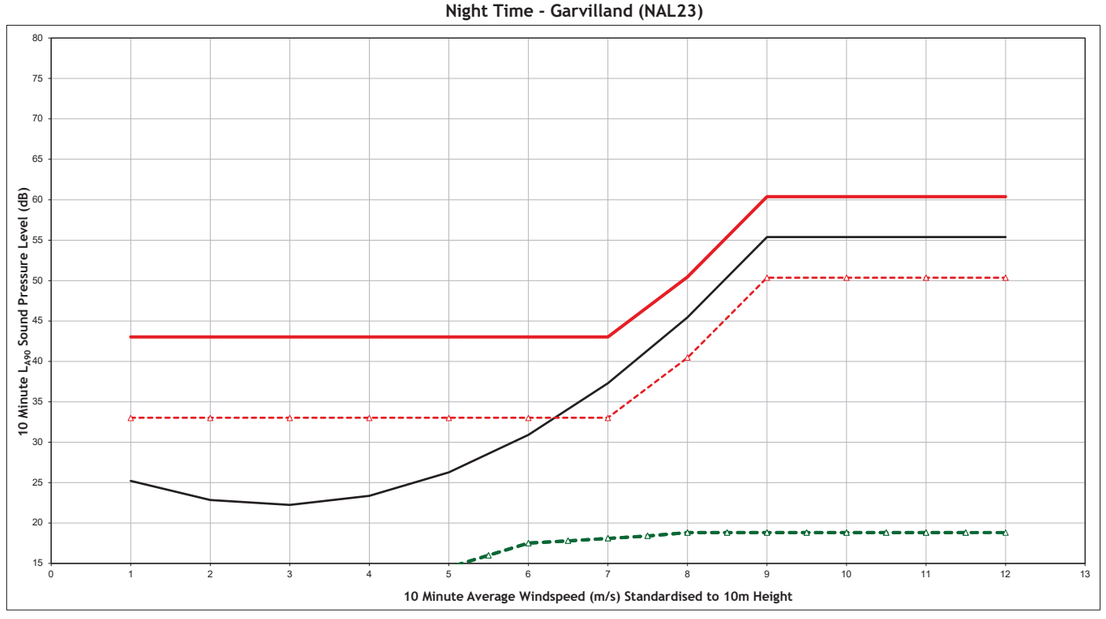
Statkraft

tnei

Quiet Daytime - Garvilland (NAL23)



Night Time - Garvilland (NAL23)



Legend:

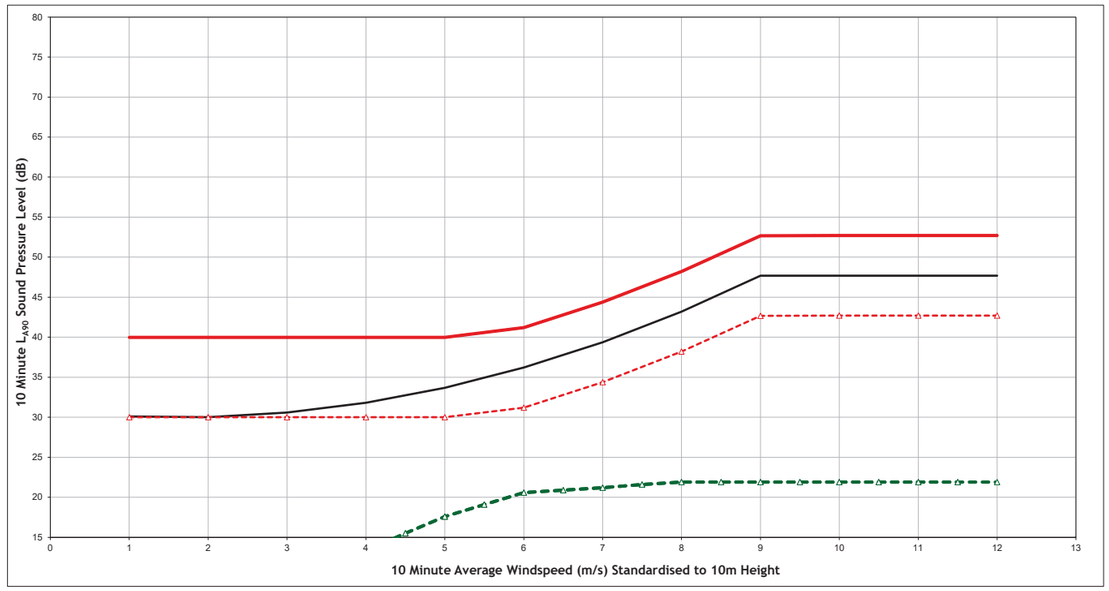
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Garvilland (NAL23)
Figure Number	Figure A1.3w
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

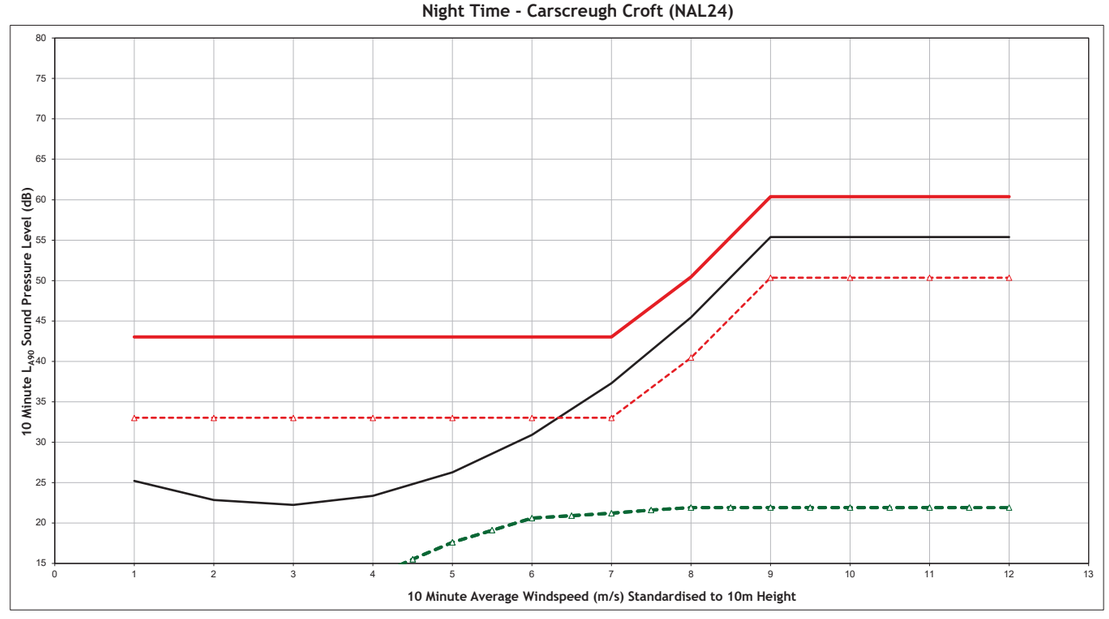
Statkraft

tnei

Quiet Daytime - Carscreugh Croft (NAL24)



Night Time - Carscreugh Croft (NAL24)



Legend:

- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Carscreugh Croft (NAL24)
Figure Number	Figure A1.3x
Scale	NTS
Drawn	JB
Checked	JM
Date	13/11/2020
Document Reference	13865-Models

Statkraft

tnei

Annex 2 – Extracts of Decision Notices

Airies Wind Farm Decision Notice Extract

building hereby granted planning permission shall not be brought into use unless it has been finished in complete accordance with such details as have been so approved. On decommissioning of the windfarm the substation building shall revert to agricultural use in conjunction with the respective surrounding farm unit.

12. That **no development in respect of this planning permission shall take place** unless a Method Statement (or Method Statements) incorporating a Pollution Prevention Plan has been prepared in consultation with Council staff, Scottish Natural Heritage, Scottish Environment Protection Agency and the Galloway Fisheries Trust. It shall detail all on-site construction, borrow pits, drainage, mitigation, forestry felling, trench and turbine base formation, culvert design, internal track construction including floating road construction where the areas of peat are in excess of one metre deep, access construction and restoration/reinstatement works with the timetable for these works, has been submitted to and approved in writing by the Council as planning authority. The Method Statement(s) shall integrate 'best practice' methods for the Scottish / UK wind farm industry with the mitigation measures identified in the Environmental Statement supporting the application to ensure environmental impacts are reduced. The Method Statement(s) shall, where agreed, include provision for additional site survey and monitoring. Thereafter, the development shall be implemented in complete accordance with the approved Method Statement(s) unless otherwise agreed in writing with the Council as planning authority.

13. That **no development in respect of this planning permission shall take place** unless a timetable for the construction period has been agreed in writing with the Council as planning authority. It shall include a start and finish date, noting that the work shall not extend beyond a period of two years from the date of commencement unless with the express consent of the Council as planning authority.

14. That **within 12 months of the wind farm hereby granted planning permission becoming fully operational**, the temporary construction compound, laydown area and any temporary power performance mast shall be removed from the site and these uses discontinued, unless otherwise agreed in writing with the Council as planning authority. Any works required for the reinstatement of the land shall be carried out prior to the expiry of the permission, in accordance with a scheme for such reinstatement works which shall be submitted to and approved in writing by the Council as planning authority.

15. That at wind speeds not exceeding 12 m/s as measured or calculated at a height of 10m above ground level at the wind farm, the wind farm noise emission level at any dwelling existing at the time of this permission shall comply with the following:

- During night time hours, as defined in ETSU-R-97 as 23.00 to 07.00 on all days, the cumulative wind farm noise emission level shall not exceed 43 dB $L_{A90,\ 10\ min}$ or the ETSU-R-97 derived "night hours" noise limit based on the measured $L_{A90,\ 10\ min}$ background noise level plus 5dB(A), whichever is the greater.

- At all other times, the cumulative wind farm noise emission level shall not exceed 35dB $L_{A90,\ 10\ min}$ or the ETSU-R-97 derived "quiet waking hours" noise limit based on the measured $L_{A90,\ 10\ min}$ background noise level plus 5dB(A), whichever is the greater.

- The above noise emission limits may be increased cumulatively to 45 dB $L_{A90,\ 10\ min}$ or the relevant ETSU-R-97 derived "quiet waking hours" or "night hours" noise limit based on the measured $L_{A90,\ 10\ min}$ noise level plus 5dB(A), whichever is the greater, when measured at any dwelling owned by persons with financial involvement with the wind farm.

(Measured background noise levels referred to in this condition shall be those recorded by the regression lines in Chapter 13 and Appendix 13.8 of the 20-20 Renewables Ltd Environmental Statement for the Airies Wind Farm).

16. That **at the written request of the Planning Authority**, and following a justified complaint to the Planning Authority relating to noise emissions arising from the operation of the wind farm, the wind farm operator shall within 28 days, and at the wind farm operators expense, employ an independent consultant approved by Dumfries and Galloway Council Environmental Standards to measure the level of noise emission from the wind farm at the property to which the complaint relates. The measurement and calculation of noise levels shall be undertaken in accordance with ETSU-R-97 having regard to paragraphs 1 to 3 and 5 to 11 inclusive of the schedule of Pages 95 to 97 inclusive and Supplementary Guidance Notes to the Planning Obligation, pages 99 to 109.

17. That the wind farm operator shall provide to Dumfries and Galloway Council as Planning Authority the independent consultant's assessment and conclusions regarding the said noise complaint, including all calculations, audio recordings and the raw data upon which those assessments and conclusions are based. **Such information shall be provided within 3 months of the date of the written request of Dumfries and Galloway Council** unless otherwise extended in writing by Dumfries and Galloway Council as Planning Authority.

Kilgallioch Wind Farm Decision Notice Extract

29. That at wind speeds not exceeding 12 metres per second as measured or calculated at a height of 10 metres above ground level at the wind farm, the wind farm noise emission level at any dwelling existing at the date of this permission shall comply with the following:

(a) During night-time hours, as defined in ETSU-R-97 as 23.00 to 07.00 on all days, the wind farm noise emission level shall not exceed 43dB LA_{90}, 10 min or the ETSU-R-97 derived "night hours" noise limit based on the measured LA_{90}, 10 min background noise level plus 5dB(A), whichever is the greater.
(b) At all other times, the wind farm noise emission level shall not exceed 40dB LA_{90}, 10 min or the ETSU-R-97 derived "quiet waking hours" noise limit based on the measured LA_{90}, 10 min background noise level plus 5dB(A), whichever is the greater.
(c) The above noise emission limits may be increased to 45 dB LA_{90}, 10 min or the relevant ETSU-R-97 derived "quiet waking hours" or "night hours" noise limit based on the measured LA_{90}, 10 min noise level plus 5dB(A), whichever is the greater, when measured at any dwelling owned by persons with financial involvement with the wind farm.
(d) Measured background noise levels referred to in this condition shall be those recorded by the regression lines in Chapter 13 Figures 13.1 to 13.14 contained in and forming part of the Environmental Statement.

***Reason**: To ensure proper environmental control in respect of noise, and to safeguard the amenities of the nearest residential properties.*

30. That at the reasonable request of the relevant Planning Authority as enforcing planning authority, and following a complaint to it relating to noise emissions arising from the operation of the wind farm, the wind farm operator shall measure the level of noise emission from the wind farm at the property to which the complaint relates. The measurement and calculation of noise levels shall be undertaken in accordance with ETSU-R-97 having regard to paragraphs 1 to 3 and 5 to 11 inclusive of the schedule of pages 95 to 97 inclusive and Supplementary Guidance Notes to the Planning Obligation, Pages 99 to 109.

The wind farm operator shall provide to the relevant Planning Authority the independent consultant's assessment and conclusions regarding the said noise complaint, including all calculations, audio recordings and the raw data upon which those assessments and conclusions are based. Such information shall be provided within 3 months of the date of the written request of the relevant Planning Authority unless otherwise extended in writing by the relevant Planning Authority.

***Reason**: To ensure proper environmental control in respect of noise, and to safeguard the amenities of the nearest residential properties.*

31. That in evaluating a complaint relating to one of the dwellings named in Table 1 (below), noise emission levels shall where appropriate be compared with the relevant ETSU-R-97 derived "quiet waking hours" or "night hours" noise limits

Glenchamber Wind Farm Decision Notice Extract

22. At wind speeds not exceeding 12 metres per second, as measured or calculated at a height of 10 metres above ground level at each turbine, the combined wind farm noise imission level at any dwelling lawfully existing at the time of the permission shall comply with the following:

- During night time hours (as defined in ETSU-R-97 "The Assessment and Rating of Noise From Wind Farms" as 23.00 to 07.00 hours, the noise emission level shall not exceed 43dB LA90, 10 minute or the ETSU-R-97 derived "night hours" noise limit based on the measured LA90, 10 minute background noise level plus 5dB(A), whichever is the greater.
- At all other times, the noise emission level shall not exceed 35dB LA90, 10 minute or the ETSU-R-97 derived "quiet waking hours" noise limit based on the measured LA90, 10 minute background noise level plus 5dB(A), whichever is the greater.
- The above noise emission limits may be increased to 45dB LA90 10 minute, or the relevant ETSU-R-97 derived "quiet waking hours" or "night hours" noise limit based on the measured LA90 10 minute noise level plus 5dB(A), whichever is the greater and when measured at any dwelling owned by persons with a financial involvement in the wind farm.

Reason: To protect the residents of nearby properties from unacceptably high levels of additional noise and disturbance from operation of the turbines.

23. Wind speed, wind direction and power generation data shall be continuously logged and provided to the planning authority at its request and in accordance with the attached Guidance Notes within 28 days of such request. Such data shall be retained for a period of not less than 12 months.

Reason: To provide a factual basis for ensuring that the noise limits imposed are not exceeded.

24. Within 28 days from receipt of a written request from the planning authority, and following a justified complaint to the planning authority relating to the operation of the wind farm from the occupant of a dwelling which lawfully exists or has planning permission at the date of this consent, the wind farm operator shall shut down the turbine(s) involved no later than 24 hours after receipt of the request. The operator shall then, at its own expense, employ an independent consultant approved by the planning authority to assess the noise levels at the complainant's property following the procedures described in the attached Guidance Notes. This condition shall not prevent the turbine(s) from being operated temporarily for acoustic testing and measurement.

25. The wind farm operator shall provide to the planning authority the independent consultant's assessment and conclusions regarding the said noise complaint, including all calculations, recordings and raw data upon which these are based, together with details of any remedial action or mitigation required to accord with the limits imposed under condition 22. Such information shall be provided within 3 months of the date of the written request of the planning authority unless otherwise extended in writing by the authority. Thereafter, the operator shall take the remedial action or mitigation referred to above, and the related

Artfield Fell / Balmurrie Wind Farm Decision Notice Extract

Prevention Plan has been prepared in consultation with Council staff, Scottish Natural Heritage and Scottish Environment Protection Agency. It shall detail all on-site construction, borrow pits, drainage, mitigation, trench and turbine base formation, cutting and embankment treatments, watercourse crossing points, internal track construction including floating road construction where the areas of peat are in excess of one metre deep, access construction and restoration/ reinstatement works with the timetable for these works, has been submitted to and approved in writing by the Council as planning authority. The Method Statement(s) shall integrate 'best practice' methods for the Scottish / UK wind farm industry with the mitigation measures identified in the Environmental Statement supporting the application to ensure environmental impacts are reduced. The Method Statement(s) shall, where agreed, include provision for additional site survey and monitoring. Thereafter, the development shall be implemented in complete accordance with the approved Method Statement(s) unless otherwise agreed in writing with the Council as planning authority.

15. No later than six months after the date on which the development is commissioned, a Habitat Management Plan shall be submitted to and approved in writing by the Planning Authority. The approved habitat management plan shall thereafter be implemented in full, unless otherwise agreed in writing with the Planning Authority. The Habitat Management Plan shall include the mitigation measures proposed in the Environmental Statement,

16. That **within six months of the wind farm hereby granted planning permission becoming fully operational**, the temporary construction compound, laydown area and any temporary power performance mast shall be removed from the site and these uses discontinued, unless otherwise agreed in writing with the Council as planning authority. Any works required for the reinstatement of the land shall be carried out prior to the expiry of the permission, in accordance with a scheme for such reinstatement works which shall be submitted to and approved in writing by the Council as planning authority.

17. At wind speeds not exceeding 12 metres per second as measured or calculated at a height of 10 metres above ground level at the wind farm, the wind farm noise emission level at any dwelling existing at the time of this permission shall comply with the following:

(a) During night-time hours, as defined in ETSU-R-97 as 23.00 to 07.00 on all days, the wind farm noise emission level shall not exceed 43dB LA_{90}, 10 min at any dwelling.

(b) At all other times, the wind farm noise emission level shall not exceed 35dB LA_{90}, 10 min at any dwelling.

Carscreugh Wind Farm Decision Notice Extract

(c) The above noise emission limits may be increased to 45 dB LA_{90}, 10 min at any dwelling owned by persons with financial involvement with the wind farm.

18. At the reasonable request of the planning authority, and following a complaint to the planning authority relating to noise emissions arising from the operation of the wind farm, the wind farm operator shall measure the level of noise emission from the wind farm at the property to which the complaint relates. The measurement and calculation of noise levels shall be undertaken in accordance with ETSU-R-97 having regard to paragraphs 1 to 3 and 5 to 11 inclusive of the schedule of pages 95 to 97 inclusive and Supplementary Guidance Notes to the Planning Obligation, Pages 99 to 109.

19. In evaluating a complaint relating to one of the dwellings named in Table 1 (below), noise emission levels shall where appropriate be compared with the relevant ETSU-R-97 derived "quiet waking hours" or "night hours" noise limits derived from previous measured background noise levels.

Table 1:

	Property Name	National Grid Reference	ETSU-R-97 Noise Limit Set
1	Artfield	NGR 223684, 566109	Financially Involved
2	Balmurrie Farm	NGR 220429, 566407	Financially Involved
3	Dranigower	NGR 220093, 565083	Standard
4	Kilmacfadzean	NGR 220303, 567466	Financially Involved
5	Balmurrie Cottage	NGR 220250, 565995	Standard

In evaluating a complaint from any dwelling existing at the date of this permission not named in Table 1 (above), the measured wind farm noise emission level shall be compared to the prevailing background noise level at the property in Table 1 which is most likely to experience background noise levels similar to the complainant property. The appropriate Table 1 property will be nominated by the developer subject to the agreement of the local planning authority at the time of investigating any complaint.

20. That, for the lifetime of the development, the wind farm operator shall log wind speed and wind direction data continually and shall retain the data which has been obtained for a period of no less than the previous 12 months. This data shall include the average wind speed in metres per second for each 10 minute period. The measuring periods shall be set to commence on the hour or in 10 minute increments thereafter. This wind speed data shall be made

Reason: To reduce the amenity impact of the turbines and to avoid visual discomfort from contra-rotating blades.

23. No advertisements of any kind, apart from safety or information notices, shall be displayed on the buildings and structures within the site.
Reason: To reduce the visual impact of the development.

24. At wind speeds not exceeding 12 metres per second, as measured or calculated at a height of 10 metres above ground level at each turbine, the noise emission level generated by the turbine cluster at any dwelling existing at the time of this planning permission shall comply with the following:

- During night time hours (as defined in ETSU-R-97 "The Assessment and Rating of Noise From Wind Farms" as 23.00 to 07.00 hours, the noise emission level shall not exceed 43dB LA90, 10 minute or the ETSU-R-97 derived "night hours" noise limit based on the measured LA90, 10 minute background noise level plus 5dB(A), whichever is the greater.
- At all other times, the noise emission level shall not exceed 35dB LA90, 10 minute or the ETSU-R-97 derived "quiet waking hours" noise limit based on the measured LA90, 10 minute background noise level plus 5dB(A), whichever is the greater.
- The above noise emission limits may be increased to 45dB LA90 10 minute, or the relevant ETSU-R-97 derived "quiet waking hours" or "night hours" noise limit based on the measured LA90 10 minute noise level plus 5dB(A), whichever is the greater and when measured at any dwelling owned by persons with a financial involvement in the energy park.
- Measured background noise levels referred to in this condition shall be those recorded in Chapter 11 (Noise Assessment) of the energy park environmental statement dated April 2006.

Reason: To protect the residents of nearby properties from unacceptably high levels of additional noise and disturbance from operation of the turbines.

25. At the request of the planning authority and following a justified complaint relating to noise emissions arising either from construction, transportation or the operation of any of the wind turbines, the operator shall cease the related activity or shut down the turbines involved no later than 24 hours after receipt of the complaint. The operator shall then at his own expense investigate the complaint, monitor the problem and submit a report on its cause to the planning authority with details of any necessary remedial action or mitigation, to accord with ETSU-R-97 above. This condition shall not prevent the turbines from being operated temporarily for acoustic testing and measurement. Thereafter, the operator shall take the approved remedial action and the related activity or the full-time operation of the turbine(s) shall only recommence with the written agreement of the planning authority.
Reason: To ensure that the set noise levels are adhered to and not exceeded, that noise is properly controlled and to enable the prompt and appropriate investigation and mitigation any noise complaints arising from the energy park, all to protect the residents of nearby properties from unacceptably high levels of additional noise and disturbance.

Annex 3 – Correspondence with the Environmental Health Department at the Council

Dumfries and Galloway Noise Scoping Response

8.5 It should be noted that Non-Inventory Designed Landscapes should also be included as regional designations with respect to the **LVIA assessment**, in addition to Inventory Designed landscapes.

8.6 On the information available, the archaeologist has advised that indirect effects on the following assets must be included in any assessment:

- Designated monuments within a 10km boundary; at Wood Cairn (HS ref SM1953), Bennan of Garvilland fort (SM1955), Caves of Kilhern (SM1928), Cairn na Gath (SM1922), Laggangarn standing stones (SM90199), Wells of the Rees (SM2002).
- Undesignated monuments at Dirvannie (MDG13123), Monandie (MDG2177), High Eldrig (MDG2180), Craigmoddie (MDG2317), Dirvachlie (MDG14483), High Eldrig cairn (MDG2179), White Cairn (MDG2165).
- Promoted Sites at Linn's Grave (MDG2327).
- East Rhins Archaeologically Sensitive Area (LDP2 Policy HE4).
- Non-Inventory designed landscape at Torwood (MDG21005).

8.7 After preliminary assessment a finalised list of illustrations for inclusion in the EIA should be agreed with the Council Archaeologist. Wireframe and photomontage visualisations will be required from Wood Cairn, Dirvannie, High Eldrig, Caves of Kilhern, Laggangarn and Garvilland.

9 Roads and Access

9.1 The Council's Roads Planning Team Leader has reviewed the submitted scoping report and has no objection with the proposed scope or methodology, although has offered a number of observations that should be considered and addressed in any future submission/EIA Report.

9.2 Attention is particularly drawn to the comments regarding excluded routes for forestry vehicles on the potential access routes to serve the site, the general suitability of some of the proposed access routes which are weak rural roads that are severely restricted (C3w and U89w), the requirement for the EIA report to confirm the proposed access route(s) and identify the full extent of proposed off-site road accommodation and mitigation works, reference to the requirement for a construction phase traffic management plan, inclusion of a worst case scenario that 100% of the aggregate required for construction shall be imported to site and identify the potential number of movements in the event that suitable and sufficient aggregate is not be available from proposed on-site Borrow Pits, and the requirements in respect of the access route crossing bridges and culverts.

10 Impact on local communities and residential interests

Noise

10.1 Environmental Health has advised that until a site-specific impact assessment has been carried out with regard to noise and potential for impact on private water supplies, they are unable to comment fully as to the expected impacts at this stage.

10.2 Environmental Health suggest that a method statement for the construction project should be provided within the EIA report for approval by Dumfries & Galloway Council. This should include an assessment of potentially noisy operations and outline the noise mitigation measures proposed. This will also include a programme and phases for each stage of work. Guidance as to construction noise prediction methodology may be found within BS5228:2009.

TNEI Dumfries and Galloway Noise Methodology Consultation Letter

25 June 2020

Ref: 13865-003– R0

Mr William Jackson
William.Jackson@dumgal.gov.uk

Sent by email only.

Dear William,

PROPOSED ARTFIELD FOREST WIND FARM ON LAND TO THE NORTH EAST OF GLENLUCE, DUMFRIES AND GALLOWAY: NOISE ASSESSMENT

As you may be aware, Artfield Forest Wind Farm Limited (owned by Statkraft UK Limited)('the applicant) are considering developing a wind farm ('the proposed development') 8 km to the northwest of Kirkcowan, and 15 km west of Newton Stewart, in Dumfries and Galloway, Scotland ('proposed development'). An initial draft wind farm layout is shown on the enclosed Figure A1.1 (Appendix 1).

TNEI Services has been appointed by the applicant to undertake a noise assessment for the proposed development, and prior to commencing the noise assessments we would like to agree the noise assessment methodologies with you.

Construction and Decommissioning Noise

If required, a construction and decommissioning noise assessment will be undertaken to determine the potential noise impacts during the construction and decommissioning phases of the proposed development. The construction and decommissioning noise assessment would be undertaken in accordance with the methodology outlined in British Standard (BS) 5228-1:2009+A1:2014 and ISO9613:1996 ('*Acoustics - Attenuation of sound during propagation outdoors -Part 2: General method of calculation'*). Impacts will be assessed using criteria contained within BS5228 and, where appropriate, mitigation measures will be proposed.

As per the Scoping Report, it is proposed that vibration is scoped out of the Environmental Impact Assessment (EIA).

Operational Noise

An operational noise assessment will be undertaken in accordance with ETSU-R-97 '*The Assessment and Rating of Noise from Wind Farms'* (ETSU-R-97) and the Institute of Acoustics document *'A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise'* (IOA GPG). In relation to wind turbine noise PAN 1/2011 '*Planning and Noise'* refers to the Scottish Governments *'Onshore Wind Turbines'* web based document which states that:

"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".

And;

"The Institute of Acoustics (IOA) has since published Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise The document provides significant support on technical issues to all users of the ETSU-R-97 method for rating and assessing wind turbine noise, and should be used by all IOA members and those undertaking assessments to ETSU-R-97. The Scottish Government accepts that the guide represents current industry good practice."

Newcastle
7th Floor, West One
Forth Banks
Newcastle Upon Tyne
NE1 3PA

Tel: +44(0)191 211 1400

VAT Reg. GB 239 0146 20 | Company Reg. 03891836

The noise limits derived in the assessment would inform appropriate noise related planning conditions should an application be made and should the determining authority be minded to grant consent.

As per the scoping report, it is proposed that low frequency noise and amplitude modulation are scoped out of the operational noise assessment as part of the EIA.

ETSU-R-97

ETSU-R-97 describes the findings of the Working Group on Noise from Wind Turbines, the aim of which is to provide information and advice to developers and planners on the environmental assessment of operational noise from wind turbines.

ETSU-R-97 recommends noise limits should be set at 5 dB(A) above existing background noise levels, subject to fixed minimum limits (35-40 dB for quiet daytime and 43 dB for night-time periods), and that these limits should reflect the variation in background noise with wind speed. Higher fixed minimum limits apply to the occupiers of properties that have a financial interest in the wind farm development.

The choice of daytime fixed minimum limits should be considered in light of the guidance contained within ETSU-R-97 and the IOA GPG. Noise limits established at properties in accordance with ETSU-R-97 shall be applicable to all existing / proposed wind turbines in the area, and will henceforth be referred to as the 'Total ETSU-R-97 Noise Limits'.

'Site Specific Noise Limits' would then be derived taking account of the noise limits already allocated to, or the limit that may be used by, other wind farm developments in the area. The Site Specific Noise Limits will be derived using the principles contained within the IOA GPG (which may include the use of the controlling property principal / determining if there is significant headroom etc). The proposed development's Specific Noise Limits will be the limits that the proposed development would have to operate within should consent be granted.

Cumulative Noise Assessment

There are a number of operational wind farms in the area, in addition to a proposed wind farm. With regards to which cumulative developments should be included within the assessment, the IOA GPG states that;

"During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary."

As such TNEI has undertaken some preliminary modelling to consider the schemes operating in conjunction with the proposed development. The schemes currently proposed for inclusion within the noise assessment have been listed below[1]:

[1] We would be grateful if you confirm whether you are aware of any other proposed, consented and operational wind turbine developments not listed that you would consider necessary to include within the noise assessment.

- Artfield Fell Wind Farm (15 x SIEMENS-SWT 1.3-62 Turbines; Consented 2004, Operational)*;
- Balmurrie Fell Wind Farm (7 x SIEMENS-SWT 1.3-62 Turbines; Consented 25 November 2011, Operational)*;
- Carscreugh Wind Farm (18 x Gamesa G52 Turbines; Consented at appeal 21 March 2012, Operational);
- Glenchamber Wind Farm (11 x Nordex N100 2.5 MW Turbines; Consented at appeal 31 July 2012, Operational);
- Kilgallioch Wind Farm (94 x Gamesa G114 & 2 x Gamesa G90 Turbine; Consented 14 February 2013, Operational);
- Airies Wind Farm (14 x GE-2.85-103 Turbines; Consented 20 August 2013, Operational); and
- Kilgallioch Wind Farm Extension (11 x Vestas-V150 5.6 MW Turbine; Proposed)

*For the purposes of this letter, Artfield Fell and Balumurrie Wind Farms will be referred to jointly as Artfield Fell Wind Farm.

The noise limits set at each operational scheme above are based on fixed minimum limits (FML) of 35 dB or background +5 dB for the Daytime period, and 43 dB or background +5 dB for the Night-time period. The exception to this is the operational Kilgallioch Wind Farm which was consented with a higher 40 dB FML for the Daytime period, and 43 dB or background +5 dB for the Night-time period. Where a property has financial involvement with a particular scheme, then noise limits are based on a higher FML of 45 dB or background + 5 dB for both Daytime and Night-time periods.

Background Noise

The cumulative windfarm landscape surrounding the proposed development is complex and any noise monitoring undertaken to derive background noise levels could be influenced by noise from existing operational turbines. Therefore, it is proposed that the original background noise measurements used to inform the other consented and operational schemes are used to derive the Total ETSU-R-97 Noise Limits.

Background noise monitoring was undertaken at a number of Noise Sensitive Receptors (NSRs) as part of Aries, Glenchamber, and Kilgallioch wind farms applications. Table 1 below details the noise monitoring locations (NMLs) used for each scheme. The locations are also shown on Figure A1.1, Appendix 1;

Table 1- Cumulative Schemes Background NMLs

Cumulative Scheme	NML	X	Y
Airies Wind Farm	Kilquockadale	229258	567804
	Three Lochs Holiday Park	227216	565515
	Low Airies	226107	566542
	Gass Farm	224928	564021
Glenchamber Wind Farm	Dranigower	220128	565132
	Glenchamber	223793	563918
Killgallioch Wind Farm	Kilmacfadzean	220363	567523
	Quarter Farm	218645	568273
	Pultadie	218253	570027

The background noise (BN) datasets derived for the Glenchamber noise assessment were based on the use of a 10 m meteorological mast and cannot be used for the derivation of Total ETSU-R-97 Noise Limits given the size of the proposed development and the cumulative schemes[2]. Therefore, only the BN datasets derived for Airies and Kilgallioch shall be considered for this noise assessment.

It can be seen from Table 1 and Figure A1.1 that noise monitoring has been undertaken at locations proximate to the proposed development in directions to the east, south, and west. The BN datasets have therefore been used to set noise limits at noise assessment locations (NALs) which share similar noise environments to those where the measurements were made[3]. Each NAL, and its respective proxy BN dataset has been detailed in Table 2 below. Appendix 2 justifies the use of the proxy locations at each NAL in more detail;

Table 2 Proxy Locations used for establishing Total ETSU-R-97 Noise Limits at NALs

NAL	X	Y	NML
NAL1 - Artfield	223713	566158	Low Airies
NAL2 - Low Airies	226107	566542	
NAL3 - Glenchamber	223793	563918	Gass Farm
NAL4 - Torwood Bungalow 2	224358	563762	
NAL5 - Torwood Bungalow	224426	563859	
NAL6 - Torwood House Hotel	224466	564064	
NAL7 - Torwood Two Dogs Lodge	224551	564121	
NAL8 - Gass Farm	224928	564021	
NAL9 - Scotts Corner	225033	564053	
NAL10 - Mark of Lochronald Bungalow	226031	564598	Three Lochs Holiday Park
NAL11 - Mark of Lochronald	226093	564491	
NAL12 - Fell of Loch Ronald	227063	564387	
NAL13 - Balminnoch	226837	565411	
NAL14 - The Old Schoolhouse	228677	566389	Kilquockadale
NAL15 - Kilquhockadale	229258	567804	
NAL16 - Urrall	229275	569553	
NAL17 - Tannielaggie	228748	572073	
NAL18 - Kilmacfadzean	220363	567523	
NAL19 - Quarter Farm	218645	568273	Quarter Farm

[2] The IOA GPG states that using a 10m mast 'for the purpose of the background noise survey, should only be adopted for smaller-scale developments for which the installation of a tall met mast or deployment of a SODAR or LIDAR system at the planning stage might not be justified economically'
[3] Referred to as a proxy location

NAL	X	Y	NML
NAL20 - Pultadie	218253	570027	Pultadie
NAL21 - Balmurrie	220495	566427	Kilmacfadzean
NAL22 - Dranigower	220128	565132	Gass Farm
NAL23 - Garvilland	221583	561787	
NAL24 - Carscreugh Croft	223200	562300	

On the basis of Table 2 above, TNEI propose to use the datasets to set Total ETSU-R-97 Noise Limits for the proposed development. The datasets will be used to derive the Total ETSU-R-97 Noise Limit (applicable to all schemes in the area) and the Site Specific Noise Limits for the proposed development which take account of the noise limit allocated to, or could be used by other schemes in the area.

Limit Derivation and Initial Noise Modelling

The preliminary noise modelling has been undertaken in three stages:

1) deriving the Total ETSU-R-97 Noise Limits (which are applicable to noise from all wind turbines in the area operating concurrently) at NSRs;
2) predicting the likely effects (undertaking a cumulative noise assessment where required) to determine whether noise immissions at NSRs will meet the Total ETSU-R-97 Noise Limits; and
3) deriving Site Specific Noise Limits for the proposed development (taking account of the noise limit that has already been allocated / could realistically be used by other schemes) and undertaking predictions against those limits.

A total of 24 NALs have been identified for the initial modelling. The NALs were chosen to represent the NSRs located closest to the proposed development and additional receptors were included to consider cumulative noise impacts. As detailed above TNEI propose to use the background noise data previously collected to set the noise limits at each NAL.

Having due regard to the guidance in ETSU-R-97, the draft layout for the proposed development, and the cumulative environment the daytime Total ETSU-R-97 Noise Limit have been derived based on 40 dB(A) or background plus 5 dB whichever is the greater[4]. The night time Total ETSU-R-97 Noise Limit has been derived based on 43 dB or background plus 5 dB whichever is the greater. Where NALs have financial involvement in a particular scheme the daytime and night time Total ETSU-R-97 Noise Limits have been derived based on 45 dB(A) or background plus 5 dB whichever is the greater.

The Site Specific daytime limit for noise associated with the proposed development has been derived based on 35 dB(A) or background plus 5 dB, whichever is the greater. This represents the lower end of the daytime limits that can be applied under ETSU-R-97. The night time Site Specific Noise Limits will be set at 43 dB or background plus 5 dB whichever is the greater.

Predictions of wind turbine noise for the proposed development were made, based upon the sound power level data for a candidate wind turbine, the Vestas 150 5.6MW with serrated blades. Please note that the layout is very much a draft and will change as we go through the EIA process. This wind turbine model has been chosen as it is considered to be representative of the type of turbine that could be installed at the site. Whatever the final turbine choice is, the proposed development would have to meet the noise limits determined and contained within any condition applied as part of the consent.

Modelling was undertaken using the ISO 9613: 1996 'Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation' noise prediction model which accords with current good practice and is considered to provide a realistic impact assessment. For the other schemes, predictions have been undertaken using sound power level data for the installed turbines or a suitable candidate. The model of turbine was either identified through an online search, or through the use of Dumfries and Galloway Councils Planning Application Portal.

The likely cumulative assessment shows that at a number of NALs the consented noise limits are already being used in their entirety (with exceedances seen at NAL1, 21 and 24, see Figures A1.2a-x), or insufficient headroom exists to apportion the Total ETSU-R-97 Noise Limits. With regard to this type of cumulative situation the IOA GPG states that;

"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 10 dB 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)". Such an approach could prevent any further wind farm development in the locality, and a more detailed analysis can be undertaken on a case by case basis."

The Site Specific Noise Limits at these locations have therefore been set 10 dB below the noise limits, such that the proposed development would be having a negligible impact on the other schemes abilities to meet the noise limits.

For the remaining NALs, the proposed development is either having a negligible impact, or requires a small share of the Total Noise Limits. Site Specific Noise Limits have therefore been derived which take account (where required) of the other wind farm developments. The process to derive the Site Specific Noise Limits at each NAL is described in Table 3 below:

[4] A daytime Total ETSU-R-97 Noise limit based on a FML of 40 dB is considered appropriate given Kilgallioch Wind Farm has already been consented with this noise limit. Given the cumulative environment it is considered appropriate to assume the other schemes are allocated the same Total Noise Limits, but individually not exceed the 35 or background + 5 dB noise limits.

Table 3 Proposed Development Site Specific Noise Limit Apportionment Method

NAL	Apportionment Method
NALs 1-4, 6-7, 10-11, 13-15, and 18-24	The Total ETSU-R-97 Noise Limit is being used in its entirety by the operational schemes and therefore a Site Specific Noise Limit set 10 dB the noise limits is required such that the proposed development would have a negligible contribution to the overall noise levels.
NALs 5, 8-9, 12, 16-17	Significant headroom is present between the other operational schemes and the Total ETSU-R-97 Noise Limits. In accordance with Section 5.4.11 of the IOA GPG, a 2 dB buffer has been added to the turbine noise predictions for each of the other developments; this is considered to be a suitable buffer in accordance with the IOA GPG and would represent a 60% increase in emitted noise levels from the other schemes. The resulting cautious predictions of cumulative wind turbine noise have then been logarithmically subtracted from the Total ETSU-R-97 Noise Limit to determine the Site Specific Noise Limit for the proposed development.

A set of figures showing the proposed Site Specific Noise Limits and predictions from the proposed development against the limits are included as Figures A1.3a-x in Appendix 1[5].

Please note that the proposed development layout considered is still a draft but we were keen to get your thoughts at this early stage on our proposed methodology for the noise assessment. To enable us to progress the assessment we would be very grateful if you confirm whether:

- You agree with our proposed approach to use the previously collected baseline noise data used to inform the other operational wind farm applications;
- You agree with the general approach we are proposing to set noise Total and Site Specific Noise Limits at the nearest receptors;
- You agree to the use of a 40 dB fixed minimum limit to derive the Total ETSU-R-97 Noise Limits, with any Site Specific Noise Limits based on a FML of 35 dB or background + 5 dB;
- The Council is aware of any schemes which should be included in the cumulative noise assessment or any other dwellings which should be considered; and
- You are in agreement that a vibration assessment, a low frequency noise assessment, and a amplitude modulation assessment are not required.

If you have any immediate concerns or queries, please do not hesitate to contact me or my colleague James Mackay. We look forward to hearing from you soon.

[5] Notwithstanding the fact the layout considered in this initial modelling is a draft and the candidate turbine may be subject to change, some exceedances of the draft limits have been identified. The final design considered in the EIAR will be compliant with the relevant noise limit, exceedances may be mitigated as the wind farm layout evolves whilst the use of low noise modes may also be considered if necessary.

Yours sincerely,

Jason Baldwin
BSc(Hons), Dip, AMIOA

Senior Technical Consultant
jason.baldwin@tneigroup.com
Tel: 0191 2111412

Reviewed and approved by:

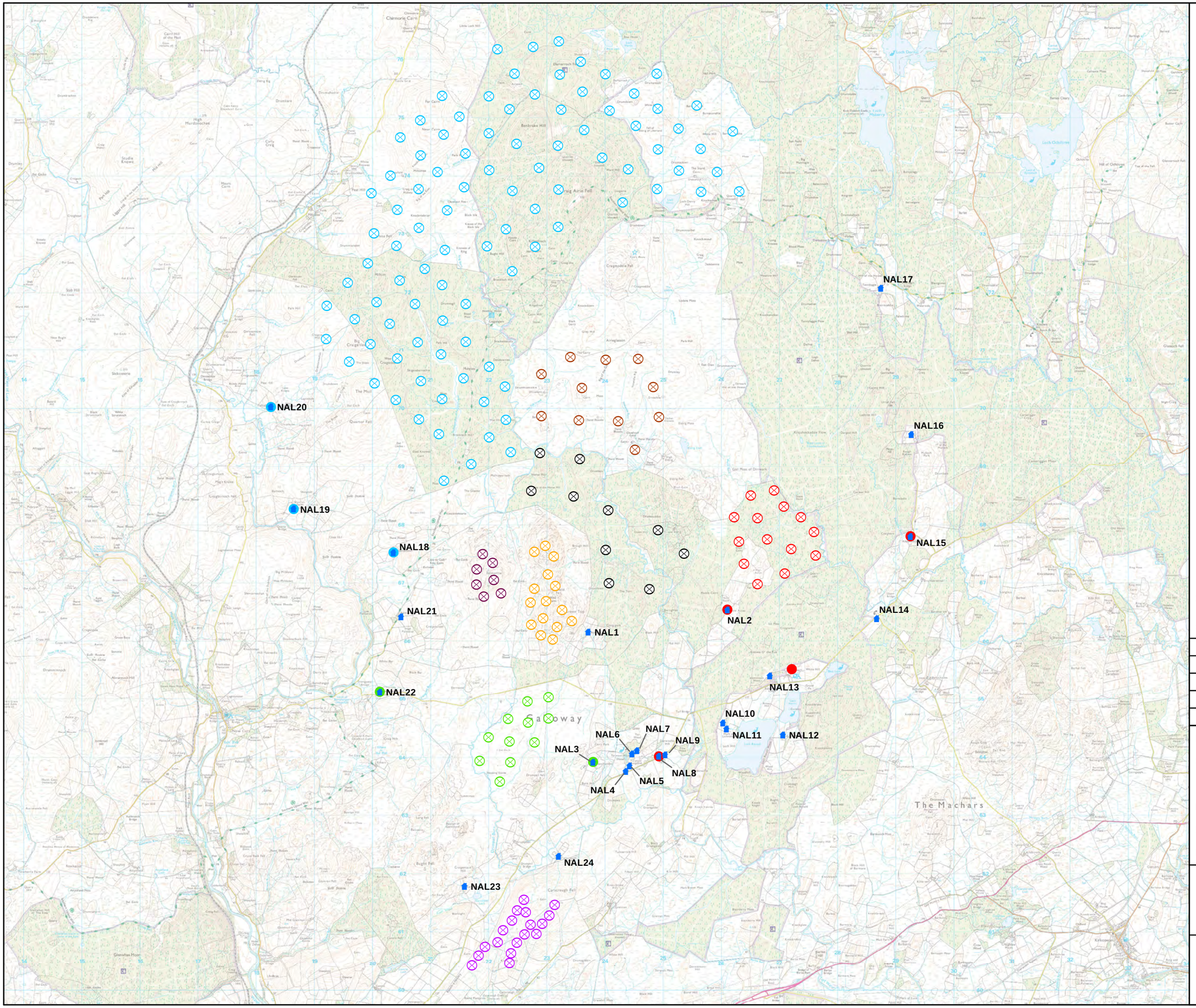
James Mackay
BSc(Hons), Dip, MIOA

Director of Site Services
james.mackay@tneigroup.com
Tel: 0191 2111414

Enc.

Appendix 1 - Figures
Appendix 2 - Proxy Locations used for establishing Total ETSU-R-97 Noise Limits

Appendix 1 – Figures



Legend

- Noise Assessment Location

Noise Monitoring Locations (NMLs)

- Airies Wind Farm
- Glenchamber Wind Farm
- Kilgallioch Wind Farm

Wind Farms

- Airies Wind Farm
- Artfield Fell Wind Farm
- Artfield Forest Wind Farm
- Balmurrie Wind Farm
- Carscreugh Wind Farm
- Glenchamber Wind Farm
- Kilgallioch Wind Farm Extension
- Kilgallioch Wind Farm

Noise Assessment Location
NAL1 - Artfield
NAL2 - Low Airies
NAL3 - Glenchamber
NAL4 - Torwood Bungalow 2
NAL5 - Torwood Bungalow
NAL6 - Torwood House Hotel
NAL7 - Torwood Two Dogs Lodge
NAL8 - Gass Farm
NAL9 - Scotts Corner
NAL10 - Mark of Lochronald Bungalow
NAL11 - Mark of Lochronald
NAL12 - Fell of Loch Ronald
NAL13 - Balminnoch
NAL14 - The Old Schoolhouse
NAL15 - Kilquhockadale
NAL16 - Urrall
NAL17 - Tannielaggie
NAL18 - Kilmacfadzean
NAL19 - Quarter Farm
NAL20 - Pultadie
NAL21 - Balmurrie
NAL22 - Dranigower
NAL23 - Garvilland
NAL24 - Carscreugh Croft

0 1,000 2,000 Metres

N

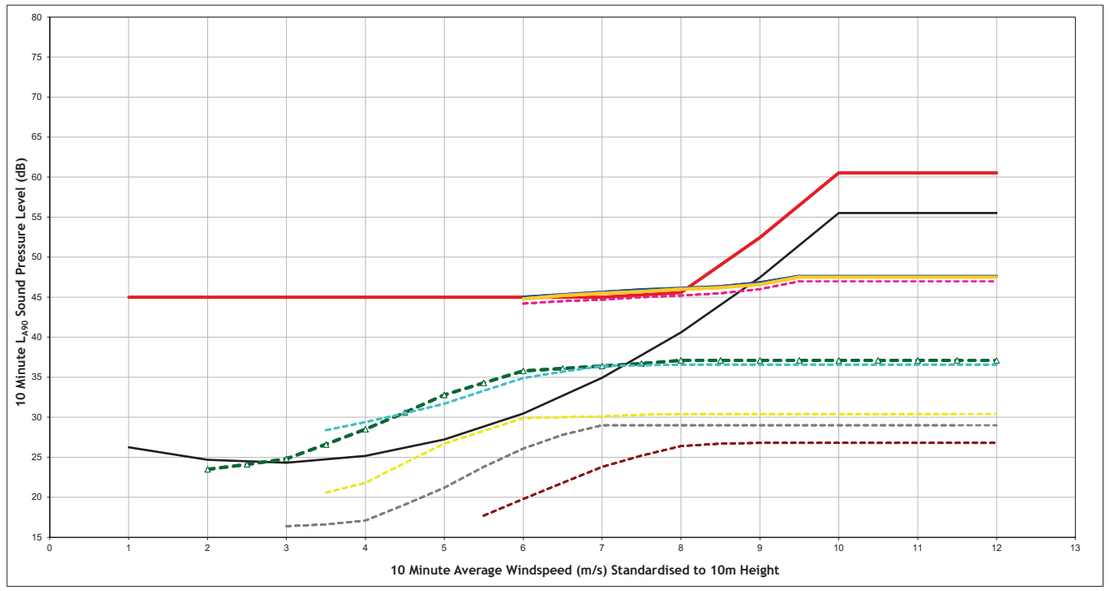
REV.	DETAILS	DRAWN	CHK'D	APP'D	DATE
R2	SECOND ISSUE	MT	JB	JB	05/06/2020
R1	FIRST ISSUE	KS	JB	JB	21/04/2020

Project	Artfield Wind Farm
Client	Statkraft
Title	Cumulative Turbine Schemes and Noise Assessment Locations
Figure No.	A1.1
Scale	1:60,000 @A3
Doc. Ref.	13865-002

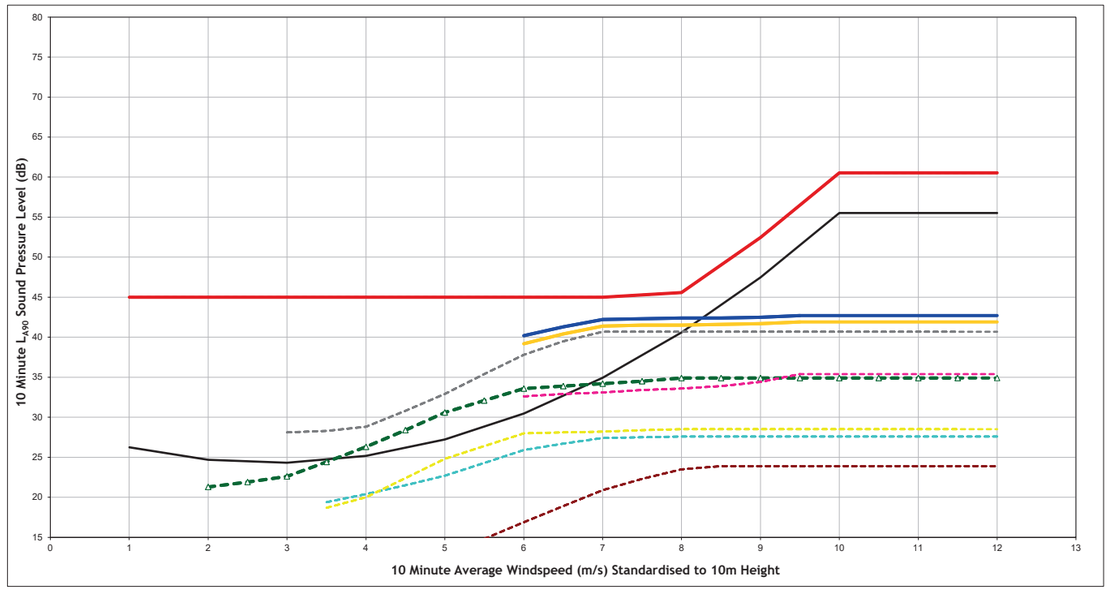
Statkraft

tnei

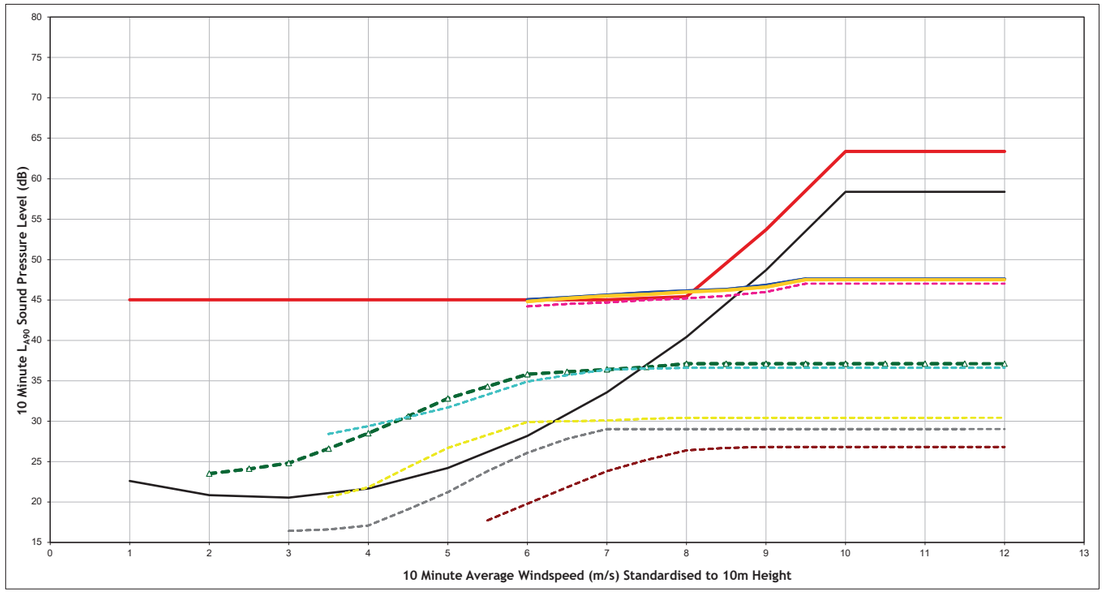
Quiet Daytime - Artfield (NAL1)



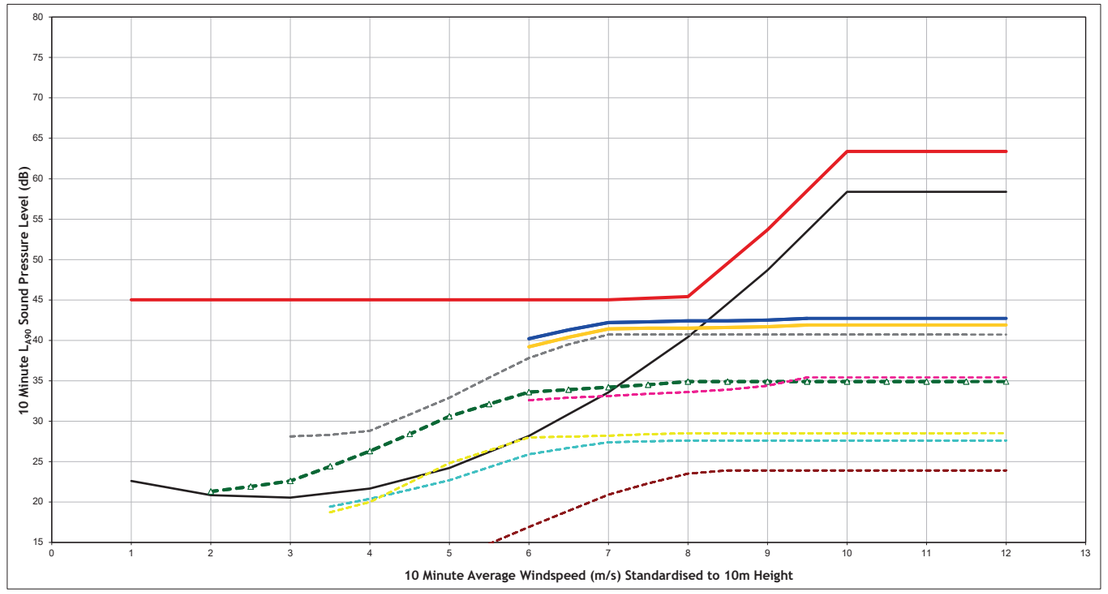
Quiet Daytime - Low Airies (NAL2)



Night Time - Artfield (NAL1)



Night Time - Low Airies (NAL2)



Legend:

- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Artfield (NAL1)
Figure Number	Figure A1.2a
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

Statkraft

tnei

Legend:

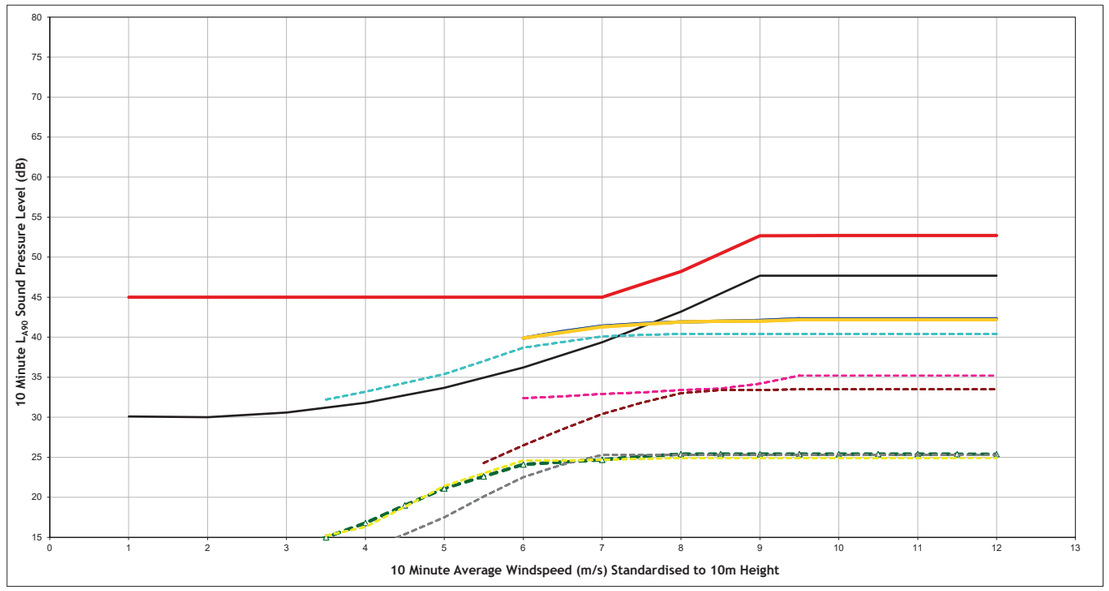
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Low Airies (NAL2)
Figure Number	Figure A1.2b
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

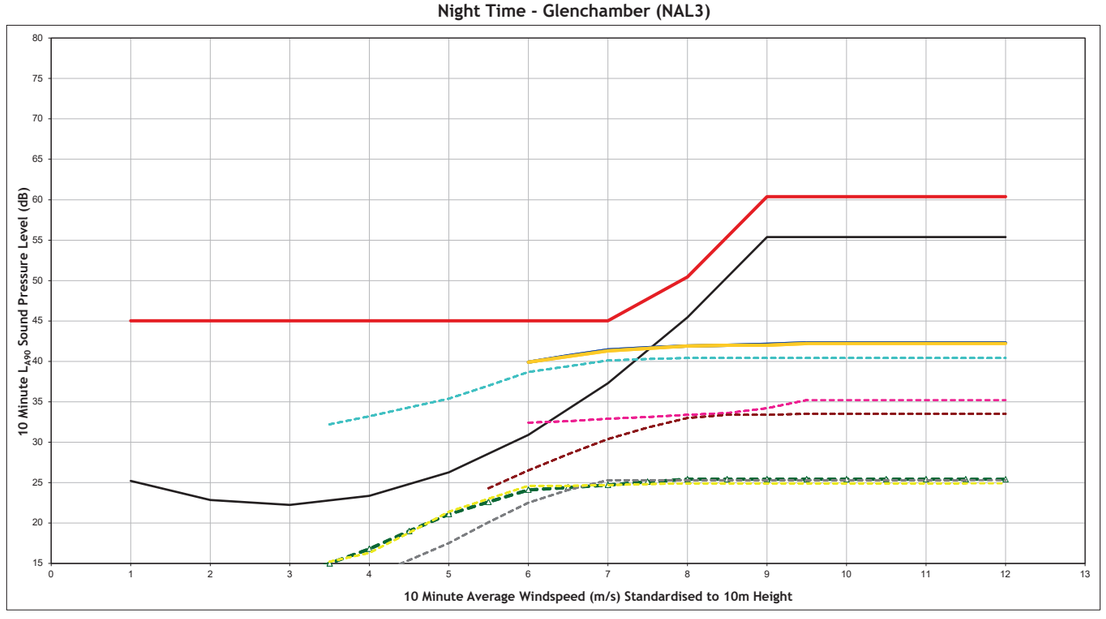
Statkraft

tnei

Quiet Daytime - Glenchamber (NAL3)



Night Time - Glenchamber (NAL3)

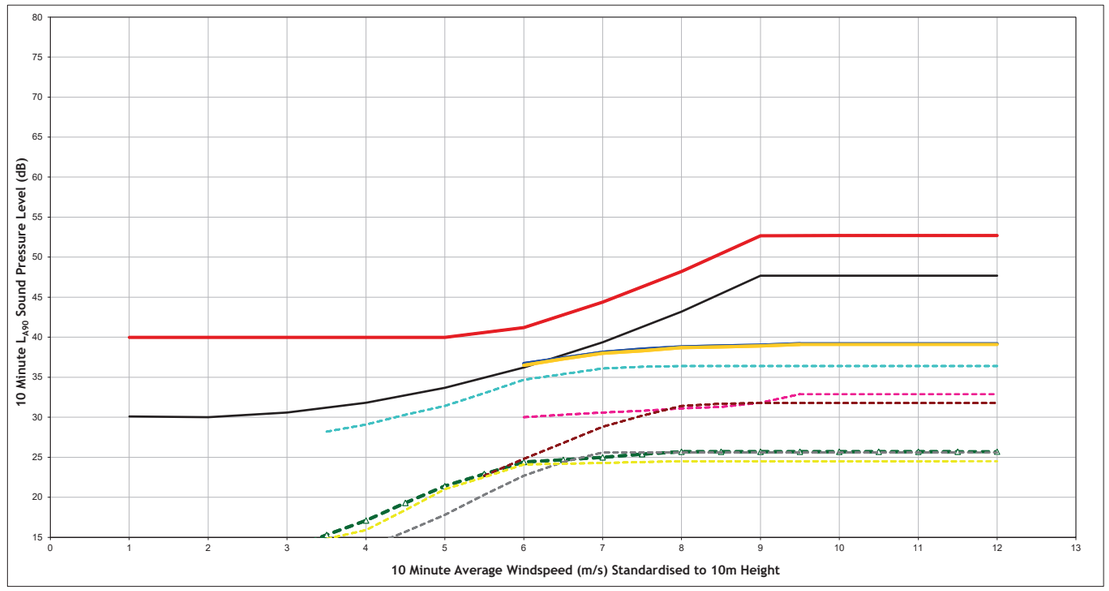


Legend:

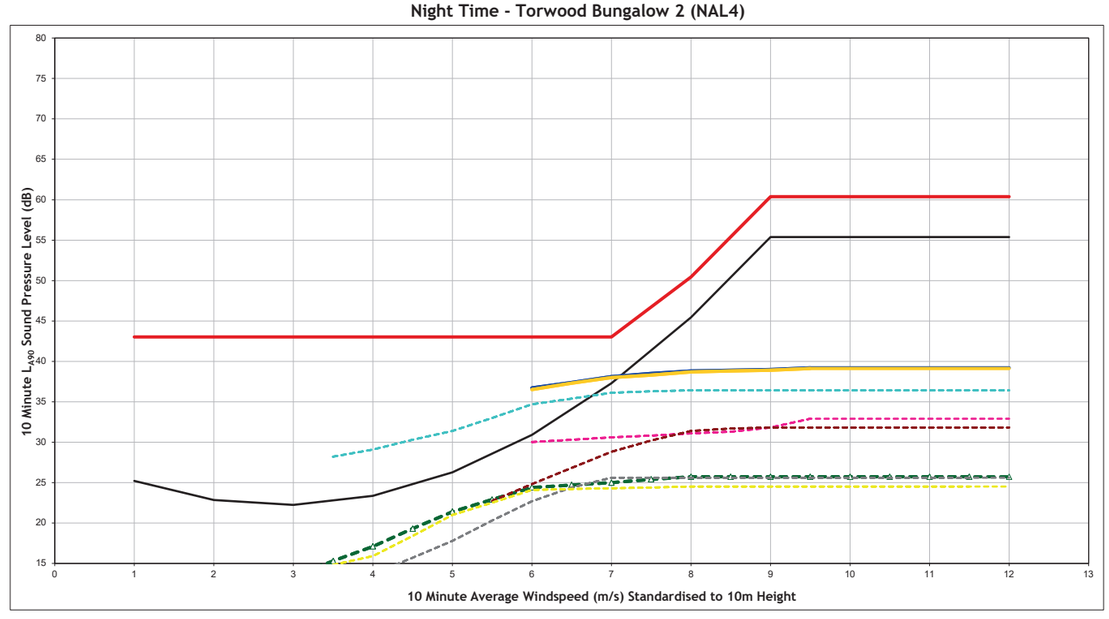
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Glenchamber (NAL3)
Figure Number	Figure A1.2c
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

Quiet Daytime - Torwood Bungalow 2 (NAL4)



Night Time - Torwood Bungalow 2 (NAL4)

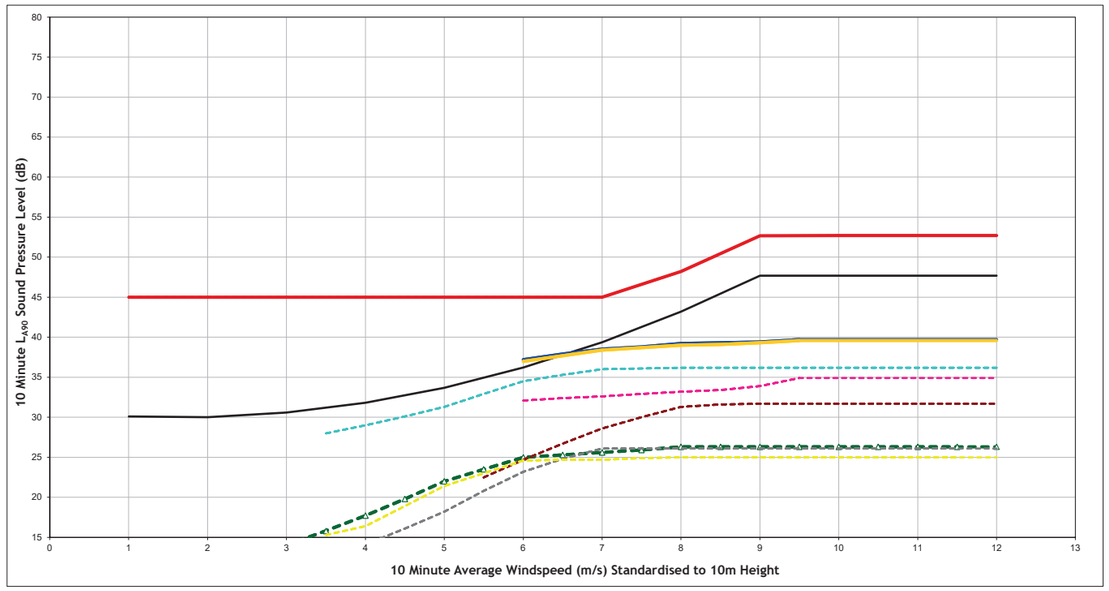


Legend:

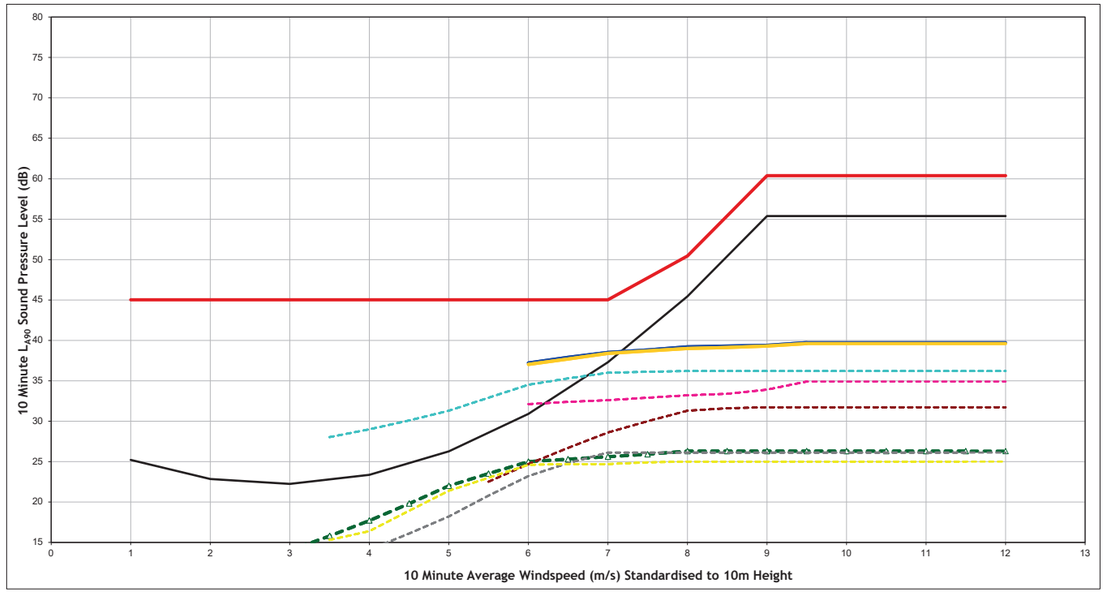
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Bungalow 2 (NAL4)
Figure Number	Figure A1.2d
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

Quiet Daytime - Torwood Bungalow (NAL5)



Night Time - Torwood Bungalow (NAL5)



Legend:

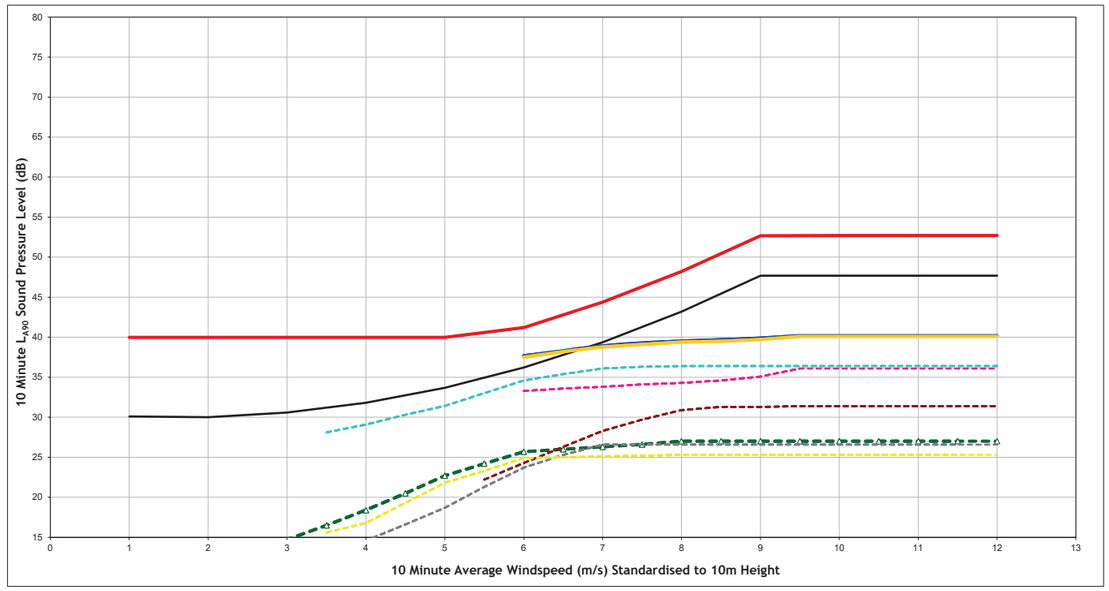
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Bungalow (NAL5)
Figure Number	Figure A1.2e
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

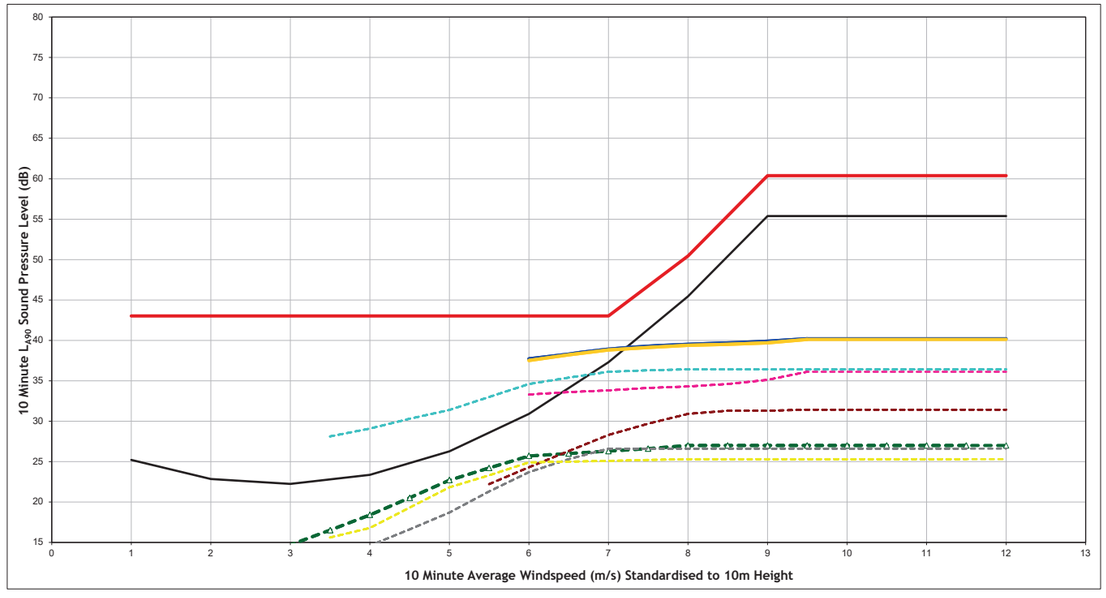
Statkraft

tnei

Quiet Daytime - Torwood House Hotel (NAL6)



Night Time - Torwood House Hotel (NAL6)



Legend:

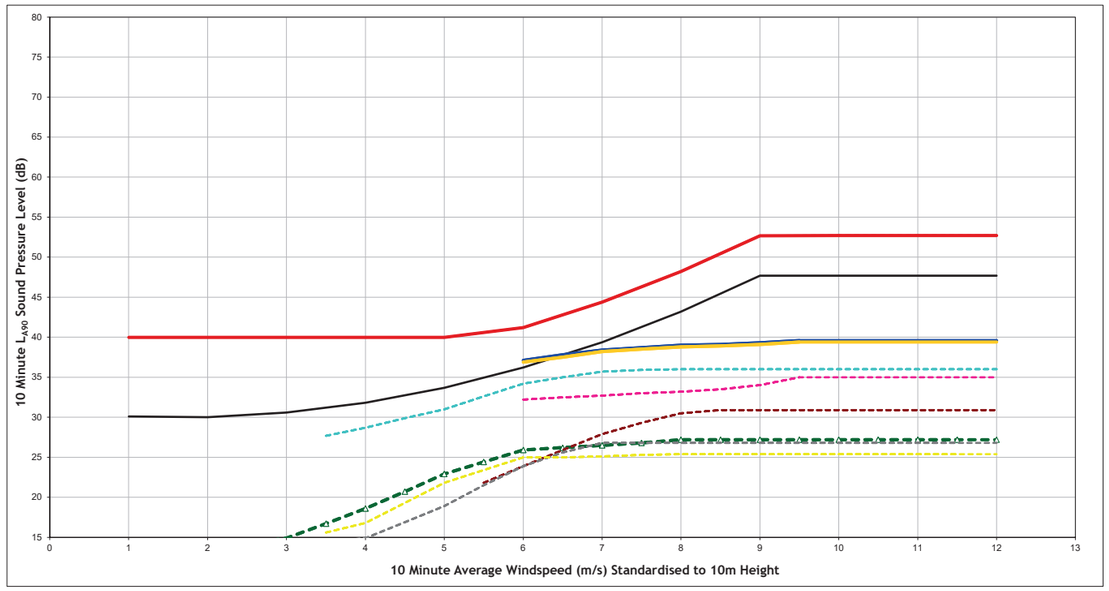
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood House Hotel (NAL6)
Figure Number	Figure A1.2f
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

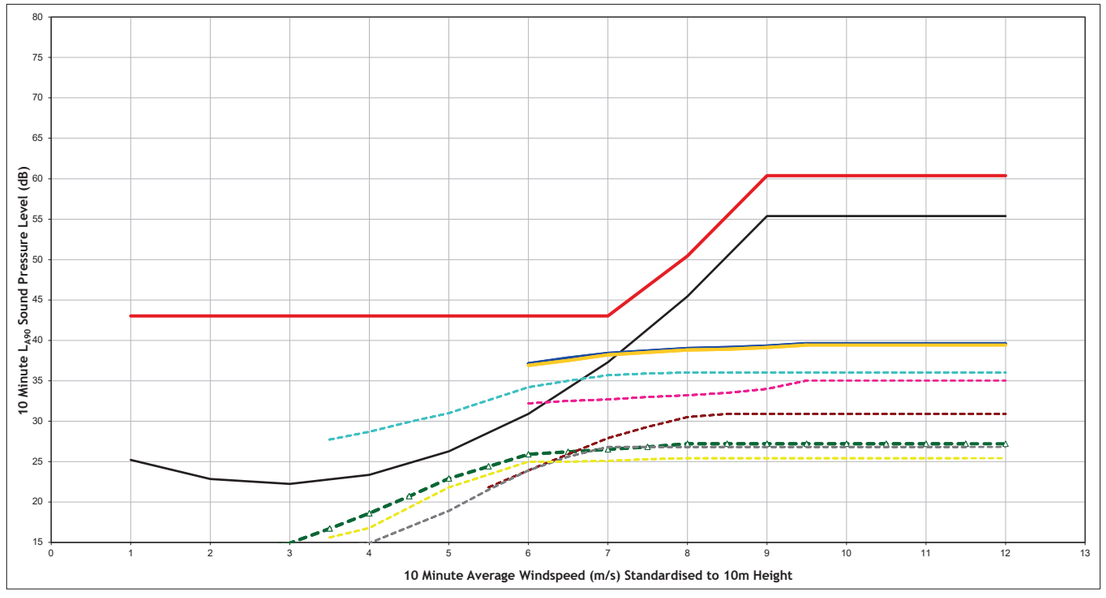
Statkraft

tnei

Quiet Daytime - Torwood Two Dogs Lodge (NAL7)



Night Time - Torwood Two Dogs Lodge (NAL7)



Legend:

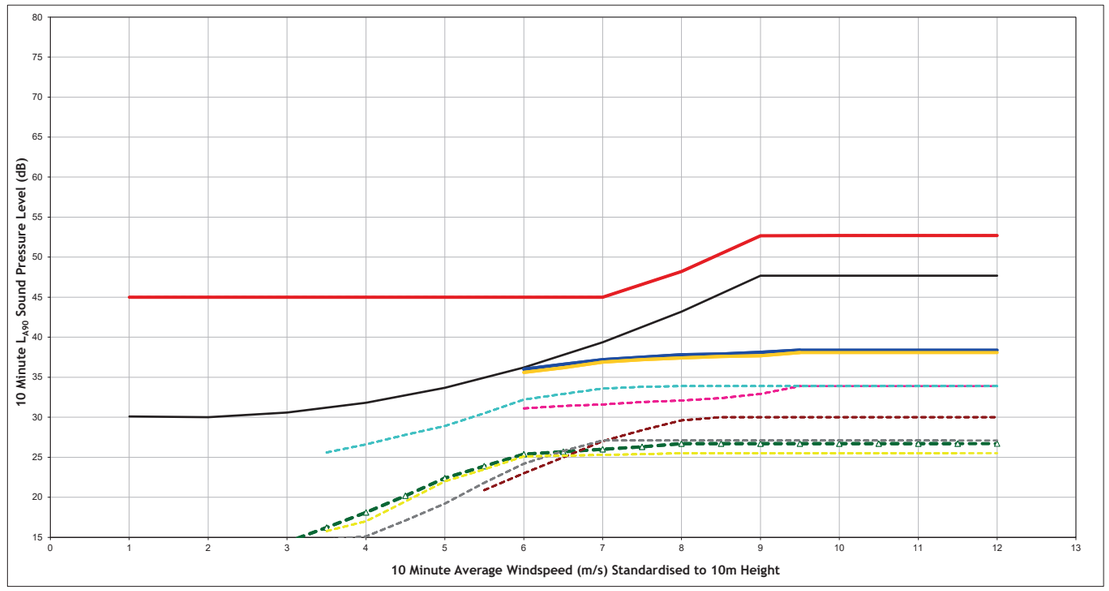
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Two Dogs Lodge (NAL7)
Figure Number	Figure A1.2g
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

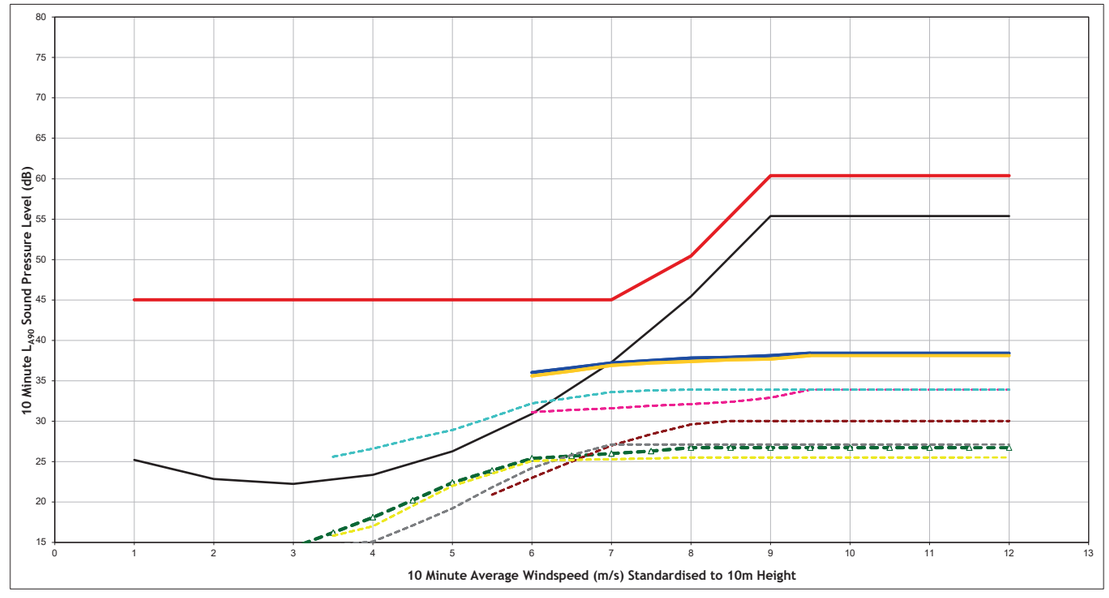
Statkraft

tnei

Quiet Daytime - Gass Farm (NAL8)



Night Time - Gass Farm (NAL8)



Legend:

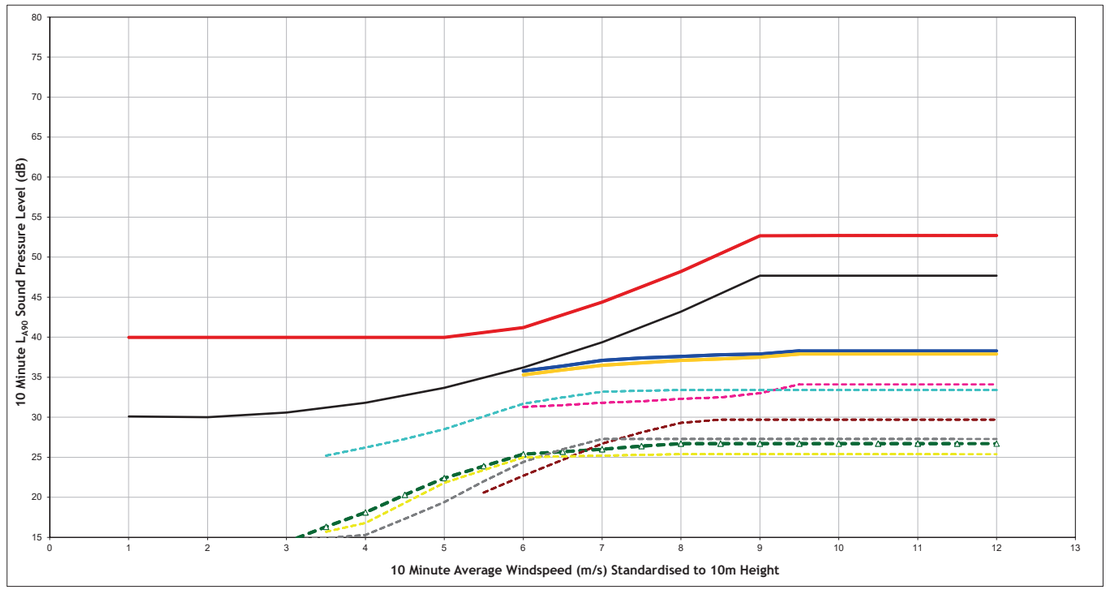
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Gass Farm (NAL8)
Figure Number	Figure A1.2h
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

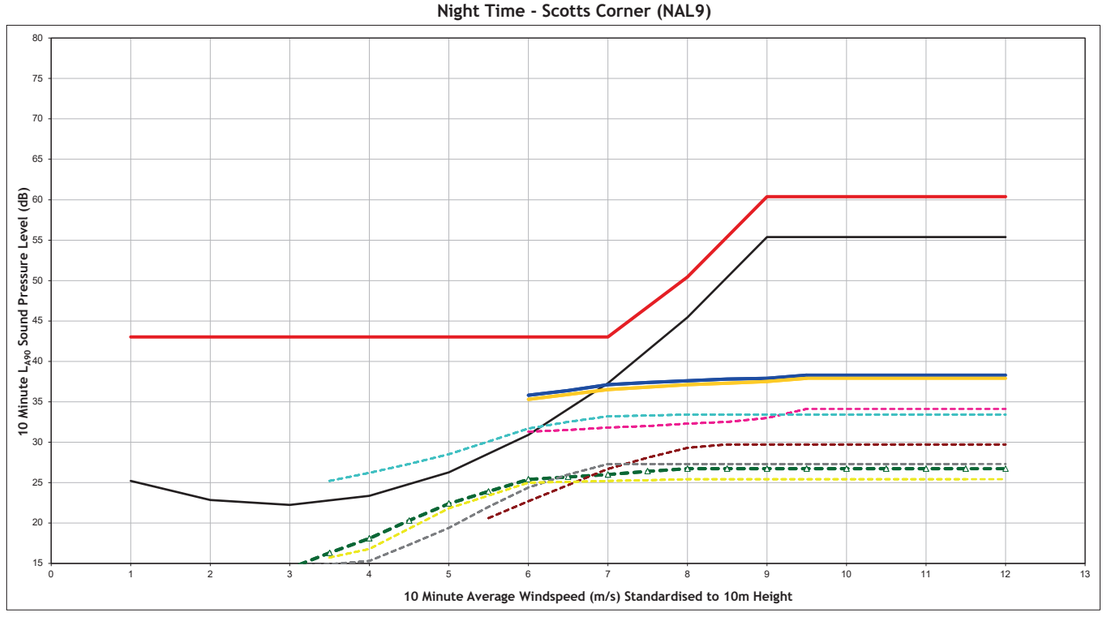
Statkraft

tnei

Quiet Daytime - Scotts Corner (NAL9)



Night Time - Scotts Corner (NAL9)

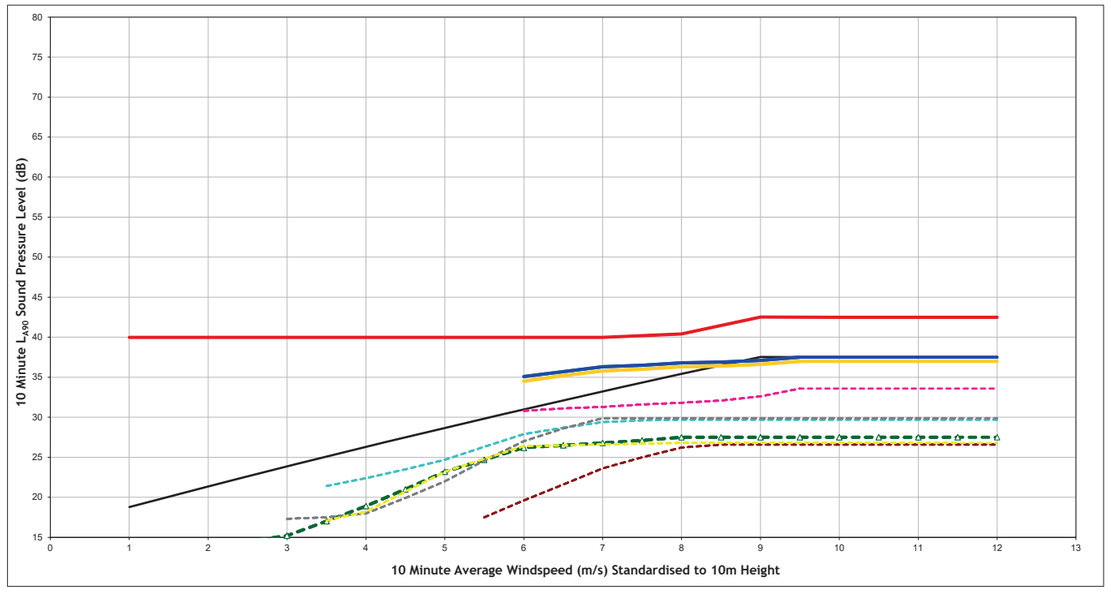


Legend:

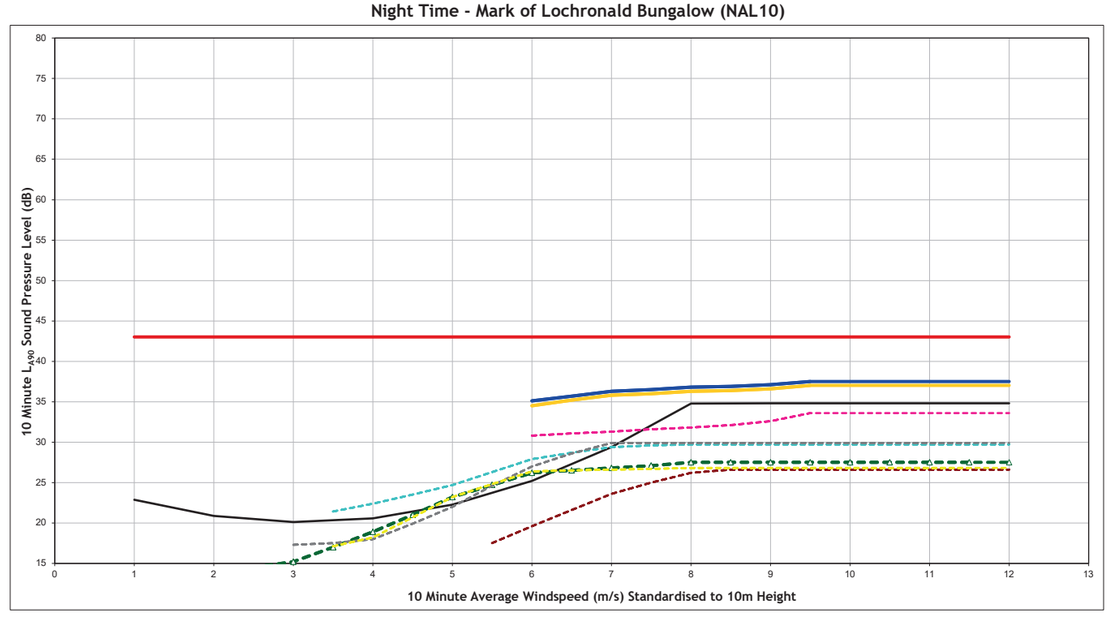
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Scotts Corner (NAL9)
Figure Number	Figure A1.2i
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

Quiet Daytime - Mark of Lochronald Bungalow (NAL10)



Night Time - Mark of Lochronald Bungalow (NAL10)

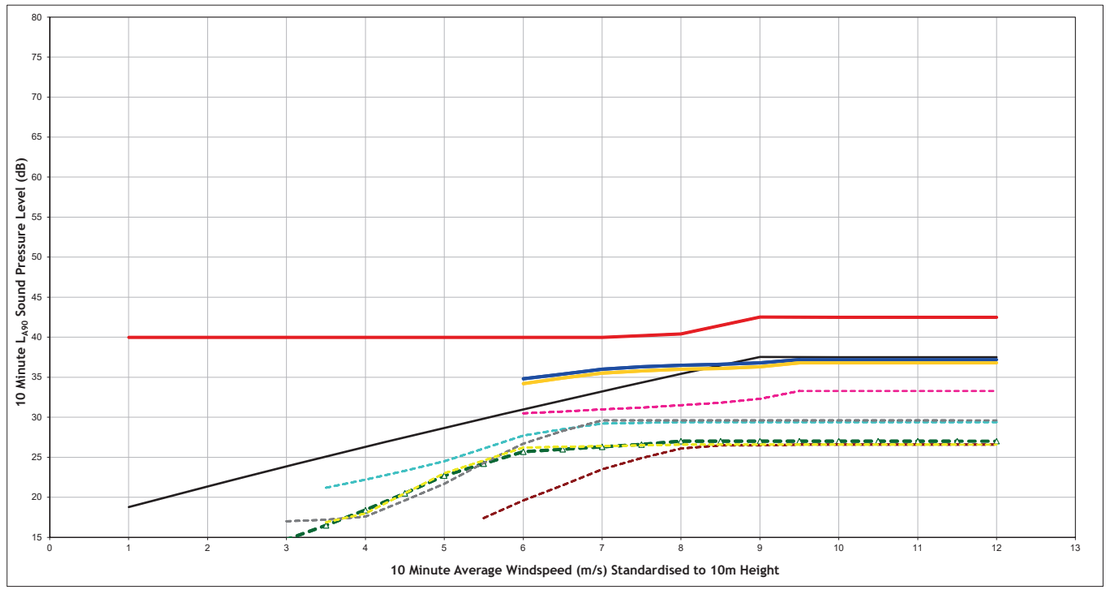


Legend:

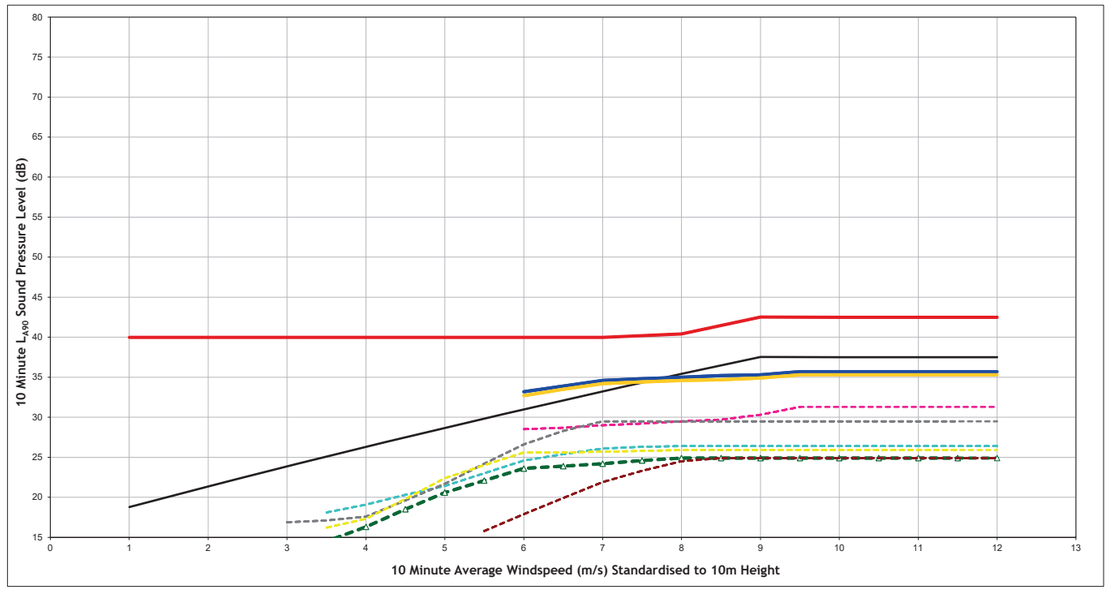
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Mark of Lochronald Bungalow (NAL10)
Figure Number	Figure A1.2j
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

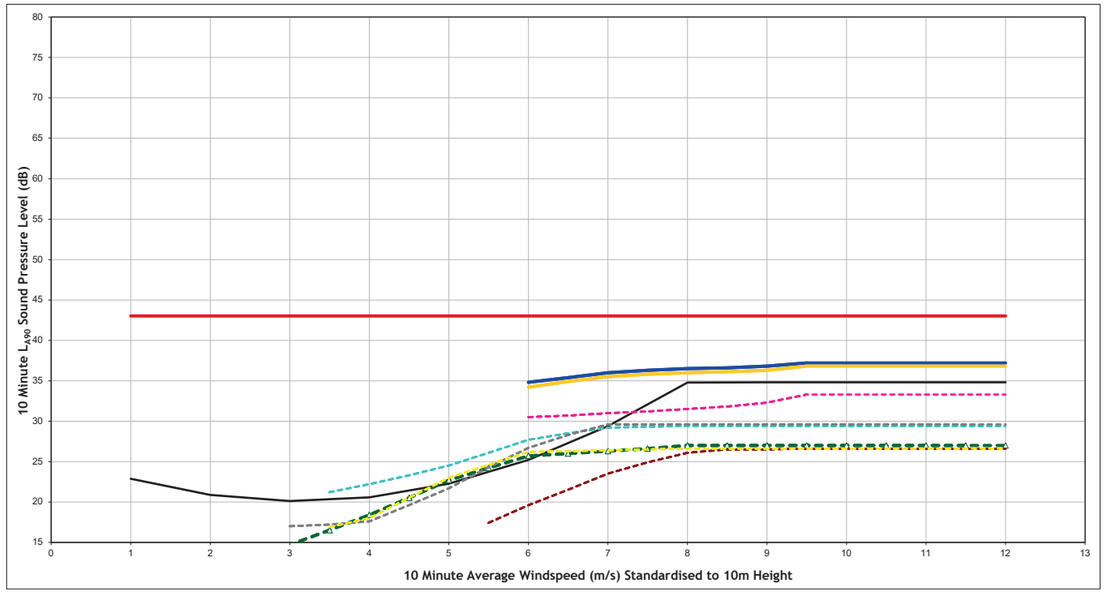
Quiet Daytime - Mark of Lochronald (NAL11)



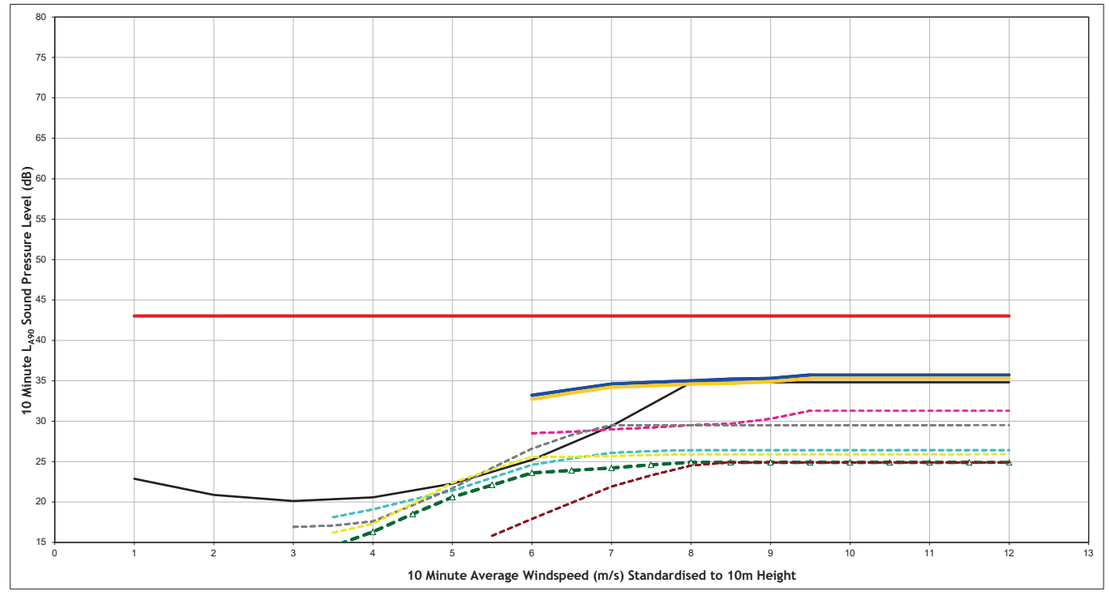
Quiet Daytime - Fell of Loch Ronald (NAL12)



Night Time - Mark of Lochronald (NAL11)



Night Time - Fell of Loch Ronald (NAL12)



Legend:

- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Mark of Lochronald (NAL11)
Figure Number	Figure A1.2k
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

Statkraft

tnei

Legend:

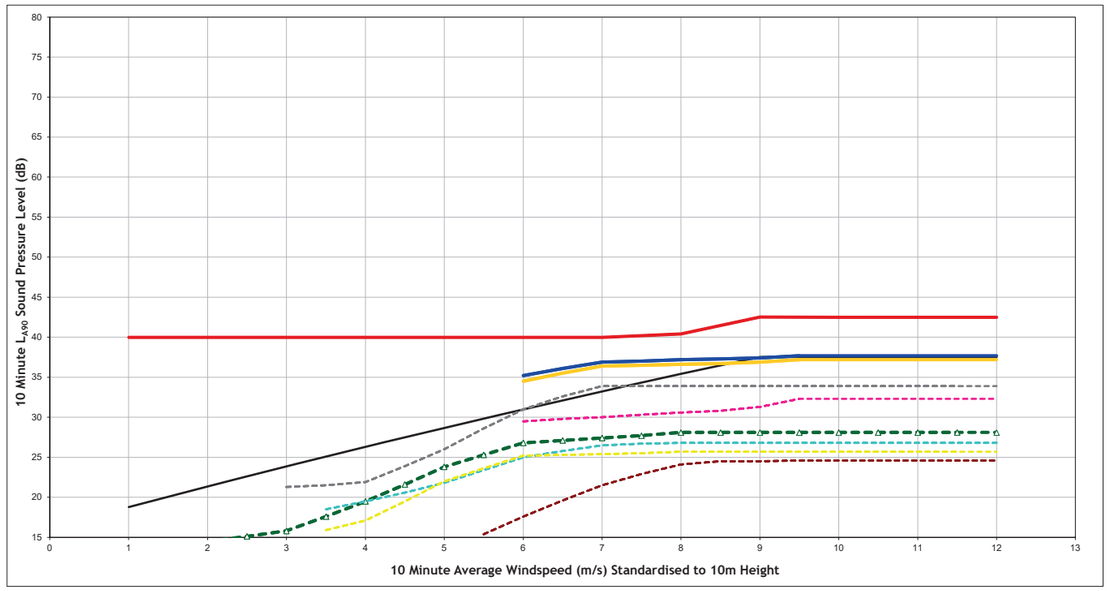
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Fell of Loch Ronald (NAL12)
Figure Number	Figure A1.2l
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

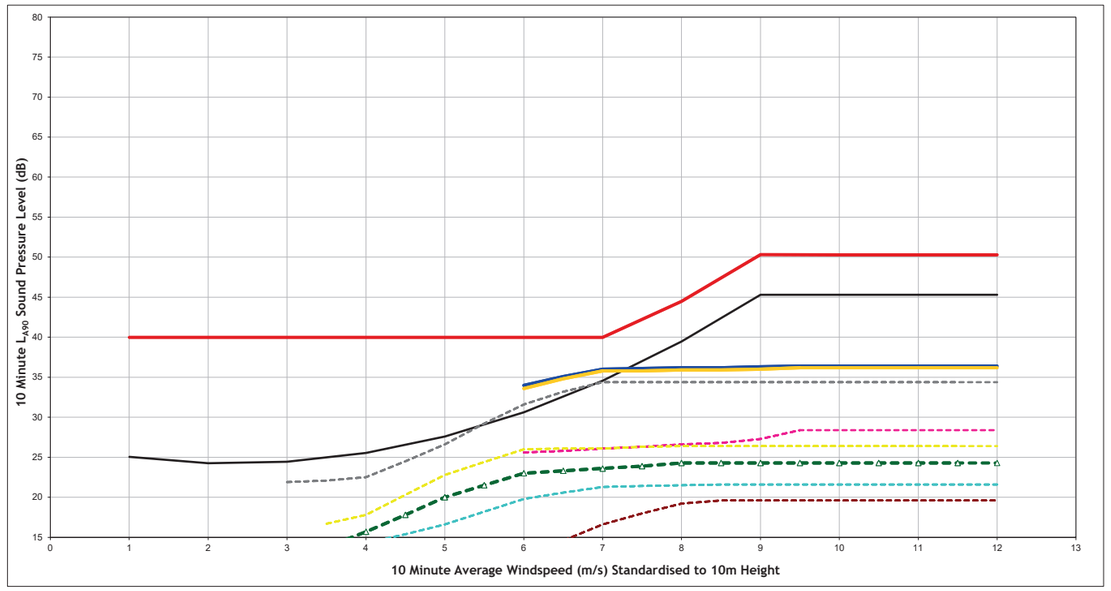
Statkraft

tnei

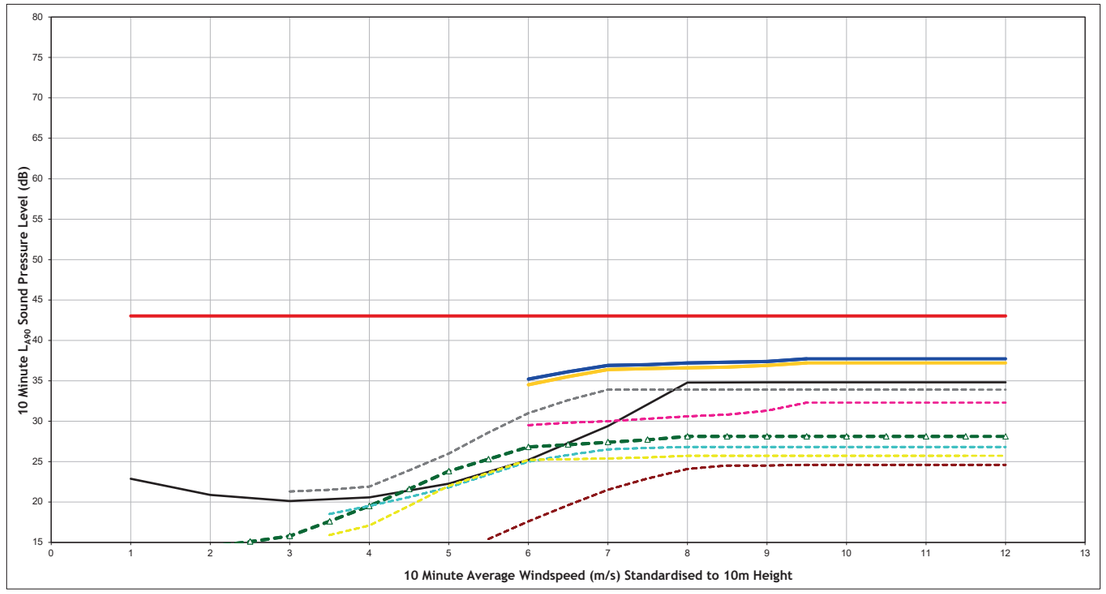
Quiet Daytime - Balminnoch (NAL13)



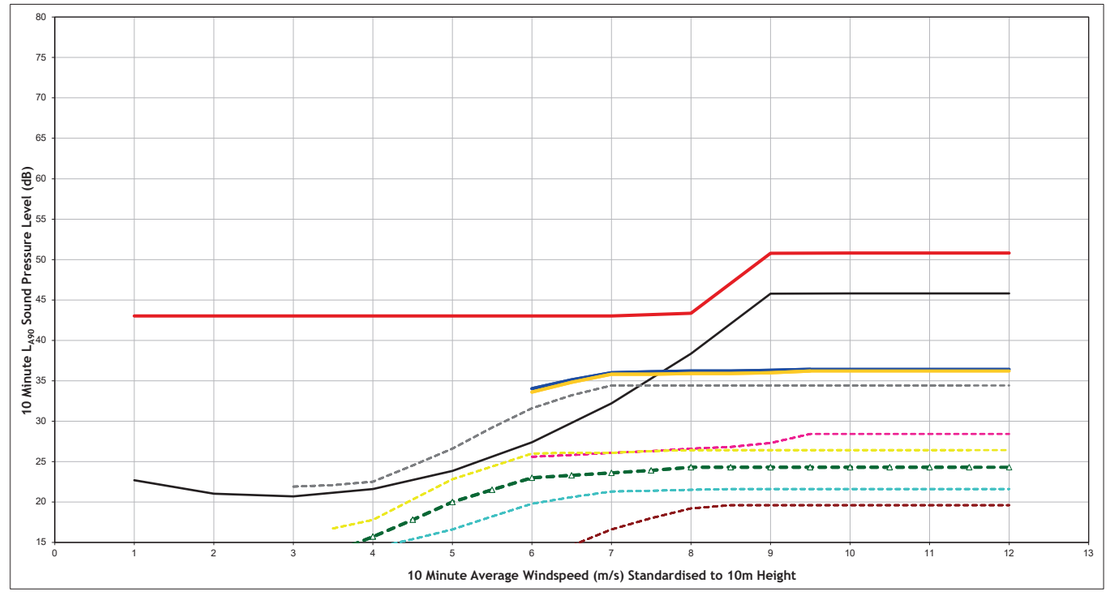
Quiet Daytime - The Old Schoolhouse (NAL14)



Night Time - Balminnoch (NAL13)



Night Time - The Old Schoolhouse (NAL14)



Legend:

- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Balminnoch (NAL13)
Figure Number	Figure A1.2m
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

Statkraft

tnei

Legend:

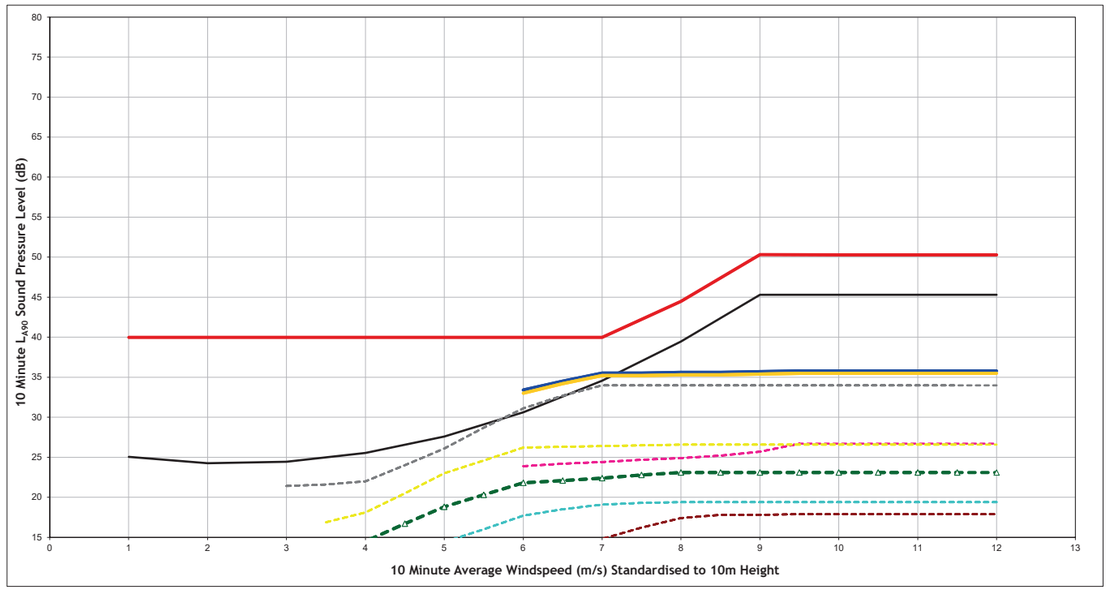
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment The Old Schoolhouse (NAL14)
Figure Number	Figure A1.2n
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

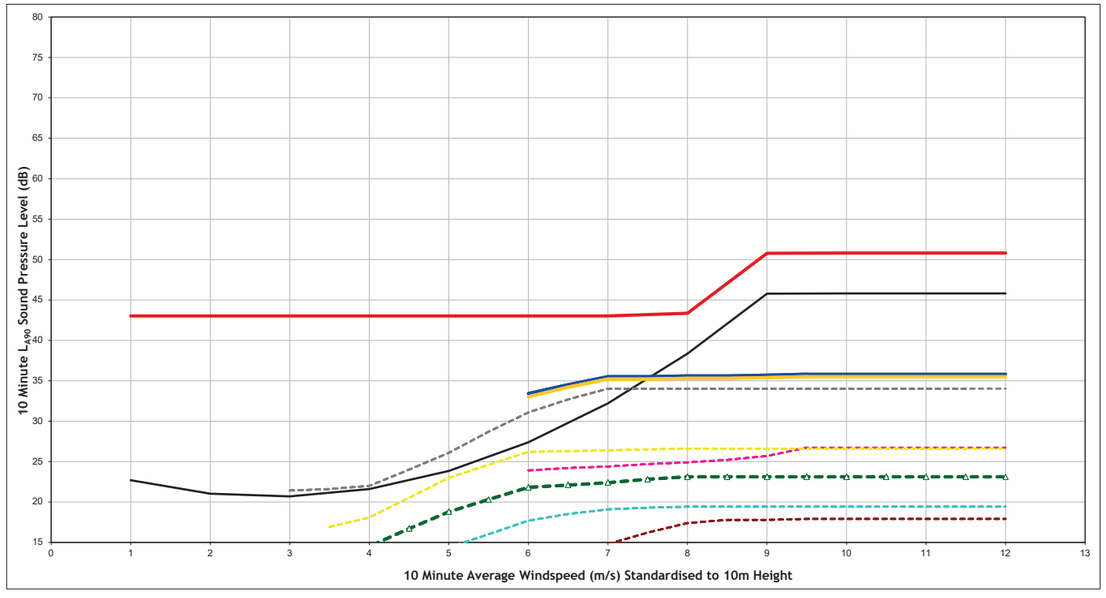
Statkraft

tnei

Quiet Daytime - Kilquhockadale (NAL15)



Night Time - Kilquhockadale (NAL15)



Legend:

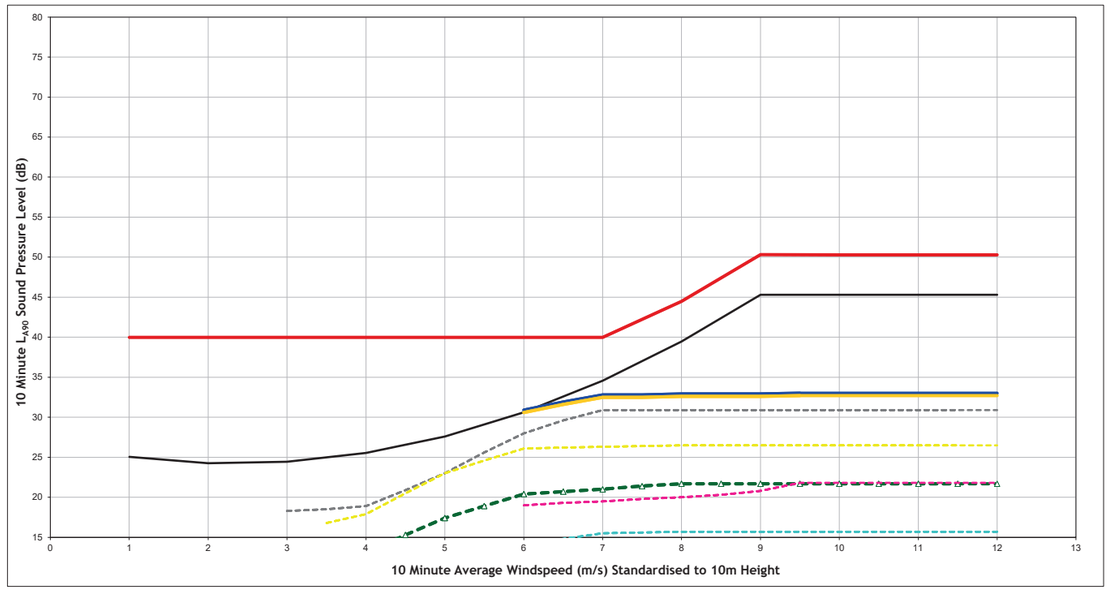
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Kilquhockadale (NAL15)
Figure Number	Figure A1.2o
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

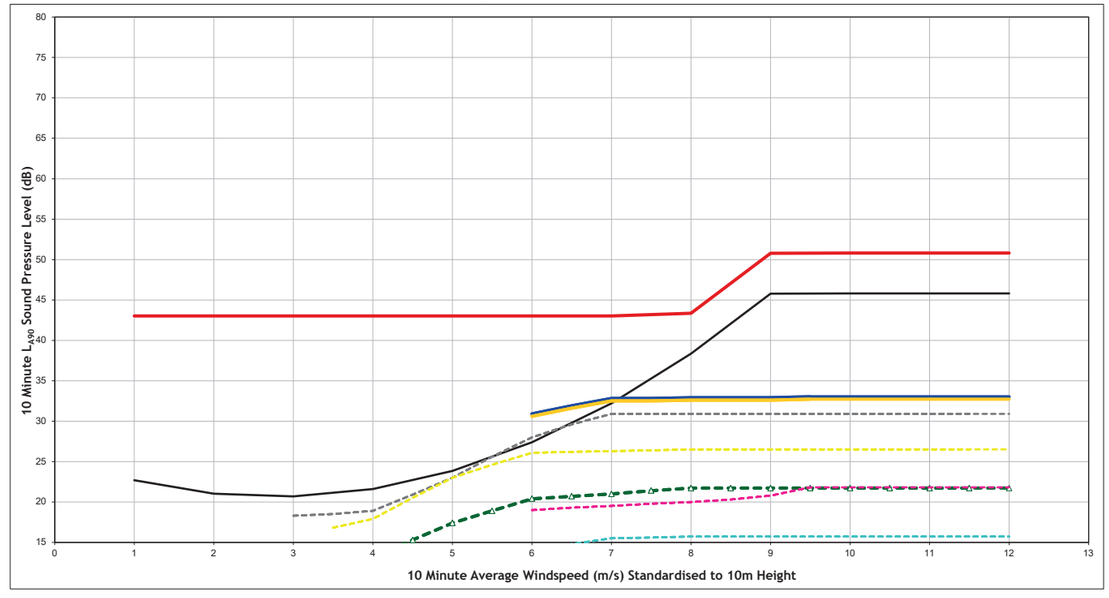
Statkraft

tnei

Quiet Daytime - Urrall (NAL16)



Night Time - Urrall (NAL16)



Legend:

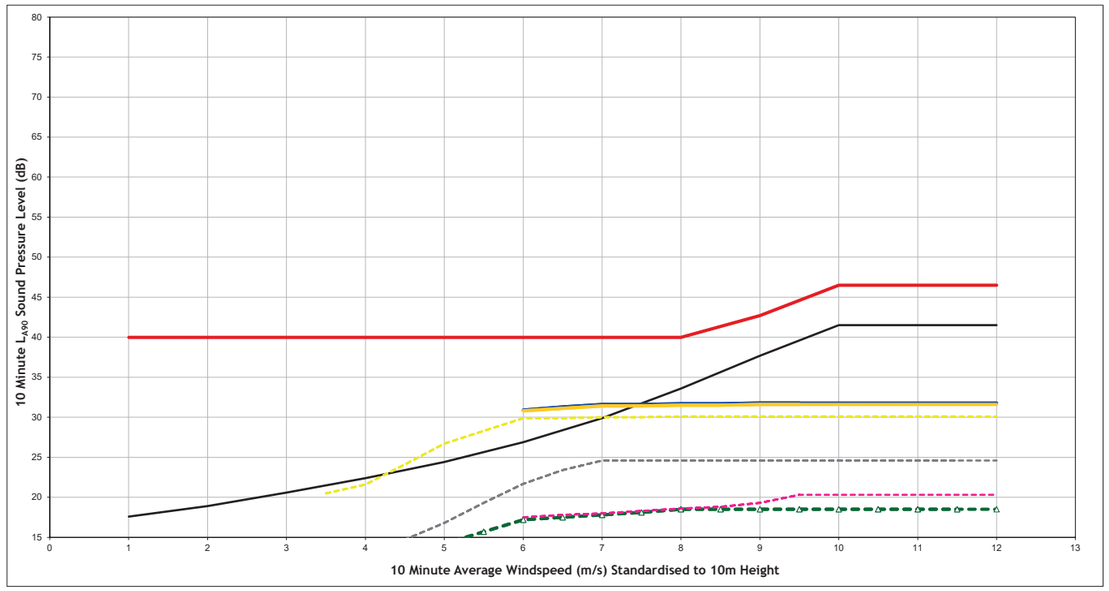
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Urrall (NAL16)
Figure Number	Figure A1.2p
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

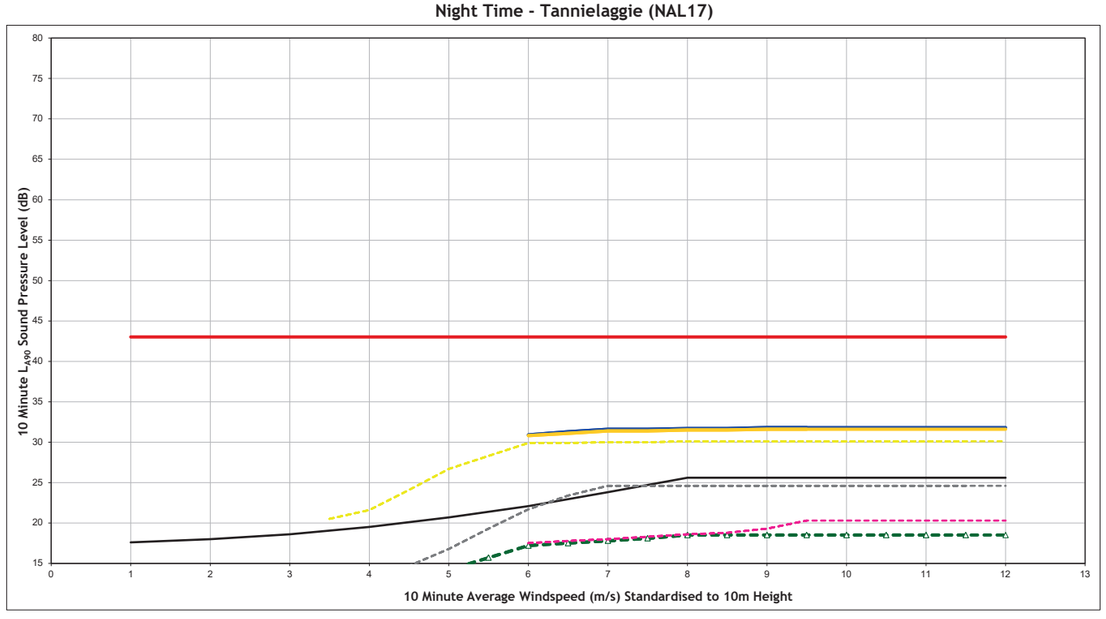
Statkraft

tnei

Quiet Daytime - Tannielaggie (NAL17)



Night Time - Tannielaggie (NAL17)



Legend:

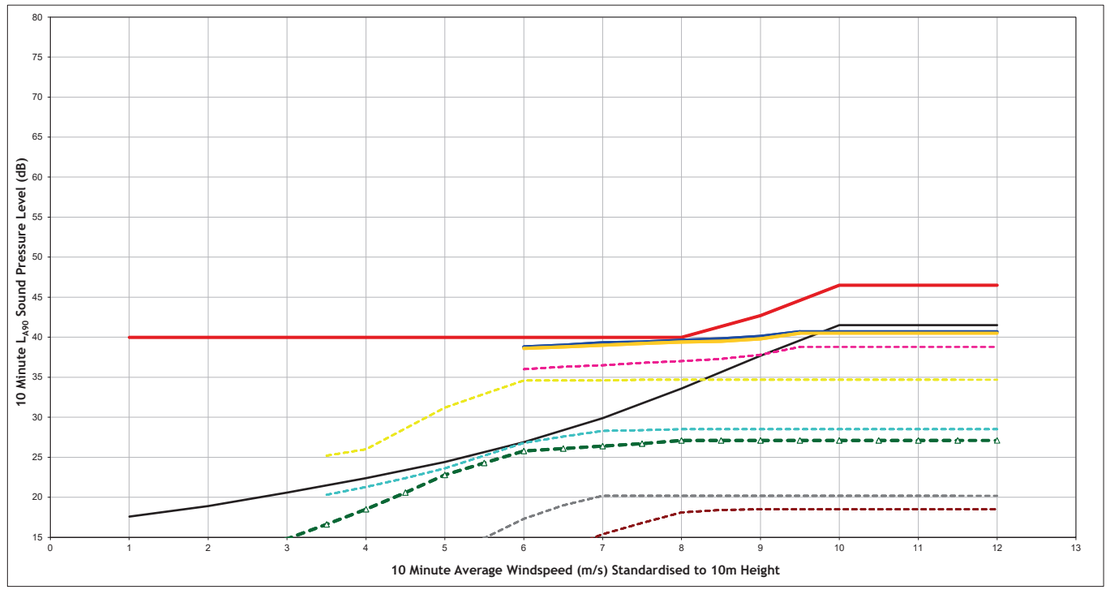
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Tannielaggie (NAL17)
Figure Number	Figure A1.2q
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

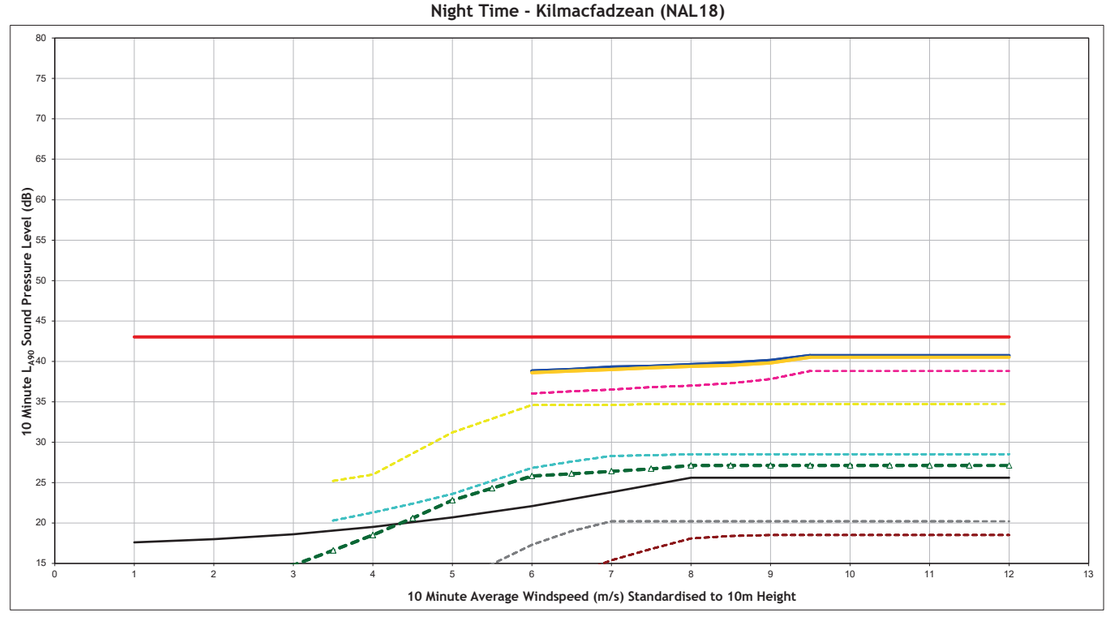
Statkraft

tnei

Quiet Daytime - Kilmacfadzean (NAL18)



Night Time - Kilmacfadzean (NAL18)



Legend:

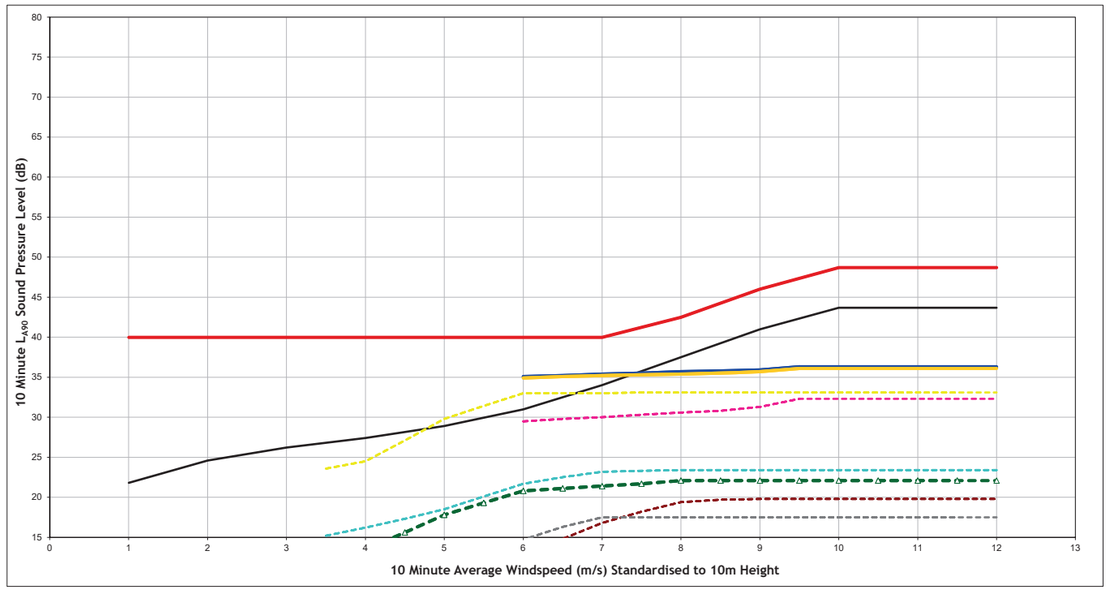
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Kilmacfadzean (NAL18)
Figure Number	Figure A1.2r
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

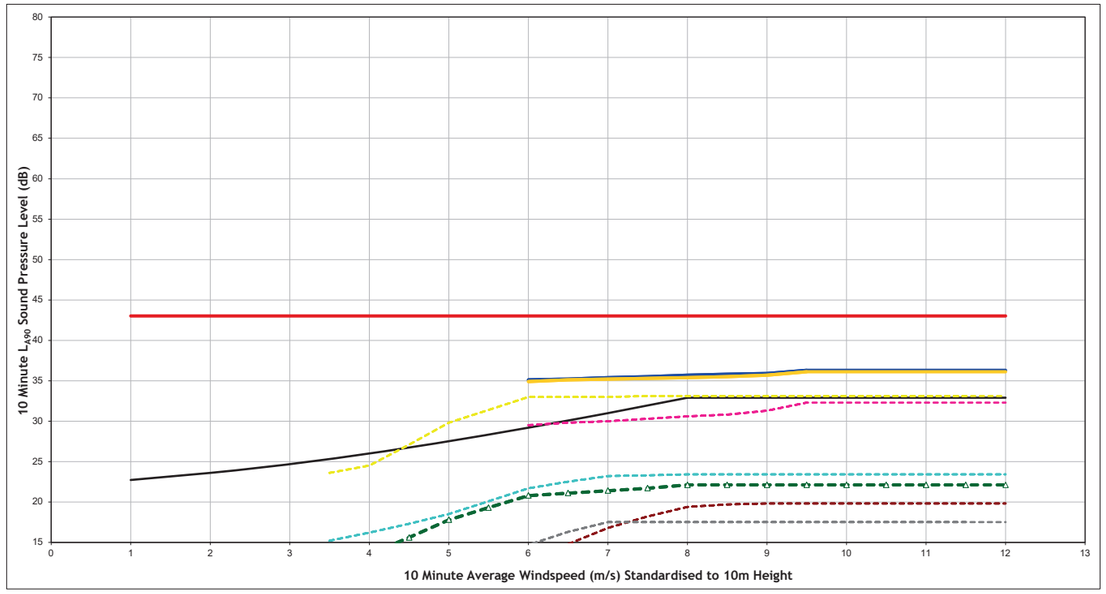
Statkraft

tnei

Quiet Daytime - Quarter Farm (NAL19)



Night Time - Quarter Farm (NAL19)

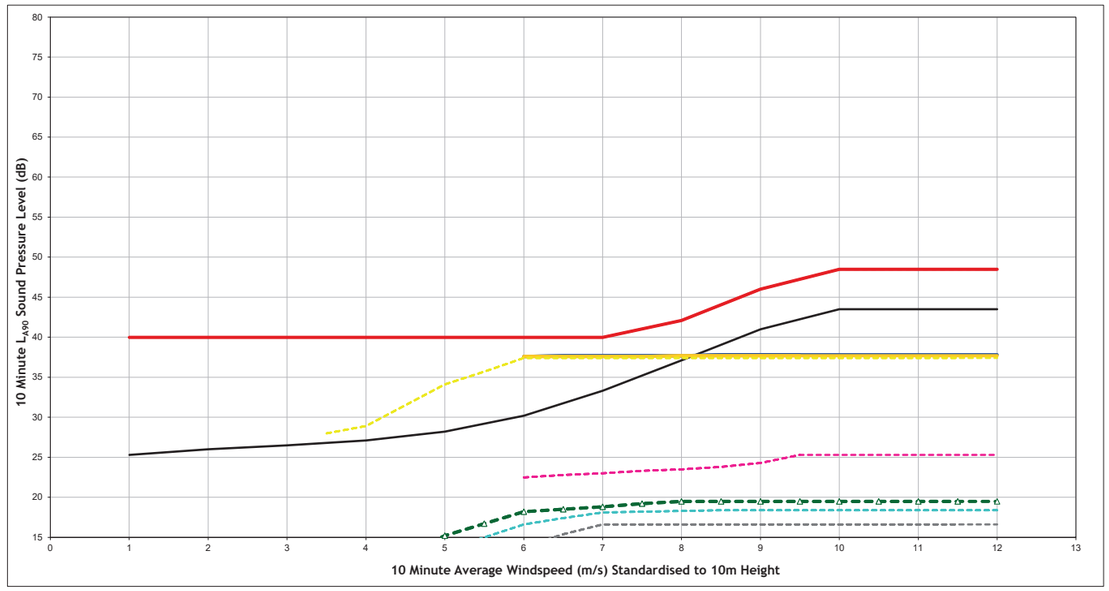


Legend:

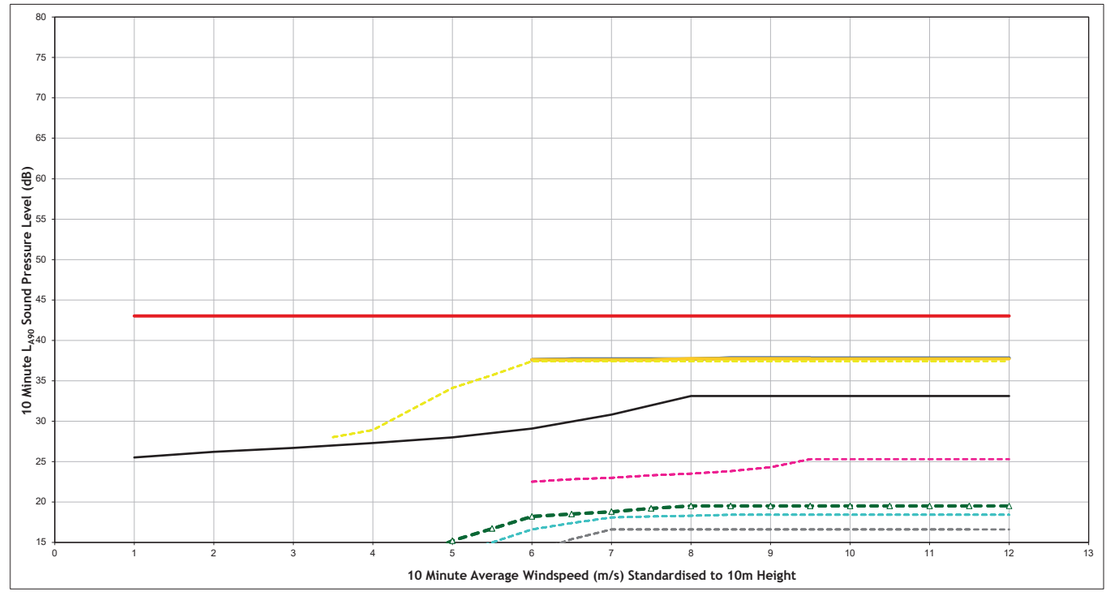
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Quarter Farm (NAL19)
Figure Number	Figure A1.2s
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

Quiet Daytime - Pultadie (NAL20)



Night Time - Pultadie (NAL20)

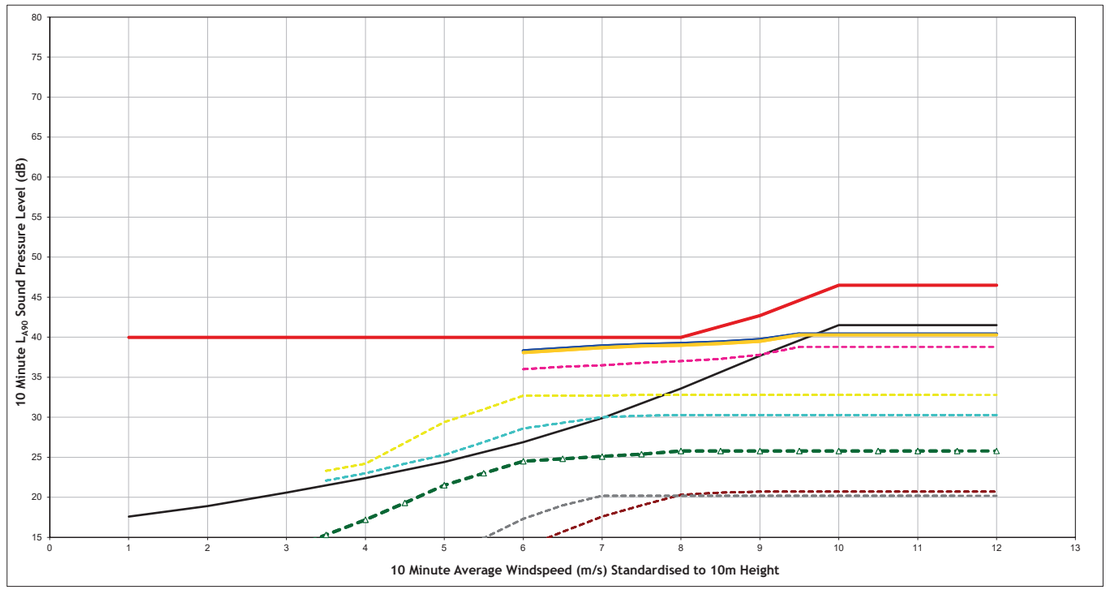


Legend:

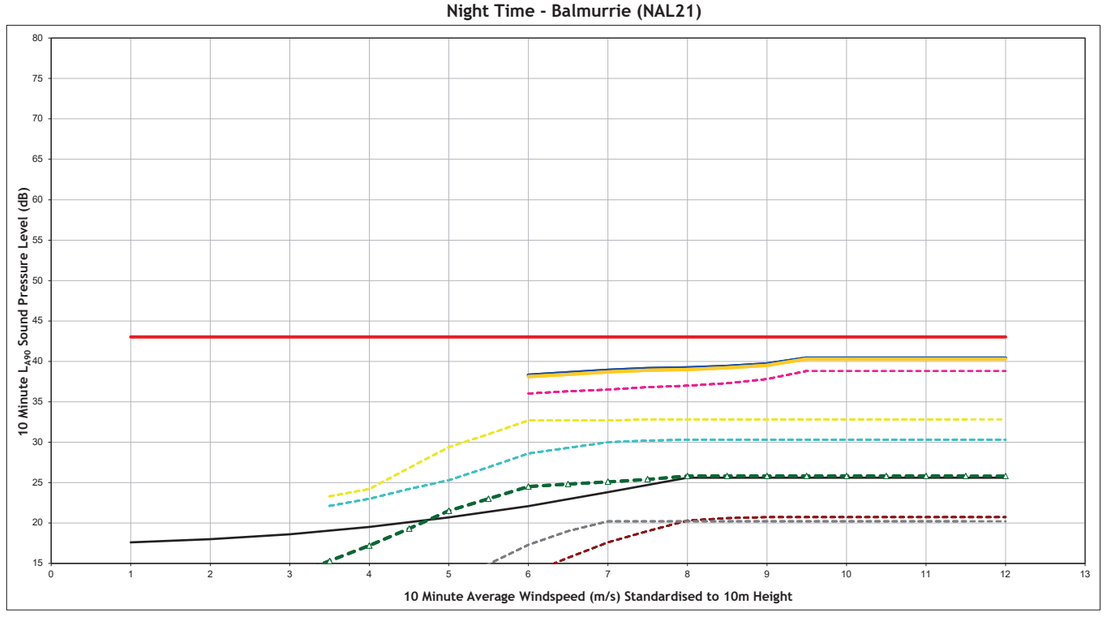
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Pultadie (NAL20)
Figure Number	Figure A1.2t
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

Quiet Daytime - Balmurrie (NAL21)



Night Time - Balmurrie (NAL21)

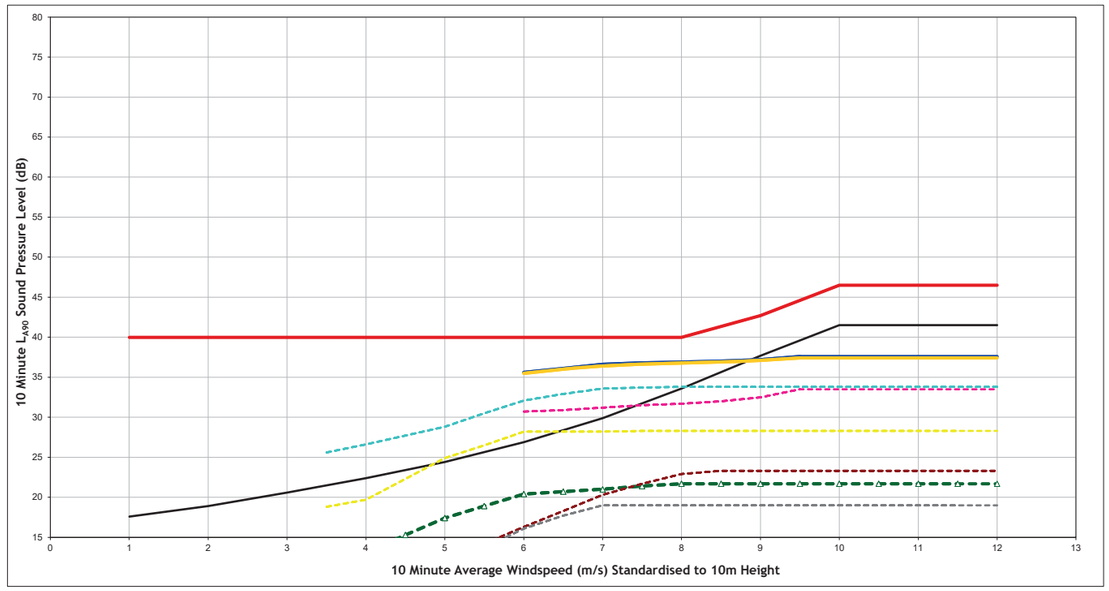


Legend:

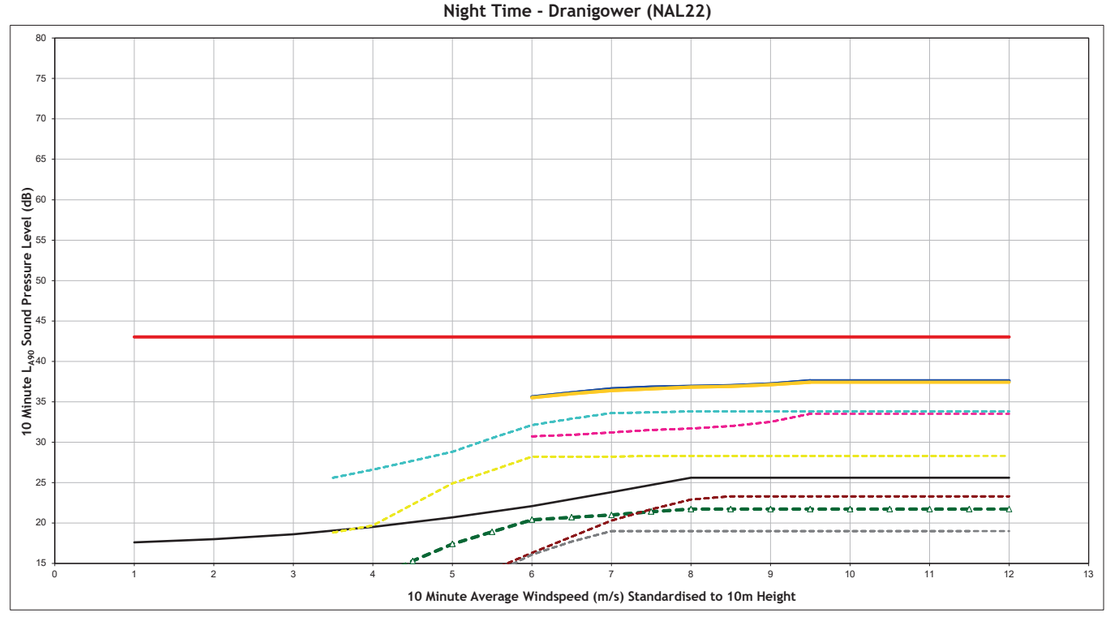
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Balmurrie (NAL21)
Figure Number	Figure A1.2u
Scale	NTS
Drawn	JB
Checked	JM
Date	07/05/2020
Document Reference	13865-Models

Quiet Daytime - Dranigower (NAL22)



Night Time - Dranigower (NAL22)

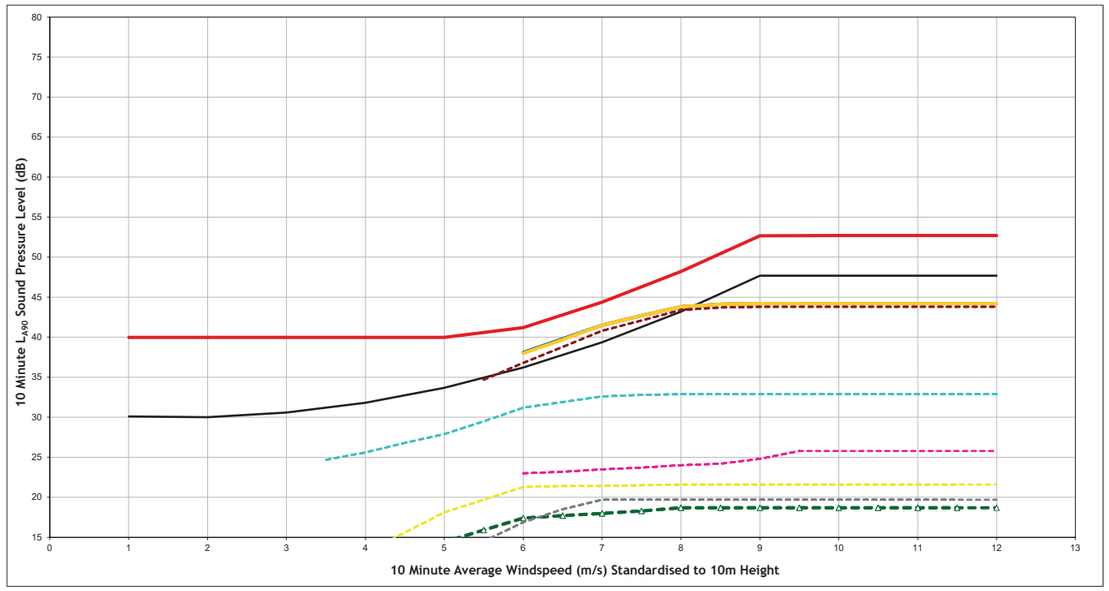


Legend:

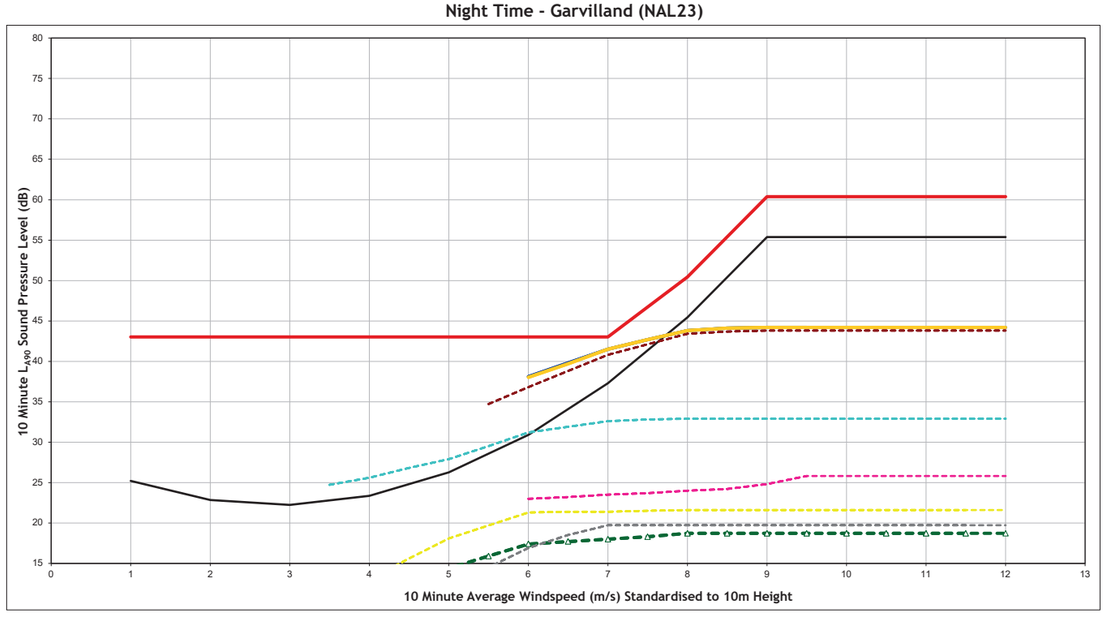
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Dranigower (NAL22)
Figure Number	Figure A1.2v
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

Quiet Daytime - Garvilland (NAL23)



Night Time - Garvilland (NAL23)



Legend:

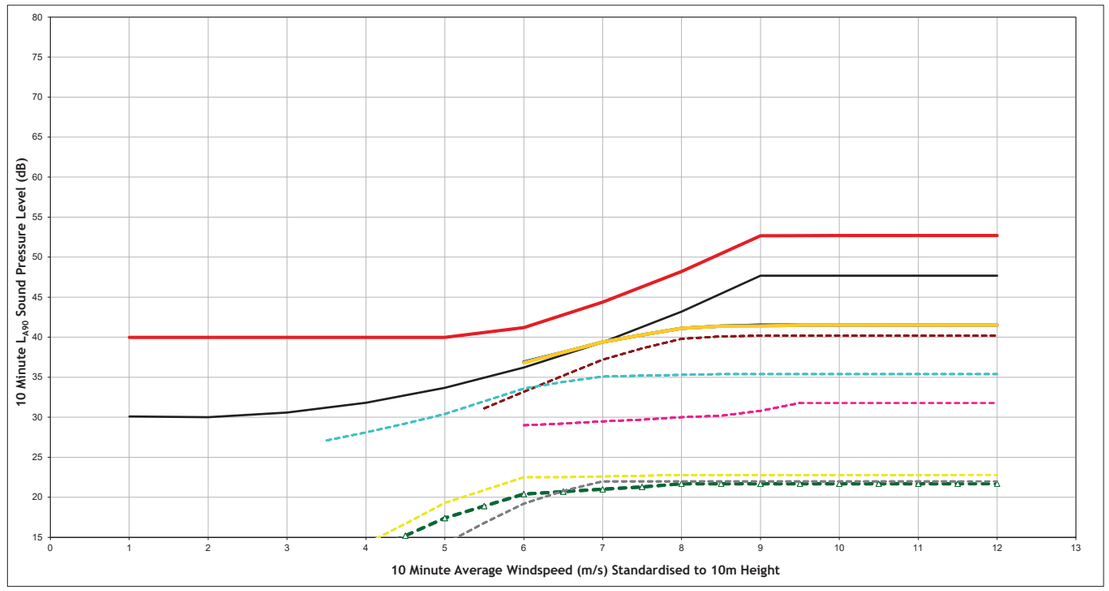
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Garvilland (NAL23)
Figure Number	Figure A1.2w
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

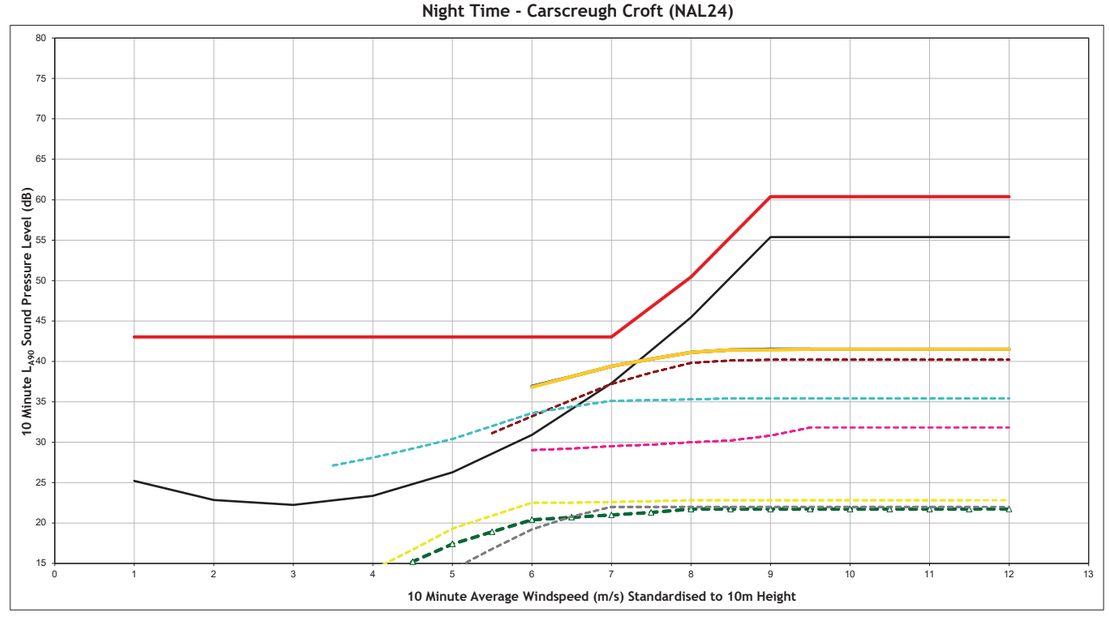
Statkraft

tnei

Quiet Daytime - Carscreugh Croft (NAL24)



Night Time - Carscreugh Croft (NAL24)



Legend:

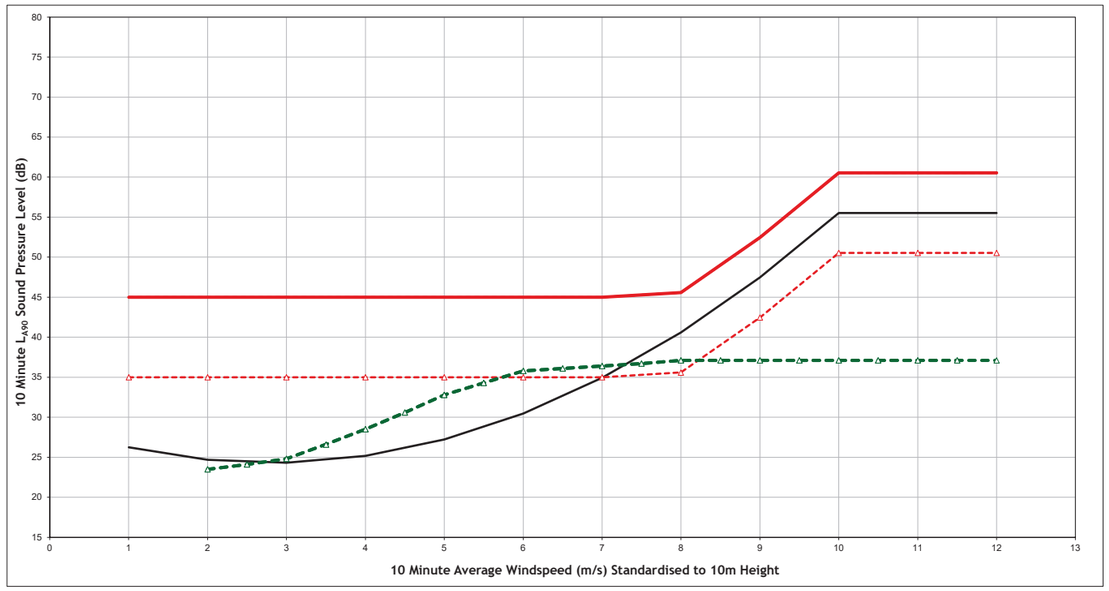
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative Wind Farms
- Artfield Forest Wind Farm
- Cumulative All Other Wind Farms
- Artfield Fell + Balmurrie
- Carscreugh
- Glenchamber
- Airies
- Killgallioch + Killgallioch Extension

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Carscreugh Croft (NAL24)
Figure Number	Figure A1.2x
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

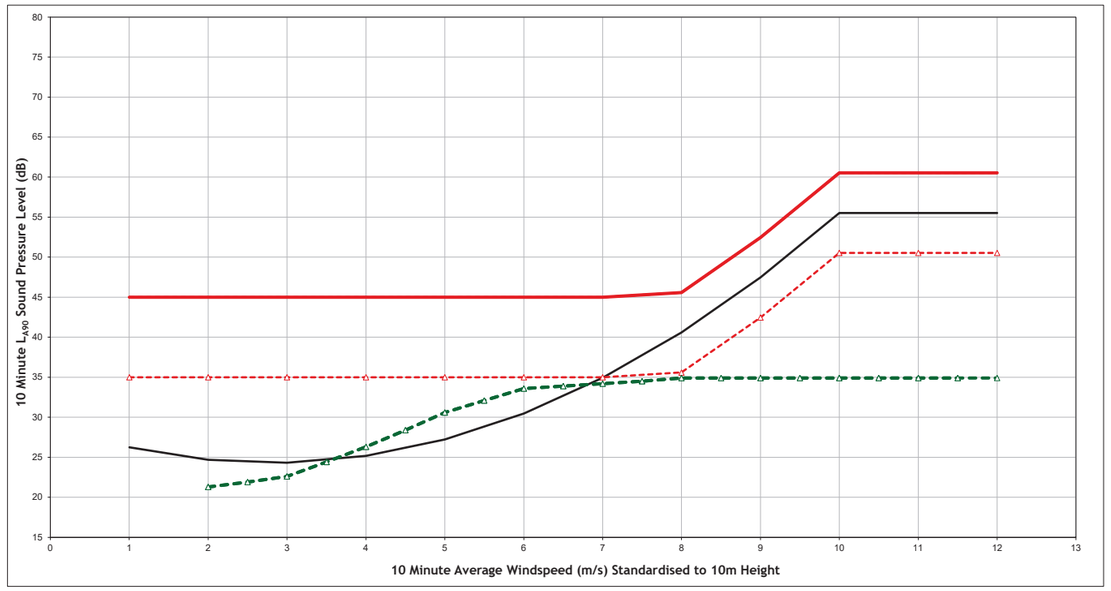
Statkraft

tnei

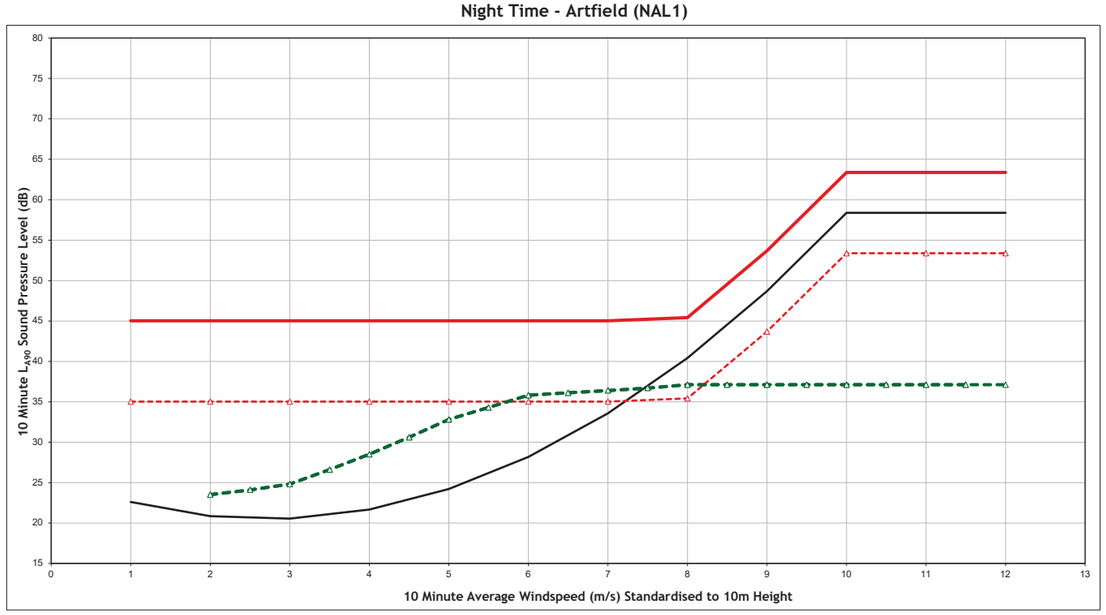
Quiet Daytime - Artfield (NAL1)



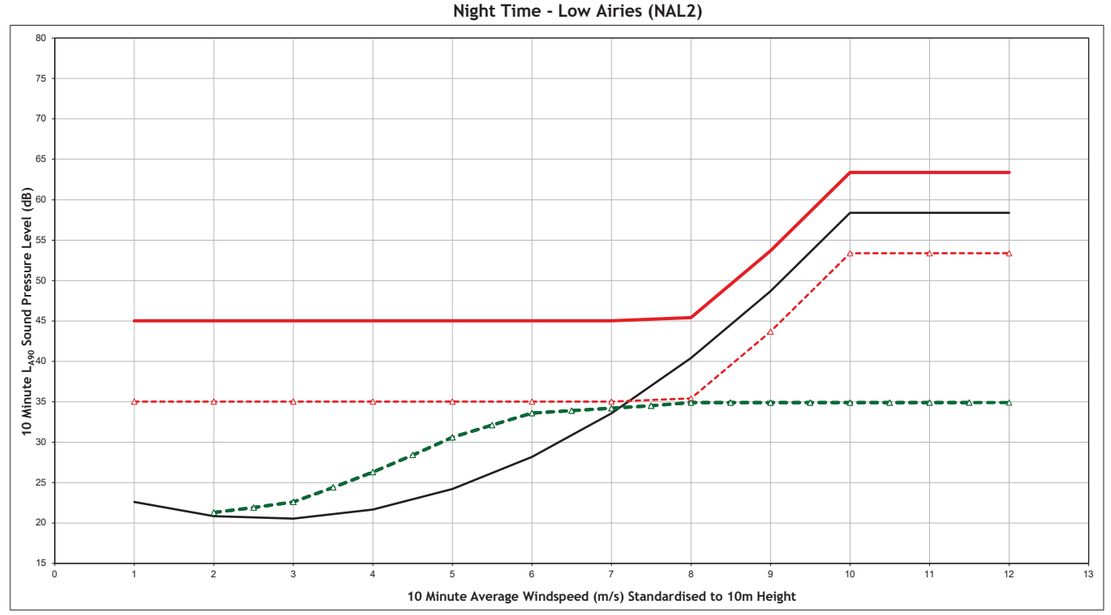
Quiet Daytime - Low Airies (NAL2)



Night Time - Artfield (NAL1)



Night Time - Low Airies (NAL2)



Legend:

- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Artfield (NAL1)
Figure Number	Figure A1.3a
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

Statkraft

tnei

Legend:

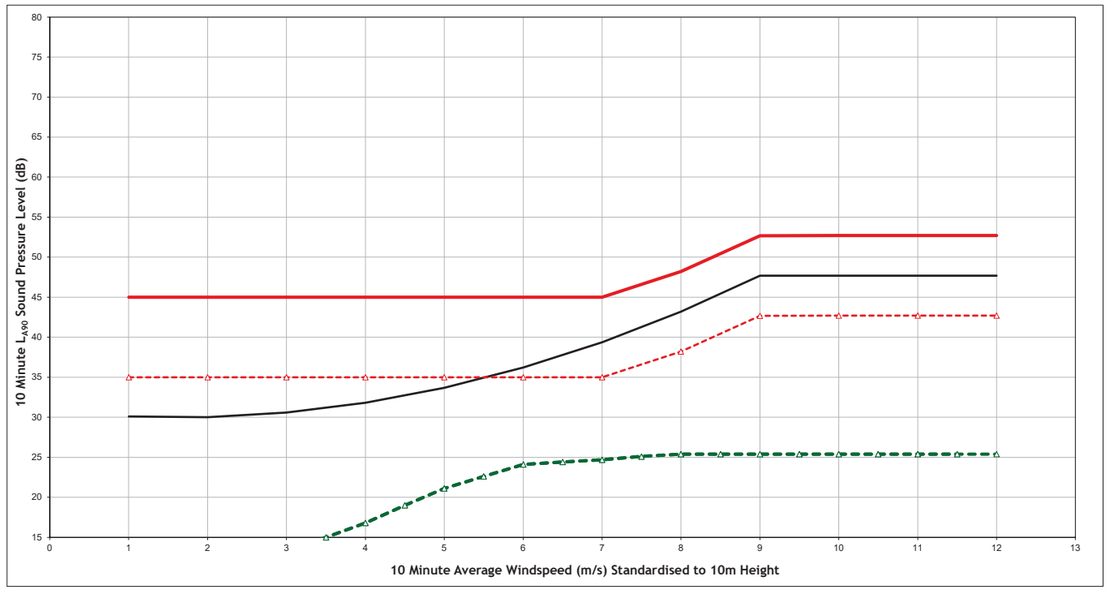
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Low Airies (NAL2)
Figure Number	Figure A1.3b
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

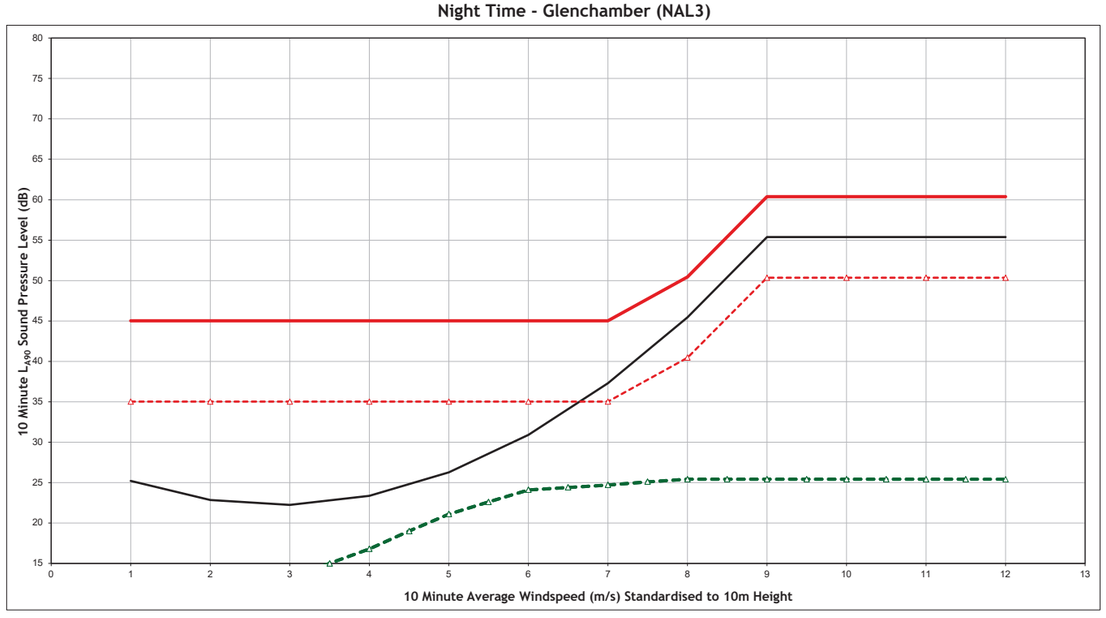
Statkraft

tnei

Quiet Daytime - Glenchamber (NAL3)



Night Time - Glenchamber (NAL3)



Legend:

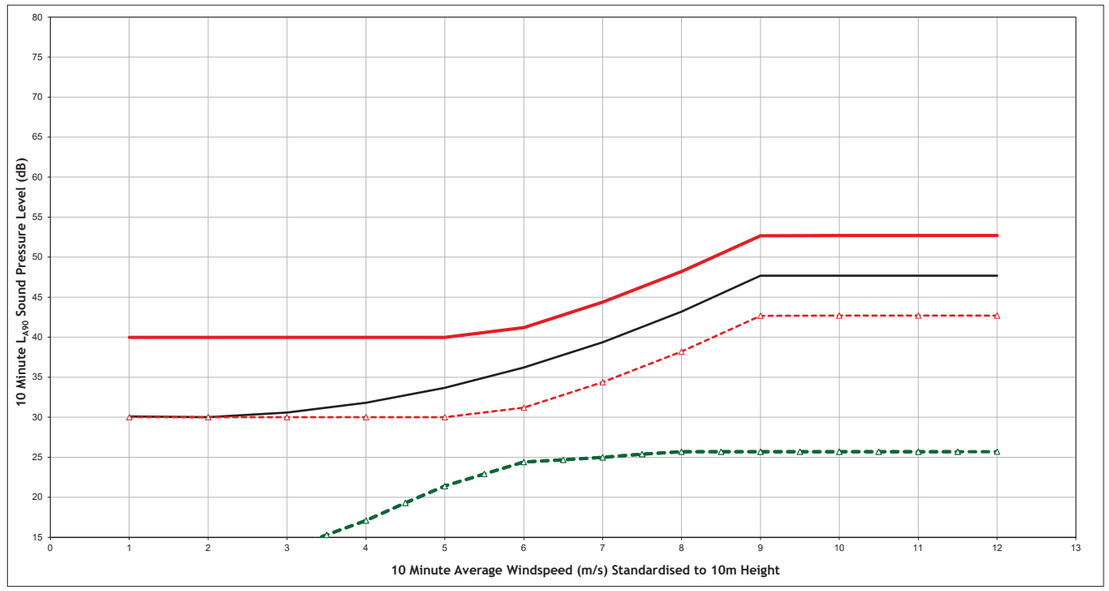
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Glenchamber (NAL3)
Figure Number	Figure A1.3c
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

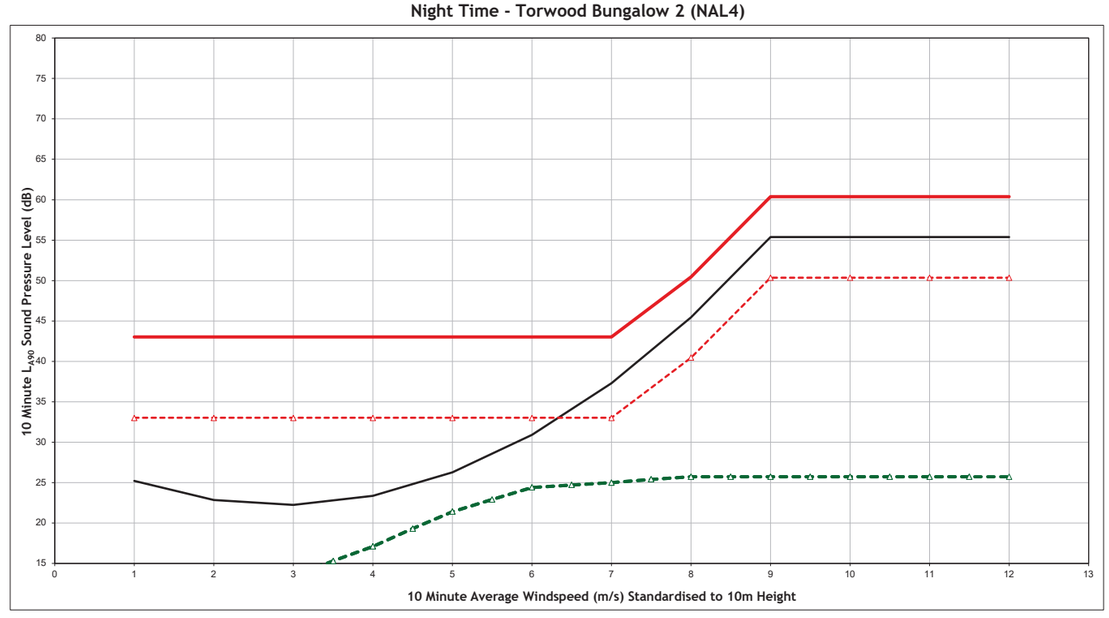
Statkraft

tnei

Quiet Daytime - Torwood Bungalow 2 (NAL4)



Night Time - Torwood Bungalow 2 (NAL4)



Legend:

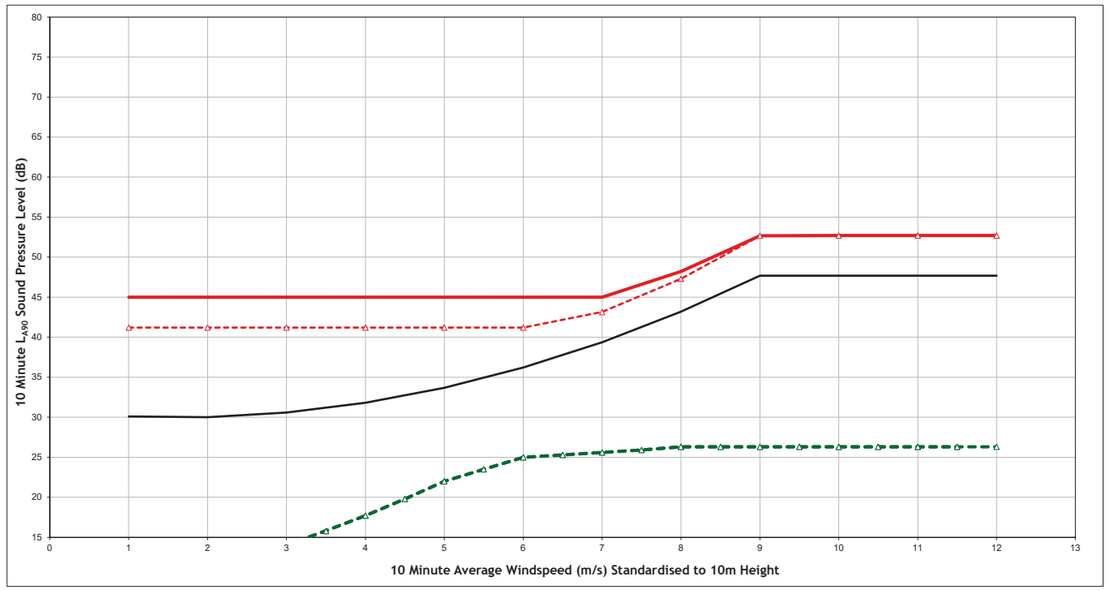
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Bungalow 2 (NAL4)
Figure Number	Figure A1.3d
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

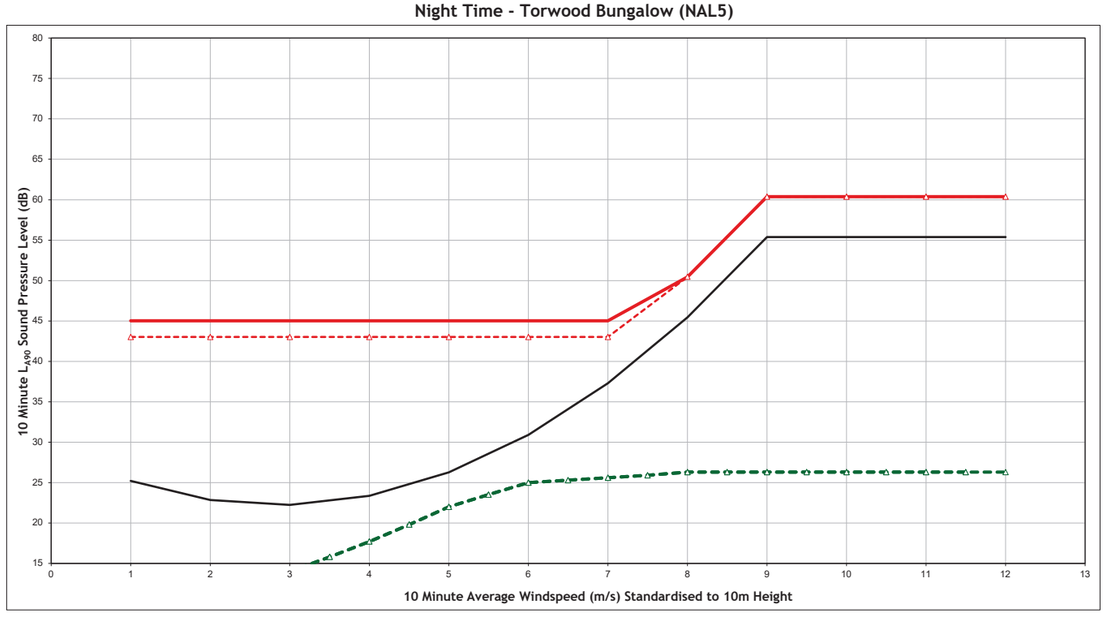
Statkraft

tnei

Quiet Daytime - Torwood Bungalow (NAL5)



Night Time - Torwood Bungalow (NAL5)



Legend:

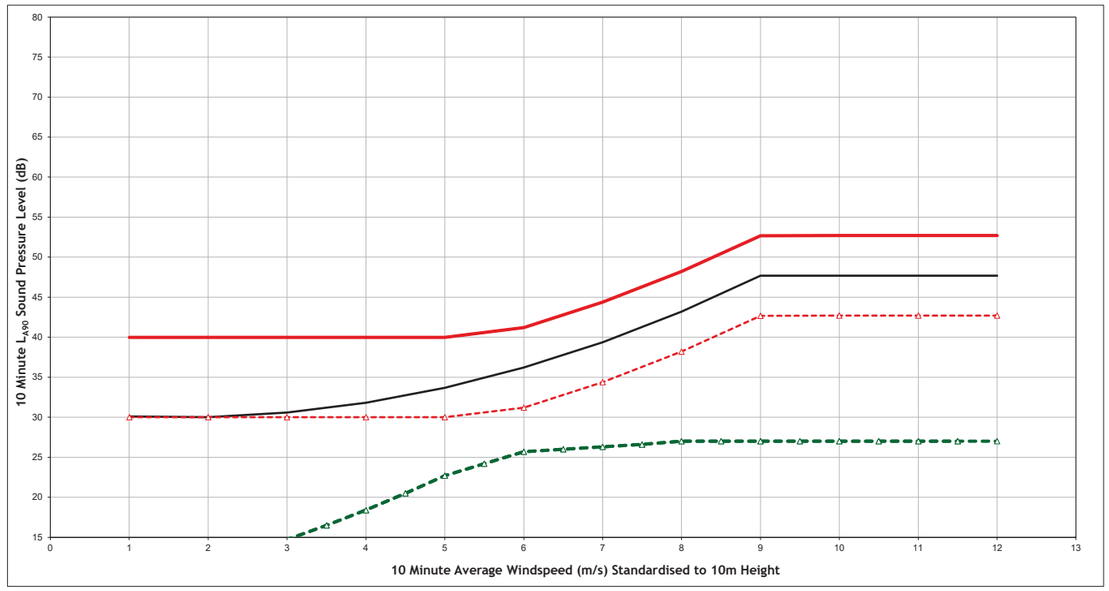
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood Bungalow (NAL5)
Figure Number	Figure A1.3e
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

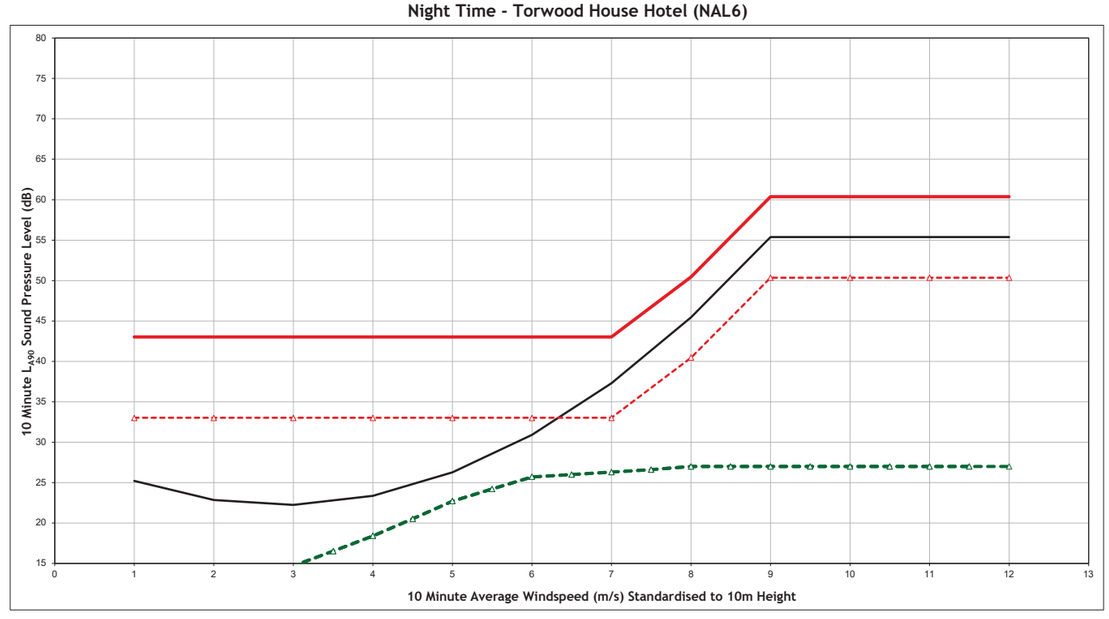
Statkraft

tnei

Quiet Daytime - Torwood House Hotel (NAL6)



Night Time - Torwood House Hotel (NAL6)



Legend:

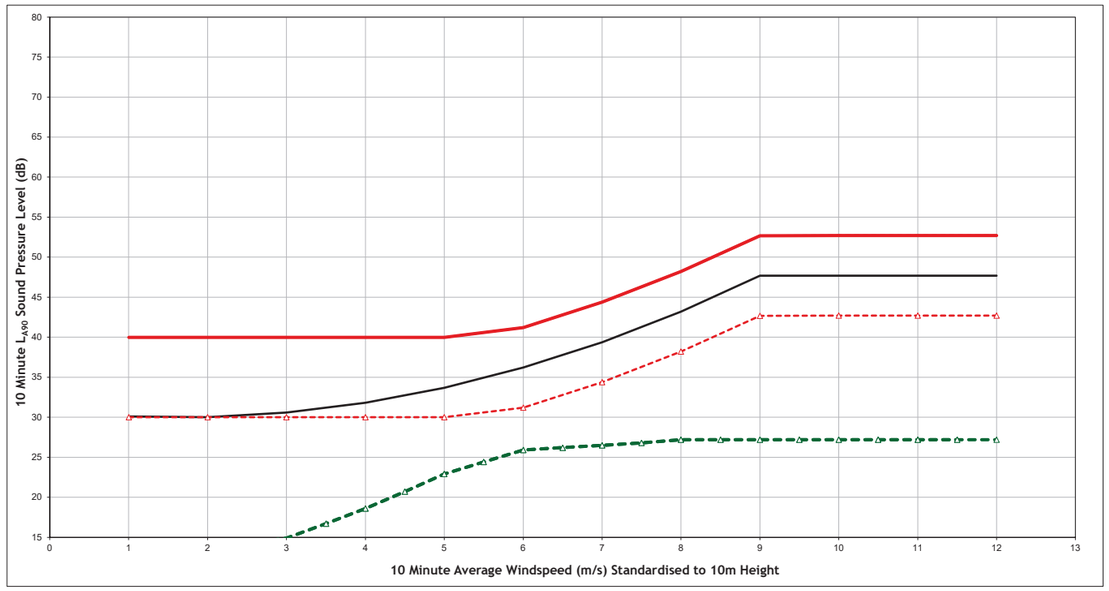
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Torwood House Hotel (NAL6)
Figure Number	Figure A1.3f
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

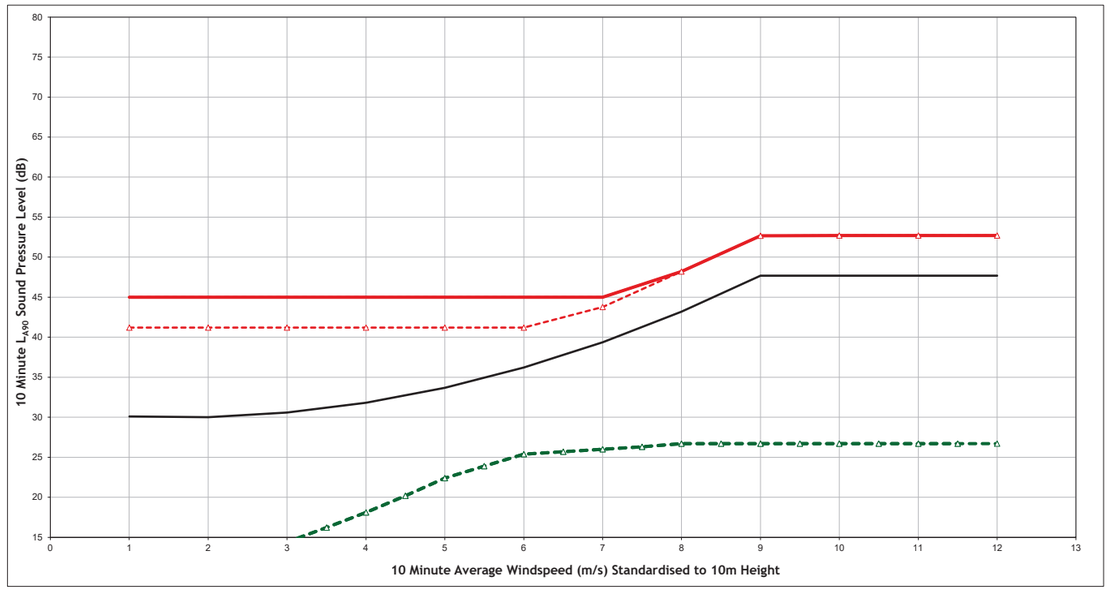
Statkraft

tnei

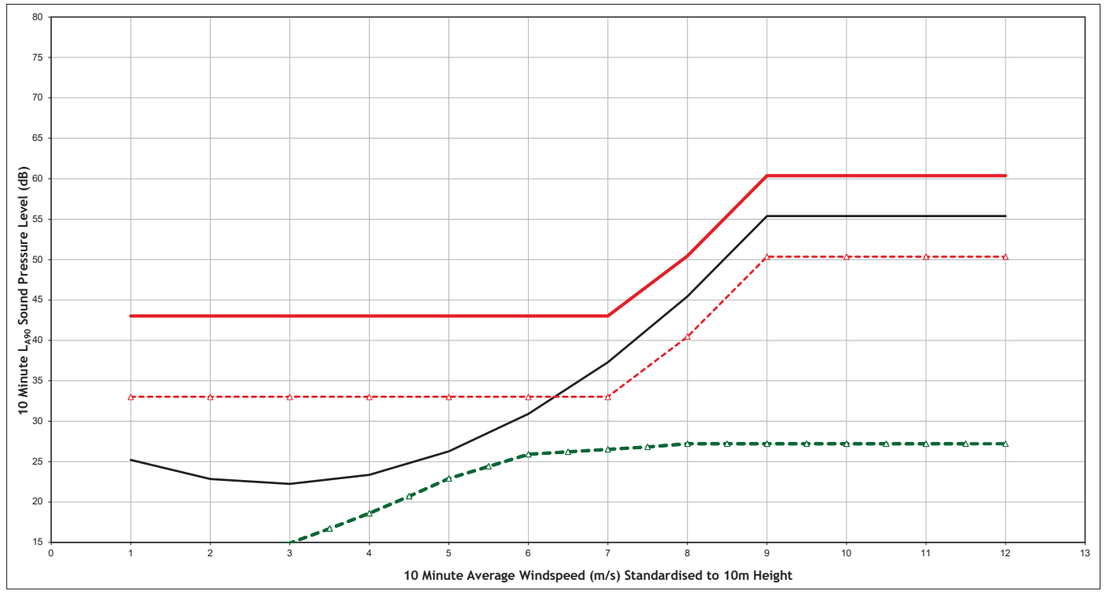
Quiet Daytime - Torwood Two Dogs Lodge (NAL7)



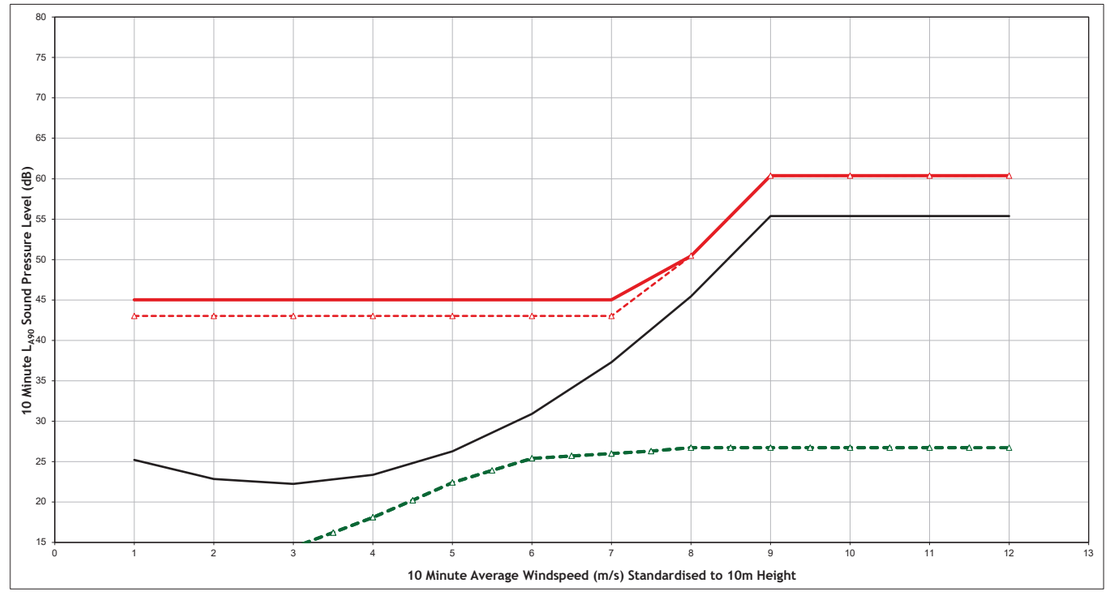
Quiet Daytime - Gass Farm (NAL8)



Night Time - Torwood Two Dogs Lodge (NAL7)



Night Time - Gass Farm (NAL8)



Legend:

- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment
	Torwood Two Dogs Lodge (NAL7)
Figure Number	Figure A1.3g
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

Statkraft

tnei

Legend:

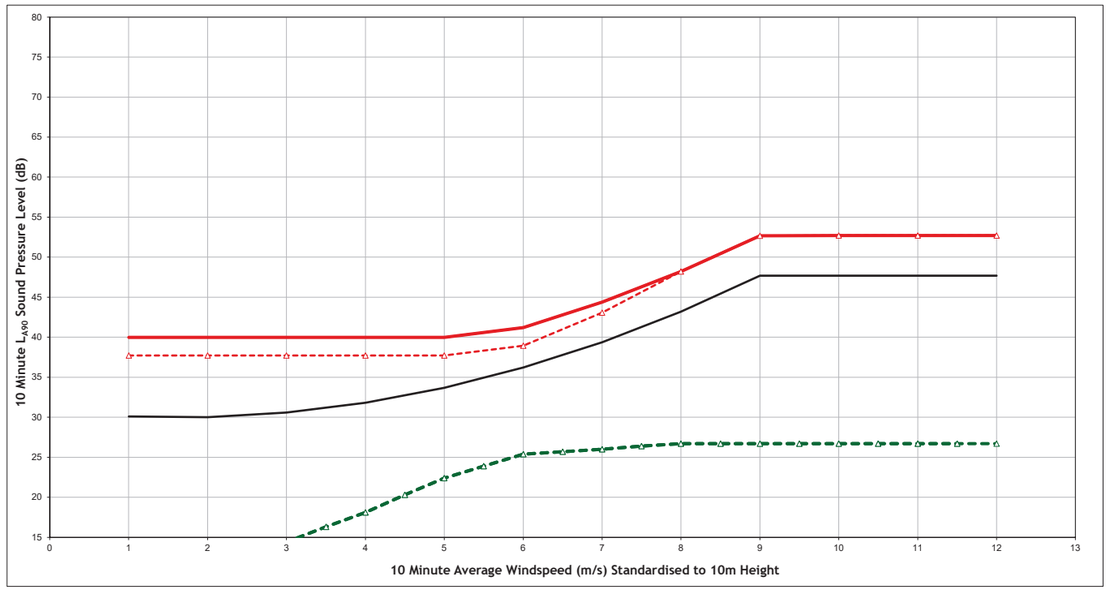
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment
	Gass Farm (NAL8)
Figure Number	Figure A1.3h
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

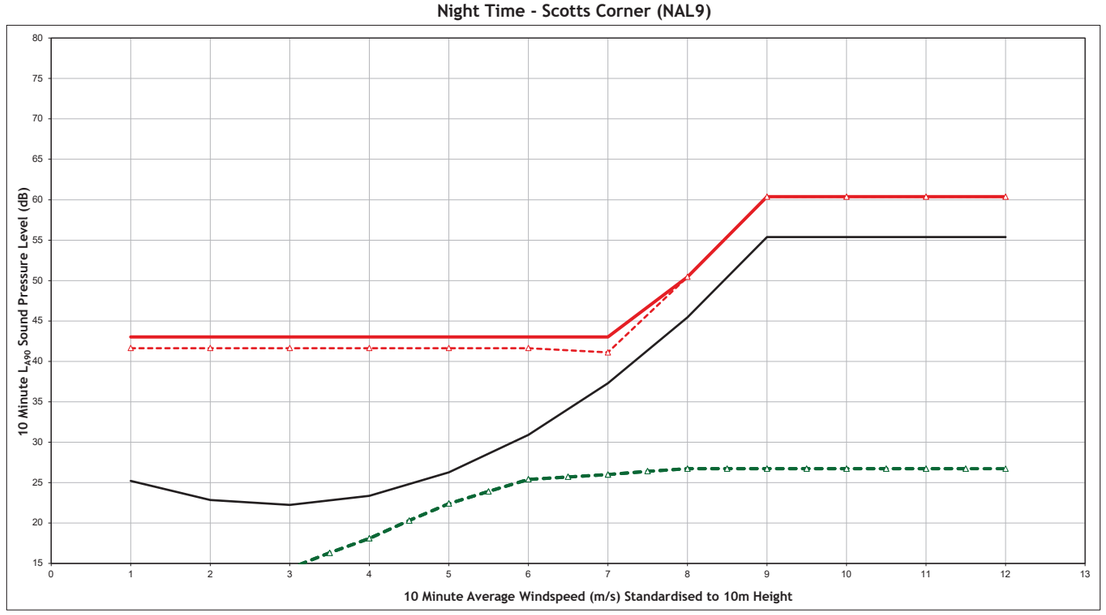
Statkraft

tnei

Quiet Daytime - Scotts Corner (NAL9)



Night Time - Scotts Corner (NAL9)



Legend:

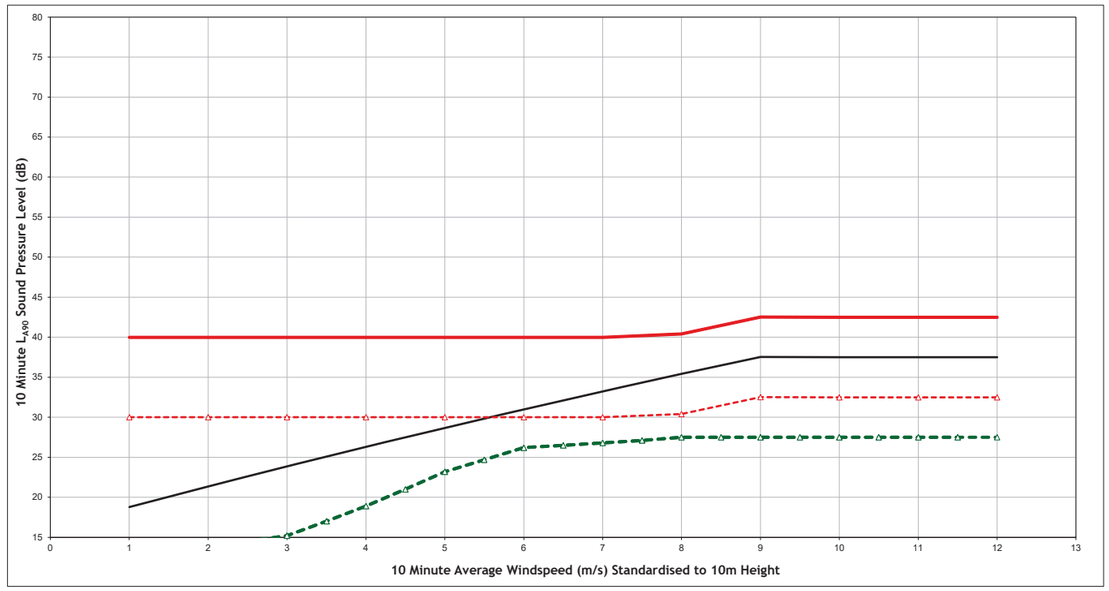
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Scotts Corner (NAL9)
Figure Number	Figure A1.3i
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

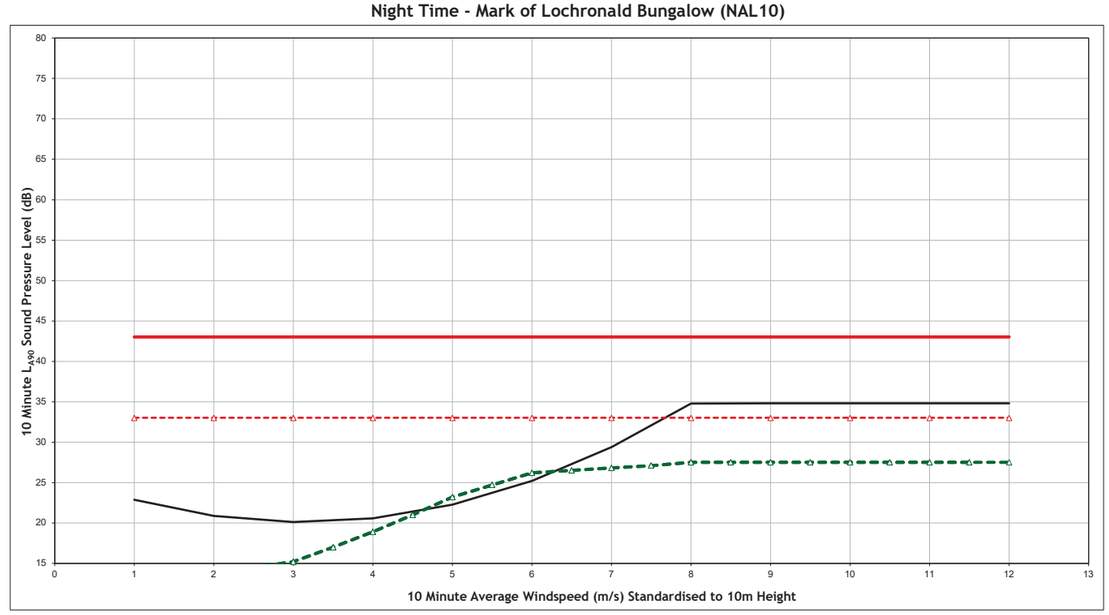
Statkraft

tnei

Quiet Daytime - Mark of Lochronald Bungalow (NAL10)



Night Time - Mark of Lochronald Bungalow (NAL10)



Legend:

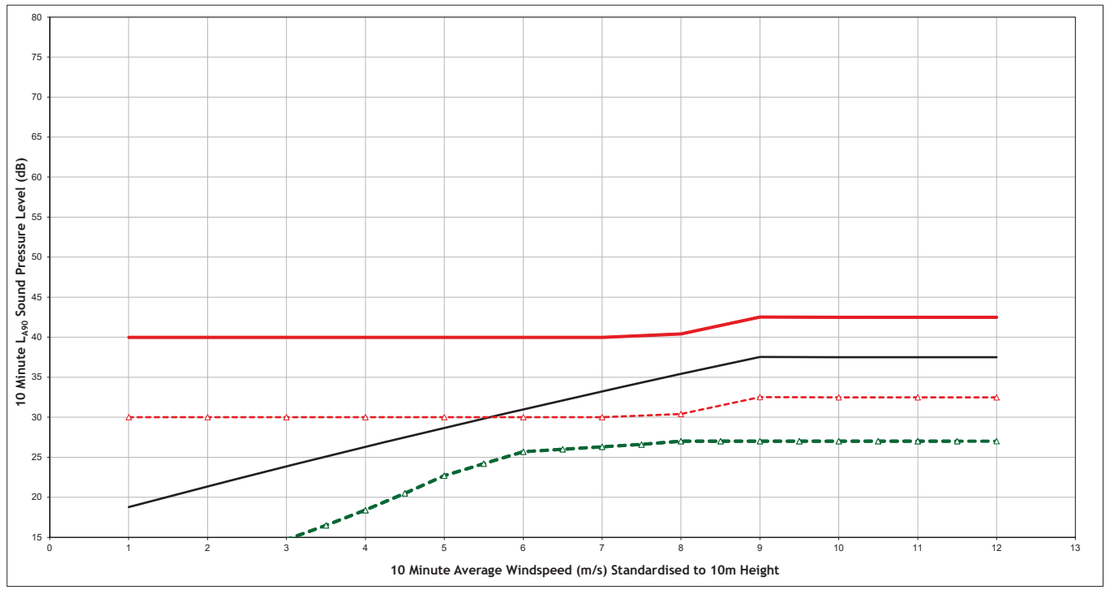
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Mark of Lochronald Bungalow (NAL10)
Figure Number	Figure A1.3j
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

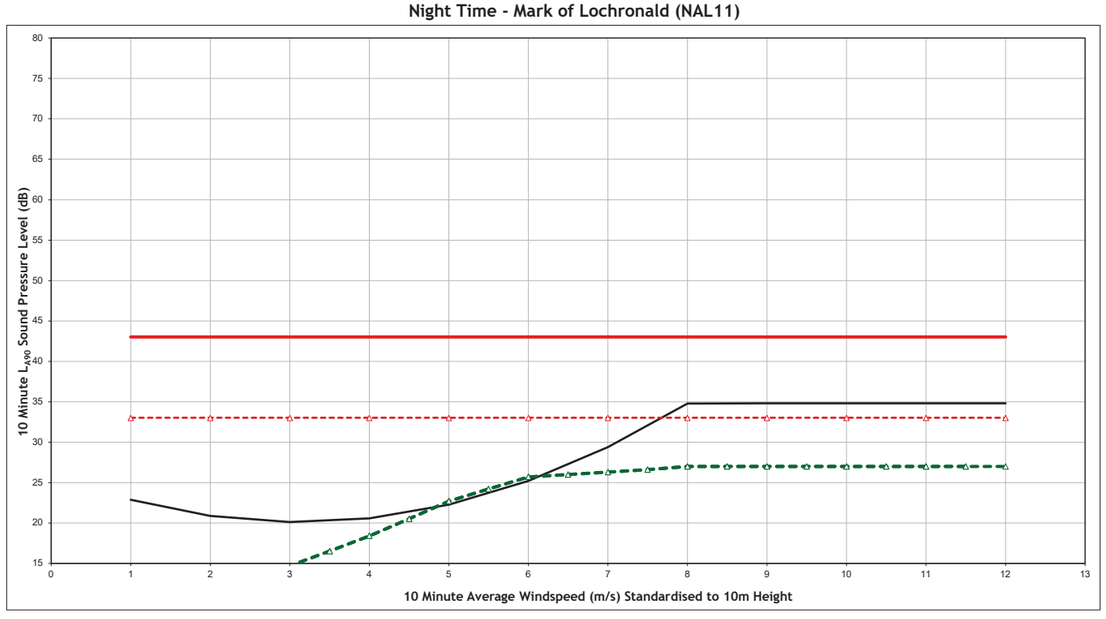
Statkraft

tnei

Quiet Daytime - Mark of Lochronald (NAL11)



Night Time - Mark of Lochronald (NAL11)



Legend:

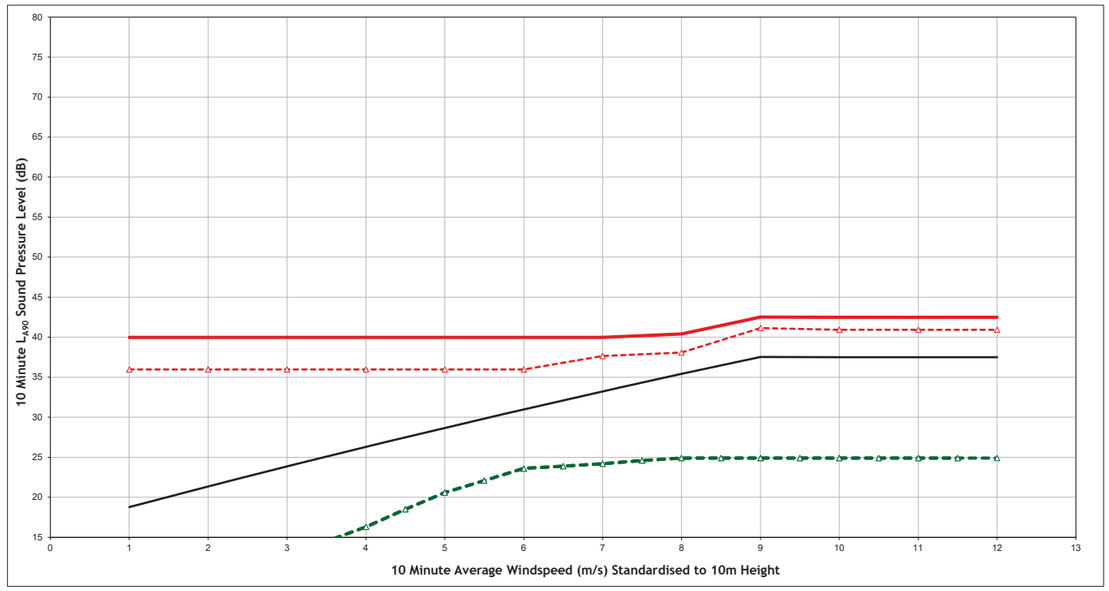
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Mark of Lochronald (NAL11)
Figure Number	Figure A1.3k
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

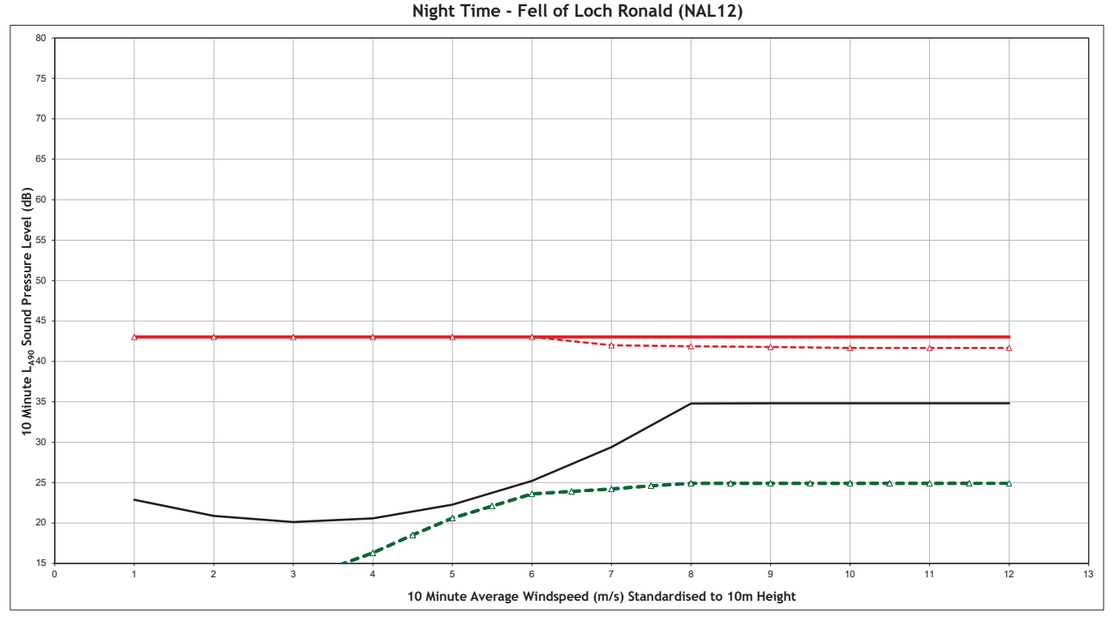
Statkraft

tnei

Quiet Daytime - Fell of Loch Ronald (NAL12)



Night Time - Fell of Loch Ronald (NAL12)



Legend:

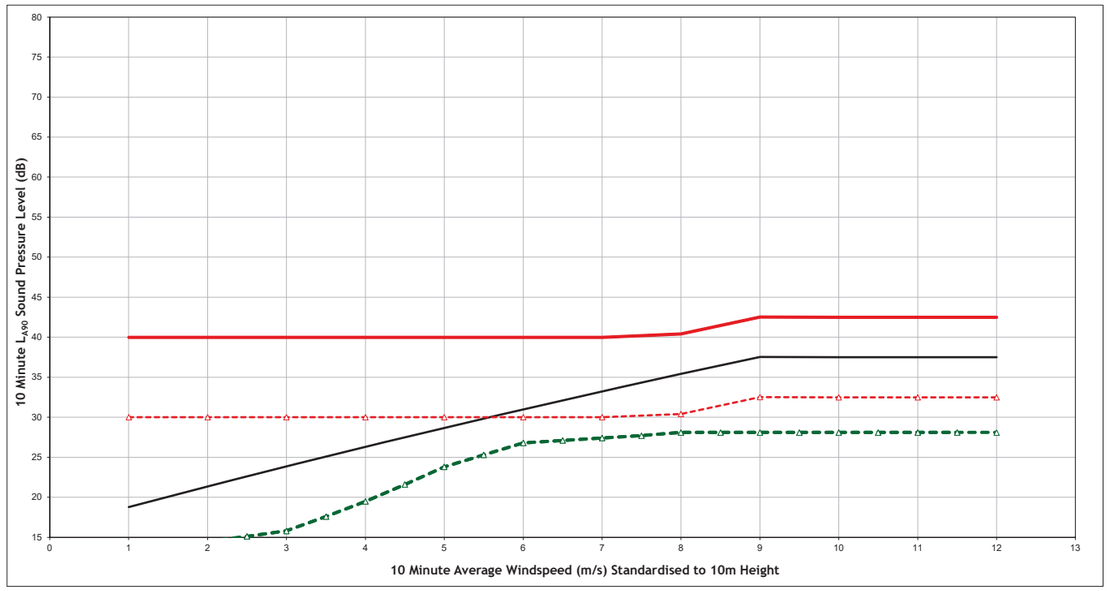
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Fell of Loch Ronald (NAL12)
Figure Number	Figure A1.3l
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

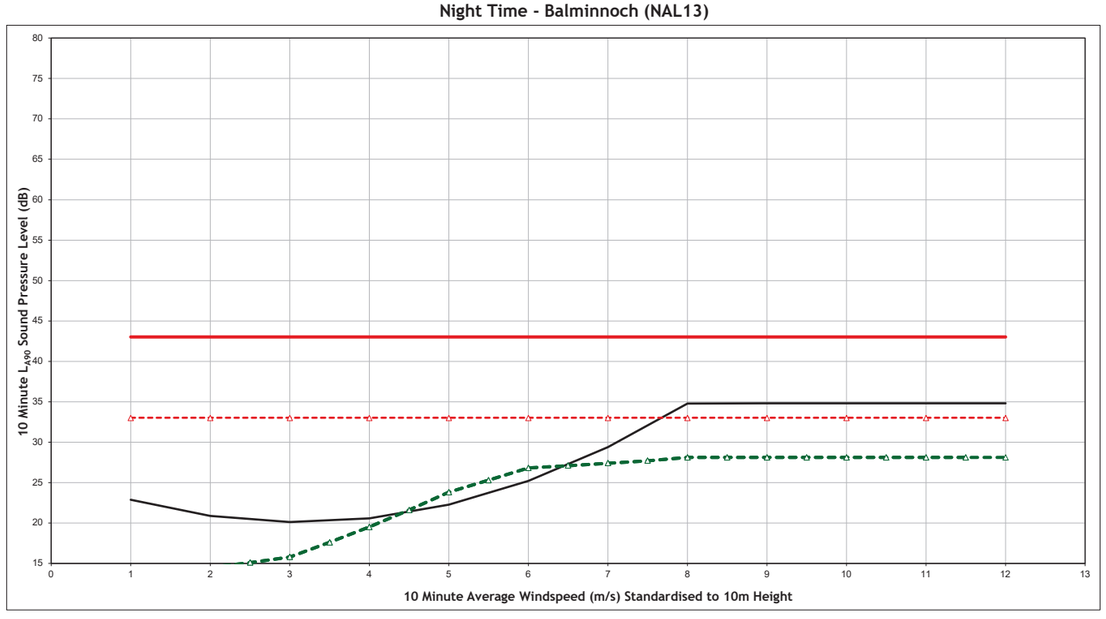
Statkraft

tnei

Quiet Daytime - Balminnoch (NAL13)



Night Time - Balminnoch (NAL13)



Legend:

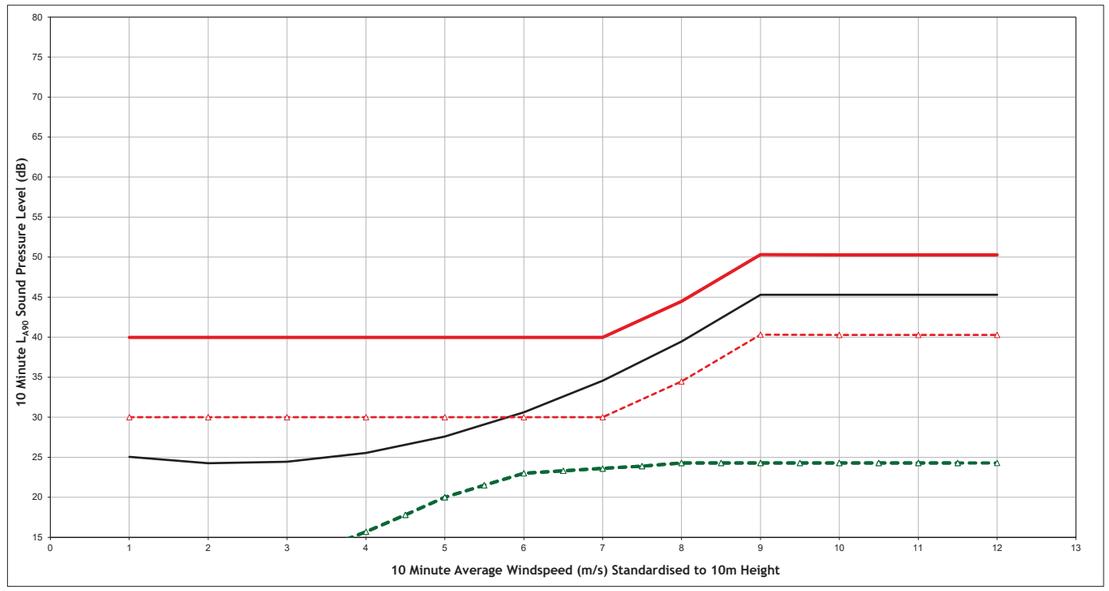
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Balminnoch (NAL13)
Figure Number	Figure A1.3m
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

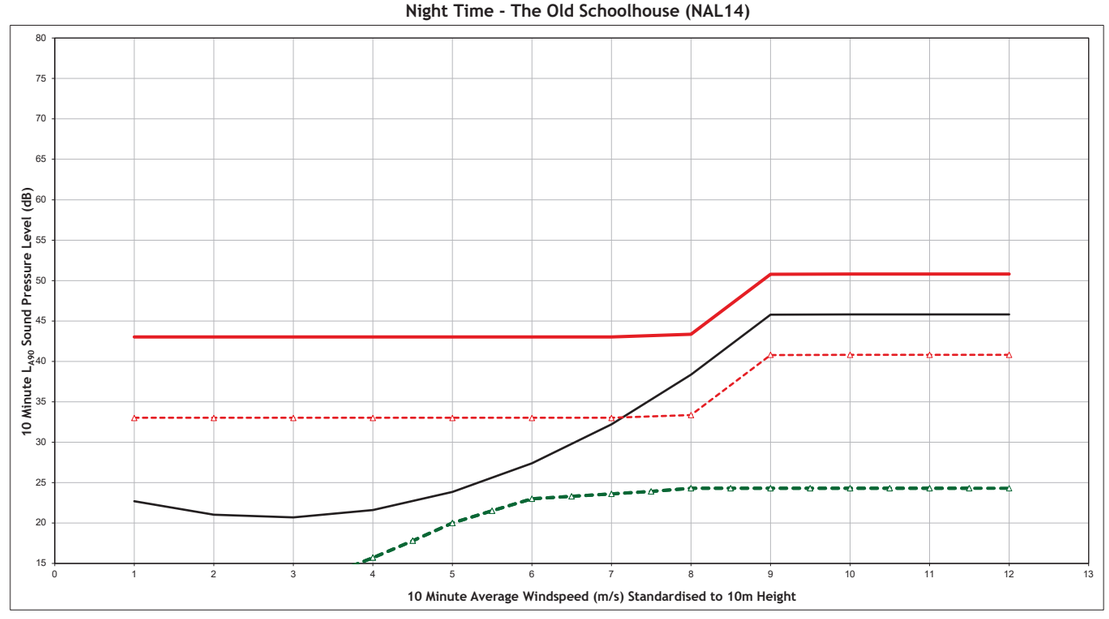
Statkraft

tnei

Quiet Daytime - The Old Schoolhouse (NAL14)



Night Time - The Old Schoolhouse (NAL14)



Legend:

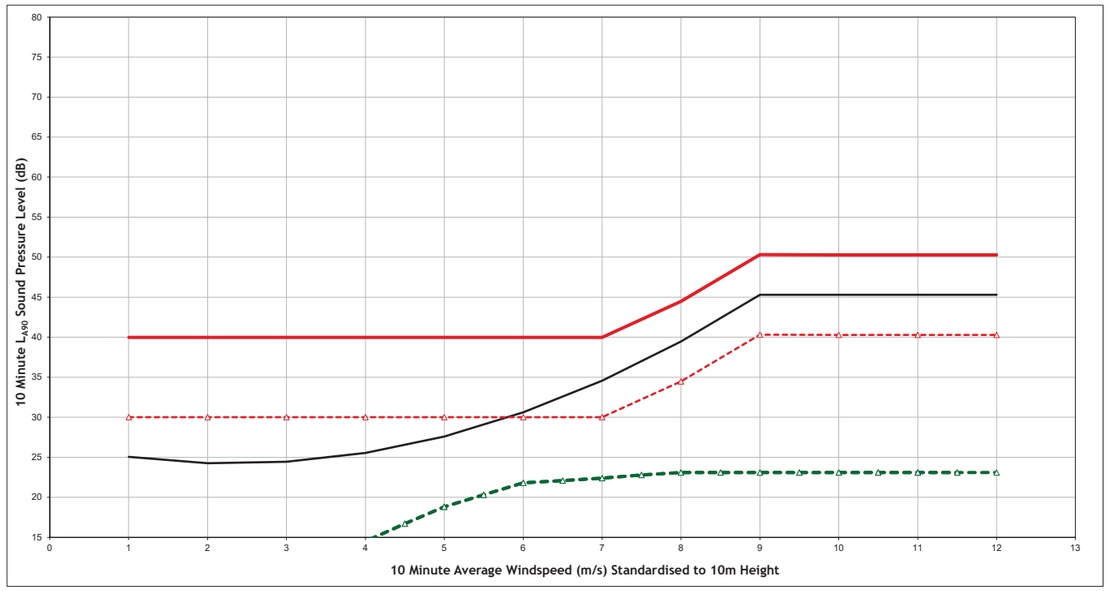
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment The Old Schoolhouse (NAL14)
Figure Number	Figure A1.3n
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

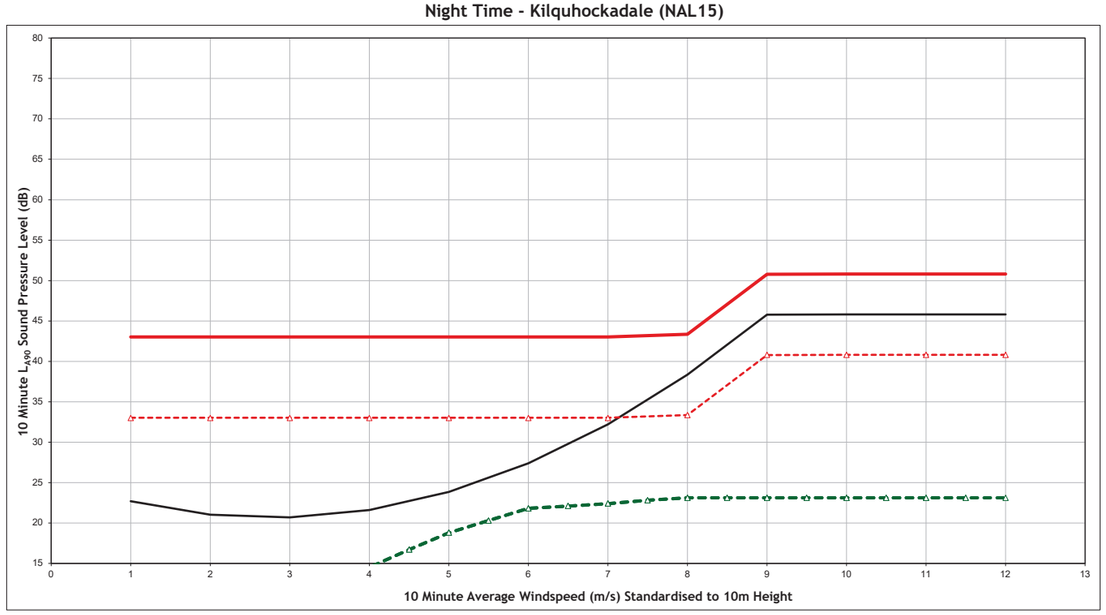
Statkraft

tnei

Quiet Daytime - Kilquhockadale (NAL15)



Night Time - Kilquhockadale (NAL15)



Legend:

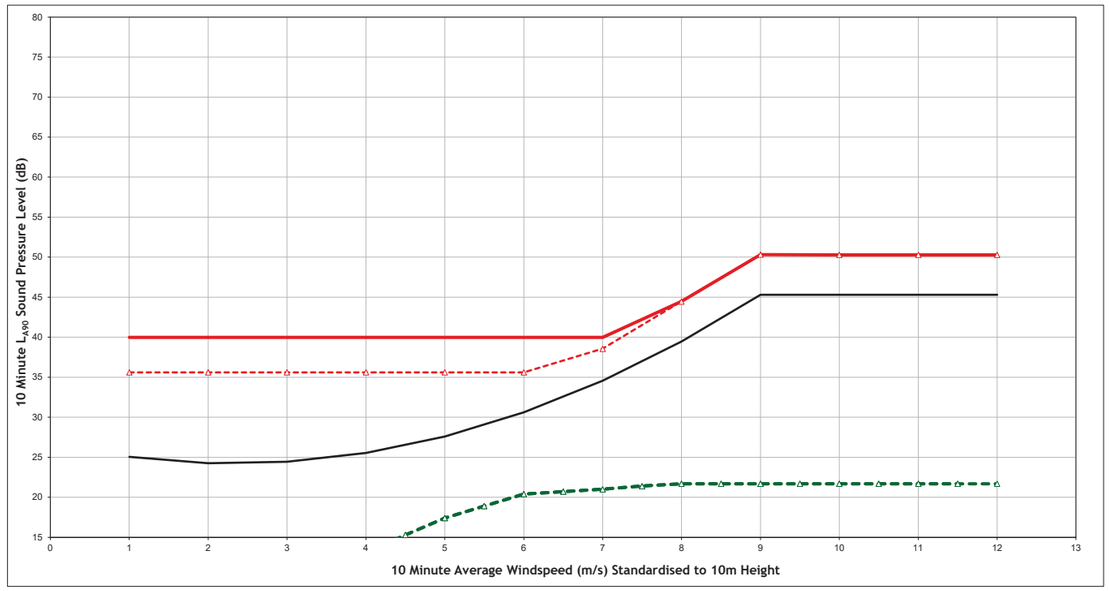
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Kilquhockadale (NAL15)
Figure Number	Figure A1.3o
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

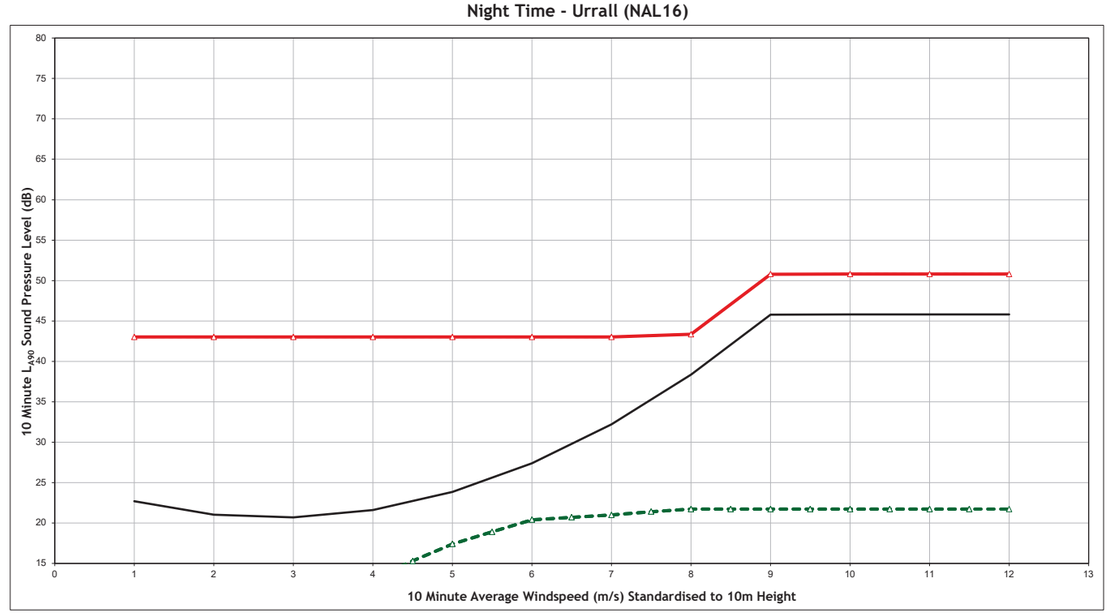
Statkraft

tnei

Quiet Daytime - Urrall (NAL16)



Night Time - Urrall (NAL16)



Legend:

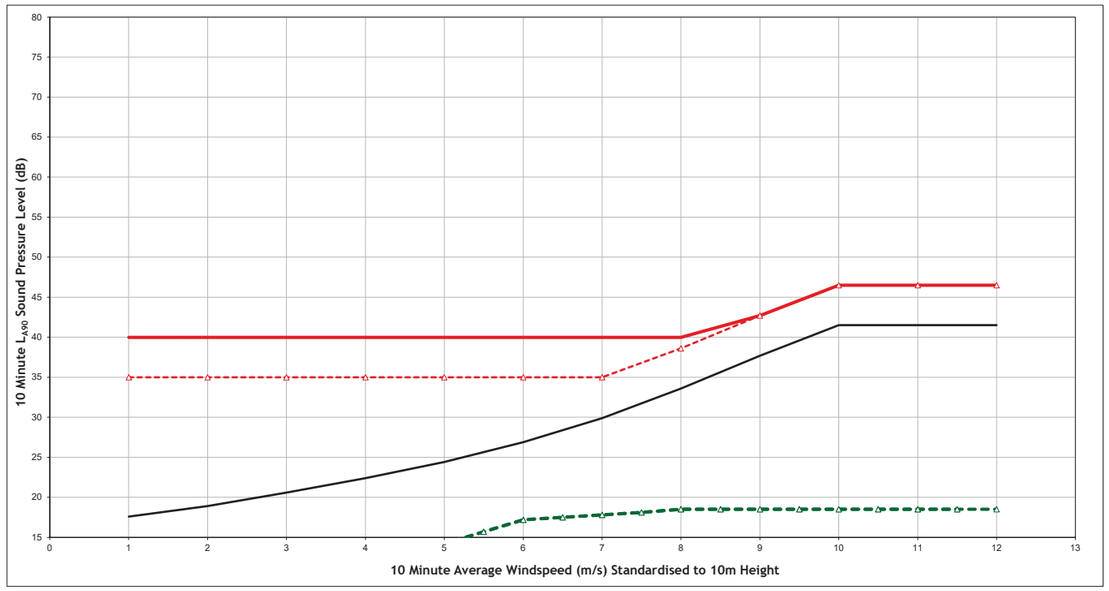
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Urrall (NAL16)
Figure Number	Figure A1.3p
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

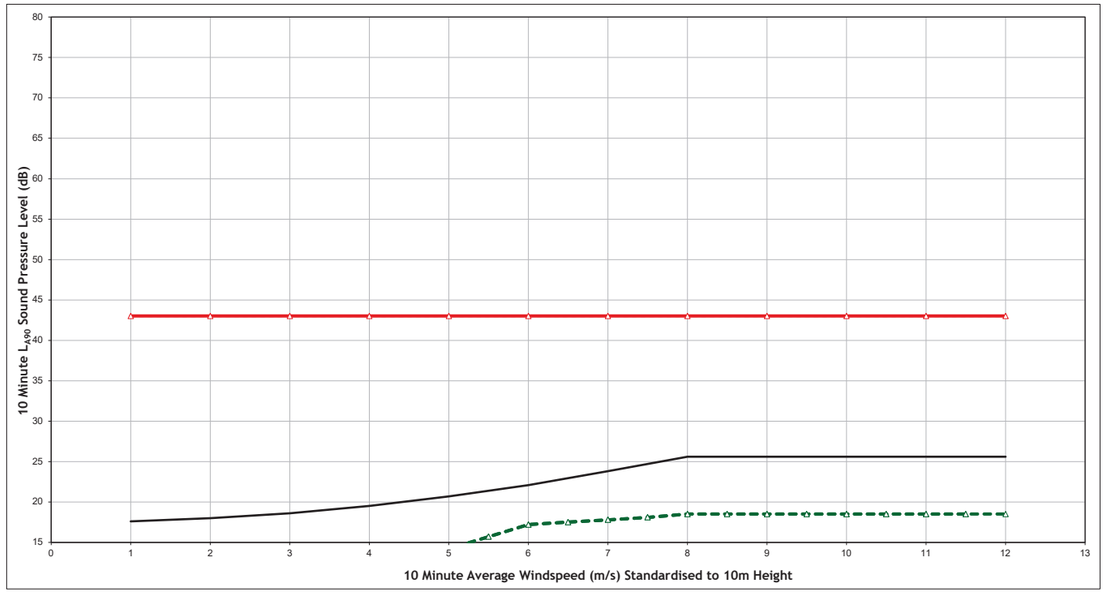
Statkraft

tnei

Quiet Daytime - Tannielaggie (NAL17)



Night Time - Tannielaggie (NAL17)



Legend:

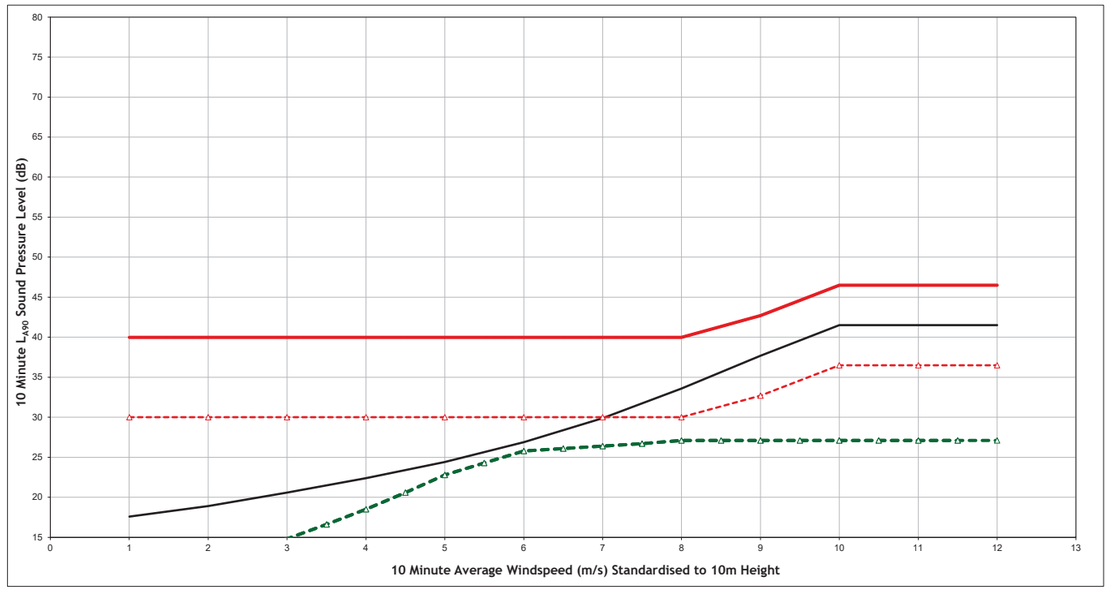
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Tannielaggie (NAL17)
Figure Number	Figure A1.3q
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

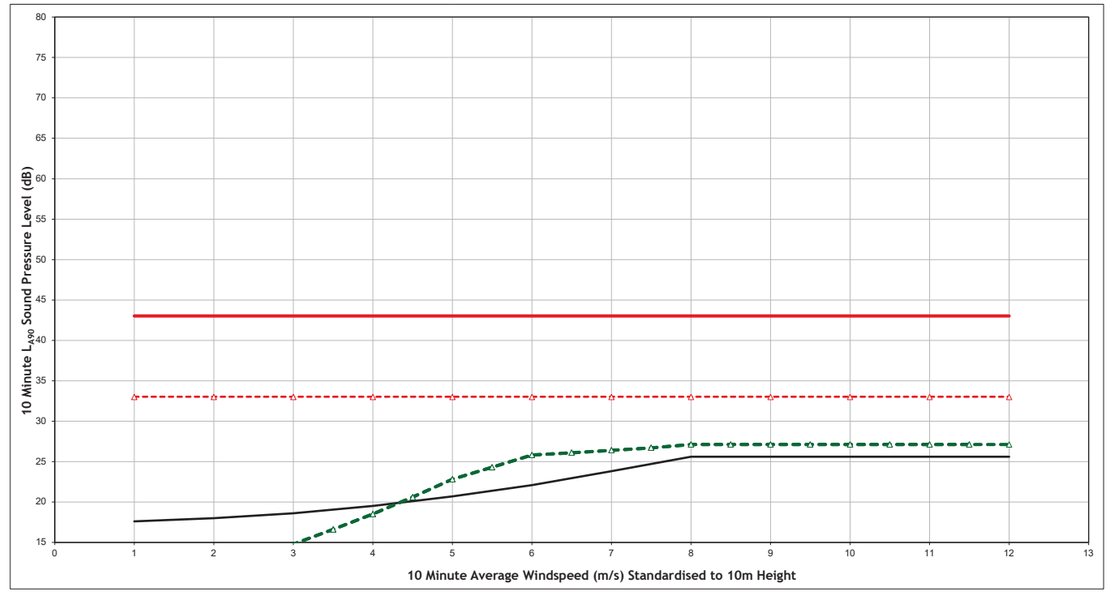
Statkraft

tnei

Quiet Daytime - Kilmacfadzean (NAL18)



Night Time - Kilmacfadzean (NAL18)



Legend:

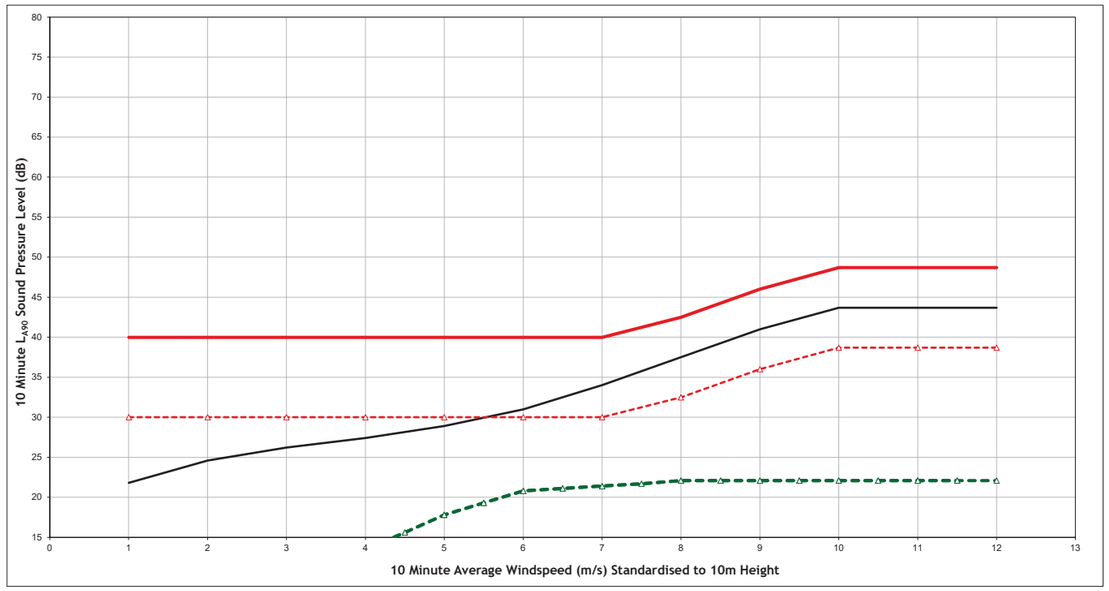
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Kilmacfadzean (NAL18)
Figure Number	Figure A1.3r
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

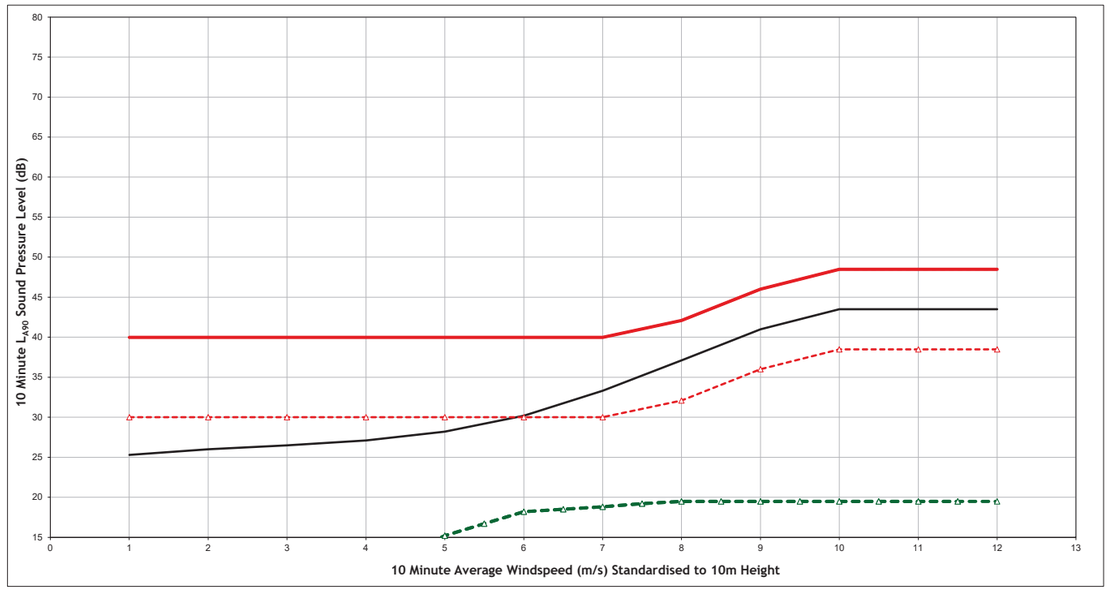
Statkraft

tnei

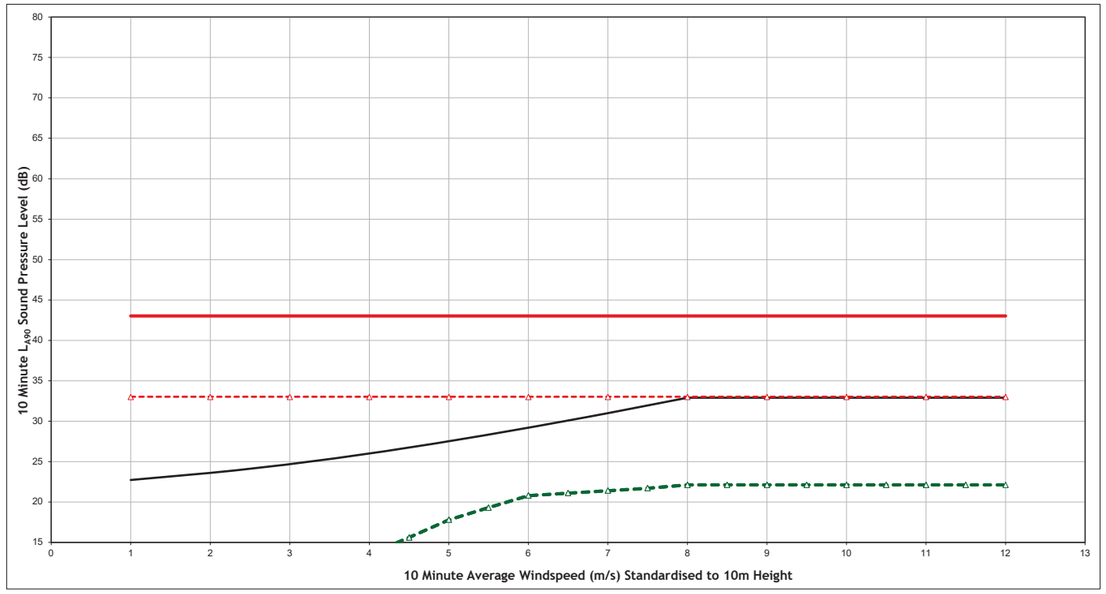
Quiet Daytime - Quarter Farm (NAL19)



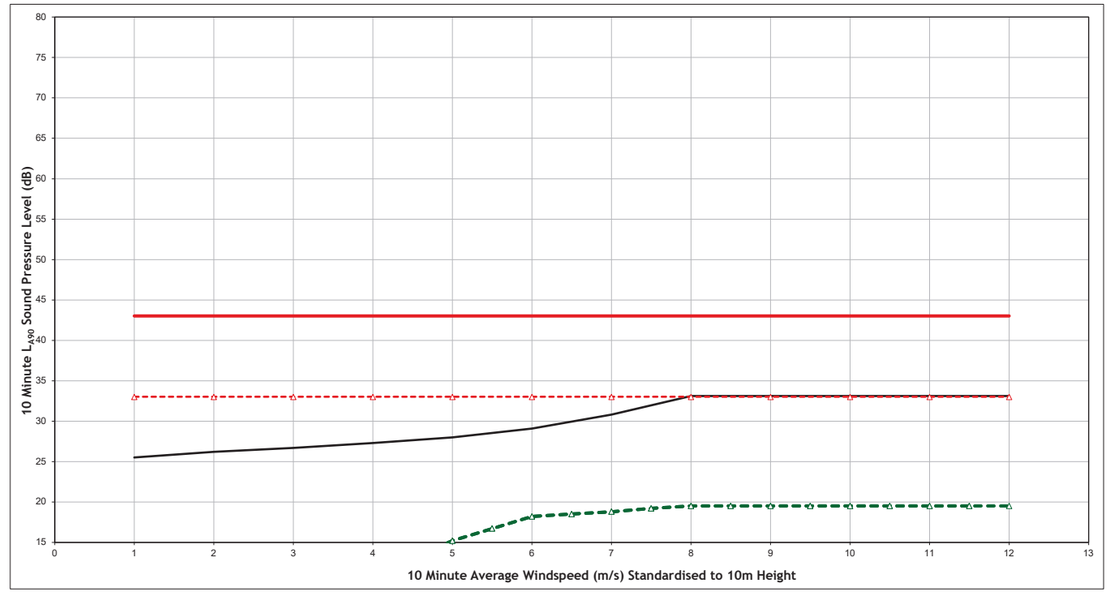
Quiet Daytime - Pultadie (NAL20)



Night Time - Quarter Farm (NAL19)



Night Time - Pultadie (NAL20)



Legend:

- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Quarter Farm (NAL19)
Figure Number	Figure A1.3s
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

Statkraft

tnei

Legend:

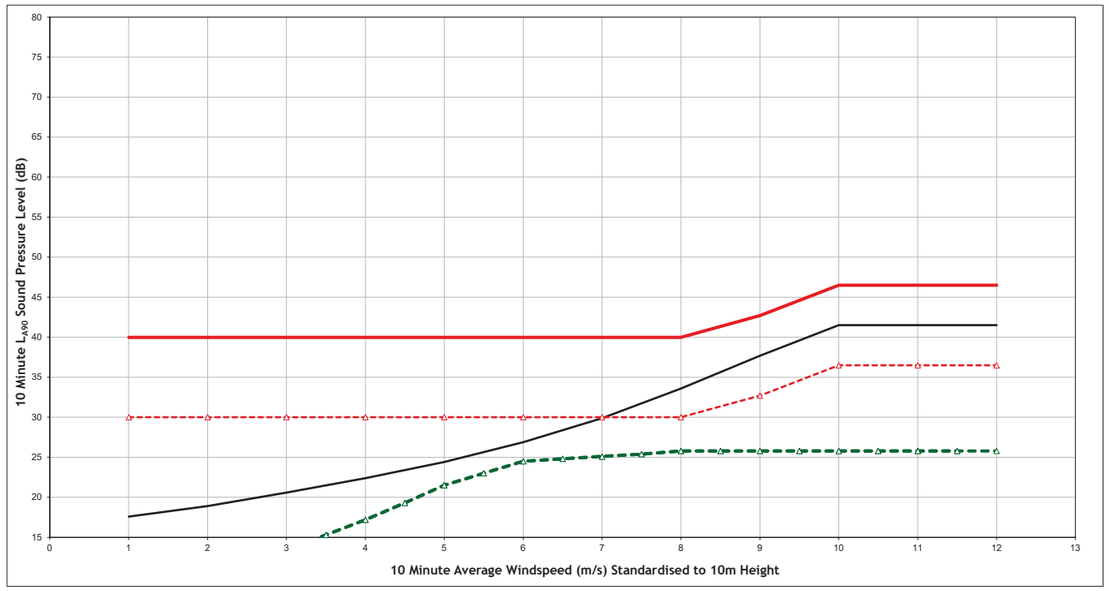
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Pultadie (NAL20)
Figure Number	Figure A1.3t
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

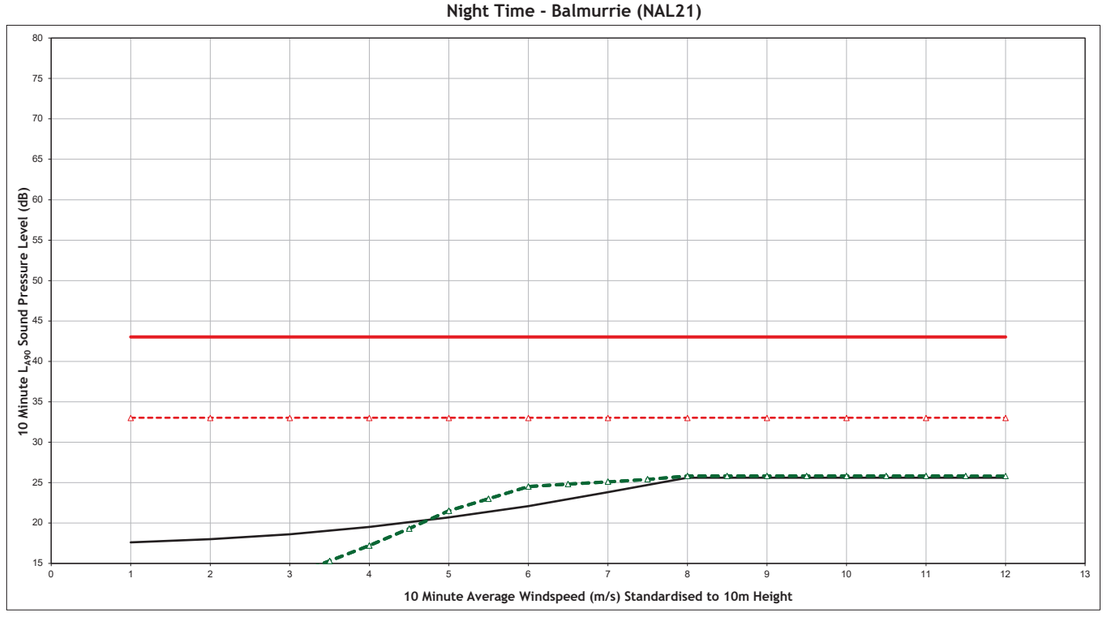
Statkraft

tnei

Quiet Daytime - Balmurrie (NAL21)



Night Time - Balmurrie (NAL21)



Legend:

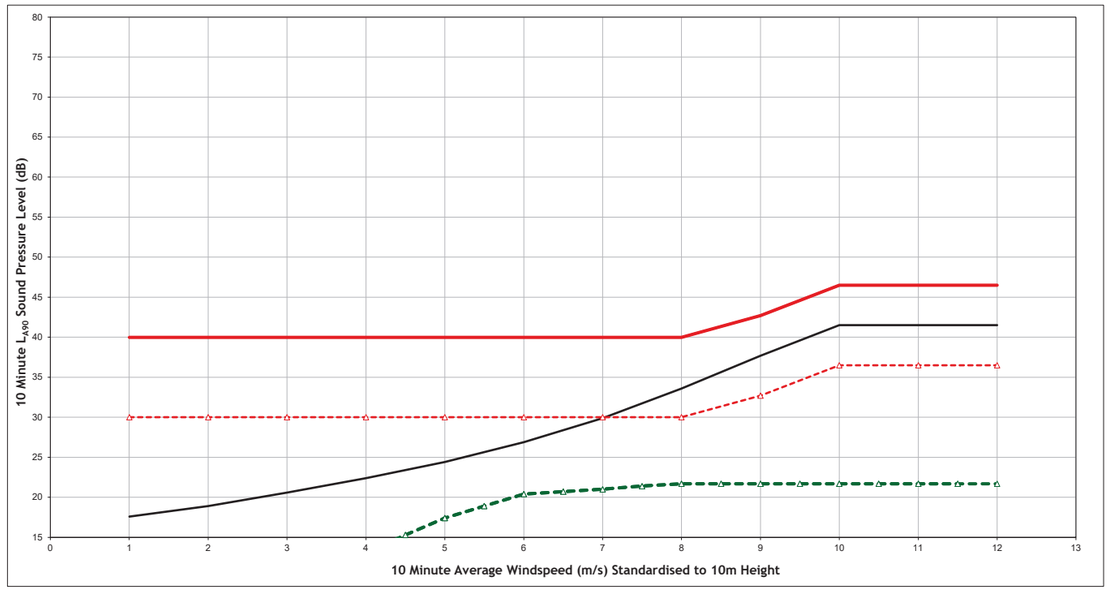
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Balmurrie (NAL21)
Figure Number	Figure A1.3u
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

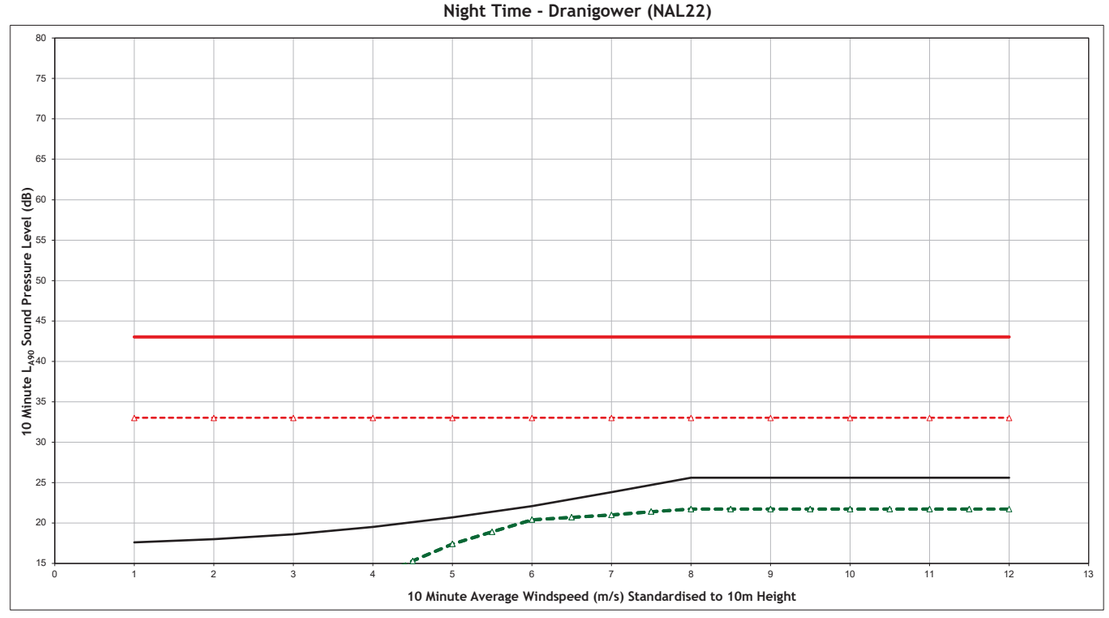
Statkraft

tnei

Quiet Daytime - Dranigower (NAL22)



Night Time - Dranigower (NAL22)



Legend:

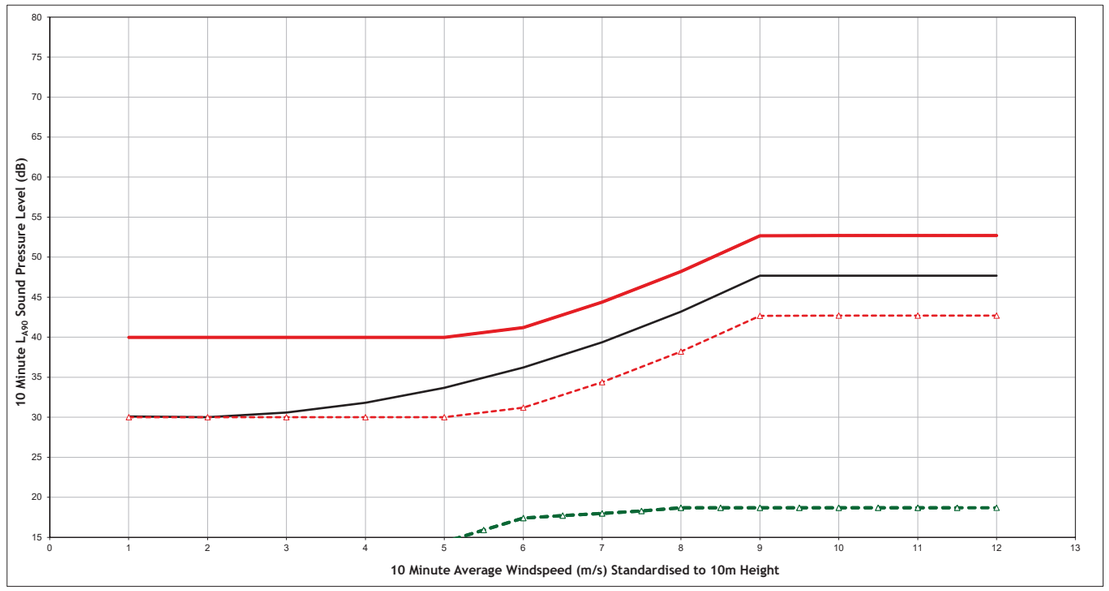
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Dranigower (NAL22)
Figure Number	Figure A1.3v
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

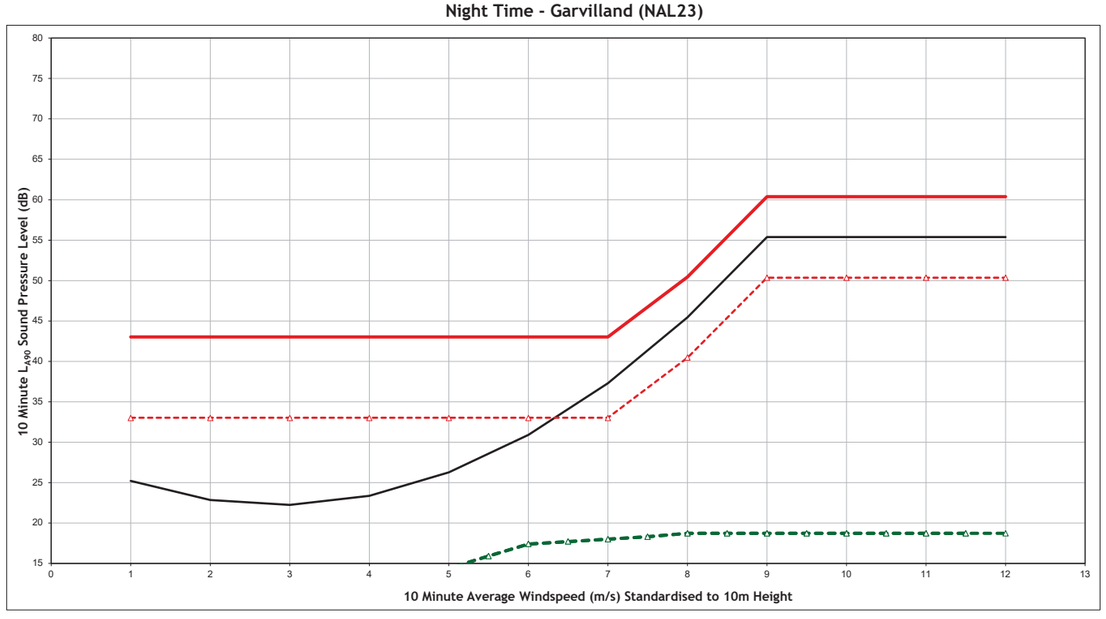
Statkraft

tnei

Quiet Daytime - Garvilland (NAL23)



Night Time - Garvilland (NAL23)



Legend:

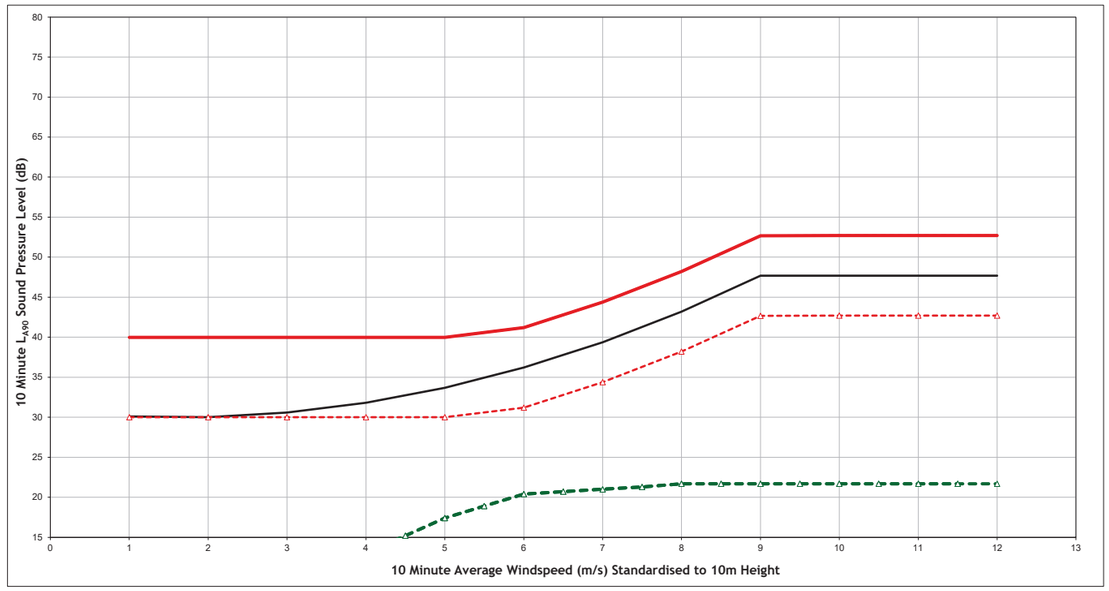
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Garvilland (NAL23)
Figure Number	Figure A1.3w
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

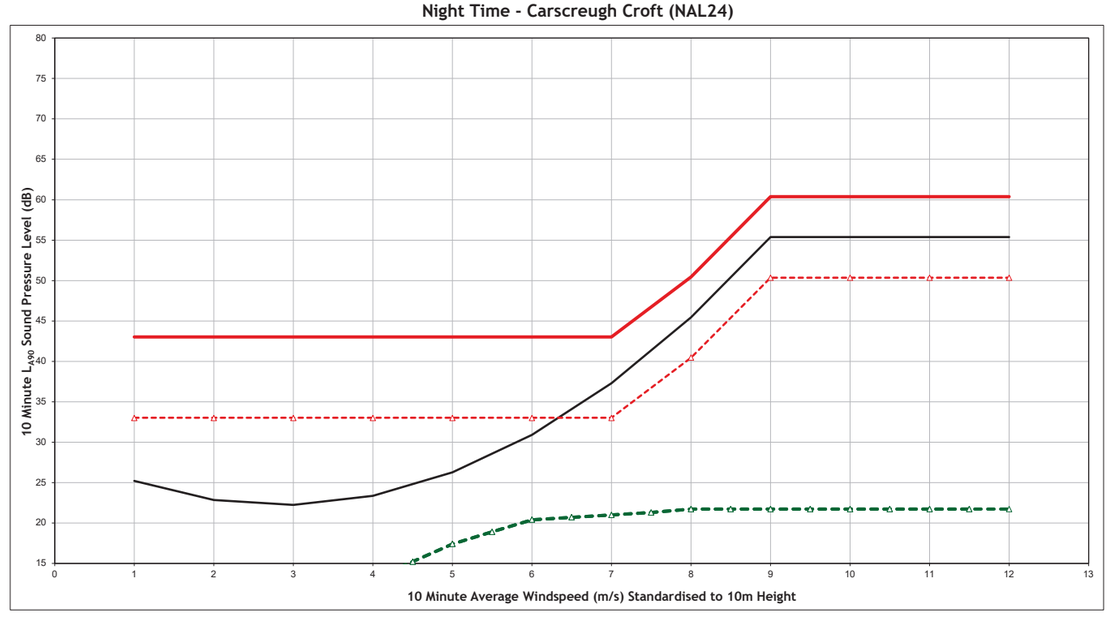
Statkraft

tnei

Quiet Daytime - Carscreugh Croft (NAL24)



Night Time - Carscreugh Croft (NAL24)



Legend:

- Background Noise Trendline
- Total ETSU-R-97-Limit
- Site Specific Limits
- Artfield Forest Wind Farm

Project	Artfield Forest
Client	Statkraft
Title	Noise Assessment Carscreugh Croft (NAL24)
Figure Number	Figure A1.3x
Scale	NTS
Drawn	JB
Checked	JM
Date	04/06/2020
Document Reference	13865-Models

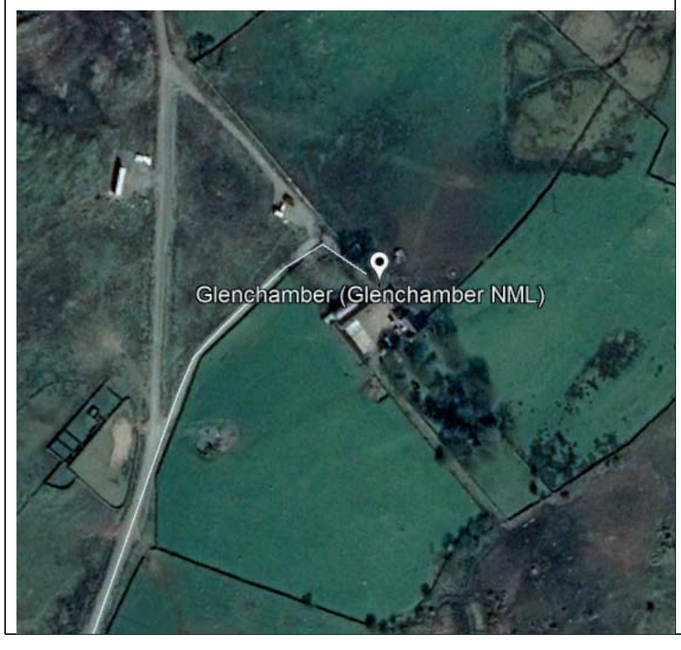
Statkraft

tnei

Appendix 2 – Proxy Locations used for establishing Total ETSU-R-97 Noise Limits

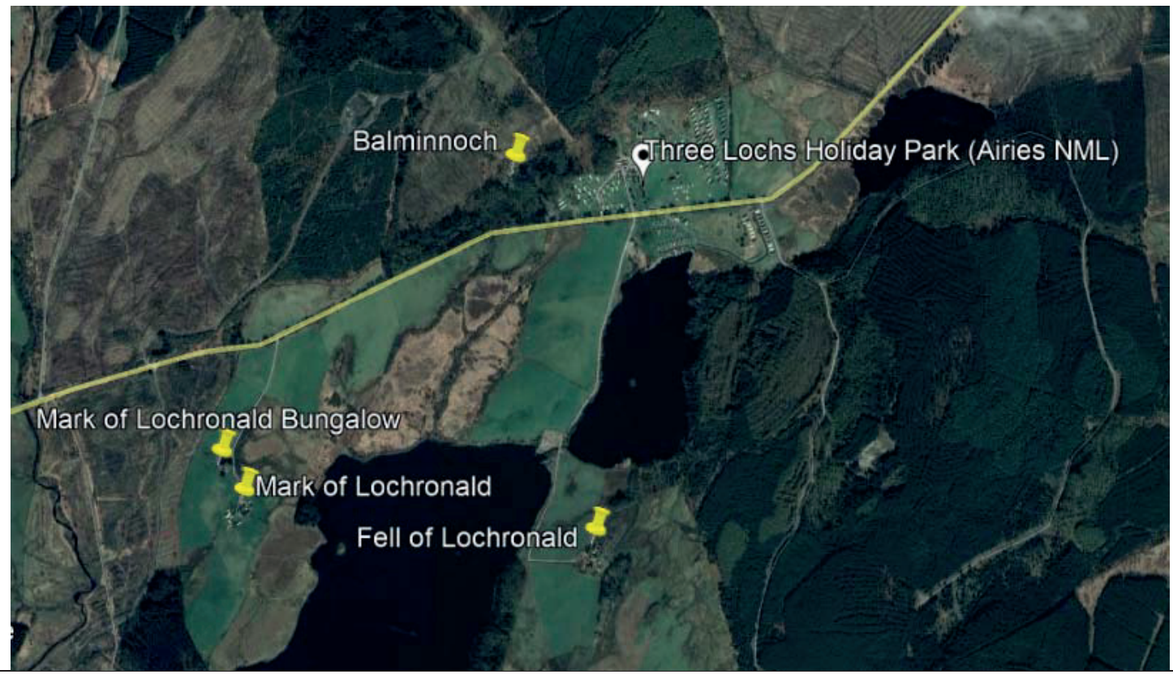
NAL	BGN	Justification
NAL1 - Artfield NAL2 - Low Airies	Low Airies	The soundscape at Low Airies is considered representative of Artfield – at both NALs we would expect that the noise levels would be influenced by woodland and farming related activity. Both NSRs are at similar distances from the B road located to the south.

NAL3 - Glenchamber	Glenchamber	Gass Farm



NAL4 - Torwood Bungalow 2 NAL5 - Torwood Bungalow NAL6 - Torwood House Hotel NAL7 - Torwood Two Dogs Lodge NAL8 - Gass Farm NAL9 - Scotts Corner	Gass Farm	The soundscape at Gass Farm is considered representative of NALs 4-9. At each NAL we would expect that the noise levels would be influenced by the B road to the south, in addition to woodland and farming related activity in the area. The Airies Wind Farm application made the same assumptions with regard to these locations.

NAL10 - Mark of Lochronald Bungalow NAL11 - Mark of Lochronald NAL12 - Fell of Loch Ronald NAL13 - Balminnoch	Three Lochs Holiday Park	The soundscape at Gass Farm is considered representative of NALs 10-13. At each NAL we would expect that the noise levels would be influenced by the B road running through the center of the NALs, in addition to woodland and lochs located in the area. The Airies Wind Farm application made the same assumptions with regard to these locations.



NAL14 - The Old Schoolhouse NAL15 - Kilquhockadale NAL16 - Urrall	Kilquockadale	The soundscape at Kilquockadale is considered representative of NALs 14-16. At each NAL we would expect that the noise levels would be influenced by woodland and farming activity. The Airies Wind Farm application made the same assumptions with regard to these locations.

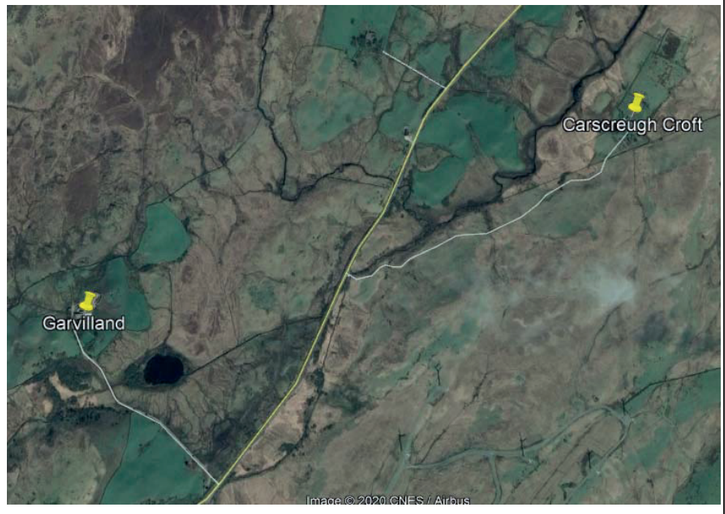
NAL17 - Tannielaggie NAL18 - Kilmacfadzean	Kilmacfadzean	The soundscape at Kilmacfadzean is considered representative of NAL 17. At each NAL we would expect that the noise levels would be influenced by farming activity. Both NALs are similar distances from the A roads located to the east and west.

NAL19 - Quarter Farm	Quarter Farm	N/A

NAL20 - Pultadie	Pultadie	N/A

NAL21 - Balmurrie NAL22 - Dranigower	Kilmacfadzean	The soundscape at Kilmacfadzean is considered representative of NALs 21 and 22. At each NAL we would expect that the noise levels would be influenced by farming activity. The NALs are similar distances from B roads. The Kilgallioch Wind Farm application made the same assumptions with regard to this location.

NAL23 - Garvilland NAL24 - Carscreugh Croft	Low Airies	The soundscape at Low Airies is considered representative of NALs 23-24. At both NALs we would expect that the noise levels would be influenced by farming activity. Both NALs are similar distances from B roads located to the west, and are equidistant from the river located to the west of both locations.



Annex 4 – Concave Barrier Corrections / Turbine Coordinates and Models

Wind Farm	Turbine Type	Easting	Northing	Height	Turbine hub height
1-Artfield Fell - 1	SIEMENS-SWT 1.3-62	223097	566023	190	49
2-Artfield Fell - 2	SIEMENS-SWT 1.3-62	222897	566096	182	49
3-Artfield Fell - 3	SIEMENS-SWT 1.3-62	222736	566284	167	49
4-Artfield Fell - 4	SIEMENS-SWT 1.3-62	223176	566240	200	49
5-Artfield Fell - 5	SIEMENS-SWT 1.3-62	222937	566390	199	49
6-Artfield Fell - 6	SIEMENS-SWT 1.3-62	222717	566658	190	49
7-Artfield Fell - 7	SIEMENS-SWT 1.3-62	223431	566342	209	49
8-Artfield Fell - 8	SIEMENS-SWT 1.3-62	222986	566684	215	49
9-Artfield Fell - 9	SIEMENS-SWT 1.3-62	222783	566900	211	49
10-Artfield Fell - 10	SIEMENS-SWT 1.3-62	223261	566537	241	49
11-Artfield Fell - 11	SIEMENS-SWT 1.3-62	223145	566946	237	49
12-Artfield Fell - 12	SIEMENS-SWT 1.3-62	223017	567142	228	49
13-Artfield Fell - 13	SIEMENS-SWT 1.3-62	222784	567535	234	49
14-Artfield Fell - 14	SIEMENS-SWT 1.3-62	222970	567641	260	49
15-Artfield Fell - 15	SIEMENS-SWT 1.3-62	223121	567458	244	49
16-Carscreugh - 1	Gamesa-G52	221712	560423	130	44
17-Carscreugh - 2	Gamesa-G52	221824	560585	132	44
18-Carscreugh - 3	Gamesa-G52	221938	560741	127	44
19-Carscreugh - 4	Gamesa-G52	222155	560820	128	44
20-Carscreugh - 5	Gamesa-G52	222248	561027	130	44
21-Carscreugh - 6	Gamesa-G52	222396	561190	137	44
22-Carscreugh - 7	Gamesa-G52	222490	561365	145	44
23-Carscreugh - 8	Gamesa-G52	222607	561551	153	44
24-Carscreugh - 9	Gamesa-G52	223133	561463	163	44
25-Carscreugh - 10	Gamesa-G52	223041	561284	158	44
26-Carscreugh - 11	Gamesa-G52	222638	561340	150	44
27-Carscreugh - 12	Gamesa-G52	222717	561127	157	44
28-Carscreugh - 13	Gamesa-G52	222920	561134	157	44
29-Carscreugh - 14	Gamesa-G52	222615	560957	143	44
30-Carscreugh - 15	Gamesa-G52	222818	560965	146	44
31-Carscreugh - 16	Gamesa-G52	222486	560815	129	44
32-Carscreugh - 17	Gamesa-G52	222384	560635	121	44
33-Carscreugh - 18	Gamesa-G52	222359	560461	117	44
34-Balmurrie - 1	SIEMENS-SWT 1.3-62	221914	566762	206	49
35-Balmurrie - 2	SIEMENS-SWT 1.3-62	221790	566974	210	49
36-Balmurrie - 3	SIEMENS-SWT 1.3-62	221796	567226	218	49
37-Balmurrie - 4	SIEMENS-SWT 1.3-62	222209	566821	204	49
38-Balmurrie - 5	SIEMENS-SWT 1.3-62	222090	567051	243	49
39-Balmurrie - 6	SIEMENS-SWT 1.3-62	222066	567341	229	49
40-Balmurrie - 7	SIEMENS-SWT 1.3-62	221896	567495	215	49
41-Glenchamber - 1	Nordex -N100 2500-LM	223029	565034	142	76
42-Glenchamber - 2	Nordex -N100 2500-LM	222669	564960	143	76
43-Glenchamber - 3	Nordex -N100 2500-LM	223030	564670	141	76
44-Glenchamber - 4	Nordex -N100 2500-LM	222679	564600	141	76
45-Glenchamber - 5	Nordex -N100 2500-LM	222330	564662	137	76
46-Glenchamber - 6	Nordex -N100 2500-LM	222791	564258	139	76
47-Glenchamber - 7	Nordex -N100 2500-LM	222357	564278	144	76
48-Glenchamber - 8	Nordex -N100 2500-LM	221997	564342	134	76
49-Glenchamber - 9	Nordex -N100 2500-LM	222372	563915	139	76
50-Glenchamber - 10	Nordex -N100 2500-LM	221845	563934	136	76
51-Glenchamber - 11	Nordex -N100 2500-LM	222191	563578	134	76
52-Airies - 1	GE-2.85 - 103	227625	567468	119	85
53-Airies - 2	GE-2.85 - 103	227597	567872	124	85
54-Airies - 3	GE-2.85 - 103	227373	568127	128	85
55-Airies - 4	GE-2.85 - 103	227078	568310	130	85
56-Airies - 5	GE-2.85 - 103	226912	568592	136	85
57-Airies - 6	GE-2.85 - 103	227203	567586	130	85
58-Airies - 7	GE-2.85 - 103	226795	567749	138	85
59-Airies - 8	GE-2.85 - 103	226625	568113	140	85
60-Airies - 9	GE-2.85 - 103	226507	568496	141	85
61-Airies - 10	GE-2.85 - 103	227092	567164	126	85
62-Airies - 11	GE-2.85 - 103	226626	566981	135	85
63-Airies - 12	GE-2.85 - 103	226393	567324	152	85
64-Airies - 13	GE-2.85 - 103	226304	567711	154	85
65-Airies - 14	GE-2.85 - 103	226223	568129	146	85
66-Airies II- 1	VESTAS-V150 5.6MW	224070	568818	147	125
67-Airies II- 2	VESTAS-V150 5.6MW	224727	568843	157	125
68-Airies II- 3	VESTAS-V150 5.6MW	224317	568265	145	125
69-Airies II- 4	VESTAS-V150 5.6MW	225051	568458	187	125
70-Airies II- 5	VESTAS-V150 5.6MW	225574	568278	169	125
71-Airies II- 6	VESTAS-V150 5.6MW	225470	567751	146	125
72-Airies II- 7	VESTAS-V150 5.6MW	225907	567459	150	125
73-Airies II- 8	VESTAS-V150 5.6MW	226332	566300	133	125
74-Airies II- 9	VESTAS-V150 5.6MW	226063	566710	160	125
75-Kilgallioch - 1	Gamesa G114	222150	576169	194	88
76-Kilgallioch - 2	Gamesa G114	223205	576313	183	88
77-Kilgallioch - 3	Gamesa G114	222765	576211	184	88
78-Kilgallioch - 4	Gamesa G114	222446	575756	199	88
79-Kilgallioch - 5	Gamesa G114	222795	575397	220	88
80-Kilgallioch - 6	Gamesa G114	222359	575142	239	88
81-Kilgallioch - 7	Gamesa G114	222001	574734	235	88
82-Kilgallioch - 8	Gamesa G114	222001	575362	236	88
83-Kilgallioch - 9	Gamesa G114	221586	575031	240	88
84-Kilgallioch - 10	Gamesa G114	221226	574707	271	88
85-Kilgallioch - 11	Gamesa G114	221199	575371	281	88
86-Kilgallioch - 12	Gamesa G114	220824	574956	272	88
87-Kilgallioch - 13	Gamesa G114	220477	574663	242	88
88-Kilgallioch - 14	Gamesa G114	220828	574345	257	88

Wind Farm	Turbine Type	Easting	Northing	Height	Turbine hub height
89-Kilgallioch - 15	Gamesa G114	221166	574043	242	88
90-Kilgallioch - 16	Gamesa G114	221598	574380	231	88
91-Kilgallioch - 17	Gamesa G114	221577	573803	220	88
92-Kilgallioch - 18	Gamesa G114	221284	573400	225	88
93-Kilgallioch - 19	Gamesa G114	220800	573102	238	88
94-Kilgallioch - 20	Gamesa G114	220410	572793	235	88
95-Kilgallioch - 21	Gamesa G90	220401	573443	233	78
96-Kilgallioch - 22	Gamesa G114	219997	573652	208	88
97-Kilgallioch - 23	Gamesa G90	220006	573048	280	78
98-Kilgallioch - 24	Gamesa G114	220795	573770	241	88
99-Kilgallioch - 25	Gamesa G114	220310	574003	209	88
100-Kilgallioch - 26	Gamesa G114	219920	572490	249	88
101-Kilgallioch - 27	Gamesa G114	219603	572134	219	88
102-Kilgallioch - 28	Gamesa G114	219195	571806	199	88
103-Kilgallioch - 29	Gamesa G114	219223	571188	209	88
104-Kilgallioch - 30	Gamesa G114	219598	570802	220	88
105-Kilgallioch - 31	Gamesa G114	220062	570464	229	88
106-Kilgallioch - 32	Gamesa G114	221228	568759	184	88
107-Kilgallioch - 33	Gamesa G114	221144	569561	183	88
108-Kilgallioch - 34	Gamesa G114	220800	569807	198	88
109-Kilgallioch - 35	Gamesa G114	220401	570143	215	88
110-Kilgallioch - 36	Gamesa G114	220832	570468	198	88
111-Kilgallioch - 37	Gamesa G114	221199	570161	184	88
112-Kilgallioch - 38	Gamesa G114	220410	570811	231	88
113-Kilgallioch - 39	Gamesa G114	219952	571135	265	88
114-Kilgallioch - 40	Gamesa G114	219695	571534	227	88
115-Kilgallioch - 41	Gamesa G114	220072	571827	236	88
116-Kilgallioch - 42	Gamesa G114	220360	571443	229	88
117-Kilgallioch - 43	Gamesa G114	220779	571135	201	88
118-Kilgallioch - 44	Gamesa G114	220465	572195	229	88
119-Kilgallioch - 45	Gamesa G114	220852	572409	213	88
120-Kilgallioch - 46	Gamesa G114	221247	572719	212	88
121-Kilgallioch - 47	Gamesa G114	221199	572116	209	88
122-Kilgallioch - 48	Gamesa G114	221608	571791	196	88
123-Kilgallioch - 49	Gamesa G114	221208	571511	201	88
124-Kilgallioch - 50	Gamesa G114	220731	571792	207	88
125-Kilgallioch - 51	Gamesa G114	221203	570890	189	88
126-Kilgallioch - 52	Gamesa G114	221608	571141	202	88
127-Kilgallioch - 53	Gamesa G114	221566	570520	184	88
128-Kilgallioch - 54	Gamesa G114	222006	570712	174	88
129-Kilgallioch - 55	Gamesa G114	222330	570384	170	88
130-Kilgallioch - 56	Gamesa G114	221918	570112	172	88
131-Kilgallioch - 57	Gamesa G114	222328	569838	169	88
132-Kilgallioch - 58	Gamesa G114	222001	569493	170	88
133-Kilgallioch - 59	Gamesa G114	221696	569041	178	88

Wind Farm	Turbine Type	Easting	Northing	Height	Turbine hub height
134-Kilgallioch - 60	Gamesa G114	222379	569253	163	88
135-Kilgallioch - 61	Gamesa G114	222380	572430	212	88
136-Kilgallioch - 62	Gamesa G114	221970	572787	209	88
137-Kilgallioch - 63	Gamesa G114	222332	573072	219	88
138-Kilgallioch - 64	Gamesa G114	222408	573742	213	88
139-Kilgallioch - 65	Gamesa G114	222864	574135	238	88
140-Kilgallioch - 66	Gamesa G114	222799	573434	251	88
141-Kilgallioch - 67	Gamesa G114	222799	572775	271	88
142-Kilgallioch - 68	Gamesa G114	223198	573124	272	88
143-Kilgallioch - 69	Gamesa G114	223186	573757	278	88
144-Kilgallioch - 70	Gamesa G114	223955	574311	239	88
145-Kilgallioch - 71	Gamesa G114	223644	574783	212	88
146-Kilgallioch - 72	Gamesa G114	224400	574111	190	88
147-Kilgallioch - 73	Gamesa G114	224333	573503	176	88
148-Kilgallioch - 74	Gamesa G114	223211	574502	248	88
149-Kilgallioch - 75	Gamesa G114	222478	574551	282	88
150-Kilgallioch - 76	Gamesa G114	222005	574092	231	88
151-Kilgallioch - 77	Gamesa G114	223198	575145	230	88
152-Kilgallioch - 78	Gamesa G114	223597	575406	210	88
153-Kilgallioch - 79	Gamesa G114	223223	575738	233	88
154-Kilgallioch - 80	Gamesa G114	224010	575746	192	88
155-Kilgallioch - 81	Gamesa G114	223583	575959	206	88
156-Kilgallioch - 82	Gamesa G114	224078	575118	180	88
157-Kilgallioch - 83	Gamesa G114	224489	575422	165	88
158-Kilgallioch - 84	Gamesa G114	224895	575753	158	88
159-Kilgallioch - 85	Gamesa G114	224920	575142	174	88
160-Kilgallioch - 86	Gamesa G114	225264	574811	159	88
161-Kilgallioch - 87	Gamesa G114	225275	574090	177	88
162-Kilgallioch - 88	Gamesa G114	224899	574475	179	88
163-Kilgallioch - 89	Gamesa G114	224861	573734	171	88
164-Kilgallioch - 90	Gamesa G114	224507	574855	174	88
165-Kilgallioch - 91	Gamesa G114	225623	575215	159	88
166-Kilgallioch - 92	Gamesa G114	226200	574760	148	88
167-Kilgallioch - 93	Gamesa G114	225644	574461	172	88
168-Kilgallioch - 94	Gamesa G114	225950	574030	171	88
169-Kilgallioch - 95	Gamesa G114	226360	573725	161	88
170-Kilgallioch - 96	Gamesa G114	225623	573684	174	88
171-Kilgallioch Extension - 1	VESTAS-V150 5.6MW	224926	569849	175	105
172-Kilgallioch Extension - 2	VESTAS-V150 5.6MW	222904	570588	190	105
173-Kilgallioch Extension - 3	VESTAS-V150 5.6MW	223603	570349	188	105
174-Kilgallioch Extension - 4	VESTAS-V150 5.6MW	222907	569869	178	105
175-Kilgallioch Extension - 5	VESTAS-V150 5.6MW	224015	570833	197	105
176-Kilgallioch Extension - 6	VESTAS-V150 5.6MW	224832	570361	184	105
177-Kilgallioch Extension - 7	VESTAS-V150 5.6MW	224572	570851	197	105
178-Kilgallioch Extension - 8	VESTAS-V150 5.6MW	223403	570880	181	105

Wind Farm	Turbine Type	Easting	Northing	Height	Turbine hub height
179-Kilgallioch Extension - 9	VESTAS-V150 5.6MW	224228	569777	181	105
180-Kilgallioch Extension - 10	VESTAS-V150 5.6MW	223551	569794	171	105
181-Kilgallioch Extension - 11	VESTAS-V150 5.6MW	224519	569291	161	105
182-Artfield Forest - 1	VESTAS-V150 5.6MW	222922	569174	165	105
183-Artfield Forest - 2	VESTAS-V150 5.6MW	223529	569173	162	105
184-Artfield Forest - 3	VESTAS-V150 5.6MW	222907	568795	166	105
185-Artfield Forest - 4	VESTAS-V150 5.6MW	223539	568745	163	105
186-Artfield Forest - 5	VESTAS-V150 5.6MW	222556	568392	164	105
187-Artfield Forest - 6	VESTAS-V150 5.6MW	223260	568206	160	105
188-Artfield Forest - 7	VESTAS-V150 5.6MW	223700	568345	156	105
189-Artfield Forest - 8	VESTAS-V150 5.6MW	223753	567904	152	105
190-Artfield Forest - 9	VESTAS-V150 5.6MW	224092	567786	148	105
191-Artfield Forest - 10	VESTAS-V150 5.6MW	224553	567788	157	105
192-Artfield Forest - 11	VESTAS-V150 5.6MW	224381	567472	141	105
193-Artfield Forest - 12	VESTAS-V150 5.6MW	224800	567475	144	105

Topographical (concave ground/ barrier) Noise Prediction Adjustment Table

Notes/Comments

Requirement to include a concave ground profile correction of +3dB has been calculated in accordance with section 4.3.9 of the IOA GPG (July 2011)
A barrier correction of -2dB is included where the landform completely obscures a turbine at the noise assessment location
Where analysis indicates that both are required the barrier correction take precedence and a correction of -2dB is applied

			Noise Assessment Locations																								
Wind Farm	**Hub**	**T ID**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Artfield Fell	49	1	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	-2	-2	-2	0	-2	3
Artfield Fell	49	2	0	3	3	-2	0	3	0	0	0	3	3	3	3	0	0	-2	-2	-2	-2	-2	-2	0	-2	3
Artfield Fell	49	3	0	0	-2	-2	0	0	-2	-2	0	0	0	3	0	0	0	-2	-2	-2	-2	-2	-2	-2	-2	0
Artfield Fell	49	4	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	-2	-2	-2	0	-2	3
Artfield Fell	49	5	0	3	3	-2	3	3	3	0	0	3	3	3	3	3	3	-2	-2	-2	-2	-2	-2	-2	-2	3
Artfield Fell	49	6	-2	3	-2	-2	0	0	-2	-2	0	0	0	3	3	0	0	-2	-2	-2	-2	-2	-2	-2	-2	3
Artfield Fell	49	7	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	-2	-2	-2	0	-2	3
Artfield Fell	49	8	-2	3	3	-2	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	-2	-2	-2	3
Artfield Fell	49	9	-2	3	-2	-2	0	3	0	0	0	3	3	3	3	3	3	-2	-2	-2	0	-2	0	-2	-2	3
Artfield Fell	49	10	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	-2	3	-2	3
Artfield Fell	49	11	0	3	-2	-2	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	0	-2	-2	3
Artfield Fell	49	12	-2	3	-2	-2	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	0	-2	-2	3
Artfield Fell	49	13	-2	3	-2	-2	0	3	-2	0	0	3	3	3	3	3	3	-2	-2	-2	3	-2	0	-2	-2	3
Artfield Fell	49	14	-2	3	-2	-2	3	3	3	3	3	3	3	3	3	3	3	-2	-2	3	3	-2	3	-2	-2	3
Artfield Fell	49	15	0	3	-2	-2	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	0	-2	-2	3
Carscreugh	44	16	3	3	3	-2	0	0	0	0	0	0	0	0	3	0	0	-2	-2	0	-2	-2	-2	-2	0	-2
Carscreugh	44	17	3	3	3	-2	0	3	0	0	0	0	0	0	3	0	0	-2	-2	-2	-2	-2	-2	-2	0	-2
Carscreugh	44	18	3	3	3	-2	0	0	0	0	0	0	0	0	3	0	0	-2	-2	-2	-2	-2	-2	-2	0	-2
Carscreugh	44	19	3	3	0	-2	0	0	0	0	0	0	0	0	3	0	0	-2	-2	-2	-2	-2	-2	-2	3	-2
Carscreugh	44	20	3	3	3	-2	0	0	0	0	0	0	0	0	3	0	0	-2	-2	-2	3	-2	-2	-2	3	-2
Carscreugh	44	21	3	3	3	-2	0	3	3	0	0	3	0	0	3	0	3	-2	-2	-2	3	-2	-2	-2	3	0
Carscreugh	44	22	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	-2	-2	3	0
Carscreugh	44	23	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	-2	-2	3	0
Carscreugh	44	24	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	-2	-2	3	0
Carscreugh	44	25	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	-2	-2	3	0
Carscreugh	44	26	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	-2	-2	3	0
Carscreugh	44	27	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	-2	-2	3	0
Carscreugh	44	28	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-2	-2	-2	3	-2	-2	-2	3	0
Carscreugh	44	29	3	3	3	0	0	0	0	0	0	0	0	0	3	0	3	-2	-2	-2	3	-2	-2	-2	3	-2
Carscreugh	44	30	3	3	3	0	0	3	3	0	0	0	0	3	3	3	3	-2	-2	-2	3	-2	-2	-2	3	-2
Carscreugh	44	31	3	3	0	-2	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	3	-2	-2	-2	3	-2
Carscreugh	44	32	0	3	0	-2	0	0	0	-2	-2	0	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	-2	0	-2

			Noise Assessment Locations																								
Wind Farm	**Hub**	**T ID**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Carscreugh	44	33	0	3	0	-2	-2	0	0	-2	-2	0	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	-2	0	-2
Balmurrie	49	34	-2	3	-2	-2	-2	3	-2	-2	0	3	3	3	-2	3	-2	-2	-2	3	3	-2	0	0	-2	-2
Balmurrie	49	35	-2	0	-2	-2	-2	3	-2	-2	0	3	3	3	-2	0	-2	-2	-2	3	3	-2	3	0	-2	-2
Balmurrie	49	36	-2	3	-2	-2	0	3	-2	-2	0	0	0	3	-2	0	-2	-2	-2	3	3	-2	3	0	-2	-2
Balmurrie	49	37	-2	3	-2	-2	3	3	-2	-2	0	3	3	3	3	0	-2	-2	-2	-2	0	-2	0	-2	-2	3
Balmurrie	49	38	-2	3	-2	-2	3	3	-2	3	3	3	3	3	3	3	3	-2	-2	3	3	-2	3	3	-2	3
Balmurrie	49	39	-2	3	-2	-2	3	3	-2	-2	0	3	3	3	-2	3	-2	-2	-2	3	3	-2	0	0	-2	3
Balmurrie	49	40	-2	-2	-2	-2	0	0	-2	-2	0	-2	-2	3	-2	0	-2	-2	-2	3	3	-2	3	0	-2	-2
Glenchamber	76.5	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0	0
Glenchamber	76.5	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	-2	-2	-2	0	-2	0
Glenchamber	76.5	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	-2	-2	-2	0	0	0
Glenchamber	76.5	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	-2	0	0	0
Glenchamber	76.5	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	-2	0	-2	0
Glenchamber	76.5	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	-2	0	0	0
Glenchamber	76.5	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	-2	0	-2	0
Glenchamber	76.5	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	-2	0	0	0
Glenchamber	76.5	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	-2	0	0	0
Glenchamber	76.5	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	0	0	0	0
Glenchamber	76.5	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	-2	0	0	0
Airies	85	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	-2	0
Airies	85	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Airies	85	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Airies	85	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	0	0
Airies	85	56	0	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	0	0
Airies	85	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0
Airies	85	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Airies	85	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Airies	85	60	0	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Airies	85	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0
Airies	85	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0
Airies	85	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0
Airies	85	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Airies	85	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Airies II	125	66	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	-2	-2	0	-2	-2	0
Airies II	125	67	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	0
Airies II	125	68	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0
Airies II	125	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	0	0

Wind Farm	Hub	T ID	Noise Assessment Locations																							
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Airies II	125	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	0	0
Airies II	125	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	0	0
Airies II	125	72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	0	0
Airies II	125	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Airies II	125	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	0	0	0
Kilgallioch	88	75	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	76	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	77	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	78	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	0	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	79	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	80	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	81	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	82	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	83	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	84	-2	-2	-2	-2	-2	-2	-2	-2	-2	3	3	3	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	85	-2	-2	-2	-2	-2	-2	-2	-2	-2	3	3	3	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	86	-2	-2	-2	-2	-2	-2	-2	-2	-2	3	3	3	-2	0	0	-2	-2	-2	-2	-2	0	0	-2	-2
Kilgallioch	88	87	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	0	-2	-2
Kilgallioch	88	88	-2	-2	-2	-2	-2	-2	-2	-2	-2	3	3	3	-2	0	0	-2	-2	-2	-2	-2	0	0	-2	-2
Kilgallioch	88	89	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	90	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	91	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	92	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	0	0	-2	-2	-2
Kilgallioch	88	93	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	3	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	94	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	3	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	95	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	96	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	97	-2	-2	-2	-2	-2	-2	-2	-2	-2	3	3	3	-2	3	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	98	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	3	-2	0	0	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	99	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	0	-2	-2
Kilgallioch	88	100	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	3	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	101	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	102	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	103	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	104	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	105	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	78	106	-2	-2	-2	-2	-2	0	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	0	0	-2	0	0	-2	-2

Wind Farm	Hub	T ID	Noise Assessment Locations																							
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Kilgallioch	88	107	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	-2	-2	-2	0	0	-2	0	0	-2	-2
Kilgallioch	78	108	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	109	-2	-2	-2	-2	-2	0	-2	-2	-2	-2	-2	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	110	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	111	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	112	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	3	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	113	-2	-2	-2	-2	-2	-2	-2	-2	-2	3	3	3	-2	3	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	114	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	115	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	3	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	116	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	3	-2	3	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	117	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	118	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	3	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	119	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	120	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	0	0	-2	-2	-2
Kilgallioch	88	121	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	0	0	-2	-2	-2
Kilgallioch	88	122	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	0	0	-2	-2	-2
Kilgallioch	88	123	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2
Kilgallioch	88	124	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	125	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2
Kilgallioch	88	126	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	0	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2
Kilgallioch	88	127	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	128	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	129	-2	-2	-2	-2	-2	-2	-2	0	0	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	130	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	131	-2	-2	-2	-2	-2	-2	-2	0	0	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	132	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	-2	-2	-2	0	-2	-2	0	-2	-2	-2
Kilgallioch	88	133	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	-2	-2	-2	0	0	-2	0	-2	-2	-2
Kilgallioch	88	134	-2	-2	-2	-2	-2	-2	-2	0	0	0	0	0	-2	0	-2	-2	-2	0	-2	-2	0	-2	-2	-2
Kilgallioch	88	135	-2	-2	-2	-2	-2	-2	-2	0	0	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	136	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	137	-2	-2	-2	-2	-2	-2	-2	0	0	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	138	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	139	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	0	-2	0	-2	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	140	-2	-2	-2	-2	-2	-2	-2	0	0	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	141	-2	-2	-2	-2	-2	-2	-2	3	3	3	3	3	-2	3	3	-2	3	-2	-2	-2	3	-2	-2	3
Kilgallioch	88	142	-2	-2	-2	-2	-2	-2	-2	3	3	3	3	3	-2	3	3	-2	3	-2	-2	-2	3	-2	-2	-2
Kilgallioch	88	143	-2	-2	-2	-2	-2	-2	-2	3	3	3	3	3	-2	3	3	-2	-2	-2	-2	-2	3	-2	-2	-2

Wind Farm	Hub	T ID	Noise Assessment Locations																							
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Kilgallioch	88	144	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	0	-2	3	3	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	145	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	146	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	147	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	148	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	149	-2	-2	-2	-2	-2	-2	-2	3	3	3	3	0	-2	0	3	-2	-2	-2	-2	-2	3	-2	-2	-2
Kilgallioch	88	150	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	151	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	152	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	153	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0	-2	-2	-2
Kilgallioch	88	154	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	155	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	156	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	157	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	158	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	159	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	0	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	160	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	161	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	162	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	0
Kilgallioch	88	163	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	0
Kilgallioch	88	164	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	-2	-2	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	165	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	166	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	167	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	168	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	169	-2	-2	-2	-2	-2	-2	-2	0	-2	-2	0	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch	88	170	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	-2	-2	-2	-2	-2	-2	-2	-2
Kilgallioch Extension	105	171	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0
Kilgallioch Extension	105	172	-2	-2	-2	-2	0	-2	-2	0	0	0	0	0	-2	0	0	-2	0	-2	-2	-2	0	-2	-2	0
Kilgallioch Extension	105	173	0	-2	-2	-2	0	0	0	0	0	0	0	0	-2	0	0	-2	0	0	-2	-2	0	-2	-2	0
Kilgallioch Extension	105	174	-2	-2	-2	-2	0	-2	-2	0	0	0	0	0	-2	0	-2	-2	-2	0	-2	-2	0	-2	-2	0
Kilgallioch Extension	105	175	0	-2	-2	-2	-2	0	0	0	0	0	0	0	-2	0	0	-2	0	0	-2	-2	0	-2	-2	0
Kilgallioch Extension	105	176	0	-2	-2	-2	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	-2	-2	0	-2	-2	0
Kilgallioch Extension	105	177	0	-2	-2	-2	-2	0	0	0	0	0	0	0	-2	0	0	-2	0	0	-2	-2	0	-2	-2	0
Kilgallioch Extension	105	178	0	-2	-2	-2	-2	-2	-2	0	0	0	0	0	-2	0	0	-2	0	-2	-2	-2	0	-2	-2	-2
Kilgallioch Extension	105	179	0	0	-2	-2	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	-2	-2	0	-2	-2	0
Kilgallioch Extension	105	180	0	-2	-2	-2	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	-2	-2	0	-2	-2	0

Wind Farm	Hub	T ID	Noise Assessment Locations																							
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Kilgallioch Extension	105	181	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	-2	-2	-2	-2	-2	0
Artfield Forest	105	182	-2	0	-2	-2	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	0	-2	-2	0	-2	-2	0
Artfield Forest	105	183	0	0	-2	-2	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	0	-2	-2	0	-2	-2	0
Artfield Forest	105	184	-2	0	-2	-2	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	0	0	-2	0	-2	-2	0
Artfield Forest	105	185	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	-2	-2	0	-2	-2	0
Artfield Forest	105	186	-2	0	-2	-2	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	0	0	-2	0
Artfield Forest	105	187	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	0	-2	-2	0
Artfield Forest	105	188	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	0	-2	-2	-2	-2	0
Artfield Forest	105	189	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	0	-2	-2	-2	-2	0
Artfield Forest	105	190	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	0	-2	-2	-2	-2	0
Artfield Forest	105	191	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Artfield Forest	105	192	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0
Artfield Forest	105	193	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	-2	-2	-2	0	0