A specialist energy consultancy

Technical Appendix 10.1

Wind Farm Operational Noise Report

South Kyle II Wind Farm

Vattenfall Wind Power Ltd

14797-012-R0
10 September 2024

PUBLISHED

tneigroup.com

Quality Assurance

TNEI Services Ltd, TNEI Africa (PTY) Ltd and TNEI Ireland Ltd operate an Integrated Management System and is registered with The British Assessment Bureau as being compliant with ISO 9001 (Quality), ISO 14001 (Environmental) and ISO 45001 (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
D0	DRAFT	AD	GC	MC	19/07/2024
R0	FINAL ISSUE	AD	MC	MC	09/09/2024

TNEI Services Ltd

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

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

TNEI Ireland Ltd

Registered: 104 Lower Baggot Street, Dublin 2, DO2 Y940
Company Registration Number: 662195 **VAT Registration Number: 3662952IH**

Unit S12, Synergy Centre
TU Dublin Tallaght Campus
Tallaght
D24 A386
Tel: +353 (0)190 36445

TNEI Africa (Pty) Ltd

Registered: Mazars House, Rialto Rd, Grand Moorings Precinct,7441 Century City, South Africa
Company Number: 2016/088929/07

Unit 514 Tyger Lake
Niagara Rd & Tyger Falls Blvd
Bellville, Cape Town
South Africa, 7530

TNEI Inc.
Registered Address: 9319 Robert D/ Snyder Rd. PORTAL Building Mecklenburg County
Charlotte, NC 228223-0001 USA
Certification Number: C202305805696-1

Unit 216 PORTAL Building,
9319 Robert D. Snyder Road
Charlotte, Mecklenburg County,
North Carolina 28223
Tel: +1 (980) 245-4024

Executive Summary

TNEI Services was commissioned by Natural Power on behalf of Vattenfall Wind Power Ltd ('the Applicant') to undertake an assessment of the potential impact of operational noise from the proposed South Kyle II Wind Farm (hereinafter referred to as '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.'* The advice document 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 operational noise assessment has been undertaken in three stages:

1) derive 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 levels at noise sensitive receptors will meet the Total ETSU-R-97 Noise Limits; and
3) derive Site Specific Noise Limits for the Proposed Development (taking account of the noise limit that has already been allocated to/ could realistically be used by other schemes) and undertake predictions against those limits.

There are a number of operational wind farms in proximity to the Proposed Development. Background noise monitoring was previously undertaken at four receptors proximate to the north of the Proposed Development to establish prevailing background noise levels, this was done as part of the noise assessment work undertaken for Enoch Hill Wind Farm. Enoch Hill Wind Farm is located to the northeast of the Proposed Development and is currently under construction. Out of the four noise monitoring locations, the quietest background noise dataset was used as a basis for deriving a set of noise limits applicable for all receptors surrounding the Proposed Development.

A total of nine 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.

Based on the guidance in ETSU-R-97 and to reflect the noise limits already set for existing wind turbines 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. The night-time Total ETSU-R-97 Noise Limit was set at 43 dB(A) or background plus 5 dB whichever is the greater. The daytime Site Specific Noise 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(A) or background plus 5 dB whichever is the greater.

The exception to the setting of both the daytime and night-time fixed minimum noise limits occur where a property occupier has a financial involvement in the wind farm development where the fixed minimum limit can be increased to 45 dB(A) or a higher permissible limit above background during the daytime and night-time periods. For the purposes of this assessment, it has been assumed that there is one Financially Involved (FI) property with the Proposed Development, this property is Clawfin, and one property FI with South Kyle Wind Farm, which is Brownhill and is relatively distant from the Proposed Development.

Predictions of wind turbine noise for the Proposed Development were made, based upon the sound power level data for a candidate wind turbine, the Siemens-Gamesa SG 6.6-170 6.6 MW with a hub height of 115 m. This wind turbine model was 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 consent. For the other nearby wind farm schemes considered, predictions were 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 the Council's Planning Application Portal.

Modelling was undertaken using the ISO 9613 *'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.

A cumulative assessment was undertaken at the NALs where predictions from the Proposed Development were found to be within 10 dB of the noise predictions from all other schemes. The likely cumulative assessment, required at seven NALs, shows that the Proposed Development with the candidate turbine operating in full mode, and operating concurrently with other nearby wind farms in the area can meet the Total ETSU-R-97 Noise Limits at all NALs.

Site Specific Noise Limits have also been derived that take account of the other wind farm developments. Where wind turbine noise predictions from the nearby 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.

Predicted noise levels indicate that wind turbine noise immissions from the Proposed Development are below the Site Specific Noise Limits at the all NALs, except NAL4, where an exceedance of up to 1.2 dB is predicted during the daytime for some wind speeds and wind directions (downwind of the Proposed Development). This assessment demonstrates that the use of Low Noise Modes available to the candidate turbine would be an effective mitigation measure to meet the limits.

There are a number of wind turbine makes and models that may be suitable for the Proposed Development. Should the Proposed Development receive planning permission 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 Site Specific Noise limits determined and contained within any condition imposed. 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.

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.

Contents

TABLES

ANNEXES

1 Introduction

1.1 Brief

1.1.1 TNEI was commissioned by Natural Power on behalf of Vattenfall Wind Power Ltd ('the Applicant') to undertake an operational noise assessment for the proposed South Kyle II 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 noise assessment undertaken for the nearby Enoch Hill Wind Farm;
- Undertake cumulative noise predictions, where required, to take account of other proposed, consented or operational schemes near to the Proposed Development;
- Compare the predicted cumulative noise levels against the Total ETSU-R-97 Noise Limits;
- Derive Site Specific Noise Limits for the Proposed Development, suitable for inclusion in noise related planning conditions should the Scottish Ministers be minded to grant consent for the Proposed Development;
- Undertake predictions of the operational wind turbine noise immission from the Proposed Development that will be incident at neighbouring noise sensitive receptors;
- Compare the predicted noise levels against the Site Specific 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 the Department of Trade and Industry Noise Working Group on Noise from Wind Turbines which are contained within ETSU-R-97 *'The Assessment and Rating of Noise from Wind Farms'* (1) and *'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'* (2) (IOA GPG) which represents current good practice.

1.2 Background

1.2.1 The Site is located approximately 3 km west of Dalmellington in East Ayrshire and has an approximate centre point of 252614, 606862 (OS National Grid Reference). The Proposed Development is located immediately to the northwest of the operational South Kyle Wind Farm and comprises up to 11 wind turbines with a maximum tip of 200 m. The proposed layout is shown on Figure A1.1 in Annex 1.

1.2.2 In the absence of a confirmed turbine model, this noise assessment models a candidate turbine, the Siemens-Gamesa SG 6.6-170 6.6 MW, with a hub height of 115 m. This turbine has been selected as it is representative of the turbine type which could be installed at the site.

1.2.3 The noise assessment has considered schemes which are operational, consented and proposed (planning application submitted). The schemes considered in the assessment are summarised in Table 1.1 and these are also shown in Figure A1.1.

Table 1.1 Cumulative Wind Farm/ Turbine Development

Wind Farm/ Wind Turbine	Number of Turbines	Status	Make and Model of Turbine considered in Modelling
South Kyle	62	Operational	Nordex N133
Enoch Hill 1&2	18	Consented, under construction.	Vestas V136
North Kyle	49	Consented, under construction.	Vestas V136
Overhill	10	Consented	Nordex N133
Greenburn	16	Consented	Vestas V136
Pencloe	19	Consented	Vestas V136
Afton	25	Operational	Gamesa G80
Benbrack	15	Consented, under construction.	Vestas V136 and V117
Windy Standard I Repowering	8	In Planning	Vestas V162
Windy Standard II	30	Operational	Vestas V90
Windy Standard III	20	Consented	Siemens-Gamesa SWT-3.2 & SWT-2.3
Windy Rig	12	Operational	Nordex N100
Polquhairn	9	Consented	Enercon E115 and E82
Knockkippen	12	In Planning	Vestas V136
Sclenteuch	9	In Planning	Vestas V150

1.2.4 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.

1.2.5 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 to the sound pressure level (the received noise) at any receptor location due to the operation of the wind turbines. All references to dB are referring to A weighted noise levels (dB(A)) unless otherwise stated. A full glossary of terms is provided in Section 8.

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:

- National Planning Policy (3);
- Local Policy;
- 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 National Planning Policy

2.2.1 As the Proposed Development has capacity to generate over 50 MW, the Proposed Development requires consent from the Scottish Ministers Energy Consenting Unit (ECU) under Section 36 of the Electricity Act 1989. In such cases the Planning Authority is a statutory consultee in the development management process and procedures.

National Planning Framework 4 (NPPF4)

2.2.2 In determining an application for Section 36 consent, the Scottish Ministers must first have regard to the extent to which the Applicant has met its duties in terms of Schedule 9 of the Electricity Act 1989. The Applicant must assess and, if required, mitigate the effects of the Proposed Development on environmental matters.

2.2.3 Furthermore, decision makers must also consider National Energy and Planning Policy, and, in the context of a Section 36 application, the statutory Development Plan. As of February 2023, National Planning Framework 4 ('NPF4') now forms part of the statutory Development Plan alongside the relevant Local Development Plan and any related Supplementary Guidance. Such plans will often contain policies tailored specifically to control certain kinds of development and such policies should carry more weight and be more dominant in the minds of decision makers.

2.2.4 National Planning Framework 4 ('NPF4') was adopted on 13 February 2023 and supersedes National Planning Framework 3 and Scottish Planning Policy. Policy 11 – Energy states that renewable energy projects must be able to demonstrate how any noise impacts on communities have been addressed through the project's design and any associated mitigation. Policy 23 – Health and Safety outline how 'development proposals that are likely to raise unacceptable noise issues will not be supported' and states that 'a Noise Impact Assessment may be required where the nature of the proposal or its location suggests that significant effects are likely.'

2.2.5 The Scottish Government's online Onshore Wind: Policy Statement 2022 (published on 21 December 2022) (6) states (in Section 3.7) that: 'The Assessment and Rating of Noise from

Wind Farms' (Final Report, Sept 1996, DTI), (ETSU-R-97) provides the framework for the measurement of wind turbine noise, and all applicants are required to follow the framework and use it to assess and rate noise from wind energy developments.'

Web Based Planning Advice – Onshore Wind Turbines

2.2.6 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.'

2.2.7 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.'

2.2.8 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.'

2.2.9 Examination of the Technical Advice Note (7) confirms that it provides advice on wind farms by 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.

Planning Advice Note PAN 1/2011: Planning and Noise

2.2.10 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.'

2.3 Local Policy

East Ayrshire Local Development Plan

2.3.1 East Ayrshire Council has started the first statutory stage in the preparation of the East Ayrshire Local Development Plan 2, however at present the 2017 Local Development Plan (LDP1) remains valid. The LDP1, adopted in April 2017 is a key material consideration in the determination of planning applications in East Ayrshire and indicates where development should and should not occur, looking to create successful places whilst maintaining general placemaking and design principles.

2.3.2 The LDP1 sets out a methodology based on that which is set out in Scottish Planning Policy which contains a spatial framework for wind energy developments of over 50 m to tip in height. Schedule 1 of the LDP1 sets out this methodology and states the following must be considered: *'Impacts on communities and individual dwellings, including visual impact, residential amenity, noise and shadow flicker'.*

Policy ENV12: Water, air and light and noise pollution states: 'All new development must take full account of any Noise Action Plan and Noise Management Areas that are in operation in the area and ensure that significant adverse noise impacts on surrounding properties and uses are avoided. A noise impact assessment may be required in this regard and noise mitigation measures may be required through planning conditions and/or Section 75 Obligations.'

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

2.4.1 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).

2.4.2 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.'

2.4.3 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).'*

2.4.4 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.'

2.4.5 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.'

2.4.6 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.'

2.4.7 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.

2.4.8 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.

2.4.9 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.'

2.4.10 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}.

2.4.11 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.'

2.4.12 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.

2.5 Current Good Practice

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

2.5.1 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.

2.5.2 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.'

2.5.3 The guidance document was endorsed, on behalf of Scottish Government by the Cabinet Secretary for Finance, Employment and Sustainable Growth, Mr John Swinney MSP (8) The recommendations included in the IOA GPG have been considered and applied throughout this noise assessment for the Proposed Development.

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

2.5.5 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.

2.6 WSP BEIS Report

2.6.1 In February 2023, WSP published *'A review of noise guidance for onshore wind turbines'* (9)('WSP BEIS report'). The report, which was subsequently re-issued as version 4 in May 2023, was commissioned by (the former) UK Government Department for Business, Energy & Industrial Strategy (BEIS). The primary aim of the review was to make a recommendation on whether, in view of government policies on noise and Net Zero, and available evidence, the existing guidance requires updating.

2.6.2 The WSP BEIS report concluded that:

'the guidance would benefit from further review and updating of the aspects identified. This could be supported by currently available evidence, which is summarised in this report. However, the study has also highlighted gaps in the state of knowledge, which should be addressed by further research, to support any updates to the guidance.'

2.6.3 A series of recommendations are made regarding further research whilst some additional suggestions are included regarding the development of new or updated guidance. The following recommendation is included on page 26 of the WSP BEIS report:

'the separation of the 'policy position' (addressing the balance between controlling noise impact and enabling renewable energy development), 'technical guidance' (application of the assessment approach), and 'technical justification' (the supporting evidence) into discrete, linked documents'

2.6.4 The WSP BEIS report notes at the outset that *'Any views expressed within it do not necessarily represent the views of the UK government or the governments of any of the devolved administrations'.* The report does state on page 25 that:

'Consideration should be given to including a clear position statement in guidance confirming the intended policy balance between protection from noise impact, and enabling of renewable energy development (to achieve Net Zero), linked with the wider policies that underpin the government approach to noise management.'

2.6.5 The UK Government Department for Energy Security and Net Zero (DESNZ) has recently issued a tender seeking support to update ETSU-R-97. At the present time there are no set timescales for such an update to be published or adopted.

2.6.6 In relation to the guidance that should be used to assess the Proposed Development, the Scottish Government Guidance is clear; the Onshore Wind Policy Statement 2022 states:

'3.7.1. 'The Assessment and Rating of Noise from Wind Farms' (Final Report, Sept 1996, DTI), (ETSU-R-97) provides the framework for the measurement of wind turbine noise, and all applicants are required to follow the framework and use it to assess and rate noise from wind energy developments.'

'3.7.4. Until such time as new guidance is produced, ETSU-R-97 should continue to be followed by applicants and used to assess and rate noise from wind energy developments.'

2.6.7 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 (10).

3.2 Other Amplitude Modulation (OAM)

3.2.1 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.'

3.2.2 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.

3.2.3 On 16 December 2013, RenewableUK (RUK) released six technical papers (11) 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).

3.2.4 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.'

3.2.5 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.

3.2.6 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.*

3.2.7 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.

3.2.8 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".

3.2.9 The report (12) 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; 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."*

3.2.10 AM was considered in the WSP BEIS report. The report notes that the IOA Method provides a suitable approach to measure and quantify AM (whilst noting that work is ongoing to refine the approach) but also highlights that further work is required to develop a robust mechanism for controlling AM that could be incorporated into a planning condition. In relation to the potential adoption of a penalty scheme to control AM the WSP BEIS report notes on page 208 that:

'In practice, the details of applying such a penalty scheme are complicated by the complexities of wind turbine sound measurements. These often involve a considerable amount of data filtering and data aggregation to address the practical difficulties of measuring a highly variable source, which is often also at a level that is relatively low

compared with other, fluctuating residual sounds present in the acoustic environment. Such details will need to be carefully considered in further study, and the example planning condition proposed by a group of IOA members in 2017 [505] *should be considered as a starting point.'*

3.2.11 Until such a 'further study' is completed, and additional guidance is published, the approach set out in the IOA GPG remains valid, the document 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.'

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 have been followed:

- Specify the location of the wind turbines for the Proposed Development and nearby relevant wind turbines / farms;
- Utilise the noise levels previously measured in the area in the absence of wind turbine noise, to establish representative background noise levels across a range of wind speeds;
- 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 previously measured background noise dataset;
- Establish for each NAL the Total ETSU-R-97 Noise Limits on analysis of the measured background noise levels;
- 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 Noise Limits;
- Determine the Site Specific Noise Limits which take account of the noise limit already allocated to/ could theoretically be used by other schemes in the area; 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 existing Total ETSU-R-97 Noise Limits at each NAL based on known background noise levels (from Enoch Hill noise assessment) which were measured in the absence of wind turbine noise in the area;
- Stage 2 – undertake a cumulative assessment where noise predictions from the Proposed Development are within 10 dB of the total noise predictions from the other wind farms/turbines within the area; 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. In the absence of a confirmed turbine model, this noise assessment models a candidate turbine, the Siemens-Gamesa SG 6.6-170 6.6 MW and a hub height of 115 m. 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 be required to comply with the noise limits which have been established for the site.

4.2 Consultation

Scoping Opinion (dated June 2022)

4.2.1 In the Scoping Opinion issued June 2022, the Scottish Government's Energy Consents Unit (ECU) stated the following in relation to noise:

'It is recommended by the Scottish Ministers that the final list of receptors in respect of noise assessment should be agreed following discussion between the Company, East Ayrshire Council and Dumfries & Galloway Council. The noise assessment should be carried out in line with relevant legislation and standards as detailed in chapter 11 of the scoping report. The noise assessment report should be formatted as per Table 6.1 of the IOA "A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise."'

4.2.2 Also, as a consultee response to the ECU, East Ayrshire Council (EAC) issued a letter dated 14th June 2022 (included in Annex A of the ECU Scoping Opinion) which stated the following in relation to noise:

'Whilst consultation with the Council's Environmental Health Service will be useful and could assist with agreeing the noise methodology, the Council currently uses the services of an independent noise consultant to deal with wind farm noise matters. The Planning Authority would recommend that discussion is undertaken with the Council's noise consultant to agree the methodology for noise assessment to inform the EIA Report. The Planning Authority would encourage the use of the lower end of the ETSU limits. Cumulative noise assessments with other wind farms is welcome although the Applicant should also consider other noise generating developments within the vicinity and consider the impacts these might have in addition to the proposed development to ensure a robust assessment of cumulative noise is undertaken for nearby receptors. The Planning Authority would agree that low frequency noise (or infrasound) can be scoped out of the assessment. The Council has experience of a wind turbine which was generating Amplitude Modulation such that it was deemed to be causing a statutory noise nuisance and a noise abatement notice was served on the operator. Nevertheless, the Planning Authority understands that until such time as the relevant guidance is updated, there is no formally adopted method for assessing Amplitude Modulation and the Planning Authority agrees that this can be scoped out of the assessment.'

4.2.3 Overall, it was acknowledged that ETSU-R-97 and the IOA GPG would be the relevant guidelines and that consultation with respect to noise should be undertaken with EAC. Details of the consultation with EAC are included below. As detailed in Section 3.2 above, there are still no available methods to predict the occurrence of OAM at the planning stage, so whilst information on OAM has been provided, an assessment of OAM has been scoped out.

Noise Consultation (dated June 2024)

4.2.4 Consultation with the Environmental Health Department at EAC was undertaken in June 2024. A copy of the full consultation correspondence is included within Annex 2 of this report. The following response was received:

'I have now had the opportunity to review your proposals and would comment as follows:

> *1.The rationale behind your proposed assessment and scoping out of the assessment certain elements relating to BESS operational noise and construction noise is accepted (these proposals are summarised by you on pages 4 and 5 of your letter) and agreed.*
>
> *2.It is noted that you intend to rely on background noise levels measured in 2015 (and presented in 2015 within the Environmental Statement for the Enoch Hill windfarm development) for preparation of the Noise Assessment for operational noise from South Kyle however I note from the map provided at Figure 1 in your letter does not identify the properties at Maneight Farm, Upper Beoch, Clawfin and Pennyvenie as having previously been considered. It would be useful if any modelling exercise using the 2015 data could be expanded to model background noise levels at the locations. The topography is such that Maneight, which sits at a higher level than Meiklehill and is in the prevailing wind direction from South Kyle 2 site could potentially be impacted by this new development. In relation to Upper Beoch, Clawfin and Pennyvenie, South Kyle 2 will be encroaching closer to these properties than previous developments and should be given consideration.'*

4.2.5 It is acknowledged that the figure accompanying the consultation letter did not show all residential dwellings in the area. It was produced to show only those selected for the assessment which are a representative sample of the closest properties in all directions. Noise impacts at properties located further away than those assessed are assumed to be lesser than what is presented herein. The background noise levels selected to represent each assessed receptor are low/ conservative values, as explained in the consultation letter and later in Section 5 of this report. The topography is considered in detail within the noise predictions, as recommended in the IOA GPG, with more detail provided in Section 6.3 this report.

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

Background Noise Levels and Wind Shear

4.3.1 The IOA GPG set outs out in Section 5.2.3 four methods which can be used to determine suitable background noise levels in areas where measured levels have the potential to be influenced by operational wind turbines. One of the option states that noise assessments can be undertaken:

'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).'

4.3.2 As agreed at consultation, background noise levels already measured at four locations in the area and presented for the nearby Enoch Hill Wind Farm planning application were judged to be suitable for this noise assessment, and TNEI also carried-out further analysis to ensure that wind shear was considered in context of a now proposed higher hub up to 115m (previous background / limits assumed up to 82m). For clarity, no new background noise survey was undertaken for this assessment.

4.3.3 Wind shear can be defined as *'the change in the relationship between wind speed at different heights'.* Due to wind shear, wind speeds recorded on one meteorological mast at different heights are usually different, generally the higher the anemometer the higher the wind speed recorded. For example, if a wind speed of 4 ms^{-1} is recorded at 80 m height, 3.5 ms^{-1} may be recorded at 40 m and 2.5 ms^{-1} may be recorded at 10 m.

4.3.4 Hub height wind speed is the key wind speed for a wind farm noise assessment, as it is the wind speed at hub height which will determine the noise emitted by the wind turbines and informs the turbine control system. Ideally, both wind turbine noise predictions and background noise level measurements should refer to hub height wind speed (or a representation thereof), ensuring that there is no discrepancy between the wind speed at which the noise is emitted and the wind speed at which the corresponding background noise is measured.

Noise Impact Criteria in ETSU-R-97

4.3.5 ETSU-R-97 recommends noise limits should be set at 5 dB(A) above existing background noise levels, or a fixed minimum limit of 35-40 dB during the daytime and 43 dB during the night-time periods where background noise levels are low, and that these limits should reflect the variation in background noise with wind speed. Different limits apply to those properties that have a financial interest in the wind energy development (45 dB or background plus 5 dB (whichever is the greater) for both daytime and night-time).

4.3.6 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 (in planning) wind farms in the area and will henceforth be referred to as the 'Total ETSU-R-97 Noise Limits'.

4.3.7 The Site Specific Noise Limits will be based on the lower daytime fixed minimum noise limit of 35 dB or background plus 5 dB whichever is the greater. The Total and Site Specific night-time noise limits will be based on 43 dB or background plus 5 dB.

4.3.8 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 The IOA GPG (2013) includes a detailed section on cumulative noise and provides guidance on where a cumulative assessment is required. Section 5.1.4 and 5.1.5 of the GPG state:

'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.

Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary.'

4.4.2 An assessment was undertaken at a selection of noise sensitive receptors proximate to the Proposed Development and other nearby wind farm developments to determine whether the wind turbine noise immission from the Proposed Development were within 10 dB of the wind turbine noise immission from the other schemes. Where predictions were found to be within 10 dB of each other, then a cumulative noise assessment was undertaken to determine the likely impacts of the Proposed Development, however, if wind turbine immission were greater than 10 dB apart then a cumulative noise assessment was not required.

Noise Prediction / Propagation Model

4.4.3 The ISO 9613-2: 2024 *'Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation'* (13) model algorithm provides a robust prediction method for calculating the noise immission levels at the nearest receptors.

4.4.4 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.'

4.4.5 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. The error bands referenced in the ISO standard itself relate to the general application of the standard. Additional, wind farm specific studies, have also been undertaken to validate the use of the standard to predict wind farm noise and these are referenced in Section 4 of the IOA GPG which goes on to conclude that: *'The outcome of this research has demonstrated that the ISO 9613-2 standard in particular, which is widely used in the UK, can be applied to obtain realistic predictions of noise from 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.'* TNEIs experience of undertaking compliance monitoring for operational wind farms indicates that the predictions undertaken using the guidance in the IOA GPG show a good correlation with measured levels.

4.4.6 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.

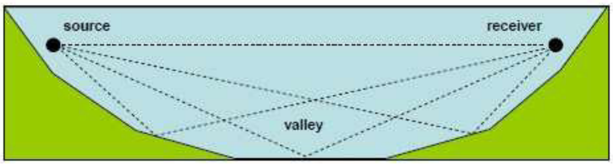
4.4.7 The model uses as its acoustic input data the octave band sound power output of the turbine and calculates, on an octave band basis, attenuation due to the factors above, as appropriate.

4.4.8 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 not with the requirements of the IOA GPG.

4.4.9 The model used in this assessment does not model barrier attenuation using the method in ISO 9613-2, but instead uses the guidance in the IOA GPG to consider whether any topographical corrections are required as set out below in Sections 4.4.10 to 4.4.13. Any differences in ground height (AOD) between the receptors and the turbines are considered when calculating the propagation distance between each source and receiver.

4.4.10 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

4.4.11 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).

4.4.12 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.

4.4.13 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.

4.4.14 The modelling parameters used in this assessment are detailed in Section 6.2.1 below.

4.5 Setting the Site Specific Noise Limits (Stage 3)

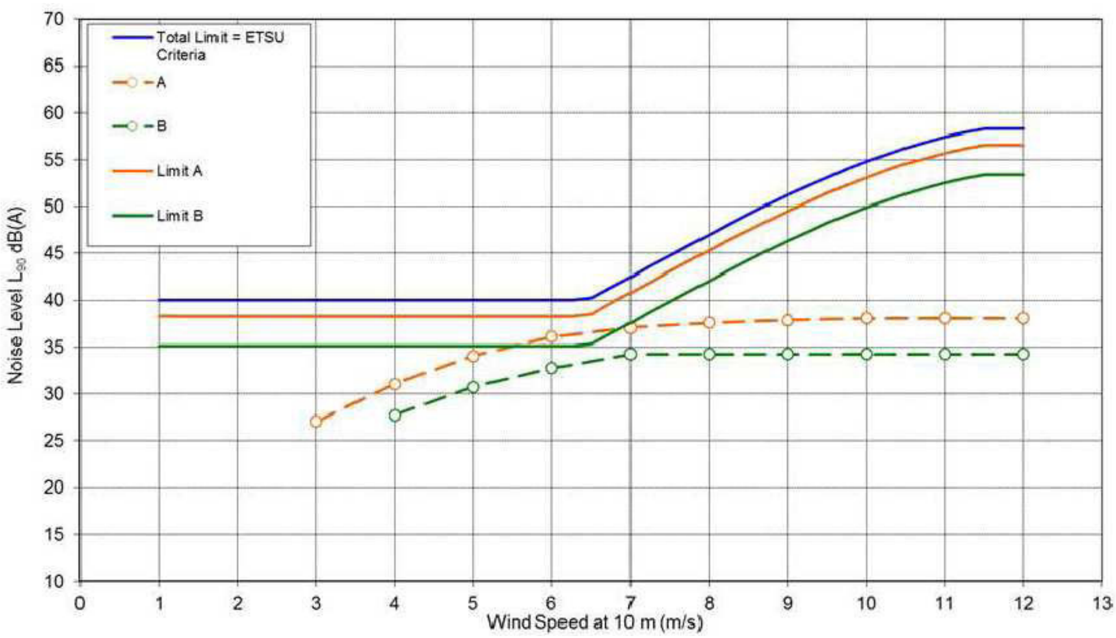
4.5.1 Summary Box 21 of the IOA GPG states:

'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 an apportionment of the Total ETSU-R-97 noise limits 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 wind farm A and wind farm 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 the individual wind farms.

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. This Information on the approach to apportionment is made on a receptor by receptor basis and specific detail of the chosen approach for each receptor is provided in Section 6.6 below.

5 Baseline

5.1.1 In order to establish Total ETSU-R-97 Noise Limits in accordance with ETSU-R-97 it is necessary to determine the relationship between wind speed measured at the Proposed Development site and background noise levels measured at the closest noise sensitive receptors. Measured background noise levels should not be influenced by noise from operational wind turbines, this is an important consideration for this assessment given the number of operational wind turbines in the area.

5.1.2 With due regard to the location of key receptors relative to operational turbines and the existing background noise data collected previously, it was acknowledged at consultation that the background noise data gathered as part of the July 2015 Environmental Statement (ES) for Enoch Hill Windfarm would be reused. The four Enoch Hill noise monitoring locations are presented on Figure A1.1 (Annex 1).

5.1.3 As can be seen on Figure A1.1, the only common receptor between the Noise Assessment Locations for the Proposed Development, and the noise monitoring locations from the Enoch Hill ES, is Meiklehill. The quiet daytime background noise levels at Meiklehill were also the quietest of all the noise monitoring locations, with the nighttime levels, whilst not the quietest of all the monitoring locations, quiet enough across the wind speed range such that the Total ETSU-R-97 Noise Limit will be solely a function of the Fixed Minimum Limit. Therefore, the Total ETSU-R-97 Noise Limits for all Noise Assessment Locations have been set using the background noise levels from Meiklehill only.

5.1.4 As part of the noise assessment undertaken for the Enoch Hill ES, the background noise measurements were correlated to wind speeds at a height of 82 m. TNEI has been supplied with the 10 minute background noise, rain and wind speed data collected as part of the baseline noise survey for Enoch Hill, with permission being granted to allow for this data to be used for the wind shear adjustments to ensure the background dataset is suitable for a hub height of up to 115 m. Regression analysis plots of all four background noise datasets are presented in Figures A1.2a-d, where the wind speed has been standardised from a height of 115 m to 10 m.

5.1.5 Table 5.1 and Table 5.2 summarise the prevailing background noise levels at Meiklehill.

Table 5.1 Prevailing Background Noise Levels during Quiet Daytime Periods (dB(A))

NML	Wind Speed (m/s) standardised to 10m											
	1	2	3	4	5	6	7	8	9	10	11	12
Meiklehill	22.0	22.3	22.9	23.8	24.9	26.3	27.9	29.9	32.1	34.7	34.7*	34.7*

* Flatlined beyond 10 m/s due to insufficient data points in each wind speed bin.

Table 5.2 Prevailing Background Noise Levels during Night-time Periods (dB(A))

NML	Wind Speed (m/s) standardised to 10m											
	1	2	3	4	5	6	7	8	9	10	11	12
Meiklehill	20.7	20.7	20.7	20.7	21.4	22.7	24.3	26.2	28.3	30.4	32.5	34.3

6 Noise Assessment Results

6.1 Noise Assessment Locations

6.1.1 Noise Assessment Locations (NAL) refer to the position where a detailed assessment was undertaken, denoted by the blue house symbol on Figure A1.1 (Annex 1). A total of nine noise sensitive receptors were chosen as representative NALs. The NALs chosen were the closest receptors to the Proposed Development in any direction. Predictions of wind turbine noise have been made at each of the NAL detailed in Table 6.1, where coordinates are intended to be the closest edge of the amenity area (usually the garden) to the wind turbines.

6.1.2 This approach ensures that the report models the worst case (highest) 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 6.3 and thus the closer to a noise source, the higher the noise level.

Table 6.1 Noise Assessment Locations

Noise Assessment Location (NAL)	Easting (m)	Northing (m)	Elevation (m AOD)	Approximate Distance to Nearest South Kyle II Turbine* (m)	Background Noise Data used
NAL1 - Maneight	254289	609687	314	2868 (T9)	Meiklehill
NAL2 - Knockenlee	253710	609315	270	2488(T5)	Meiklehill
NAL3 - Nith Lodge	253633	609133	275	2296 (T5)	Meiklehill
NAL4 - Meiklehill	253491	608827	294	1965(T5)	Meiklehill
NAL5 – Clawfin	250608	607295	256	1274 (T2)	Meiklehill
NAL6 - Pennyvenie	249453	606652	212	2169 (T1)	Meiklehill
NAL7 - Mossdale Farm	249404	604217	229	3063 (T1)	Meiklehill
NAL8 - Glenmuck	251495	602140	304	3590(T4)	Meiklehill
NAL9 - Brownhill	255895	602599	300	3620 (T10)	Meiklehill

** 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).*

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 Siemens-Gamesa SG 6.6-170 6.6 MW with a hub height of 115 m and a layout composed of 11 wind turbines, coordinates of which are provided in Annex 3. The wind turbines considered for the other nearby wind farms considered are also detailed in Annex 3 and all wind turbines are shown on Figure A1.1.

6.2.2 Details of the sound power level, octave data and measurement uncertainty used for all the turbines considered in this assessment are included in Annex 4. 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. The data for some turbines has not been included due to data confidentiality. The noise data would be available upon request subject to the signing of the appropriate Non-Disclosure Agreement.

6.2.3 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 heights considered for all wind turbines are detailed in Annex 3.

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 2 dB(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 (14) 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 3.

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 sight 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 3. 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 in all of the Tables and Graphs in this report.

6.3.6 The noise predictions have 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.

6.3.7 Hubbard (1990) (IOA GPG Section 4.4.3) 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.

6.3.8 This observation was adopted in the IOA GPG, which states (Section 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 Section 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.

6.3.9 The IOA GPG recommends (Section 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 (Section 4.4.2), using interpolation where required, and adopting a single attenuation value for receptors located more than 5 tip heights from a turbine.

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 by establishing the ‘best fit’ correlation between background noise level and wind speed. 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 A Fixed Minimum Limit of 40 dB has been adopted to establish the daytime Total ETSU-R-97 Noise Limit. This has been selected by considering the cumulative impacts of the Proposed

Development operating in conjunction with other operational, consented and proposed schemes, and the fact that a daytime Total ETSU-R-97 Noise Limit based on a fixed minimum limit of 40 dB has been used to set the noise limits for North Kyle Wind Farm at key receptors, such as Meiklehill.

6.4.3 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.

6.4.4 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 40 dB(A) (daytime) or 43 dB(A) (Nighttime) or background plus 5 dB(A). An exception occurs where the properties are financially involved with the proposed development where the daytime and night-time fixed minimum limit is increased to 45 dB(A).

6.4.5 It should be noted that due to very low background levels which never exceed 35 dB at any wind speed, the resulting Total ETSU-R-97 limits for this assessment only rely on Fixed Minimum Limits and will therefore be worst-case, with a flat 40 dB limit at all wind speeds during the daytime and a flat 43 dB limit during the night-time. For financially involved properties it is therefore a flat 45 dB limit for both the daytime and night time.

6.4.6 The Total ETSU-R-97 Noise Limits for each of the NALs are detailed in Table 6.3.

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 - Maneight	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL2 - Knockenlee	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL3 - Nith Lodge	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL4 - Meiklehill	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL5 – Clawfin*	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NAL6 - Pennyvenie	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL7 - Mossdale Farm	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL8 - Glenmuck	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL9 – Brownhill**	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

* FI with the Proposed Development.
** FI with the South Kyle Wind Farm.

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 - Maneight	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL2 - Knockenlee	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL3 - Nith Lodge	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL4 - Meiklehill	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL5 – Clawfin*	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NAL6 - Pennyvenie	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL7 - Mossdale Farm	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL8 - Glenmuck	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL9 - Brownhill**	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

* FI with the Proposed Development.
** FI with the South Kyle Wind Farm.

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

6.5.1 A comparison has been undertaken of the predicted wind turbine noise immission levels from the Proposed Development alongside all other schemes at each of the NALs in order to demonstrate whether predictions are within 10 dB of each other. All turbines have been assumed to be operating in full unconstrained mode. Table 6.5 below summarises the results and whether a cumulative noise assessment is required. As is detailed in Section 4.4 above, if the predictions are greater than 10 dB apart then a cumulative noise assessment is not required. Where predictions are found to be within 10 dB of each other a cumulative assessment is required.

Table 6.5 Cumulative Assessment Requirement

Noise Assessment Location (NAL)	Are predicted wind turbine noise levels within 10 dB?	Is a cumulative assessment required?
NAL1 - Maneight	YES	YES
NAL2 - Knockenlee	YES	YES
NAL3 - Nith Lodge	YES	YES
NAL4 - Meiklehill	YES	YES
NAL5 - Clawfin	YES	YES
NAL6 - Pennyvenie	YES	YES
NAL7 - Mossdale Farm	YES	YES
NAL8 - Glenmuck	NO	NO
NAL9 - Brownhill	NO	NO

6.5.2 As summarised in Table 6.5 above, a cumulative noise assessment was required at NALs 1 – 7, the results of which are presented in Table 6.6 and Table 6.7. A detailed list of all assessed wind farms/ wind turbine developments, along with a summary of the cumulative noise predictions comparison, are included within Annex 4 of this assessment.

6.5.3 The results show that the predicted cumulative wind turbine noise immission levels meet the Total ETSU-R-97 Noise limits under all conditions at all NALs. The predicted 'likely' cumulative levels are the actual levels expected at an NAL and include the addition of an appropriate level of uncertainty to the turbine source data as per Section 4.2 of the IOA GPG. The uncertainty level added by TNEI when interpreting manufacturer data is generally +2 dB but this can vary depending on the turbine manufacturer data available for each turbine.

6.5.4 Figures A1.3a-g (Annex 1) show predictions from the Proposed Development and cumulative (including Proposed Development) against the Total ETSU-R-97 Noise Limits. The individual contributions of the cumulative schemes are also shown.

Table 6.6 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 - Maneight	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	27.7	32.7	36.4	37.0	37.0	37.0	37.0	37.0	37.0
	Exceedance Level	-	-	-	-12.3	-7.3	-3.6	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
NAL2 – Knockenlee	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	25.9	30.9	34.6	35.3	35.3	35.3	35.3	35.3	35.3
	Exceedance Level	-	-	-	-14.1	-9.1	-5.4	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7
NAL3 - Nith Lodge	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	26.0	31.0	34.7	35.4	35.4	35.5	35.5	35.5	35.5
	Exceedance Level	-	-	-	-14.0	-9.0	-5.3	-4.6	-4.6	-4.5	-4.5	-4.5	-4.5
NAL4 - Meiklehill	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	27.1	32.0	35.6	36.2	36.3	36.3	36.3	36.3	36.3
	Exceedance Level	-	-	-	-12.9	-8.0	-4.4	-3.8	-3.7	-3.7	-3.7	-3.7	-3.7
NAL5 – Clawfin*	Total Noise Limit: ETSU-R-97 L_{A90}	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	28.5	33.3	36.5	37.0	37.0	37.1	37.1	37.1	37.1
	Exceedance Level	-	-	-	-16.5	-11.7	-8.5	-8.0	-8.0	-7.9	-7.9	-7.9	-7.9
NAL6 - Pennyvenie	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	24.0	28.8	32.2	32.9	32.9	32.9	32.9	32.9	32.9
	Exceedance Level	-	-	-	-16.0	-11.2	-7.8	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1
NAL7 - Mossdale Farm	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	21.7	26.5	30.1	30.8	30.9	31.0	31.0	31.0	31.0
	Exceedance Level	-	-	-	-18.3	-13.5	-9.9	-9.2	-9.1	-9.0	-9.0	-9.0	-9.0

Note: For the cumulative noise predictions, the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for lower wind speeds therefore no cumulative predictions are included for some low wind speeds.

* FI with the Proposed Development.

Table 6.7 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 - Maneight	Total Noise Limit: ETSU-R-97 L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	27.7	32.7	36.4	37.0	37.0	37.0	37.0	37.0	37.0
	Exceedance Level	-	-	-	-15.3	-10.3	-6.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
NAL2 – Knockenlee	Total Noise Limit: ETSU-R-97 L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	25.9	30.9	34.6	35.3	35.3	35.3	35.3	35.3	35.3
	Exceedance Level	-	-	-	-17.1	-12.1	-8.4	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7
NAL3 - Nith Lodge	Total Noise Limit: ETSU-R-97 L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	26.0	31.0	34.7	35.4	35.4	35.5	35.5	35.5	35.5
	Exceedance Level	-	-	-	-17.0	-12.0	-8.3	-7.6	-7.6	-7.5	-7.5	-7.5	-7.5
NAL4 - Meiklehill	Total Noise Limit: ETSU-R-97 L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	27.1	32.0	35.6	36.2	36.3	36.3	36.3	36.3	36.3
	Exceedance Level	-	-	-	-15.9	-11.0	-7.4	-6.8	-6.7	-6.7	-6.7	-6.7	-6.7
NAL5 – Clawfin*	Total Noise Limit: ETSU-R-97 L_{A90}	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	28.5	33.3	36.5	37.0	37.0	37.1	37.1	37.1	37.1
	Exceedance Level	-	-	-	-16.5	-11.7	-8.5	-8.0	-8.0	-7.9	-7.9	-7.9	-7.9
NAL6 - Pennyvenie	Total Noise Limit: ETSU-R-97 L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	24.0	28.8	32.2	32.9	32.9	32.9	32.9	32.9	32.9
	Exceedance Level	-	-	-	-19.0	-14.2	-10.8	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1
NAL7 - Mossdale Farm	Total Noise Limit: ETSU-R-97 L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	21.7	26.5	30.1	30.8	30.9	31.0	31.0	31.0	31.0
	Exceedance Level	-	-	-	-21.3	-16.5	-12.9	-12.2	-12.1	-12.0	-12.0	-12.0	-12.0

Note: For the cumulative noise predictions, the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for lower wind speeds therefore no cumulative predictions are included for some low wind speeds.
*FI with the Proposed Development.

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 The stage 2 has demonstrated that there would be no cumulative excess of the total ETSU-R-97 noise limit. This stage 3 is a further step to consider the fact nearby wind farm may have the right to operate a higher levels than 'likely' predictions and also to consider potential noise conditions applicable to the Proposed Development on its own.

6.6.3 Site Specific Noise Limits have been calculated as an apportionment of the Total ETSU-R-97 noise limits. The modelling done for any apportionment assumes that all nearby wind turbines considerer are operating which is a worst-case assumption.

6.6.4 The apportionment options provided in the IOA GPG were considered to determine the most appropriate option for each NAL, as detailed in Table 6.8 .

Table 6.8 Limit Derivation Strategy

NAL	Limit Derivation Strategy
NALs 1 – 4	At certain wind speeds there is not significant headroom between the predicted levels from the other schemes and the Total ETSU-R-97 Noise Limits, therefore at these wind speeds the Site Specific Noise Limits have been set at 10 dB below the Total ETSU-R-97 Noise Limits. This occurs during both the daytime. At wind speeds where there is significant headroom in both daytime and night-time, a 2 dB cautious buffer has been added to the nearby turbines noise predictions) to assume they could have the right to be louder) and 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 'residual noise limit'. As a summary, the resulting Site Specific Noise Limits were determined as follows: • The night-time limit was set to the residual noise limit. • The daytime noise limit was determined by taking the lowest of either: o The residual noise limit; or o Background noise plus 5 dB or the daytime fixed minimum limit of 35 dB (whichever is greater).
NALs 5, 7	The likely predictions level from all other third party schemes were found to be more than 10 dB below the Total ETSU-R-97 Noise Limits during both the daytime and nighttime and as such the entire noise limits has been allocated to the Proposed Development.
NAL6	The likely predictions level from other schemes were found to be within 5 - 10 dB of the daytime Total Noise Limit between 6 – 9 m/s. As such, the daytime limit has

NAL	Limit Derivation Strategy
	been apportioned based on a cautious prediction of cumulative turbine noise. The daytime Site Specific Noise Limits have been determined as either: • The residual noise limit; or • Background noise plus 5 dB or the daytime fixed minimum limit of 35 dB (whichever is greater). The likely predictions level from all other third party schemes were found to be more than 10 dB below the Total ETSU-R-97 Noise Limits during the night time and as such the entire noise limits has been allocated to the Proposed Development.

6.6.5 Please note the buffers detailed above are in addition to the appropriate level of uncertainty already added to the nearby wind turbines likely predictions as per Section 4.2 of the IOA GPG.

6.6.6 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 A1.4a-g(Annex 1). There is a set of graphs for NAL1 – NAL7, which show the Total ETSU-R-97 Noise Limit (solid red line), the Site Specific Noise Limit (dashed red line with triangles) and the predicted wind turbine noise from the Proposed Development in full mode for the candidate turbine (solid blue line) and an illustrative Low Noise Mode when required (dashed blue line).

6.6.7 Table 6.9 and Table 6.10 show the daytime and night-time Site Specific Noise Limits, noise predictions for the Proposed Development (based on low noise mode operation where required) and the exceedance level. A negative exceedance demonstrates compliance with the Site Specific Noise Limits.

6.6.8 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. As illustrated in Figure A1.4d (NAL4), low noise mode operation is assumed for the candidate turbine during the daytime; by assuming T5, 6 and 9 operate in Mode N3, with the remaining turbines unconstrained in mode AMO, predictions from the Proposed Development meet the daytime Site Specific Noise Limit at NAL4. This would only be required for specific wind speeds and wind directions. The candidate turbine 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 and that may not require the use of Low Noise Modes. 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 have to meet the noise limits.

Table 6.9 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 - Maneight	Site Specific Noise Limit L_{A90}	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predicted Wind Turbine Noise L_{A90}	-	-	-	18.6	23.3	26.3	26.7	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-	-	-	-16.4	-11.7	-3.7	-3.3	-3.3	-3.3	-3.3	-3.3	-3.3
NAL2 – Knockenlee	Site Specific Noise Limit L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.8	25.6	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Exceedance Level	-	-	-	-14.2	-9.4	-6.5	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
NAL3 - Nith Lodge	Site Specific Noise Limit L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predicted Wind Turbine Noise L_{A90}	-	-	-	21.6	26.4	29.3	29.7	29.7	29.7	29.7	29.7	29.7
	Exceedance Level	-	-	-	-13.4	-8.6	-5.7	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
NAL4 - Meiklehill	Site Specific Noise Limit L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predicted Wind Turbine Noise L_{A90}	-	-	-	23.1	27.5*	29.5*	29.8*	29.8*	29.8*	29.8*	29.8*	29.8*
	Exceedance Level	-	-	-	-11.9	-7.5	-5.5	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
NAL5 - Clawfin	Site Specific Noise Limit L_{A90}	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	Predicted Wind Turbine Noise L_{A90}	-	-	-	27.1	31.8	34.8	35.2	35.2	35.2	35.2	35.2	35.2
	Exceedance Level	-	-	-	-17.9	-13.2	-10.2	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8
NAL6 - Pennyvenie	Site Specific Noise Limit L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	37.1	39.1	39.1	39.1
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.7	25.5	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Exceedance Level	-	-	-	-14.3	-9.5	-6.5	-6.1	-6.1	-8.2	-10.2	-10.2	-10.2
NAL7 - Mossdale Farm	Site Specific Noise Limit L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	37.1	39.7	39.7	39.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.0	21.7	24.7	25.1	25.1	25.1	25.1	25.1	25.1
	Exceedance Level	-	-	-	-18.0	-13.3	-10.3	-9.9	-9.9	-12.0	-14.6	-14.6	-14.6

** Low noise modes applied, see details in Figure A1.4d.*

Table 6.10 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 - Maneight	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	41.3	40.9	40.9	40.9	40.9	40.9	40.9
	Predicted Wind Turbine Noise L_{A90}	-	-	-	18.6	23.3	26.3	26.7	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-	-	-	-24.4	-19.7	-15.0	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2
NAL2 – Knockenlee	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	41.9	41.7	41.7	41.7	41.7	41.7	41.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.8	25.6	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Exceedance Level	-	-	-	-22.2	-17.4	-13.4	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8
NAL3 - Nith Lodge	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	41.9	41.7	41.7	41.7	41.7	41.7	41.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	21.6	26.4	29.3	29.7	29.7	29.7	29.7	29.7	29.7
	Exceedance Level	-	-	-	-21.4	-16.6	-12.6	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0
NAL4 - Meiklehill	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	41.7	41.5	41.5	41.5	41.5	41.5	41.5
	Predicted Wind Turbine Noise L_{A90}	-	-	-	23.0	27.8	30.8	31.2	31.2	31.2	31.2	31.2	31.2
	Exceedance Level	-	-	-	-20.0	-15.2	-10.9	-10.3	-10.3	-10.3	-10.3	-10.3	-10.3
NAL5 - Clawfin	Site Specific Noise Limit L_{A90}	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	Predicted Wind Turbine Noise L_{A90}	-	-	-	27.1	31.8	34.8	35.2	35.2	35.2	35.2	35.2	35.2
	Exceedance Level	-	-	-	-17.9	-13.2	-10.2	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8
NAL6 - Pennyvenie	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.7	25.5	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Exceedance Level	-	-	-	-22.3	-17.5	-14.5	-14.1	-14.1	-14.1	-14.1	-14.1	-14.1
NAL7 - Mossdale Farm	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.0	21.7	24.7	25.1	25.1	25.1	25.1	25.1	25.1
	Exceedance Level	-	-	-	-26.0	-21.3	-18.3	-17.9	-17.9	-17.9	-17.9	-17.9	-17.9

6.7 Micrositing

6.7.1 A 50 m micrositing distance is proposed. 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 Summary and Conclusions

7.1.1 This report has assessed the potential impact of operational noise from the Proposed Development on the nearby noise sensitive receptors which are residential properties. 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 data previously collected for Enoch Hill Wind Farm at four locations in the area was used to establish representative background noise levels (in the absence of any wind turbine noise) and to set the Total ETSU-R-97 Noise Limits at the nearest receptors to the Proposed Development.

7.1.3 As the hub heights of the Proposed Development is 115 m and the background noise levels referenced wind speeds up to 82 m, a wind shear analysis was undertaken and the background noise levels and subsequent noise limits in this report are valid to 115 m.

7.1.4 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 in this assessment.

7.1.5 There are a number of operational and proposed wind farms in proximity to the Proposed Development. A cumulative assessment was undertaken where predicted levels from Proposed Development were found to be within 10 dB of the predicted cumulative levels from other wind farm in the area. The results show that the predicted cumulative wind farm noise immission levels meet the Total ETSU-R-97 Noise Limits at all locations.

7.1.6 Site Specific Noise Limits have also been derived based on a daytime fixed minimum limit of 35 dB or background plus 5 dB and a night time limit of 43 dB or background plus 5 dB. The limit derivation took account (where required) of the other wind farms in the area. Where immission 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 10 dB of the Total ETSU-R-97 Noise Limits, apportionment of the Total ETSU-R-97 Noise Limits was undertaken in accordance with good practice.

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 (excluding NAL4) wind turbine noise immission were below the Site Specific Noise Limits. At NAL4 predicted noise levels exceed the daytime Site Specific Noise Limit by up to 1.2 dB across a range of wind speeds. The use of low noise modes would mitigate this exceedance the predicted levels presented within this report include the necessary mitigation.

7.1.8 The candidate turbine 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 and that may not require the use of Low Noise Modes. 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 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. **Government, Scottish.** National Planning Policy Framework 4. *https://www.transformingplanning.scot/national-planning-framework/what-is-the-national-planning-framework/.* [Online]

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

6. **Governement, Scottish.** Onshore wind: policy statement 2022. [Online] https://www.gov.scot/publications/onshore-wind-policy-statement-2022/.

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

8. **Letter John Swinney, MSP Cabinet Secretary for Finance, Employment and Sustainable Growth to Prof B Shield, IOA, 29 May 2013. *http://www.ioa.org.uk/pdf/scottish-government-endorsement-of-ioa-gpg.pdf.* [Online]**

9. **WSP. A review of noise guidance for onshore wind turbines. [Online] 10 02 2023. https://www.wsp.com/en-gb/insights/wind-turbine-noise-report.**

10. ***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.**

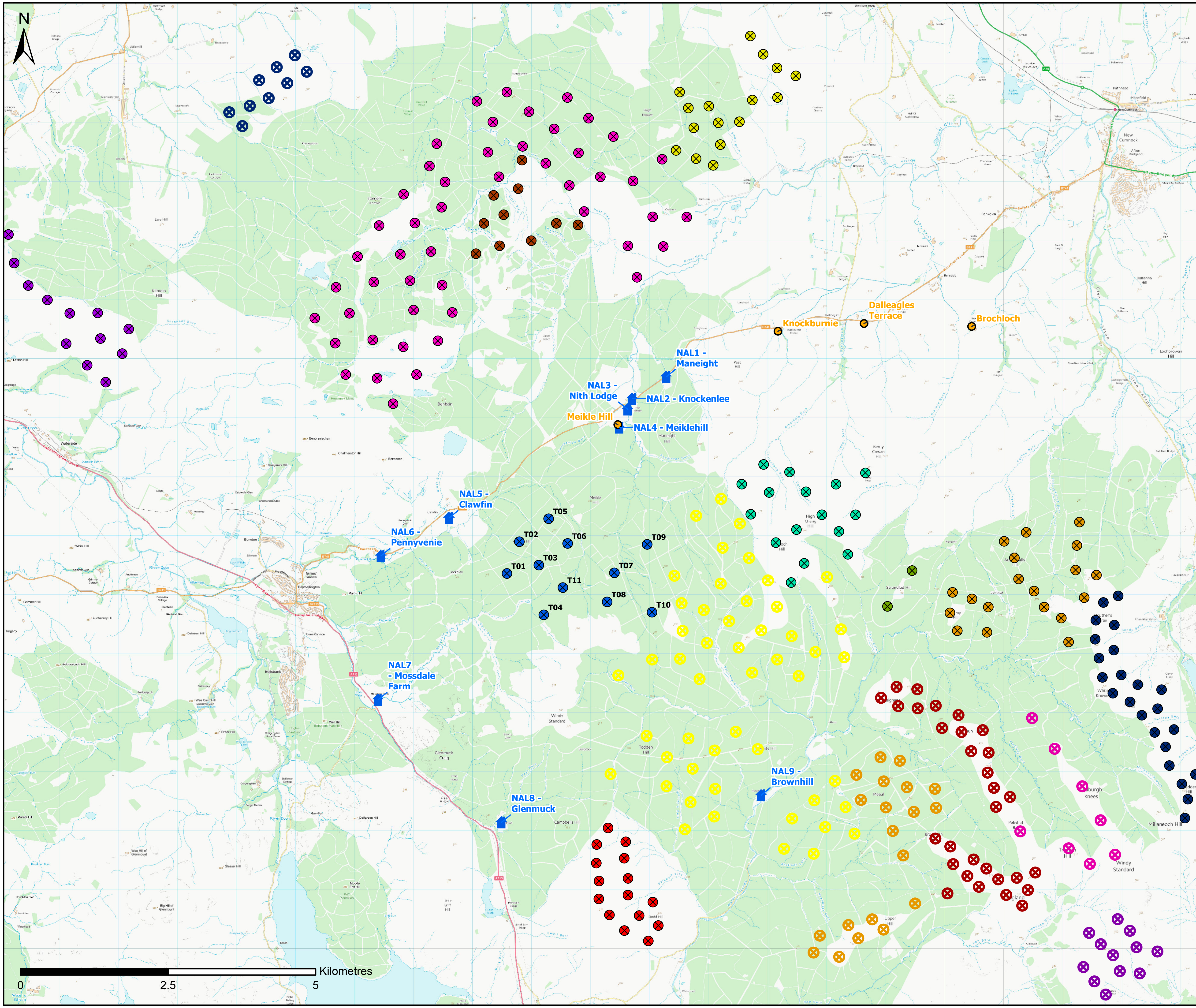
11. **renewable UK. http://www.renewableuk.com/search/all.asp?bst=amplitude+modulation. [Online]**

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

13. **International Standards Organisation. *ISO9613:2024 'Acoustics – Attenuation of sound during propagation outdoors' – Part 2: General method of calculation.* 2024.**

14. **DataKustik Gmbh. CadnaA Version 4.4.**

Annex 1 – Figures



Contains OS data © Crown copyright and database right 2024

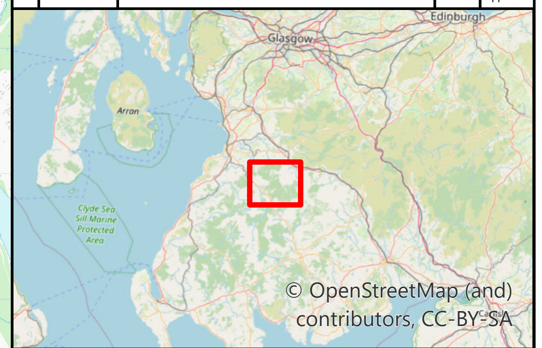
LEGEND

- Noise Monitoring Location (NML) - from Enoch Hill noise survey 2015
- Noise Assessment Location (NAL)

Wind Farm / Turbine

- South Kyle II / Proposed Development
- South Kyle
- Enoch Hill
- Enoch Hill 2
- North Kyle
- Overhill
- Greenburn
- Pencloe
- Afton
- Windy Standard I (Repowering)
- Windy Standard II
- Windy Standard III
- Windy Rig
- Polquhairn
- Knockkippen
- Sclenteuch
- Benbrack

Rev.	Date	Amendment Details	Drawn	Approved
0	23/07/2024	FIRST ISSUE	JCM	MC



Client: VATTENFALL

Drawing Status: FOR PLANNING

Project Title: SOUTH KYLE II WIND FARM

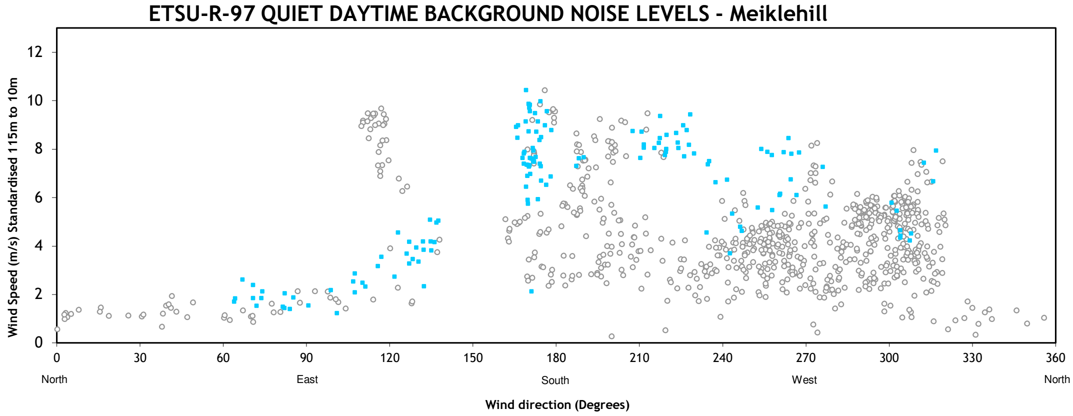
Drawing Title: FIGURE A1.1 - WIND TURBINE & NOISE ASSESSMENT LOCATIONS

Scale:	Original Size:	Spatial Reference:
1:60,000	A3	British National Grid

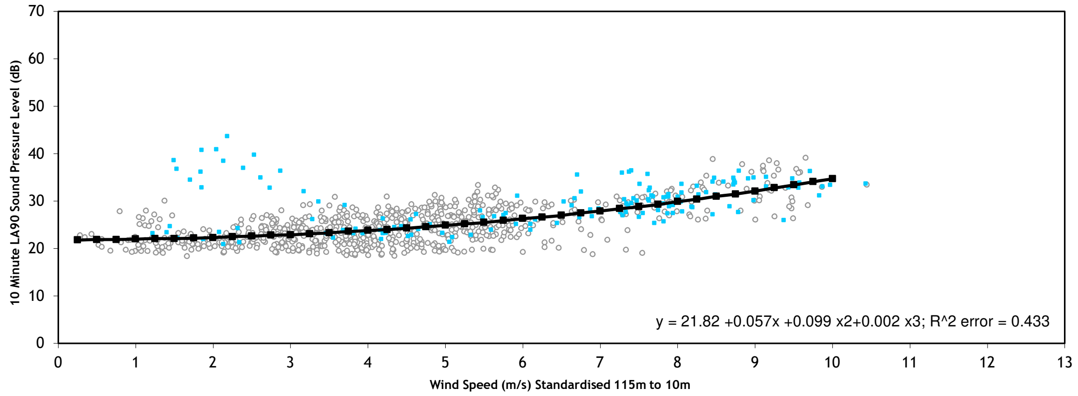
Drawing Number: 14797-009

ETSU-R-97 QUIET DAYTIME BACKGROUND NOISE LEVELS - Meiklehill

Wind Conditions Quiet Daytime



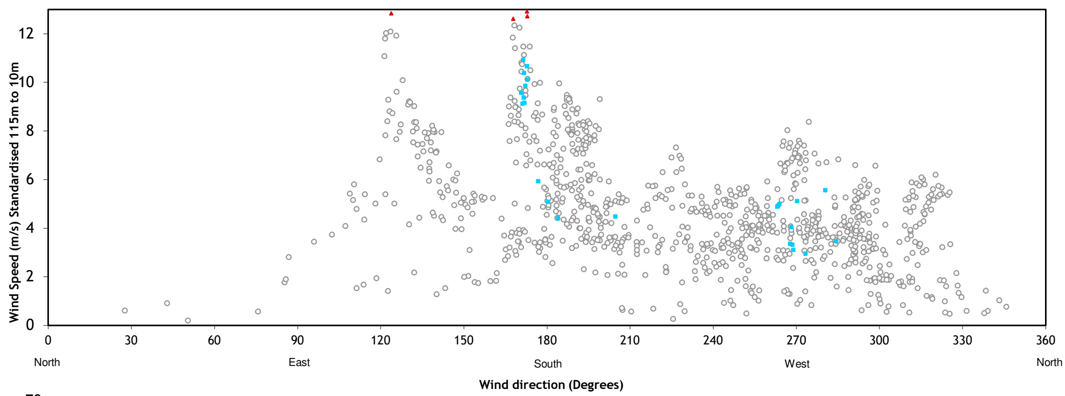
Regression Analysis Quiet Daytime



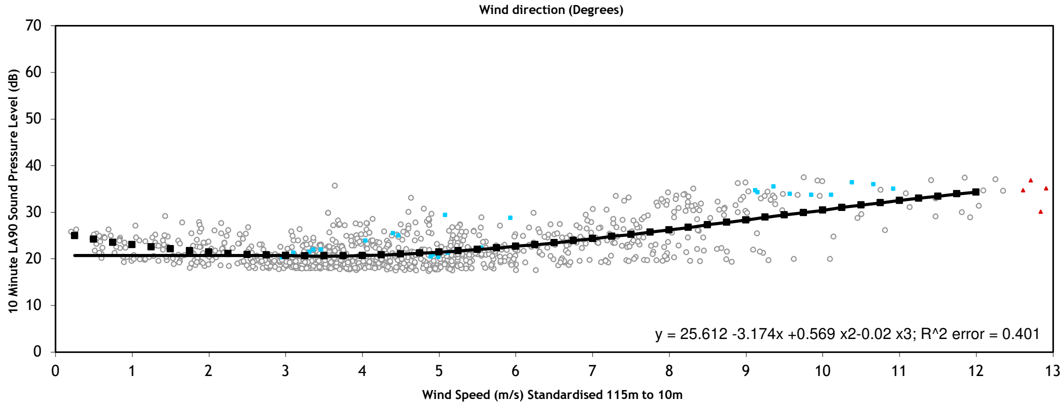
Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	69	141	157	152	74	30	33	27	7	0	0	690
Prevailing Background	22.3	22.9	23.8	24.9	26.3	27.9	29.9	32.1	34.7	-	-	

ETSU-R-97 NIGHT-TIME BACKGROUND NOISE LEVELS - Meiklehill

Wind Conditions Night-Time



Regression Analysis Night-Time



Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	78	151	188	182	78	70	69	36	9	8	7	876
Prevailing Background	20.7	20.7	20.7	21.4	22.7	24.3	26.2	28.3	30.4	32.5	34.3	

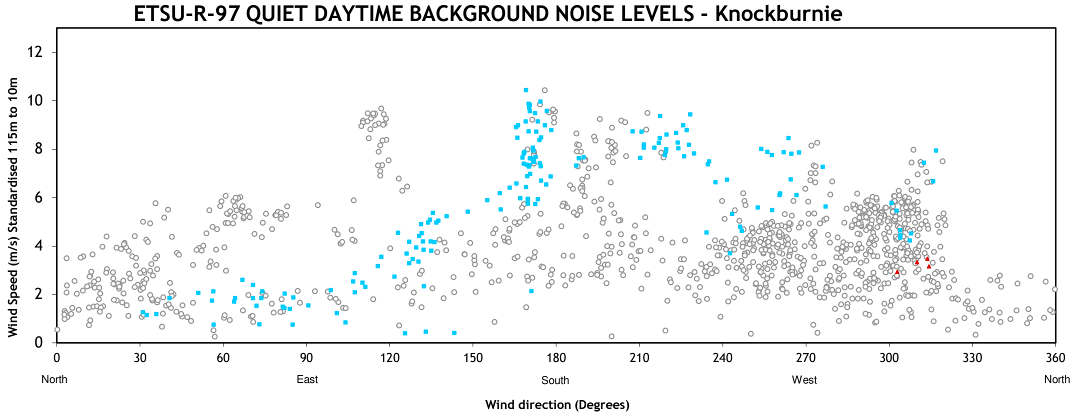
Legend:

- O — L_{A90} 10 Minute Measurement Point
- Line of best fit
- Line of best fit flat lined where appropriate(Prevailing Background)
- Excluded Data-Manual exclusion
- Excluded Data-Rain
- X — Excluded Data-Filtered Wind Direction

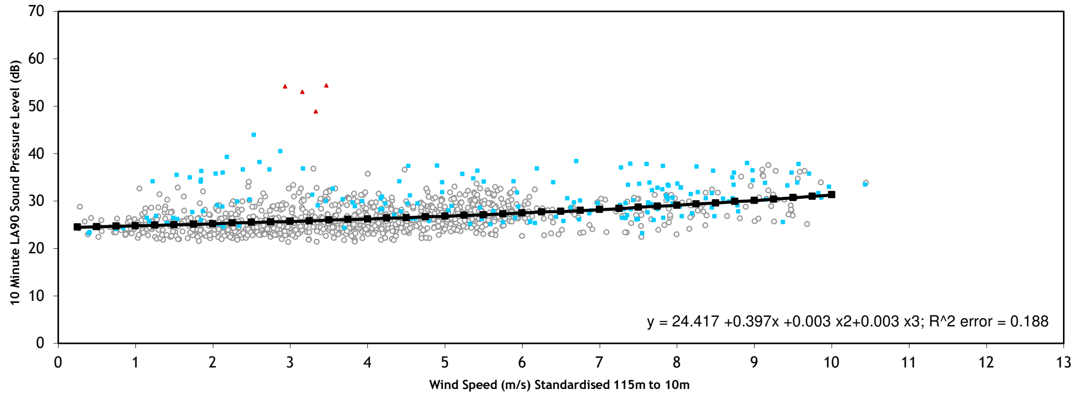
Project	South Kyle II Wind Farm
Client	Vattenfall
Title	Background Noise Levels for up to 115 m hub Meiklehill
Figure Number	A1.2a
Drawn	AD
Checked	MC
Date	28/06/2024
Document Reference	14797 - Models

ETSU-R-97 QUIET DAYTIME BACKGROUND NOISE LEVELS - Knockburnie

Wind Conditions Quiet Daytime



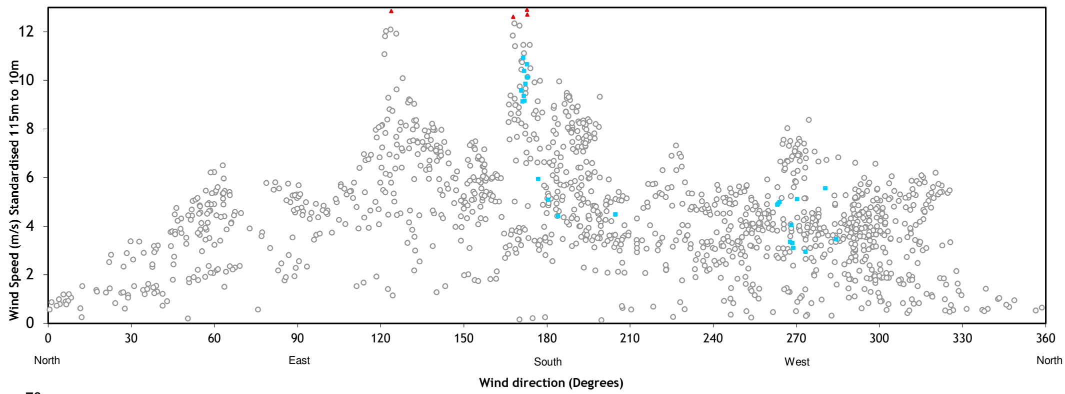
Regression Analysis Quiet Daytime



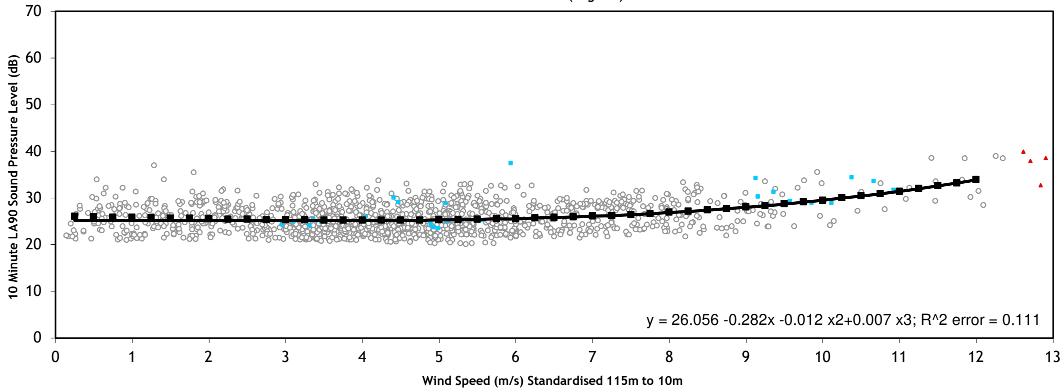
Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	158	196	221	195	92	31	32	27	7	0	0	959
Prevailing Background	25.2	25.7	26.2	26.8	27.5	28.2	29.1	30.1	31.3	-	-	

ETSU-R-97 NIGHT-TIME BACKGROUND NOISE LEVELS - Knockburnie

Wind Conditions Night-Time



Regression Analysis Night-Time



Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	118	178	264	268	129	107	76	36	10	7	7	1200
Prevailing Background	25.2	25.2	25.2	25.3	25.5	26.1	26.9	28	29.5	31.4	33.9	

Legend:

- O — L_{A90} 10 Minute Measurement Point
- Line of best fit
- Line of best fit flat lined where appropriate(Prevailing Background)
- Excluded Data-Manual exclusion
- Excluded Data-Rain
- X — Excluded Data-Filtered Wind Direction

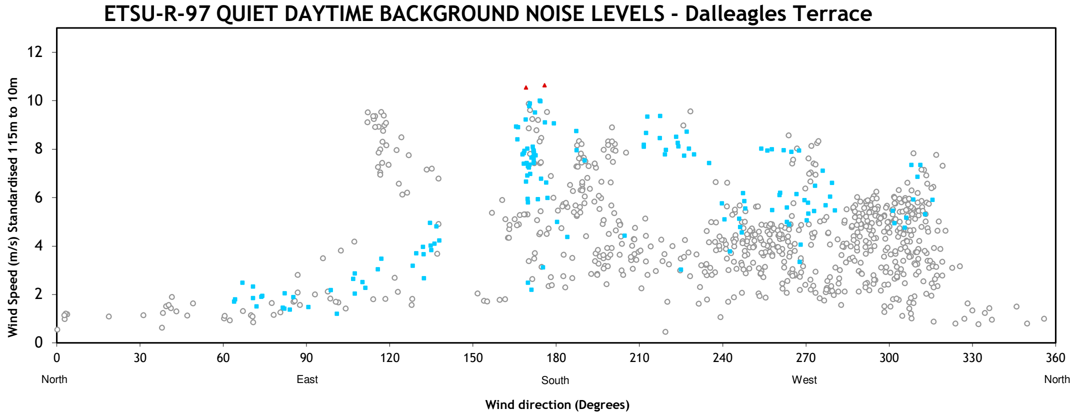
Project	South Kyle II Wind Farm
Client	Vattenfall
Title	Background Noise Levels for up to 115 m hub Knockburnie
Figure Number	A1.2b
Drawn	AD
Checked	MC
Date	28/06/2024
Document Reference	14797 - Models

VATTENFALL

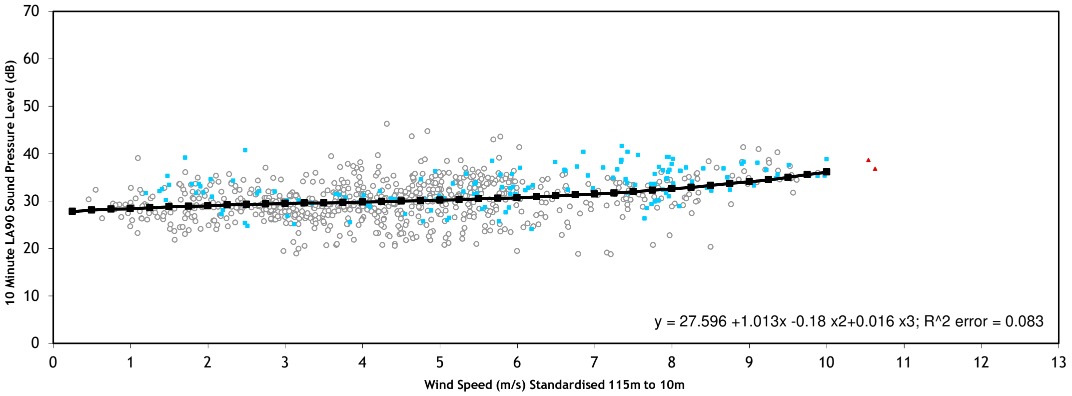
tnei

ETSU-R-97 QUIET DAYTIME BACKGROUND NOISE LEVELS - Dalleagles Terrace

Wind Conditions Quiet Daytime



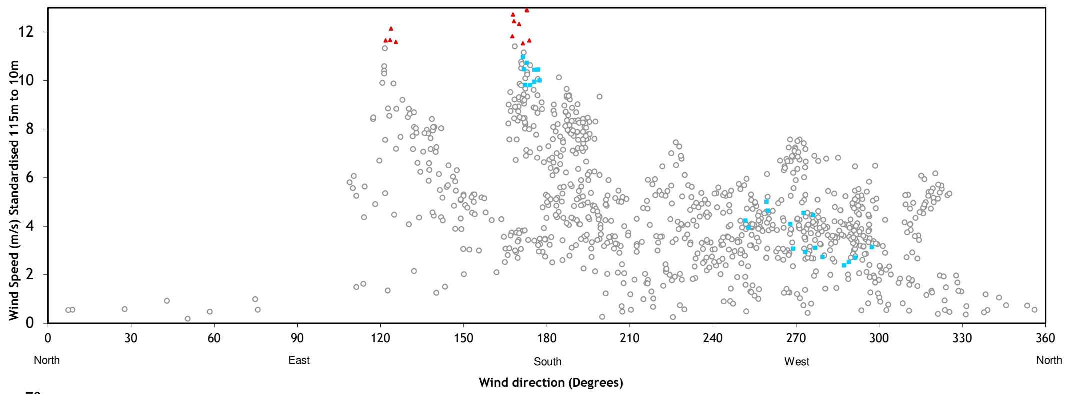
Regression Analysis Quiet Daytime



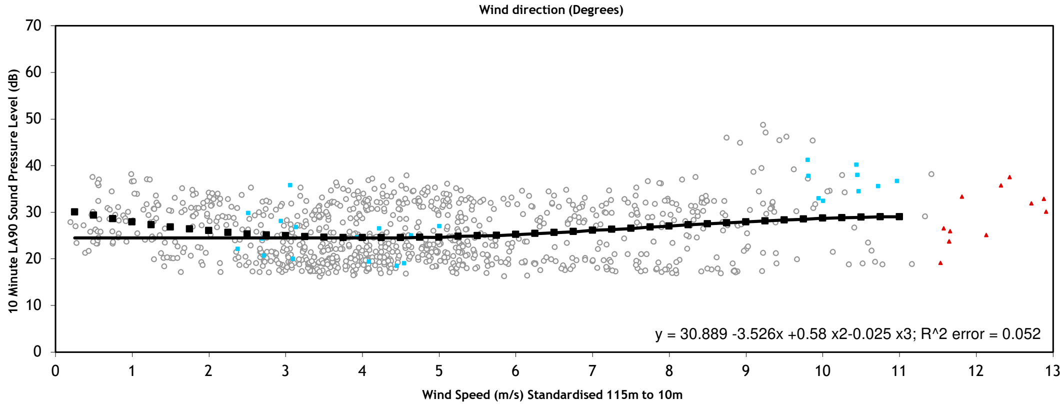
Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	86	120	164	153	80	42	35	17	6	0	0	703
Prevailing Background	29	29.5	29.8	30.2	30.7	31.5	32.6	34.1	36.1	-	-	

ETSU-R-97 NIGHT-TIME BACKGROUND NOISE LEVELS - Dalleagles Terrace

Wind Conditions Night-Time



Regression Analysis Night-Time



Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	74	152	191	160	65	60	78	46	15	8	0	849
Prevailing Background	24.5	24.5	24.5	24.6	25.2	26.1	27	27.9	28.7	29	-	

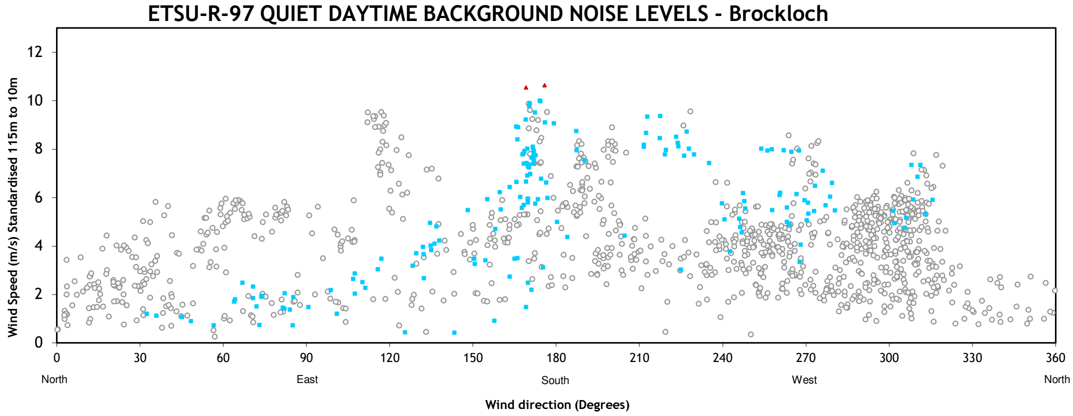
Legend:

- O — L_{A90} 10 Minute Measurement Point
- Line of best fit
- Line of best fit flat lined where appropriate(Prevailing Background)
- Excluded Data-Manual exclusion
- Excluded Data-Rain
- X — Excluded Data-Filtered Wind Direction

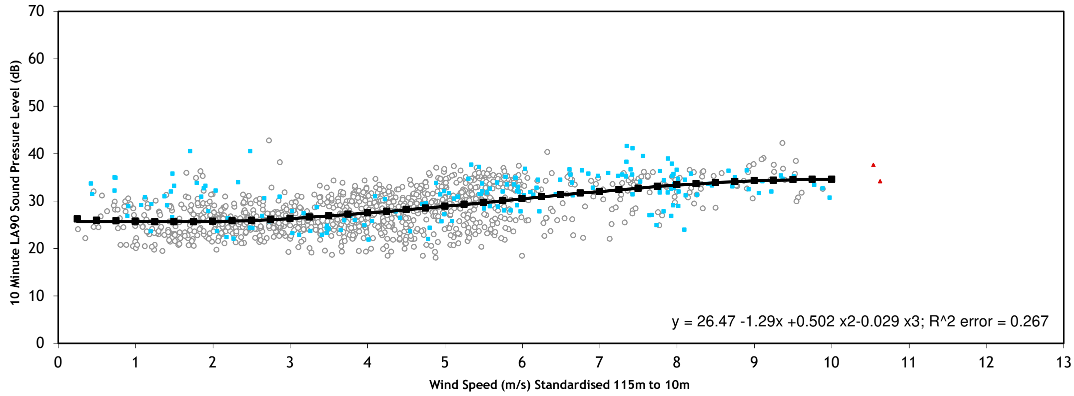
Project	South Kyle II Wind Farm
Client	Vattenfall
Title	Background Noise Levels for up to 115 m hub Dalleagles Terrace
Figure Number	1.2c
Drawn	AD
Checked	MC
Date	28/06/2024
Document Reference	14797 - Models

ETSU-R-97 QUIET DAYTIME BACKGROUND NOISE LEVELS - Brockloch

Wind Conditions Quiet Daytime



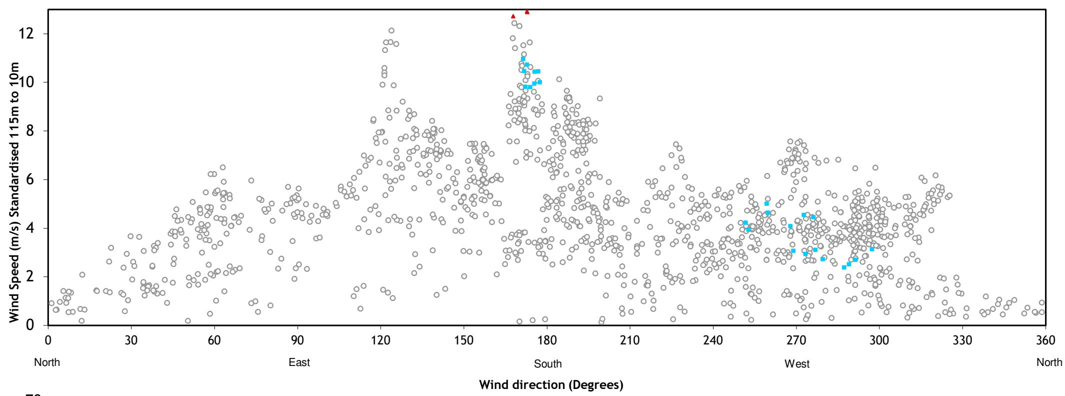
Regression Analysis Quiet Daytime



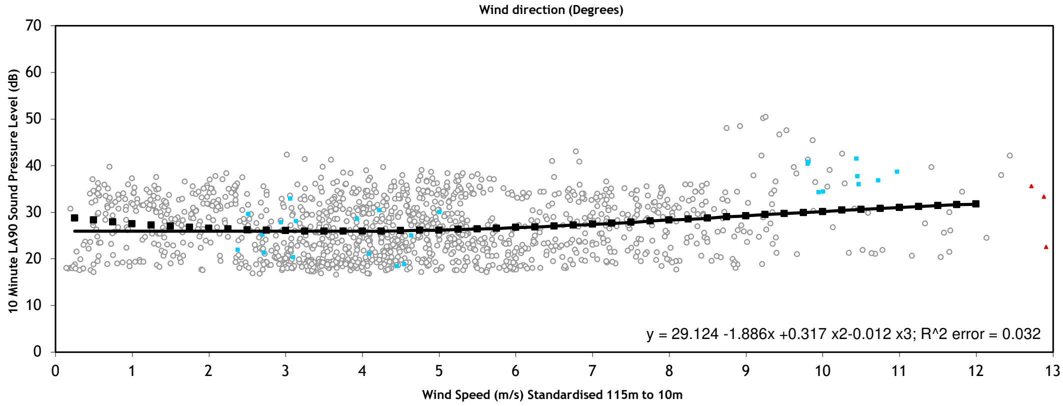
Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	170	162	225	211	103	43	35	17	6	0	0	972
Prevailing Background	25.7	26.3	27.5	28.9	30.5	32	33.4	34.3	34.6	-	-	

ETSU-R-97 NIGHT-TIME BACKGROUND NOISE LEVELS - Brockloch

Wind Conditions Night-Time



Regression Analysis Night-Time



Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	111	177	274	232	111	103	89	46	15	8	9	1175
Prevailing Background	25.9	25.9	25.9	26.1	26.7	27.4	28.3	29.2	30.1	31	31.7	

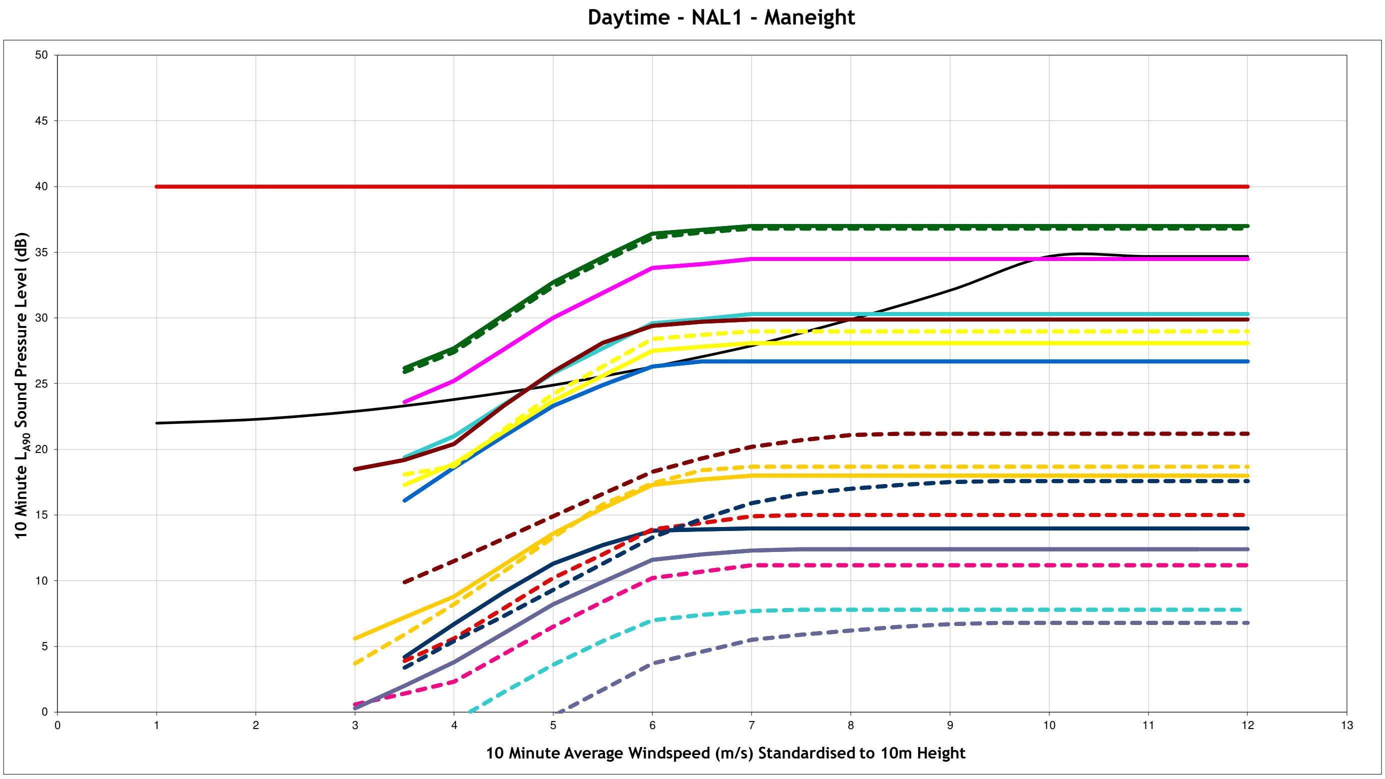
Legend:

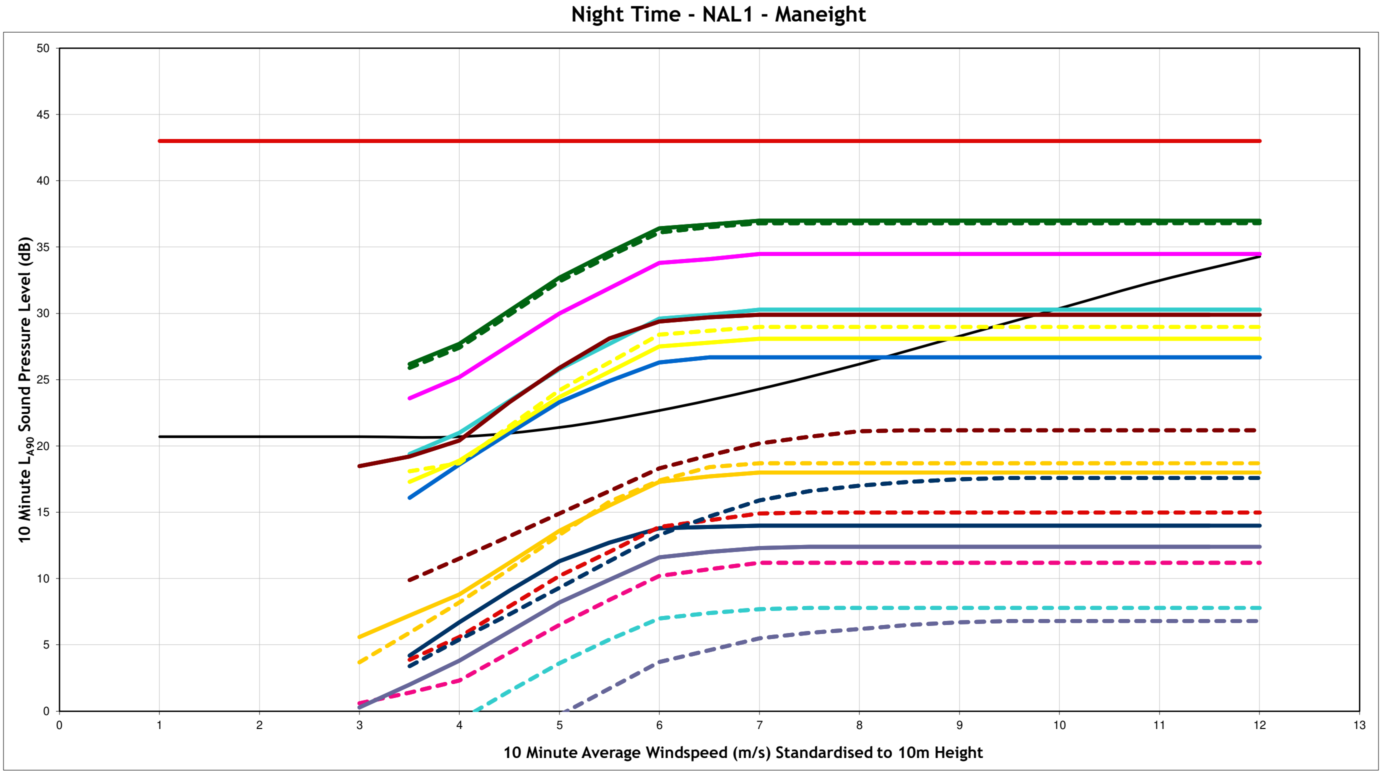
- O L_{A90} 10 Minute Measurement Point
- Line of best fit
- Line of best fit flat lined where appropriate(Prevailing Background)
- Excluded Data-Manual exclusion
- Excluded Data-Rain
- X Excluded Data-Filtered Wind Direction

Project	South Kyle II Wind Farm
Client	Vattenfall
Title	Background Noise Levels for up to 115 m hub Brockloch
Figure Number	1.2d
Drawn	AD
Checked	MC
Date	28/06/2024
Document Reference	14797 - Models

VATTENFALL

tnei



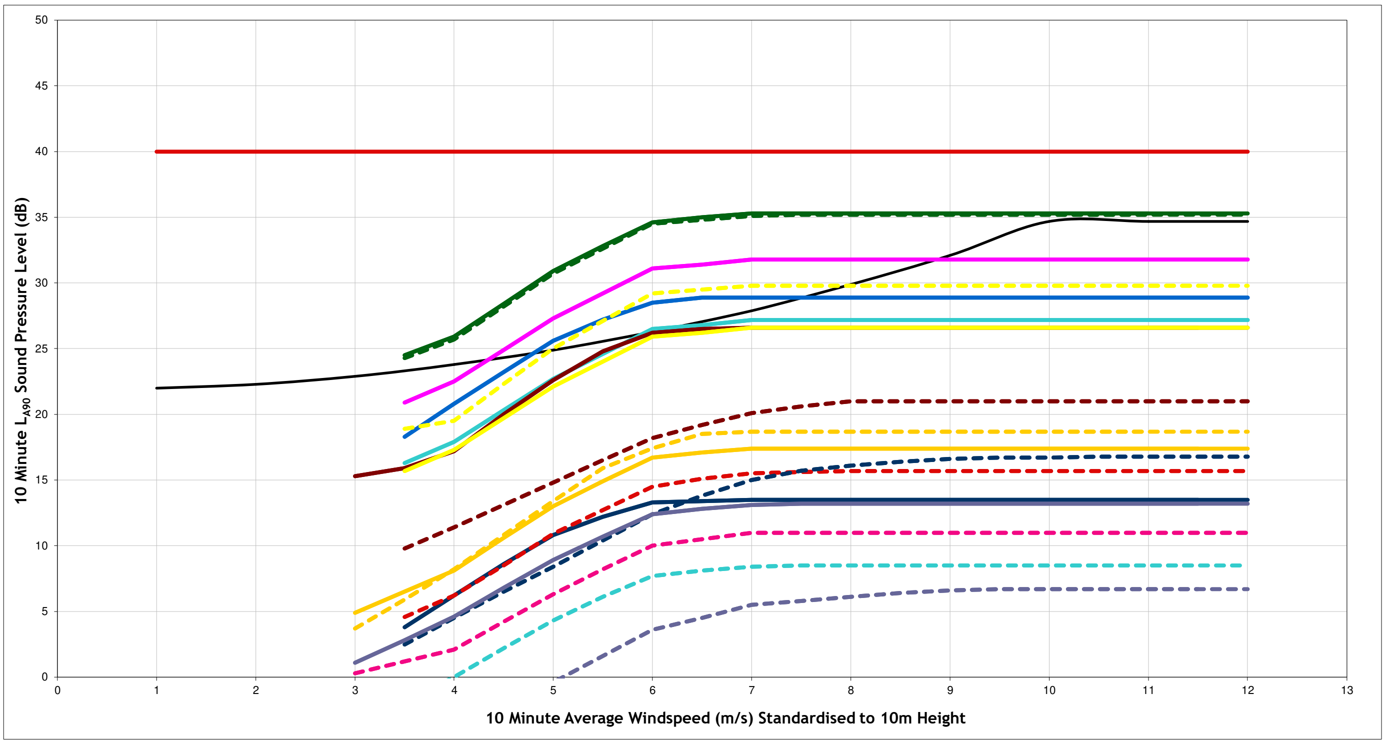


Legend:

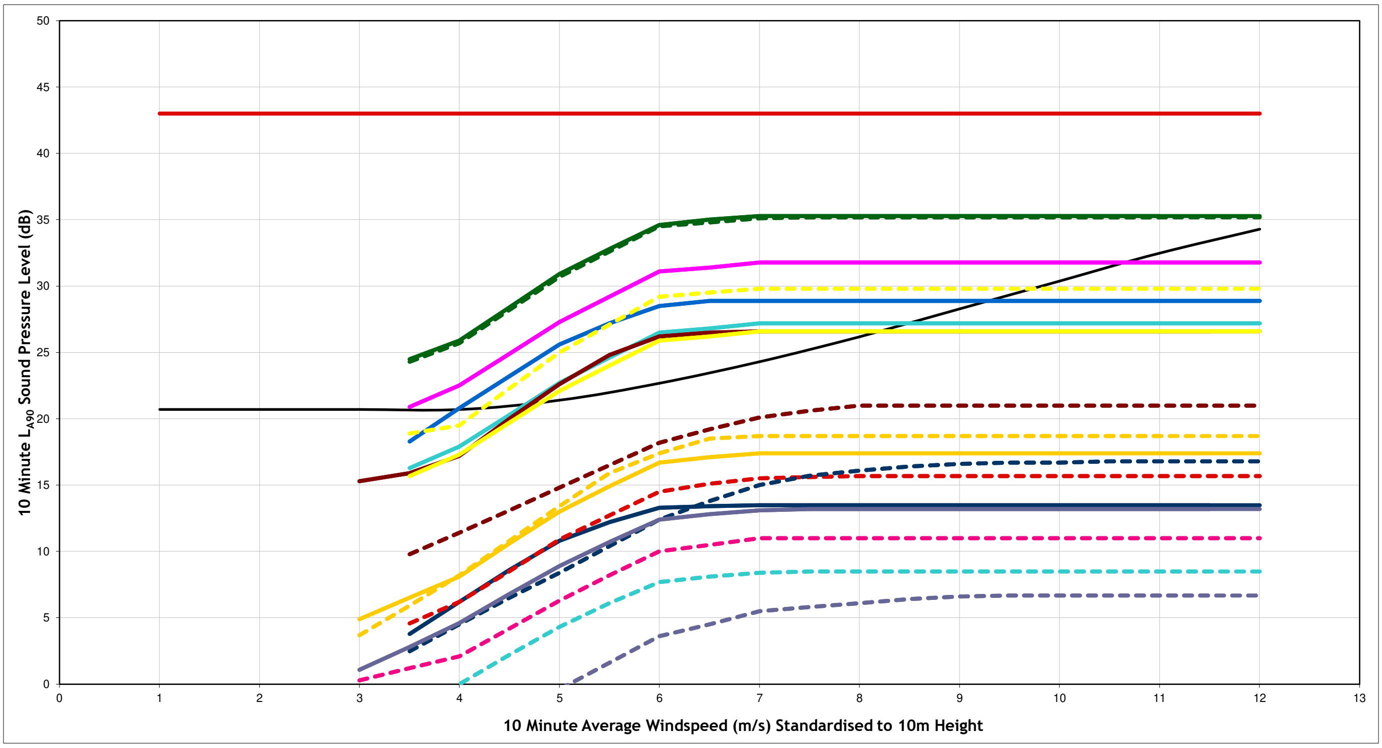
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative (including the Proposed Development)
- Cumulative (excluding the Proposed Development)
- Proposed Development (11 x SG 6.6-170)
- South Kyle (62 x N133, Operational)
- Enoch Hill 1 & 2 (18 x V136, Consented)
- North Kyle (49 x V136, Consented)
- Overhill (10 x N133, Consented)
- Greenburn (16 x V136, Consented)
- Pencloe (19 x V136, Consented)
- Afton (25 x G80, Operational)
- Benbrack (15 x V136 & V117, Under Construction)
- Windy Standard I Repowering (8 x V162, In Planning)
- Windy Standard II (30 x V90, Operational)
- Windy Standard III (20 x SWT-3.2 & SWT-2.3, Consented)
- Windy Rig (12 x N100, Operational)
- Polquhairn (9 x E115 & E82, Consented)
- Knockkippen (12 x V136 & V150, In Planning)
- Sclenteuch (9 x V150, In Planning)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Likely Predictions NAL1 - Maneight
Figure No	Figure A1.3a
Scale	NTS
Drawn	AD
Checked	MC
Date	09/09/2024
Doc. Ref	14797 - Models

Daytime - NAL2 - Knockenlee



Night Time - NAL2 - Knockenlee



Legend:

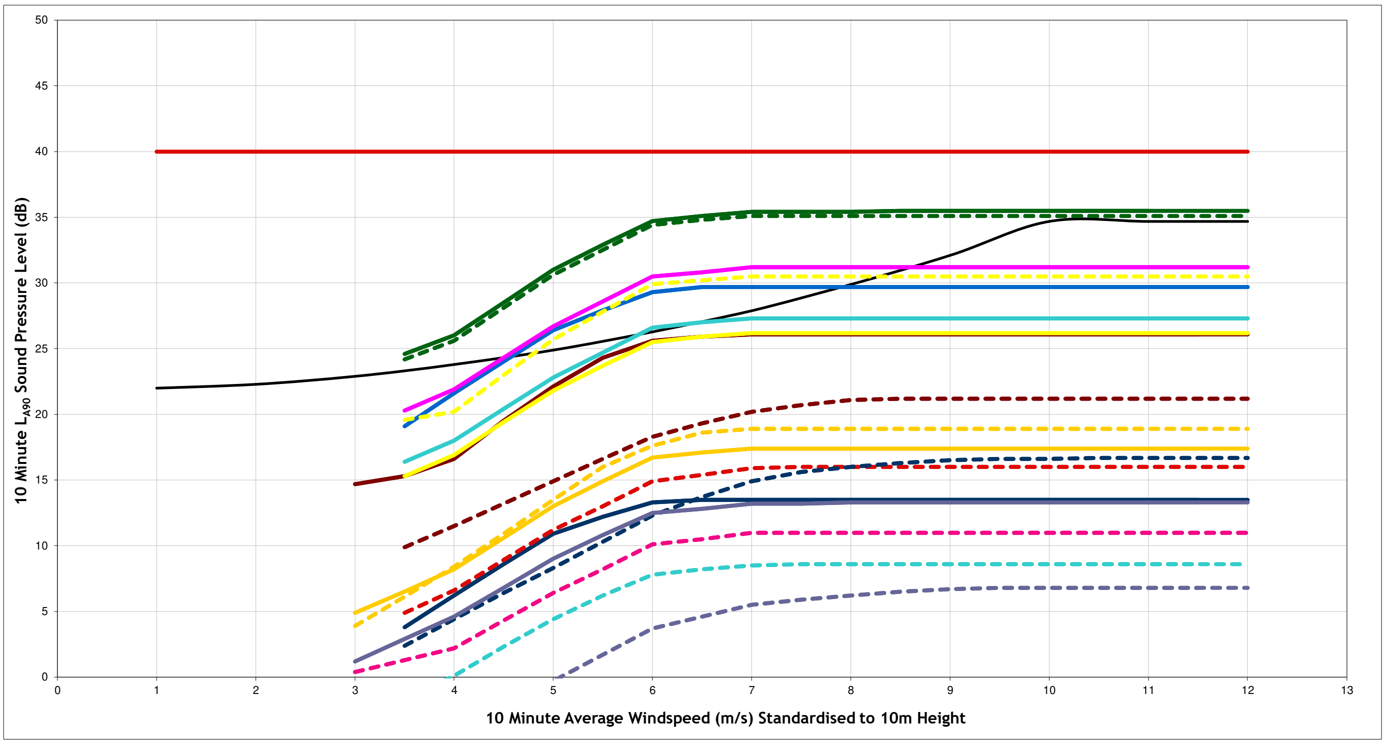
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative (including the Proposed Development)
- Cumulative (excluding the Proposed Development)
- Proposed Development (11 x SG 6.6-170)
- South Kyle (62 x N133, Operational)
- Enoch Hill 1 & 2 (18 x V136, Consented)
- North Kyle (49 x V136, Consented)
- Overhill (10 x N133, Consented)
- Greenburn (16 x V136, Consented)
- Pencloe (19 x V136, Consented)
- Afton (25 x G80, Operational)
- Benbrack (15 x V136 & V117, Under Construction)
- Windy Standard I Repowering (8 x V162, In Planning)
- Windy Standard II (30 x V90, Operational)
- Windy Standard III (20 x SWT-3.2 & SWT-2.3, Consented)
- Windy Rig (12 x N100, Operational)
- Polquhairn (9 x E115 & E82, Consented)
- Knockkippen (12 x V136 & V150, In Planning)
- Sclenteuch (9 x V150, In Planning)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Likely Predictions NAL2 - Knockenlee
Figure No	Figure A1.3b
Scale	NTS
Drawn	AD
Checked	MC
Date	09/09/2024
Doc. Ref	14797 - Models

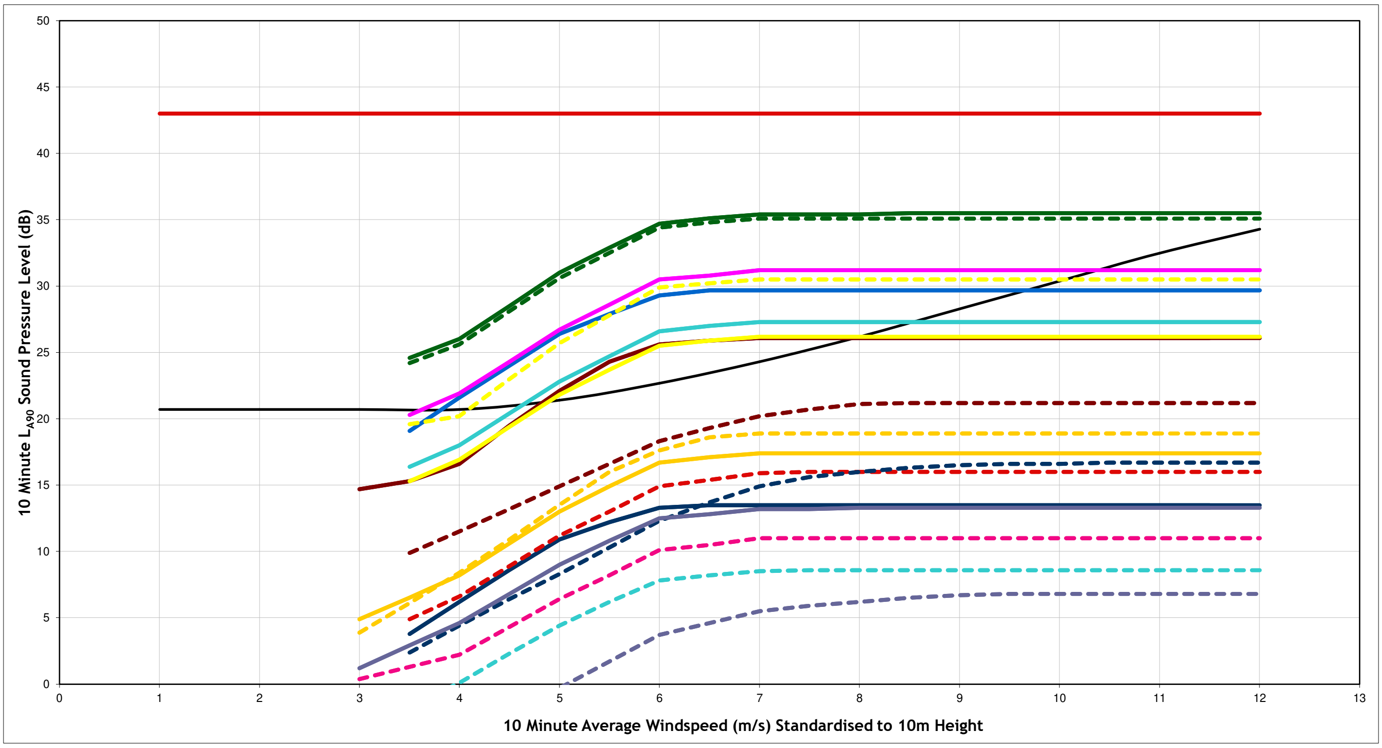
VATTENFALL

tnei

Daytime - NAL3 - Nith Lodge



Night Time - NAL3 - Nith Lodge



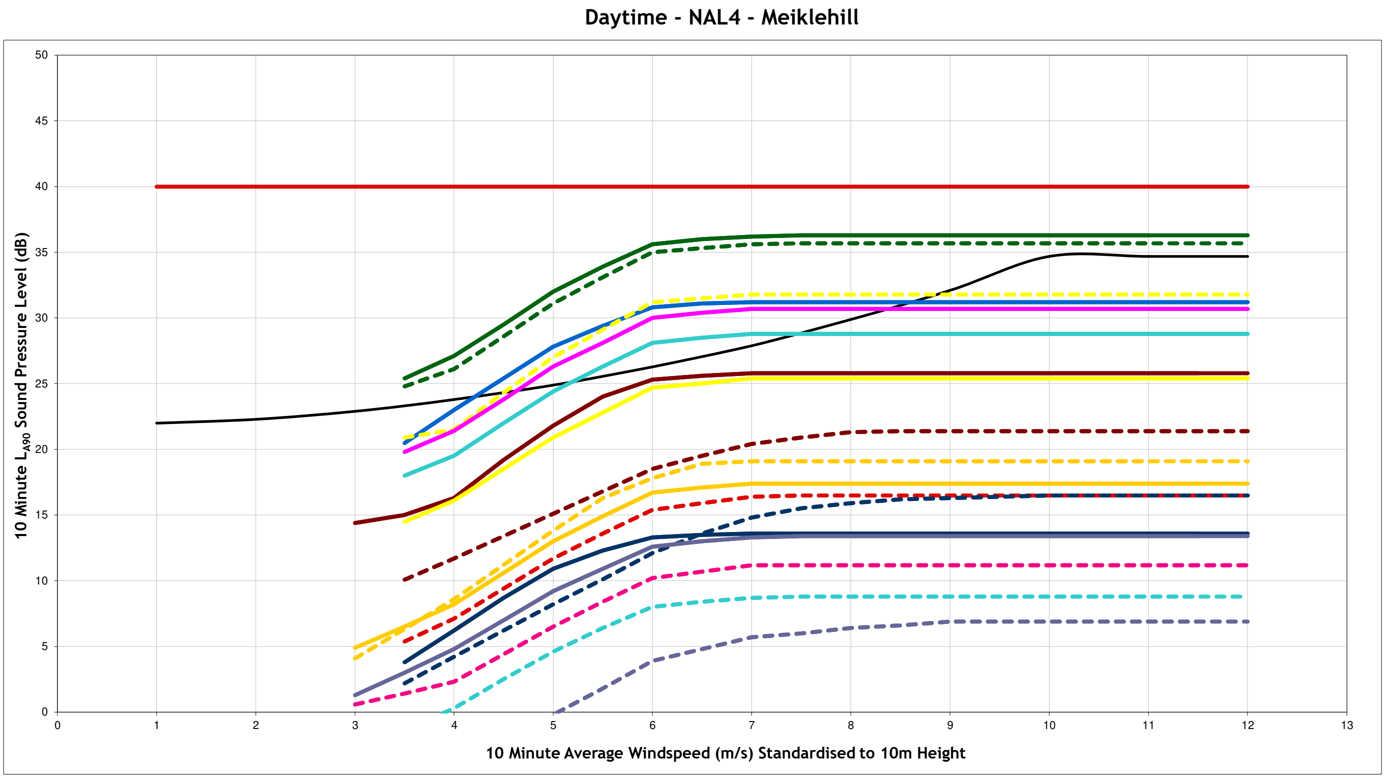
Legend:

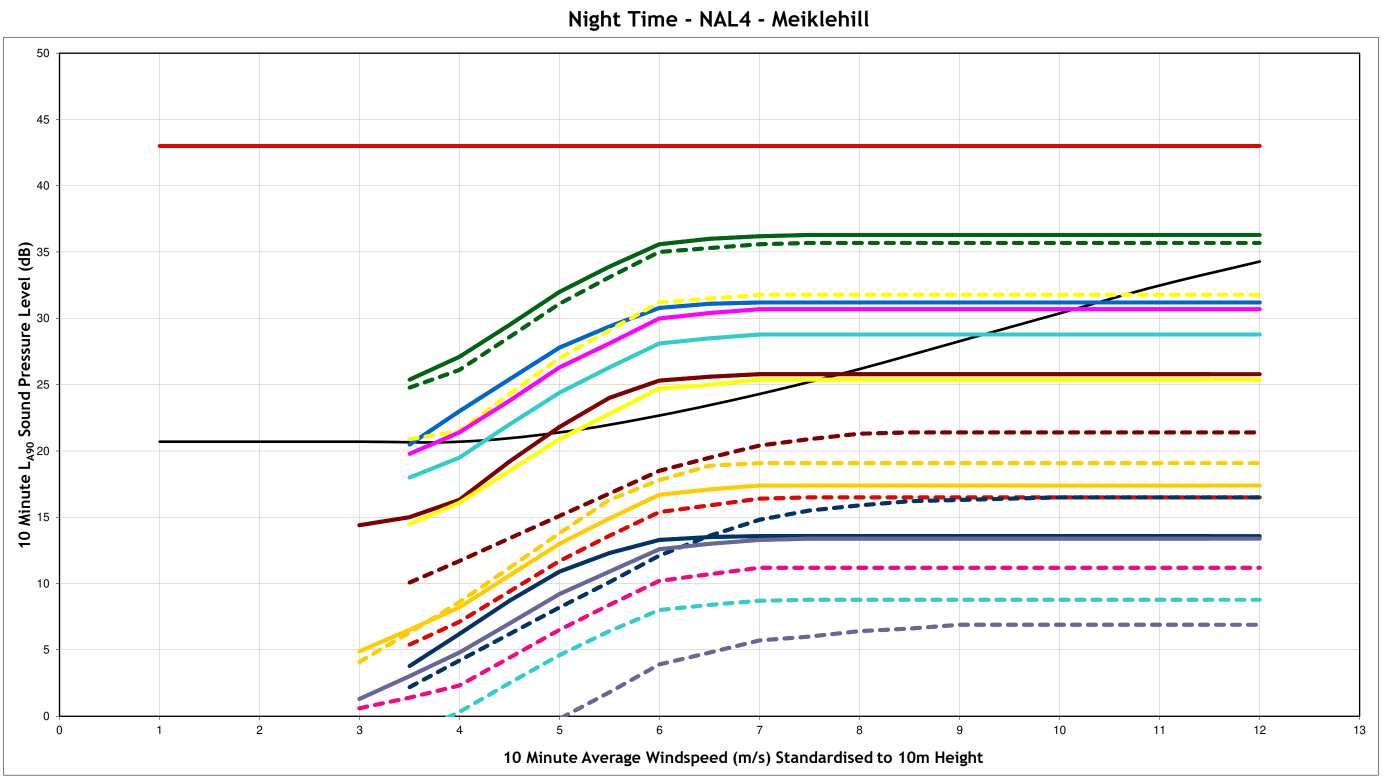
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative (including the Proposed Development)
- Cumulative (excluding the Proposed Development)
- Proposed Development (11 x SG 6.6-170)
- South Kyle (62 x N133, Operational)
- Enoch Hill 1 & 2 (18 x V136, Consented)
- North Kyle (49 x V136, Consented)
- Overhill (10 x N133, Consented)
- Greenburn (16 x V136, Consented)
- Pencloe (19 x V136, Consented)
- Afton (25 x G80, Operational)
- Benbrack (15 x V136 & V117, Under Construction)
- Windy Standard I Repowering (8 x V162, In Planning)
- Windy Standard II (30 x V90, Operational)
- Windy Standard III (20 x SWT-3.2 & SWT-2.3, Consented)
- Windy Rig (12 x N100, Operational)
- Polquhairn (9 x E115 & E82, Consented)
- Knockkippen (12 x V136 & V150, In Planning)
- Sclenteuch (9 x V150, In Planning)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Likely Predictions NAL3 - Nith Lodge
Figure No	Figure A1.3c
Scale	NTS
Drawn	AD
Checked	MC
Date	09/09/2024
Doc. Ref	14797 - Models

VATTENFALL

tnei



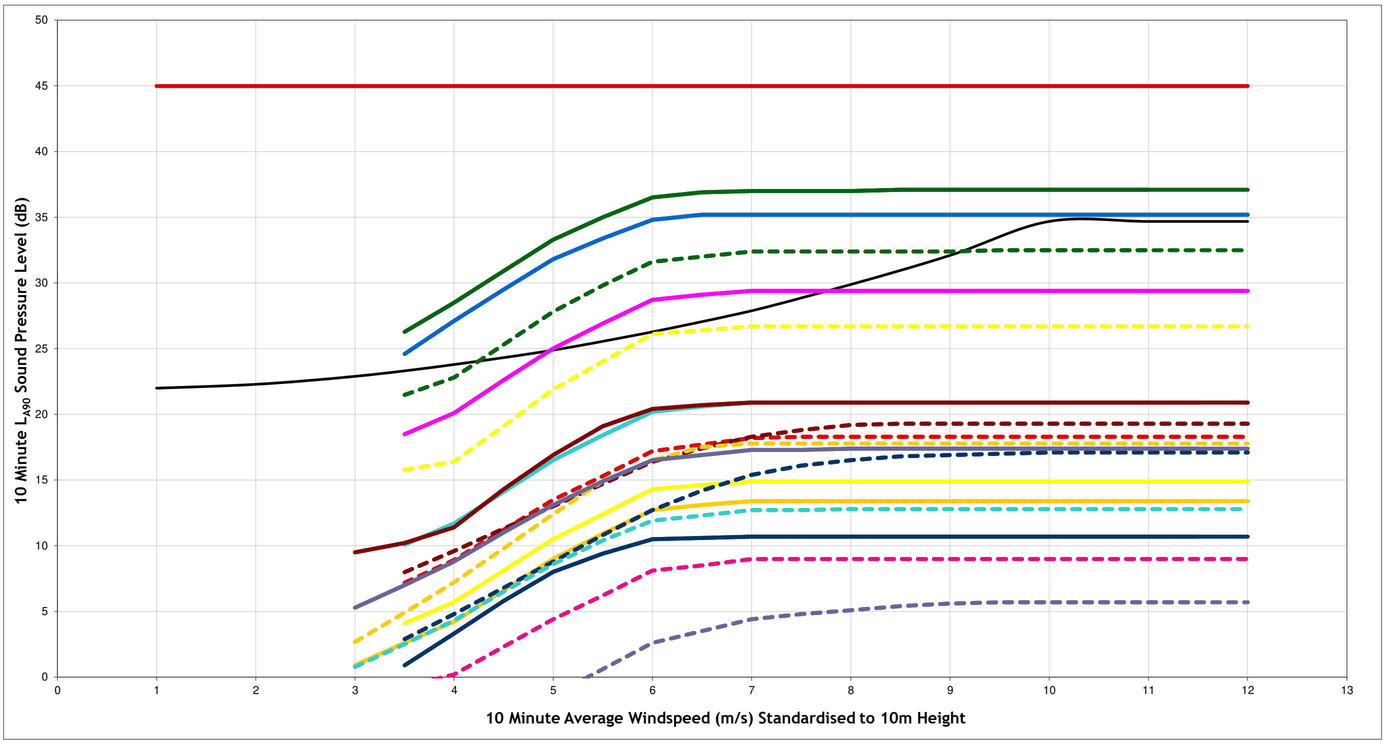


Legend:

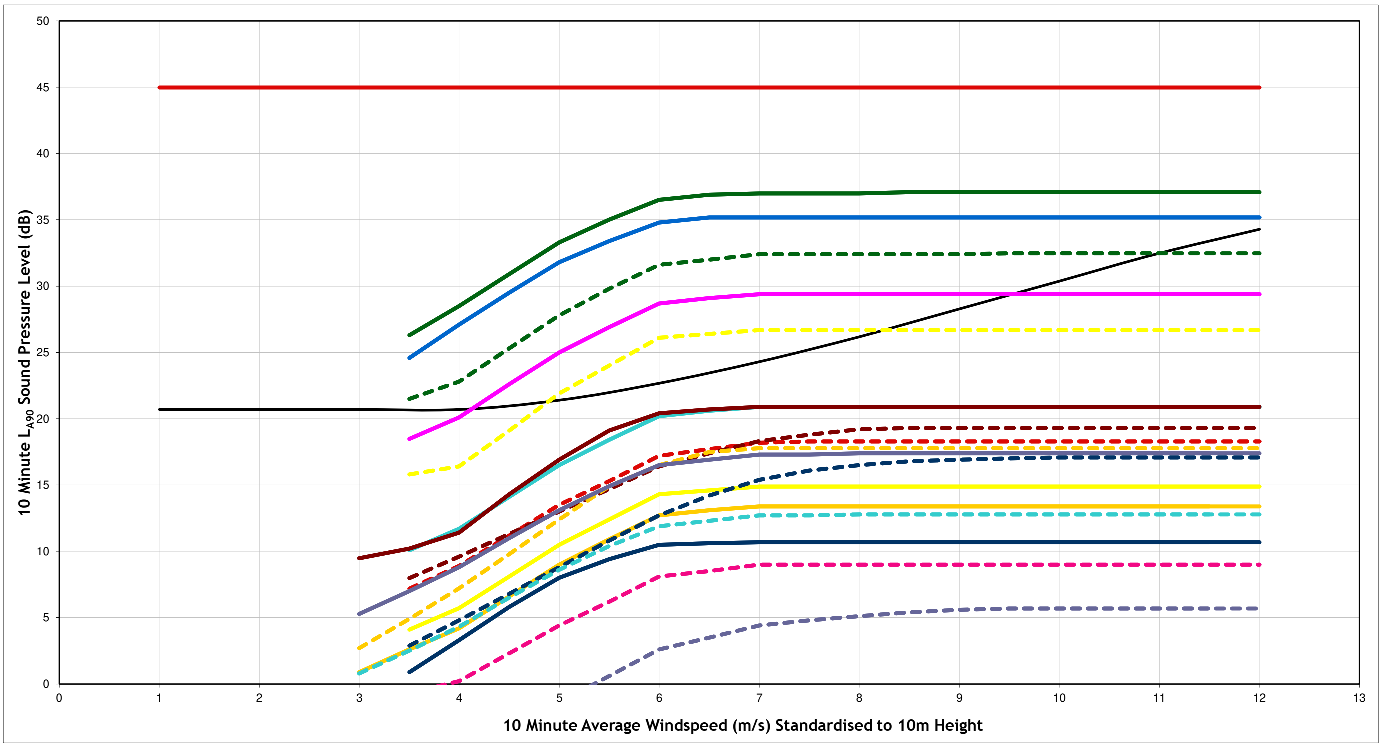
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative (including the Proposed Development)
- Cumulative (excluding the Proposed Development)
- Proposed Development (11 x SG 6.6-170)
- South Kyle (62 x N133, Operational)
- Enoch Hill 1 & 2 (18 x V136, Consented)
- North Kyle (49 x V136, Consented)
- Overhill (10 x N133, Consented)
- Greenburn (16 x V136, Consented)
- Pencloe (19 x V136, Consented)
- Afton (25 x G80, Operational)
- Benbrack (15 x V136 & V117, Under Construction)
- Windy Standard I Repowering (8 x V162, In Planning)
- Windy Standard II (30 x V90, Operational)
- Windy Standard III (20 x SWT-3.2 & SWT-2.3, Consented)
- Windy Rig (12 x N100, Operational)
- Polquhairn (9 x E115 & E82, Consented)
- Knockkippen (12 x V136 & V150, In Planning)
- Sclenteuch (9 x V150, In Planning)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Likely Predictions NAL4 - Meiklehill
Figure No	Figure A1.3d
Scale	NTS
Drawn	AD
Checked	MC
Date	09/09/2024
Doc. Ref	14797 - Models

Daytime - NAL5 - Clawfin (FI with the Proposed Development)



Night Time - NAL5 - Clawfin (FI with the Proposed Development)

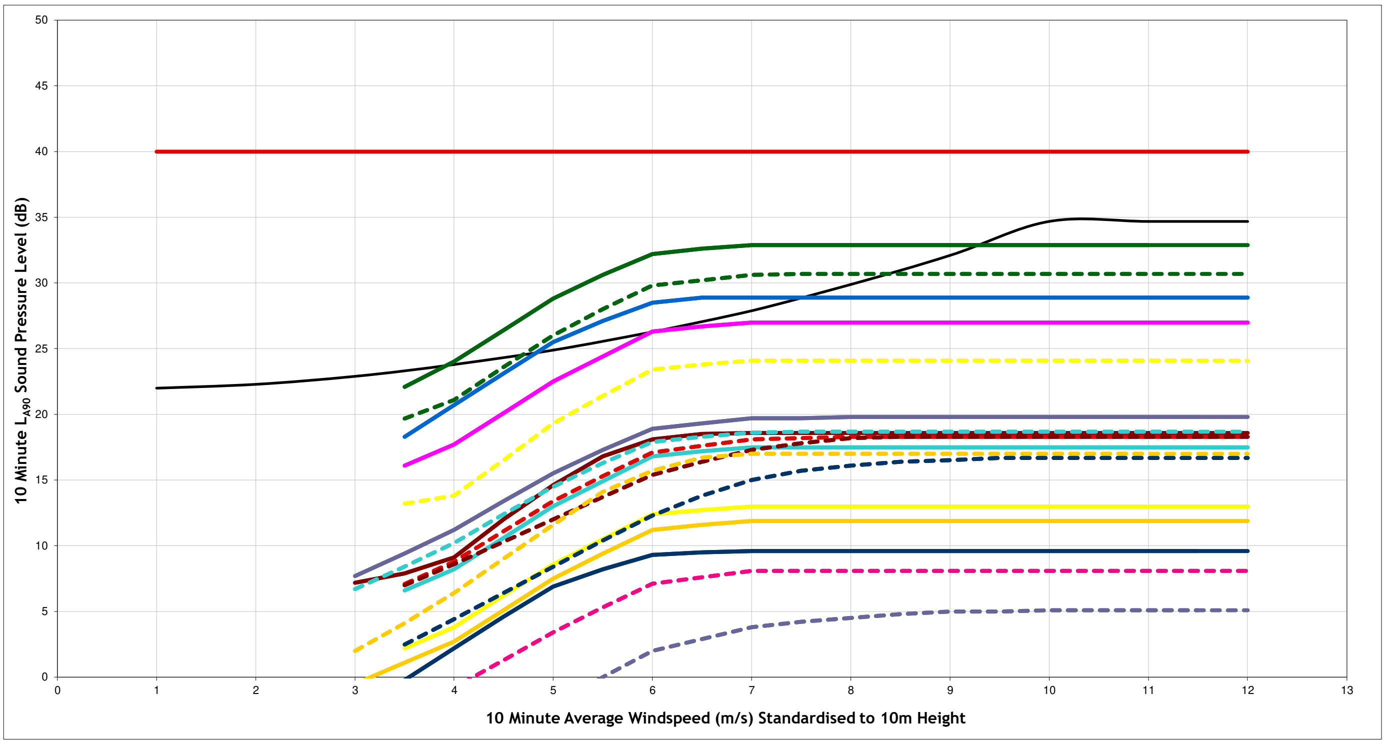


Legend:

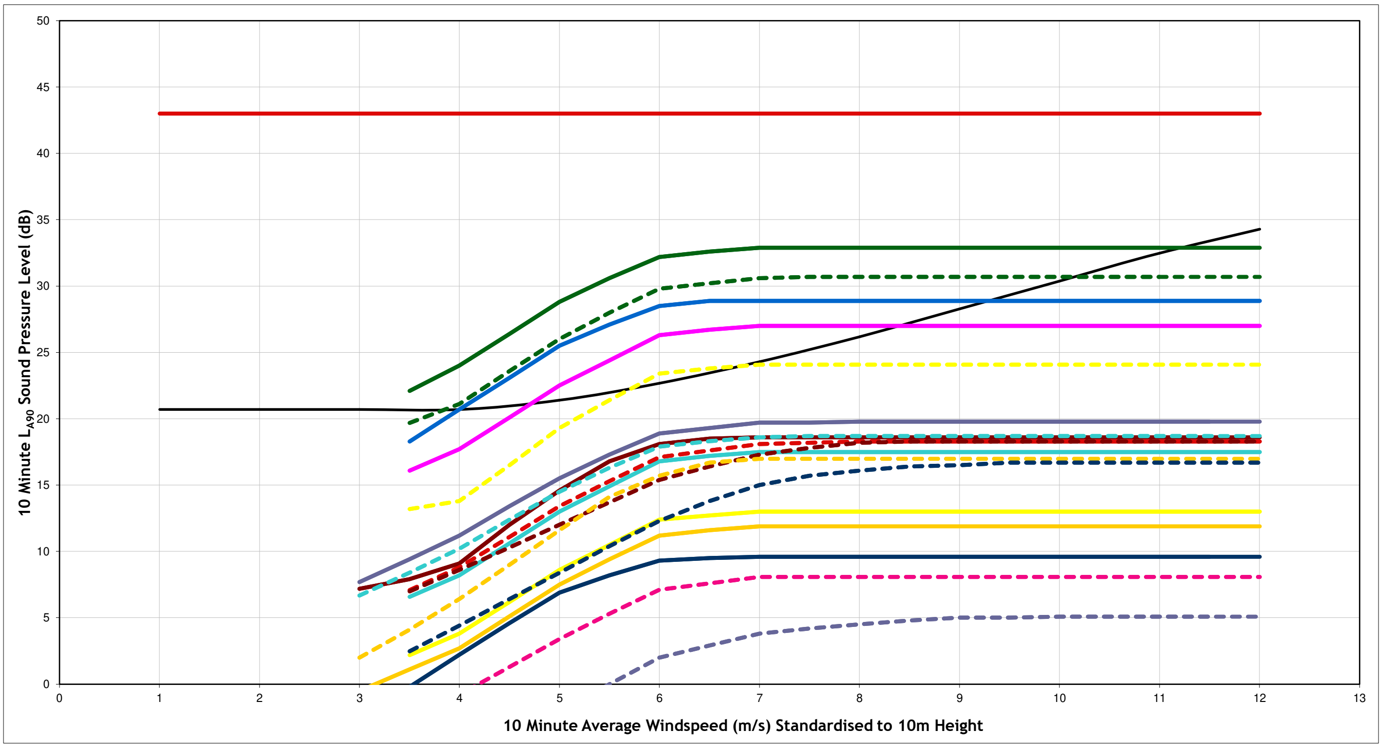
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative (including the Proposed Development)
- Cumulative (excluding the Proposed Development)
- Proposed Development (11 x SG 6.6-170)
- South Kyle (62 x N133, Operational)
- Enoch Hill 1 & 2 (18 x V136, Consented)
- North Kyle (49 x V136, Consented)
- Overhill (10 x N133, Consented)
- Greenburn (16 x V136, Consented)
- Pencloe (19 x V136, Consented)
- Afton (25 x G80, Operational)
- Benbrack (15 x V136 & V117, Under Construction)
- Windy Standard I Repowering (8 x V162, In Planning)
- Windy Standard II (30 x V90, Operational)
- Windy Standard III (20 x SWT-3.2 & SWT-2.3, Consented)
- Windy Rig (12 x N100, Operational)
- Polquhairn (9 x E115 & E82, Consented)
- Knockkippen (12 x V136 & V150, In Planning)
- Sclenteuch (9 x V150, In Planning)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Likely Predictions
	NAL5 - Clawfin (FI with the Proposed Development)
Figure No	Figure A1.3e
Scale	NTS
Drawn	AD
Checked	MC
Date	09/09/2024
Doc. Ref	14797 - Models

Daytime - NAL6 - Pennyvenie



Night Time - NAL6 - Pennyvenie

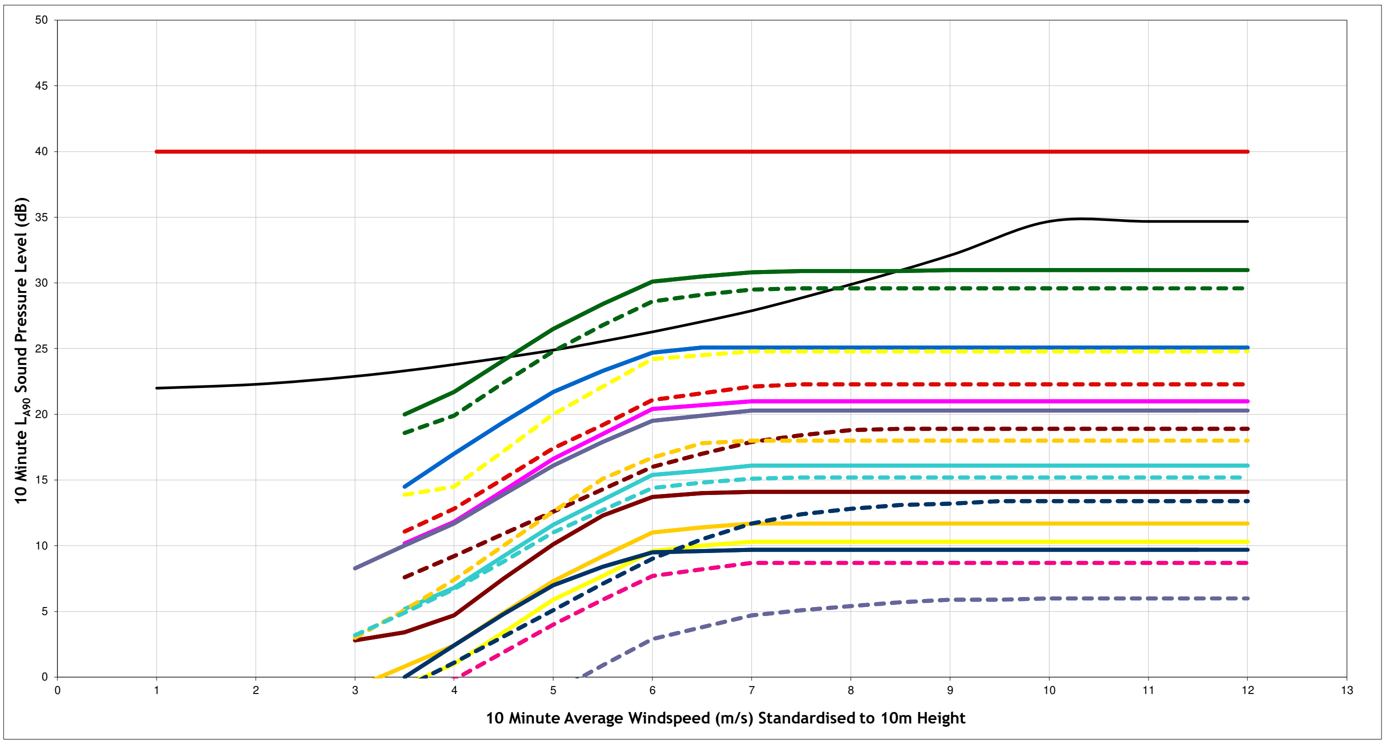


Legend:

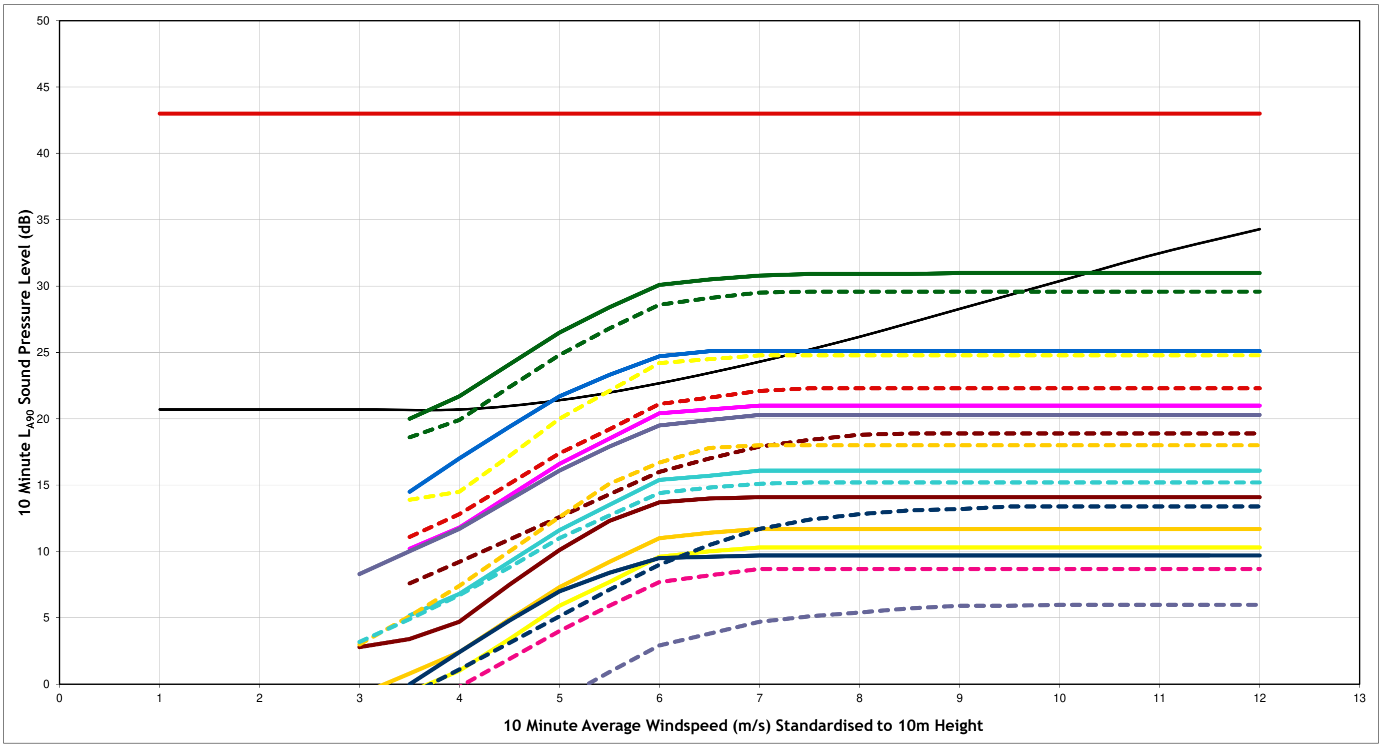
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative (including the Proposed Development)
- Cumulative (excluding the Proposed Development)
- Proposed Development (11 x SG 6.6-170)
- South Kyle (62 x N133, Operational)
- Enoch Hill 1 & 2 (18 x V136, Consented)
- North Kyle (49 x V136, Consented)
- Overhill (10 x N133, Consented)
- Greenburn (16 x V136, Consented)
- Pencloe (19 x V136, Consented)
- Afton (25 x G80, Operational)
- Benbrack (15 x V136 & V117, Under Construction)
- Windy Standard I Repowering (8 x V162, In Planning)
- Windy Standard II (30 x V90, Operational)
- Windy Standard III (20 x SWT-3.2 & SWT-2.3, Consented)
- Windy Rig (12 x N100, Operational)
- Polquhairn (9 x E115 & E82, Consented)
- Knockkippen (12 x V136 & V150, In Planning)
- Sclenteuch (9 x V150, In Planning)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Likely Predictions NAL6 - Pennyvenie
Figure No	Figure A1.3f
Scale	NTS
Drawn	AD
Checked	MC
Date	09/09/2024
Doc. Ref	14797 - Models

Daytime - NAL7 - Mossdale Farm



Night Time - NAL7 - Mossdale Farm



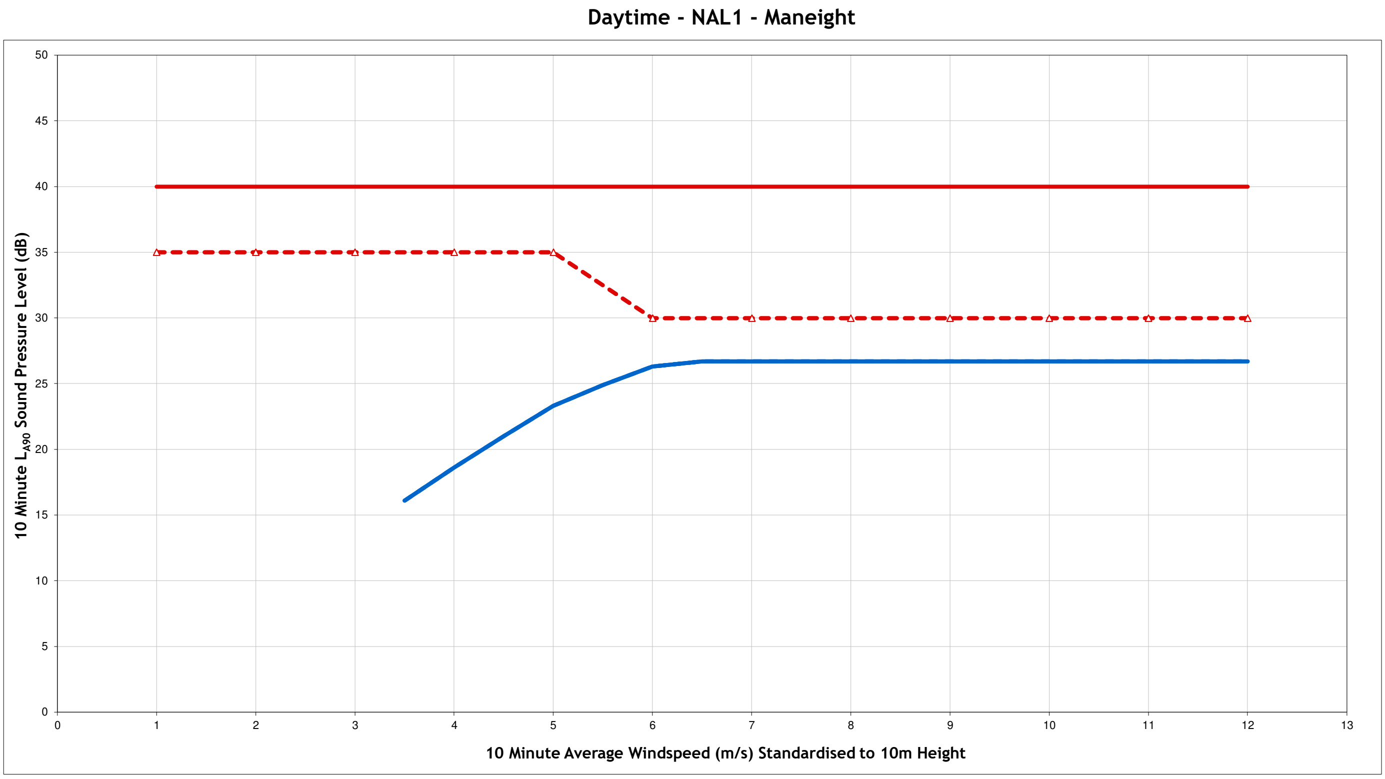
Legend:

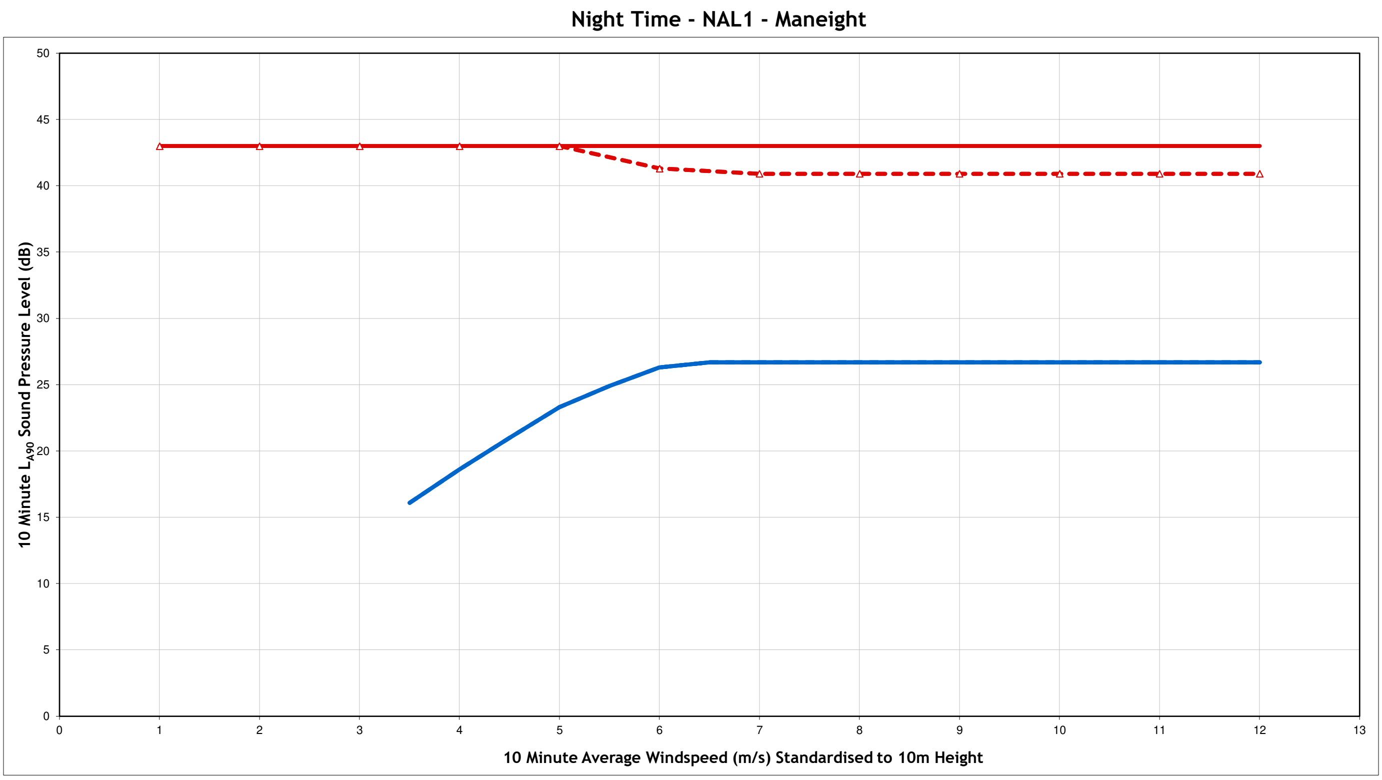
- Background Noise Trendline
- Total ETSU-R-97-Limit
- Cumulative (including the Proposed Development)
- Cumulative (excluding the Proposed Development)
- Proposed Development (11 x SG 6.6-170)
- South Kyle (62 x N133, Operational)
- Enoch Hill 1 & 2 (18 x V136, Consented)
- North Kyle (49 x V136, Consented)
- Overhill (10 x N133, Consented)
- Greenburn (16 x V136, Consented)
- Pencloe (19 x V136, Consented)
- Afton (25 x G80, Operational)
- Benbrack (15 x V136 & V117, Under Construction)
- Windy Standard I Repowering (8 x V162, In Planning)
- Windy Standard II (30 x V90, Operational)
- Windy Standard III (20 x SWT-3.2 & SWT-2.3, Consented)
- Windy Rig (12 x N100, Operational)
- Polquhairn (9 x E115 & E82, Consented)
- Knockkippen (12 x V136 & V150, In Planning)
- Sclenteuch (9 x V150, In Planning)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Likely Predictions
	NAL7 - Mossdale Farm
Figure No	Figure A1.3g
Scale	NTS
Drawn	AD
Checked	MC
Date	09/09/2024
Doc. Ref	14797 - Models

VATTENFALL

tnei





Legend:

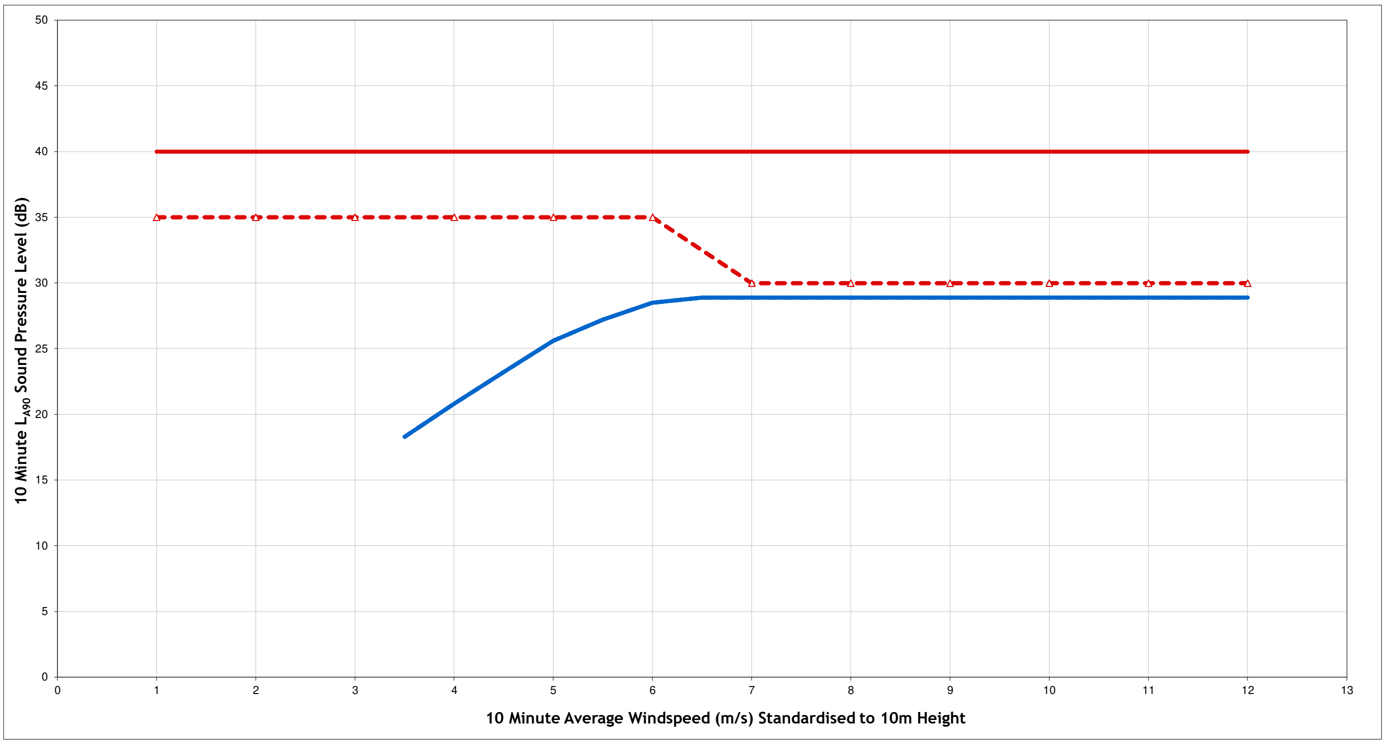
- Total ETSU-R-97 Noise Limit
- Site Specific Limits
- Proposed Development (11 x SG 6.6-170 Mode AM0)
- Unused (No Mitigation Required)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Site Specific Limits
	NAL1 - Maneight
Figure No	Figure A1.4a
Scale	NTS
Drawn	AD
Checked	MC
Date	11/09/2024
Doc. Ref	14797 - Models

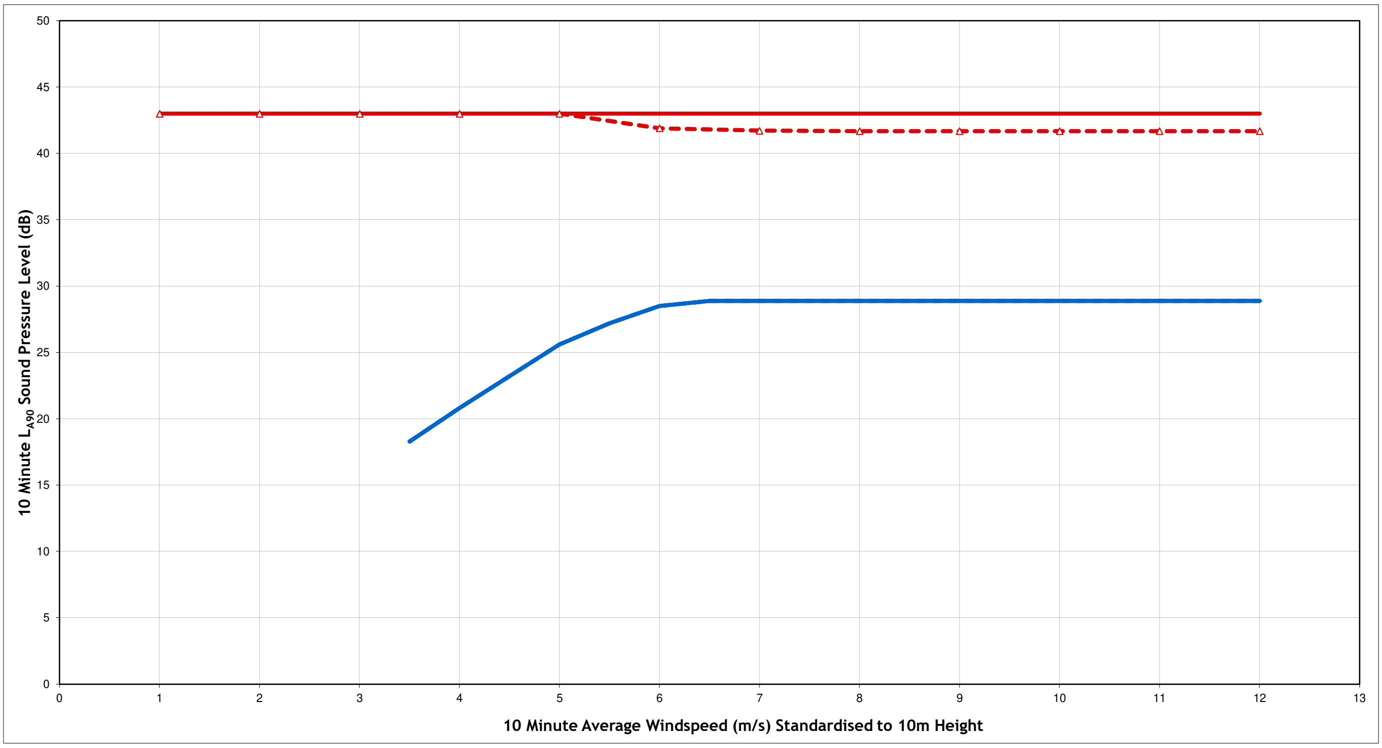
VATTENFALL

tnei

Daytime - NAL2 - Knockenlee



Night Time - NAL2 - Knockenlee



Legend:

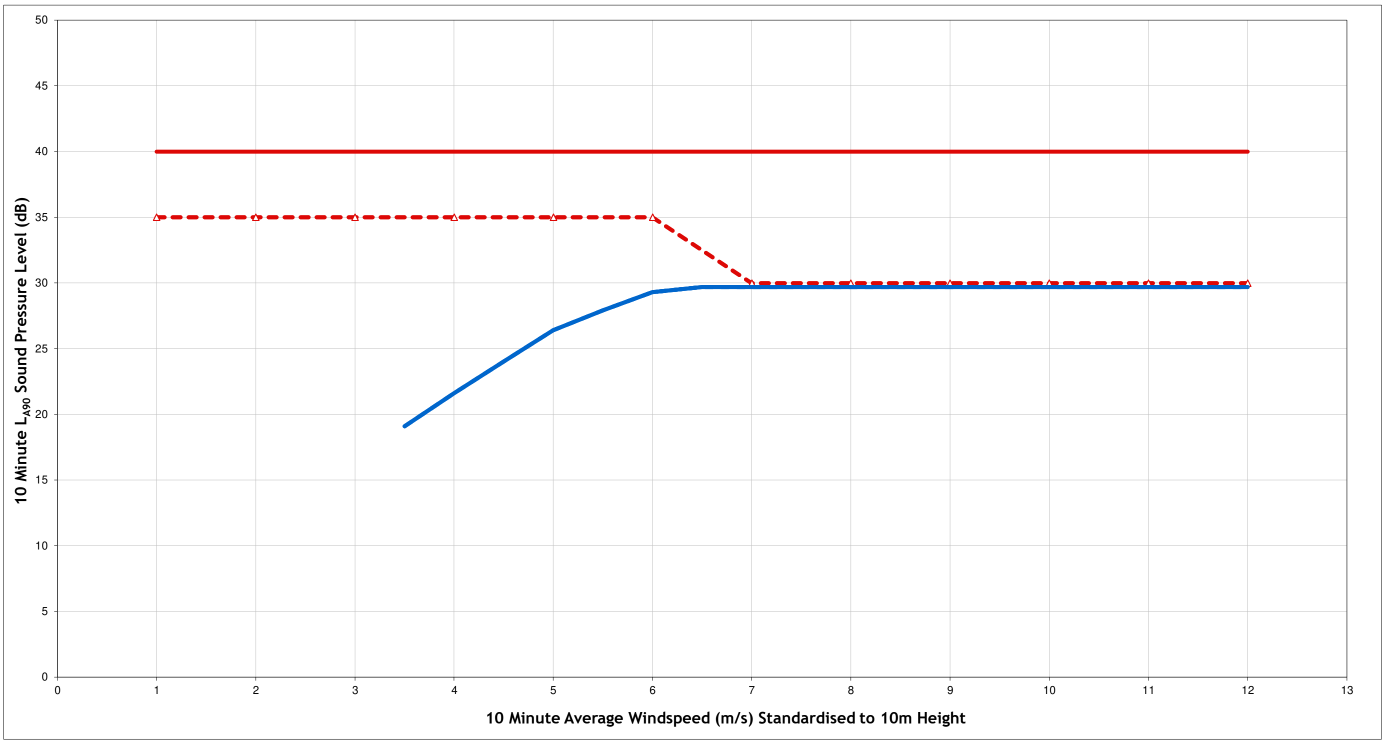
- Total ETSU-R-97 Noise Limit
- Site Specific Limits
- Proposed Development (11 x SG 6.6-170 Mode AM0)
- Unused (No Mitigation Required)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Site Specific Limits
	NAL2 - Knockenlee
Figure No	Figure A1.4b
Scale	NTS
Drawn	AD
Checked	MC
Date	11/09/2024
Doc. Ref	14797 - Models

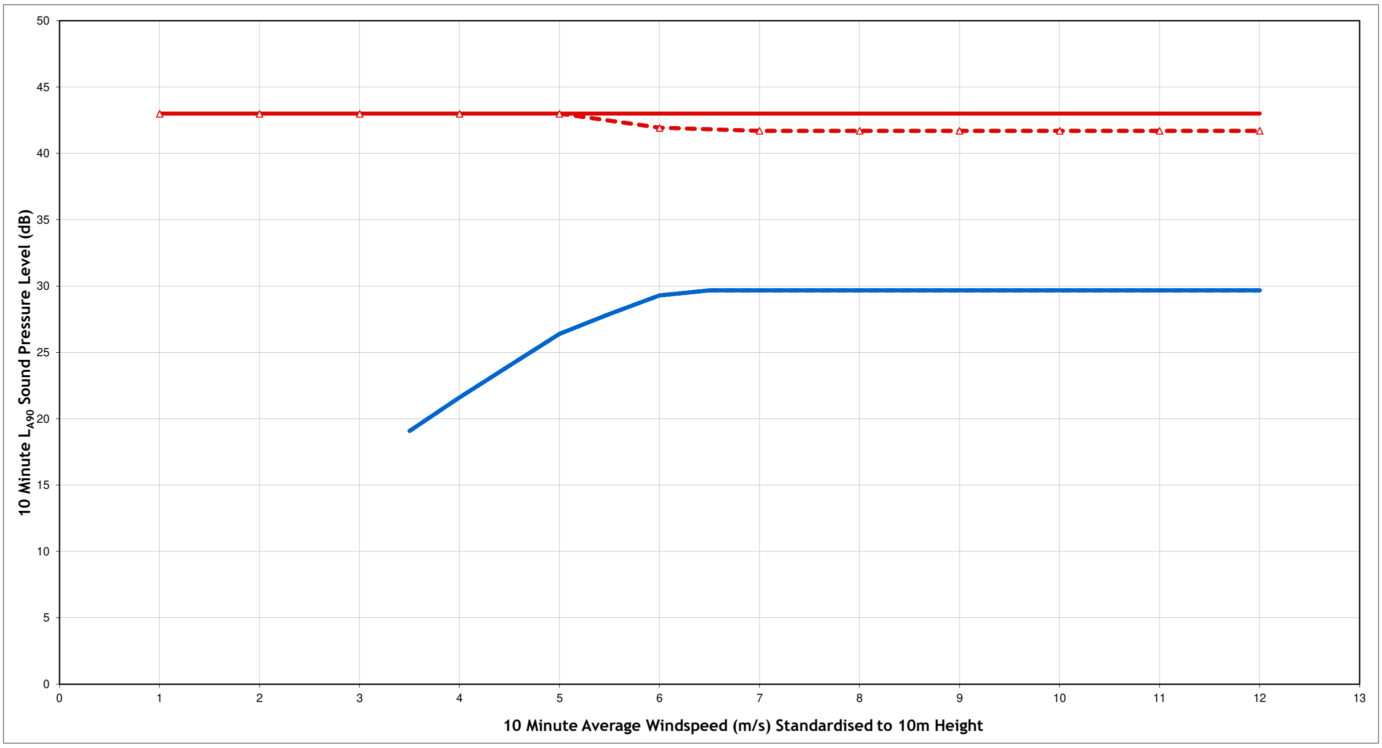
VATTENFALL

tnei

Daytime - NAL3 - Nith Lodge



Night Time - NAL3 - Nith Lodge



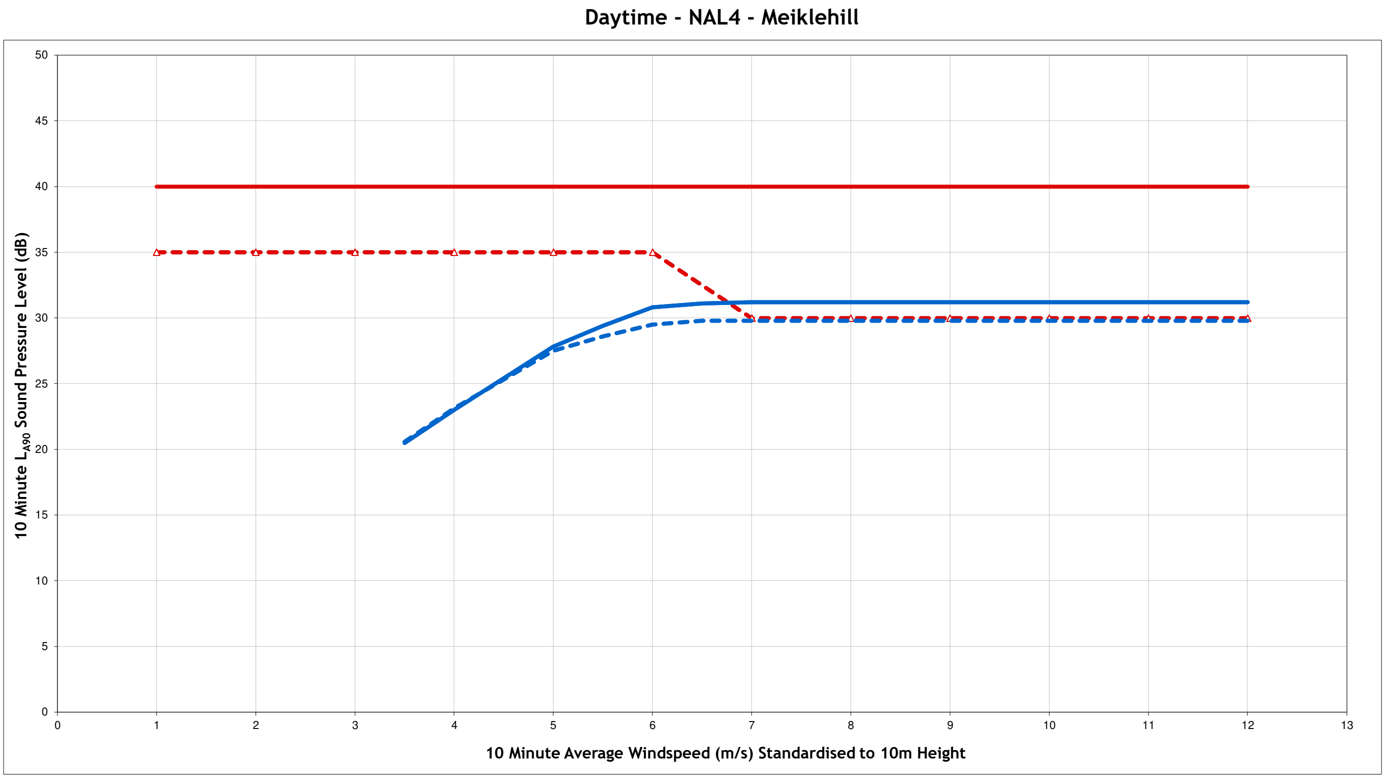
Legend:

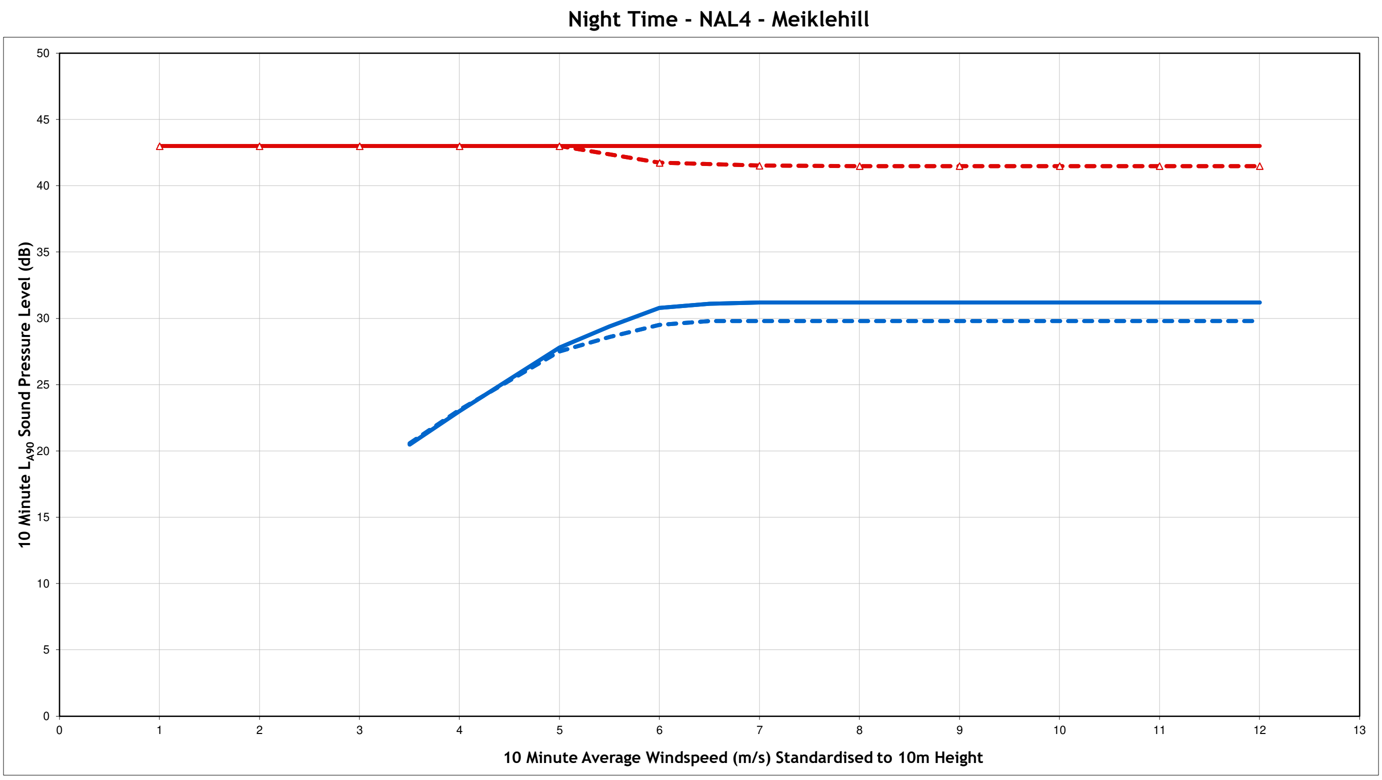
- Total ETSU-R-97 Noise Limit
- Site Specific Limits
- Proposed Development (11 x SG 6.6-170 Mode AM0)
- Unused (No Mitigation Required)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Site Specific Limits NAL3 - Nith Lodge
Figure No	Figure A1.4c
Scale	NTS
Drawn	AD
Checked	MC
Date	11/09/2024
Doc. Ref	14797 - Models

VATTENFALL

tnei





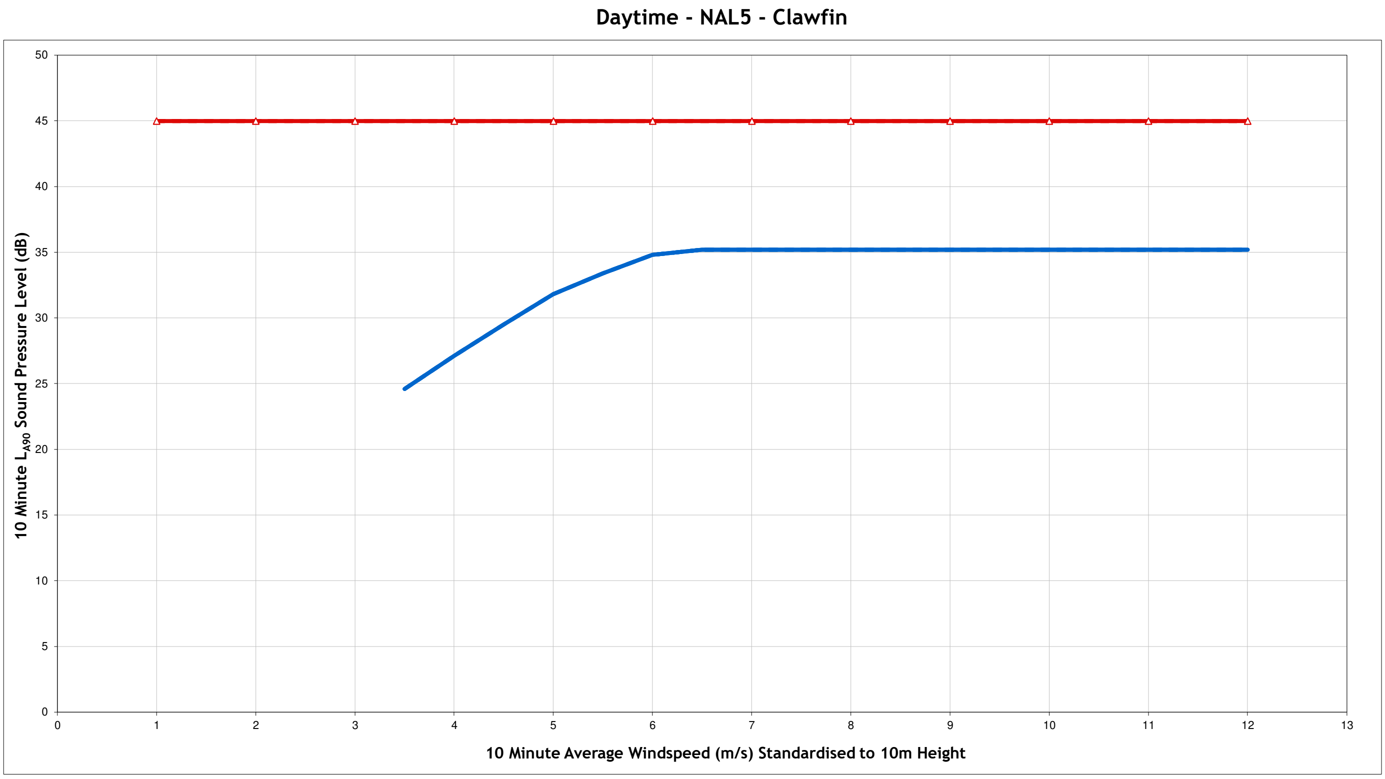
Legend:

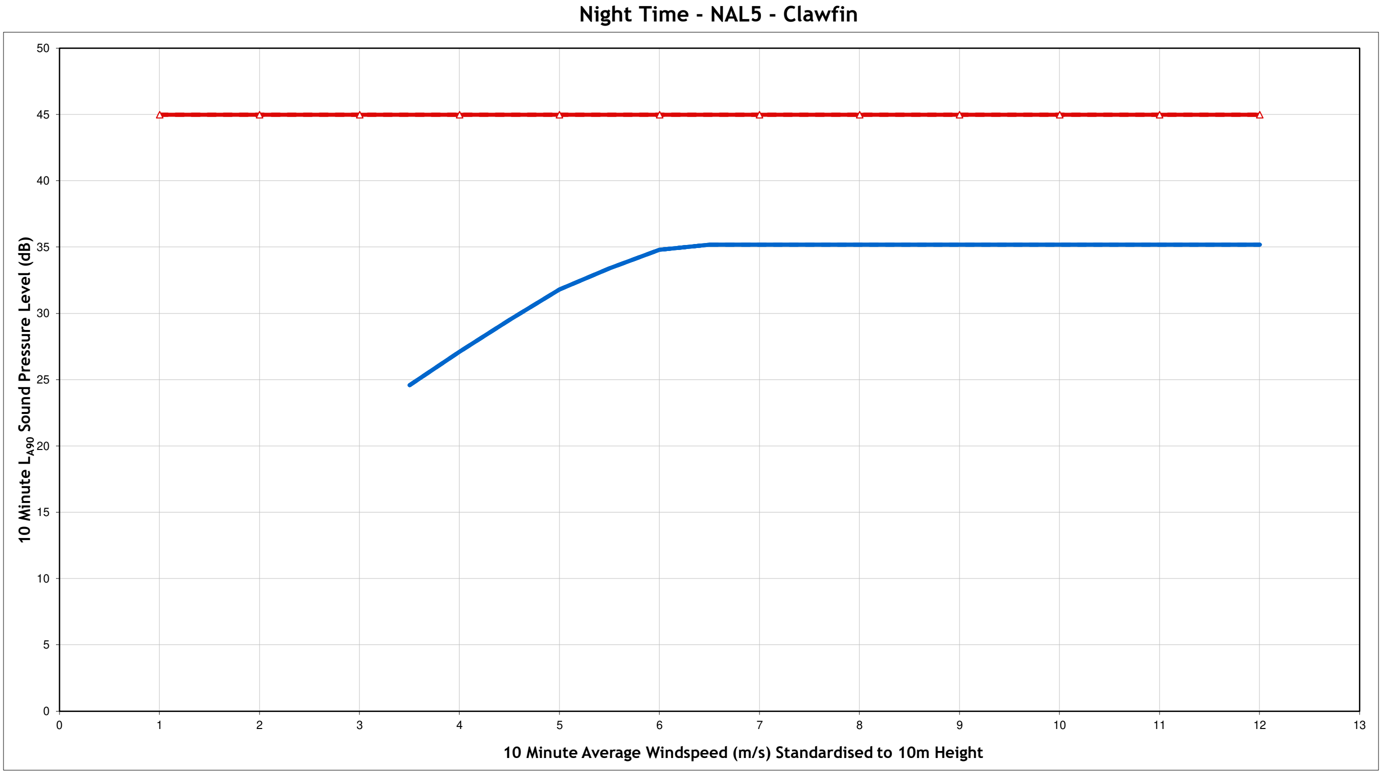
- Total ETSU-R-97 Noise Limit
- Site Specific Limits
- Proposed Development (11 x SG 6.6-170 Mode AM0)
- Proposed Development (11 x SG 6.6-170 with T5, 6 & 9 in Mode N3)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Site Specific Limits
	NAL4 - Meiklehill
Figure No	Figure A1.4d
Scale	NTS
Drawn	AD
Checked	MC
Date	11/09/2024
Doc. Ref	14797 - Models

VATTENFALL

tnei





Legend:

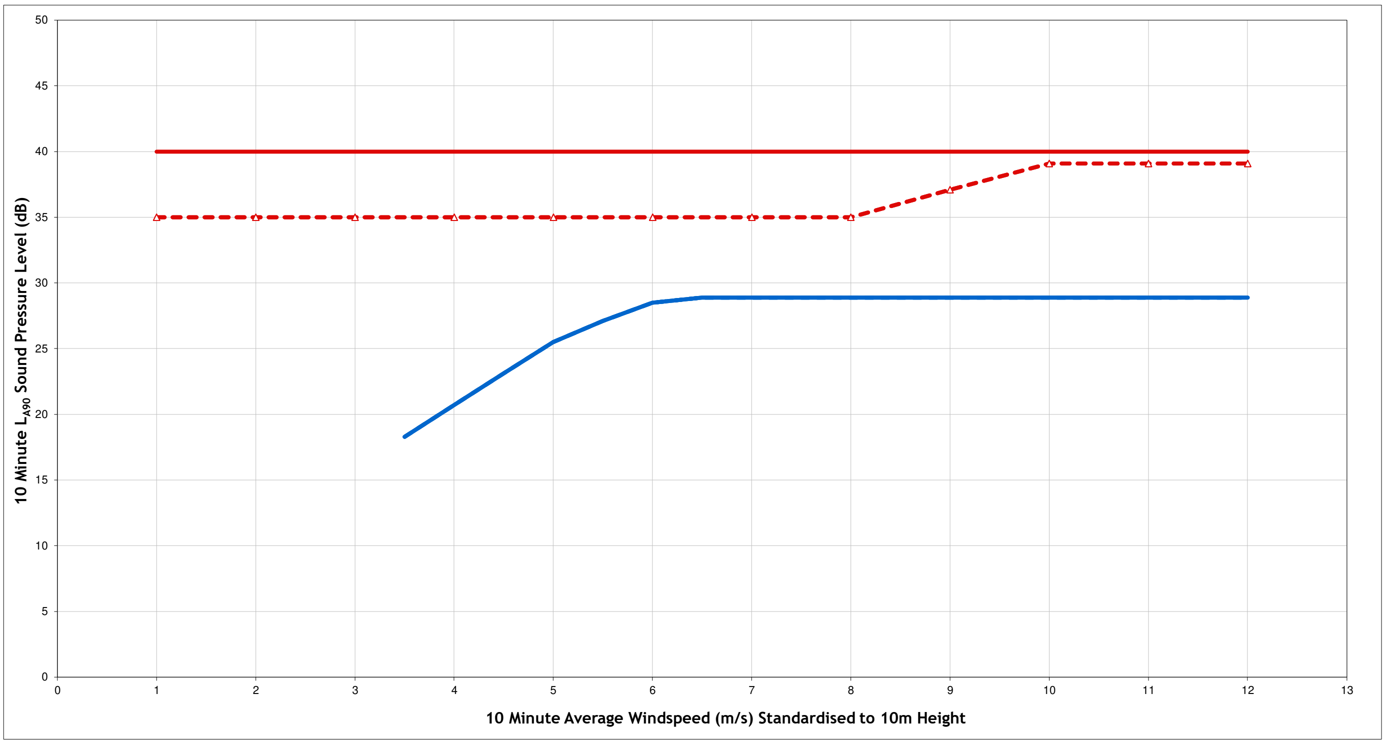
- Total ETSU-R-97 Noise Limit
- Site Specific Limits
- Proposed Development (11 x SG 6.6-170 Mode AM0)
- Unused (No Mitigation Required)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Site Specific Limits
	NAL5 - Clawfin
Figure No	Figure A1.4e
Scale	NTS
Drawn	AD
Checked	MC
Date	11/09/2024
Doc. Ref	14797 - Models

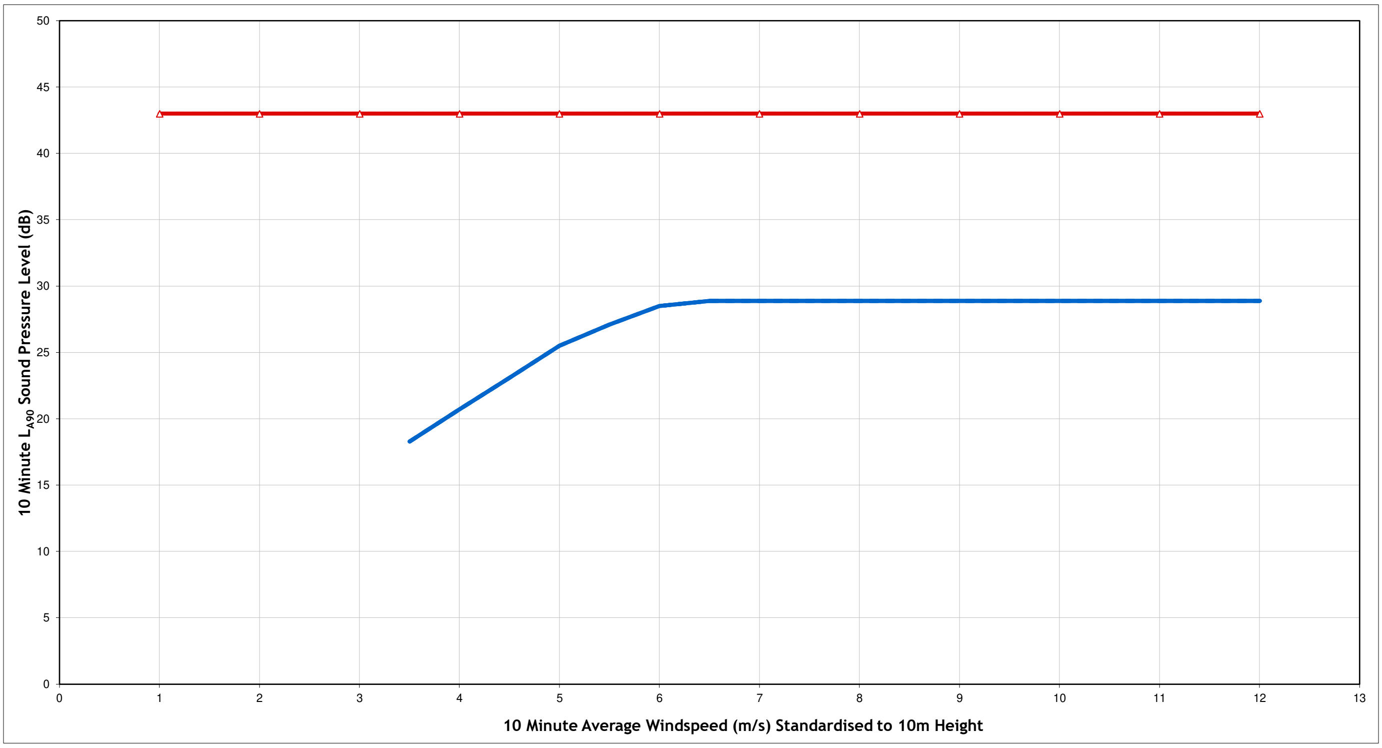
VATTENFALL

tnei

Daytime - NAL6 - Pennyvenie



Night Time - NAL6 - Pennyvenie

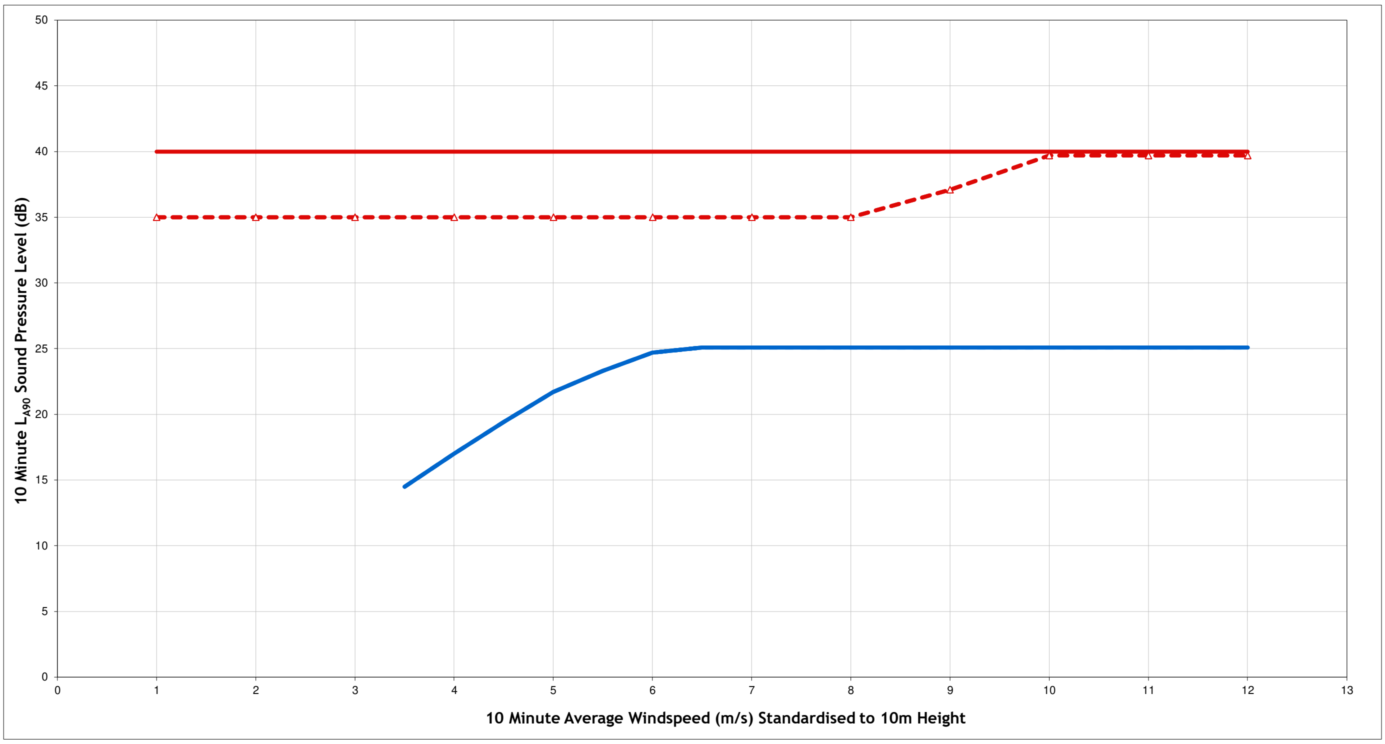


Legend:

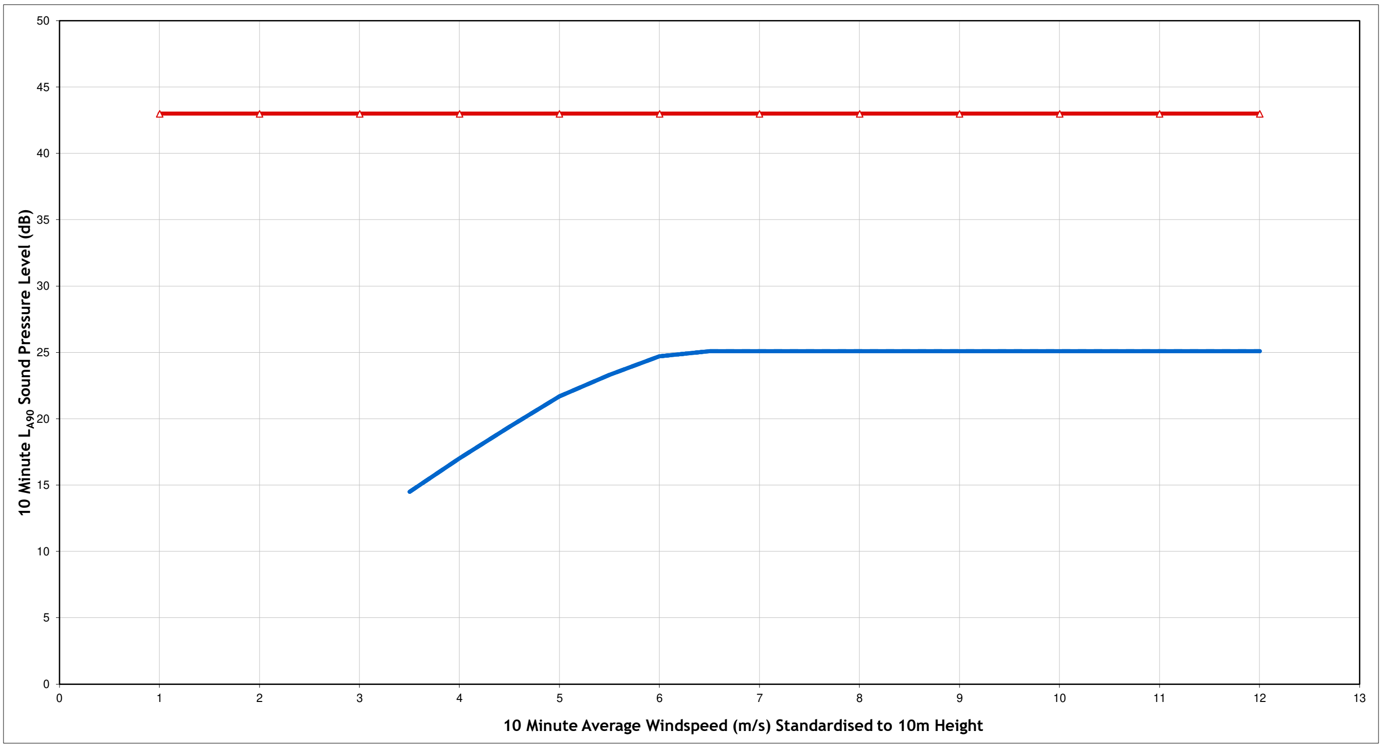
- Total ETSU-R-97 Noise Limit
- Site Specific Limits
- Proposed Development (11 x SG 6.6-170 Mode AM0)
- Unused (No Mitigation Required)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Site Specific Limits
	NAL6 - Pennyvenie
Figure No	Figure A1.4f
Scale	NTS
Drawn	AD
Checked	MC
Date	11/09/2024
Doc. Ref	14797 - Models

Daytime - NAL7 - Mossdale Farm



Night Time - NAL7 - Mossdale Farm



Legend:

- Total ETSU-R-97 Noise Limit
- Site Specific Limits
- Proposed Development (11 x SG 6.6-170 Mode AM0)
- Unused (No Mitigation Required)

Project	South Kyle II Wind Farm
Client	Vattenfall Wind Power Ltd
Title	Noise Assessment - Site Specific Limits
	NAL7 - Mossdale Farm
Figure No	Figure A1.4g
Scale	NTS
Drawn	AD
Checked	MC
Date	11/09/2024
Doc. Ref	14797 - Models

Annex 2 – Consultation

17 June 2024

Ref: 14797-009– R0

Sent by email only.

[redacted]

Dear [redacted]

PROPOSED SOUTH KYLE II WIND FARM ON LAND SOUTHEAST OF THE B741, SOUTH OF DALMELLINGTON AND SOUTHWEST OF NEW CUMNOCK: NOISE ASSESSMENT

Vattenfall Wind Power Ltd ('hereinafter referred to as the Applicant') are proposing to develop a wind farm and Battery Energy Storage System (BESS) ('the Proposed Development') on land southeast of the B741, south of Dalmellington and southwest of New Cumnock. The Applicant submitted a Scoping Report for the Proposed Development in March 2022. The turbine layout is shown on the enclosed Figure 1 (Annex 1).

TNEI Services Ltd (TNEI) has been appointed by the Applicant to undertake the noise assessment for the Proposed Development, and we would like to agree the noise assessment methodology with you.

Noise would be emitted from the Proposed Development during the construction, operation and decommissioning phases. Noise emitted during the construction and decommissioning phases would be temporary and short term in nature and can be minimised through careful construction practices. Operational noise would be controlled through the use of appropriate noise limits, which would be imposed to protect the amenity of neighbouring properties without unduly restricting wind energy development. Operational noise limits need to be derived at an early stage of the development to ensure they are satisfied throughout the design process.

BESS Operational Noise

As part of the Proposed Development, a BESS and substation will be located close to the existing New Cumnock Substation. Due to the separation distance between the proposed BESS and substation and the nearest noise sensitive receptor (NSRs) to the west (1.2 km) and east (1.9 km) and the relatively small scale of the BESS (up to 50 MW), operational noise levels from the BESS and substation at the nearest NSRs are expected to be low. On that basis, it is proposed that the operational noise from the BESS and substation is scoped out of the noise assessment.

Construction Noise

The Proposed Development will utilise existing access tracks which traverse the site and, as such, the requirement for the

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

construction of further track is reduced to areas upon which turbines will be erected. Therefore, all construction activities, including the temporary construction compound, will be at distances of greater than 1 km from the nearest receptors and any noise impacts from construction activities are anticipated to be negligible. It is proposed that a detailed construction noise assessment can be scoped out of the assessment, however a summary of the best practicable means to minimise noise immission during the construction phase will be included. A Figure of the Site Layout can be found in Appendix 1.

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."

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

ETSU-R-97

ETSU-R-97 describes the findings of the Working Group on Noise from Wind Turbines, the aim of which was 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, or a fixed minimum limit of 35-40 dB during the daytime and 43 dB during the night-time periods where background noise levels are low, and that these limits should reflect the variation in background noise with wind speed. Different limits apply to those properties that have a financial interest in the wind energy development (45 dB or background plus 5 dB (whichever is the greater) for both daytime and night-time).

The choice of quiet 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 (in planning) wind farms in the area and will henceforth be referred to as the 'Total ETSU-R-97 Noise Limits'. Given the number of operational and consented wind farms in the area, and the fact that a daytime Total ETSU-R-97 Noise Limit based on a fixed minimum limit of 40 dB has been used to set the noise limits for North Kyle Wind Farm at key receptors, such as Meiklehill, daytime Total ETSU-R-97 Noise Limits based on a fixed minimum limit of 40 dB will be derived for the Proposed Development.

The Site Specific Noise Limits will be based on the lower daytime fixed minimum noise limit of 35 dB or background plus 5 dB whichever is the greater. The Total and Site Specific night-time noise limits will be based on 43 dB or background plus 5 dB.

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 Site Specific Noise Limits will be the limits that the Proposed Development would have to operate within, should consent be granted.

Paragraph 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 ETSU-R-97 limits, where there would be no realistic prospect of the existing wind farm producing noise levels up to the total ETSU-R-97 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."*

Where there is significant headroom we propose to utilise the available headroom to derive the Site Specific Noise Limits for the Proposed Development and consider a +2 dB addition to predicted cumulative levels (excluding the Proposed Development) to be "an *appropriate margin to cover factors such as potential increases in noise".* We would be grateful if the Council would confirm its agreement to this approach.

In order to establish Total ETSU-R-97 Noise Limits in accordance with ETSU-R-97 it is necessary to determine the relationship between wind speed measured at the Proposed Development site and background noise levels measured at the closest noise sensitive receptors. Measured background noise levels should not be influenced by noise from operational wind turbines, this is an important consideration for this assessment given the number of operational wind turbines in the area.

The IOA GPG provides guidance on the methods that can be used to determine background noise levels in areas which are potentially influenced by operational wind turbines. The IOA GPG states that:

'In the presence of an existing wind farm, suitable background noise levels can be derived by one of the following methods:

- *switching off the existing wind farm during the background noise level survey (with associated significant cost implications);*
- *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;*
- *utilising an agreed proxy location removed from the area acoustically affected by the existing wind farm/s; or*
- *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).'*

With due regard to the location of key receptors relative to operational turbines and the existing background noise data collected previously, it is proposed that the background noise data gathered as part of the July 2015 Environmental Statement (ES) for Enoch Hill Windfarm is reused (as per the fourth bullet point above). The Enoch Hill noise monitoring locations are presented on Figure 1 (Annex 1).

As can be seen on Figure 1, the only common receptor between the Noise Assessment Locations for the Proposed Development, and the noise monitoring locations from the Enoch Hill ES, is Meiklehill. The quiet daytime background noise levels at Meiklehill were also the quietest of all the noise monitoring locations, with the night time levels, whilst not the quietest of all the monitoring locations, quiet enough across the wind speed range such that the Total ETSU-R-97 Noise Limit will be solely a function of the Fixed Minimum Limit. Therefore, the Total ETSU-R-97 Noise Limits for all Noise Assessment Locations will utilise the background noise levels from Meiklehill.

As part of the noise assessment undertaken for the Enoch Hill ES, the background noise measurements were correlated to hub height wind speeds of 82 m. Therefore, a wind shear adjustment to the Proposed Development hub height of 115 m was required. TNEI has been supplied with the 10 minute background noise, rain and wind speed data collected as part of the baseline noise survey for Enoch Hill, with permission being granted to allow for this data to be used for the wind shear correction.

During the Enoch Hill baseline survey, concurrent wind speed measurements at heights of 81 m and 62 m were recorded by a meteorological mast sited within the Enoch Hill site boundary (co-ordinates 256524, 607053). The mast was sited at a higher AOD than the Proposed Development site, and therefore wind speed measurements can be deemed conservative. Using these concurrent wind speed measurements, wind speeds at the Proposed Development hub height of 115 m have been calculated using Method B within the IOA GPG Supplementary Guidance Note 4. These have then been standardised to 10 m.

For the operational noise assessment (to be included within the EIAR for the Proposed Development) it is proposed that the background noise polynomials will be used to derive the Total ETSU-R-97 Noise Limits and Site Specific Noise Limits for the Proposed Development. The operational noise assessment in the EIAR will be undertaken in three separate stages:

- Stage 1 – establish the Total ETSU-R-97 Noise Limits for each Noise Assessment Location (NAL) using the re-derived background noise polynomials;
- Stage 2 – undertake noise modelling to determine whether noise predictions from the Proposed Development on its own are within 10 dB of the noise predictions from other wind turbines within the area. Where turbine predictions are within 10 dB then a likely cumulative noise assessment will be undertaken; and
- Stage 3 – derive the Site Specific Noise Limits for the Proposed Development (through apportioning the Total ETSU-R-97 Noise Limits) and compare the noise predictions from the Proposed Development on its own against the Site Specific Noise Limits.

Summary

Prior to commencing the final modelling and write up we would be very grateful if you confirm whether:

- You are happy with the proposed assessment methods outlined above (ETSU-R-97 and the IOA GPG);
- You agree that the BESS and proposed Substation Operational Noise and Construction Noise Assessments can be scoped out;
- You agree to the use of Total ETSU-R-97 Noise Limits based on the upper daytime fixed minimum noise limit of 40 dB or background plus 5 dB whichever is the greater and a fixed

limit of 43 dB or background plus 5 dB whichever is the greater during the night time period;

- You agree with the proposed approach that, in line with IOA GPG, the cumulative assessment and derivation of Site Specific Noise Limits for the Proposed Development will utilise available significant headroom with an appropriate margin +2 dB above predicted noise levels; and
- You agree in the reuse of the background datasets from the Enoch Hill Wind Farm noise assessments subject to the data being reanalysed to consider the higher hub height (115 m) being considered for the Proposed Development.

If you have any comments or questions on the above or would like to have a call to discuss any aspects of the noise assessment methodology, then please do not hesitate to contact myself or my colleague Gemma. We look forward to hearing from you.

Yours sincerely,

[redacted]

Alex Dell
MEng, PhD, AMIOA

[redacted]

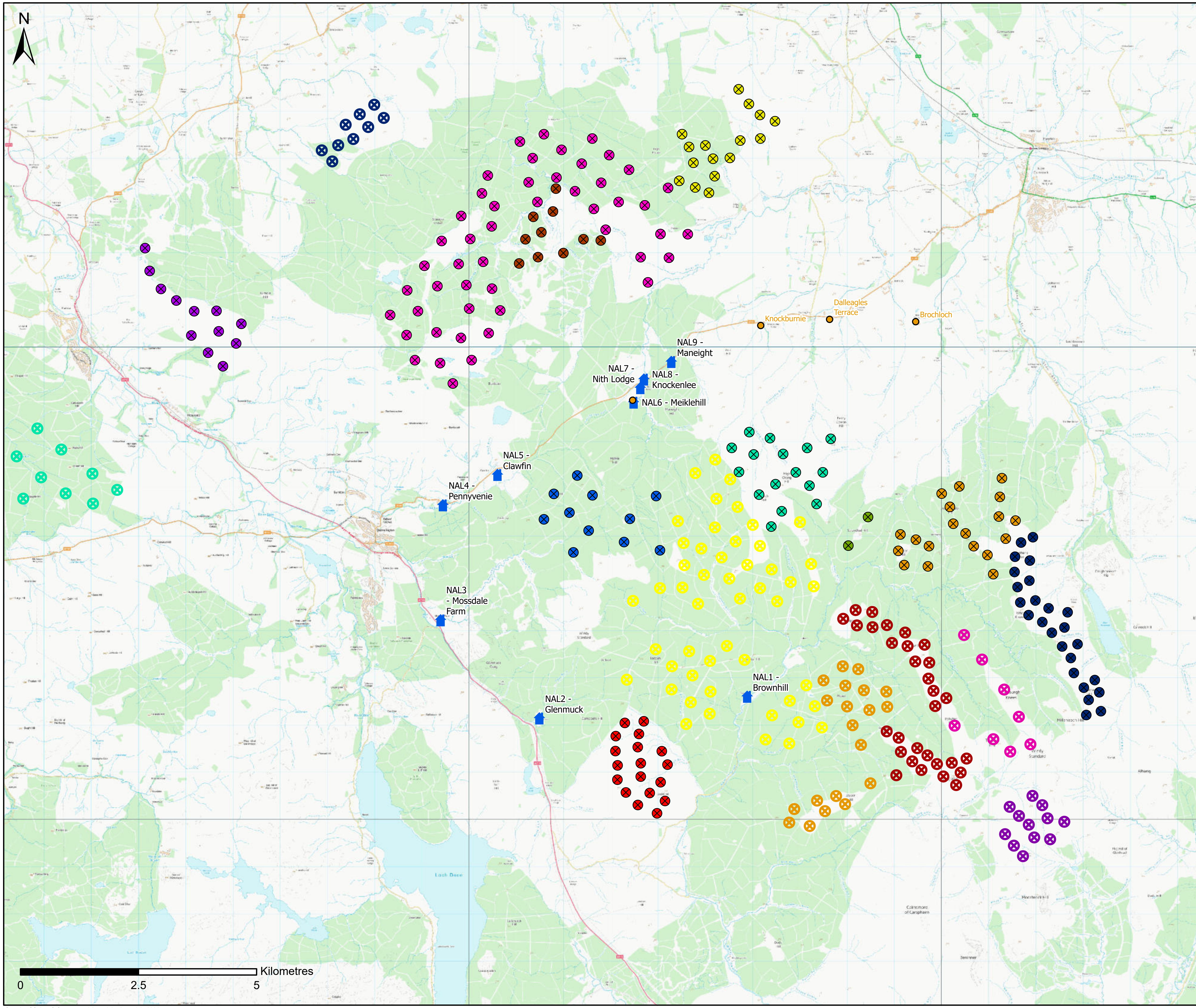
Reviewed and approved by:

[redacted]

Gemma Clark
BSc(Hons), MSc, MIOA

[redacted]

Annex 1



LEGEND

- Enoch Hill Noise Monitoring Locations
- Noise Assessment Locations (NALs)
- Afton
- Enoch Hill
- Enoch Hill 2
- Greenburn
- Knockkippen
- North Kyle
- Overhill
- Penncloe
- Polquhairn
- Sclenteuch
- South Kyle
- South Kyle II
- Windy Rig
- Windy Standard I (Repowering)
- Windy Standard II
- Windy Standard III
- Benbrack

Rev.	Date	Amendment Details	Drawn	Approved
1	13/06/24	CLIENT COMMENTS	JCM	GC
0	01/05/24	FOR INFORMATION	AD	GC

tnei

Client

VATTENFALL

Drawing Status:

FOR INFORMATION

Project Title:

SOUTH KYLE II WIND FARM

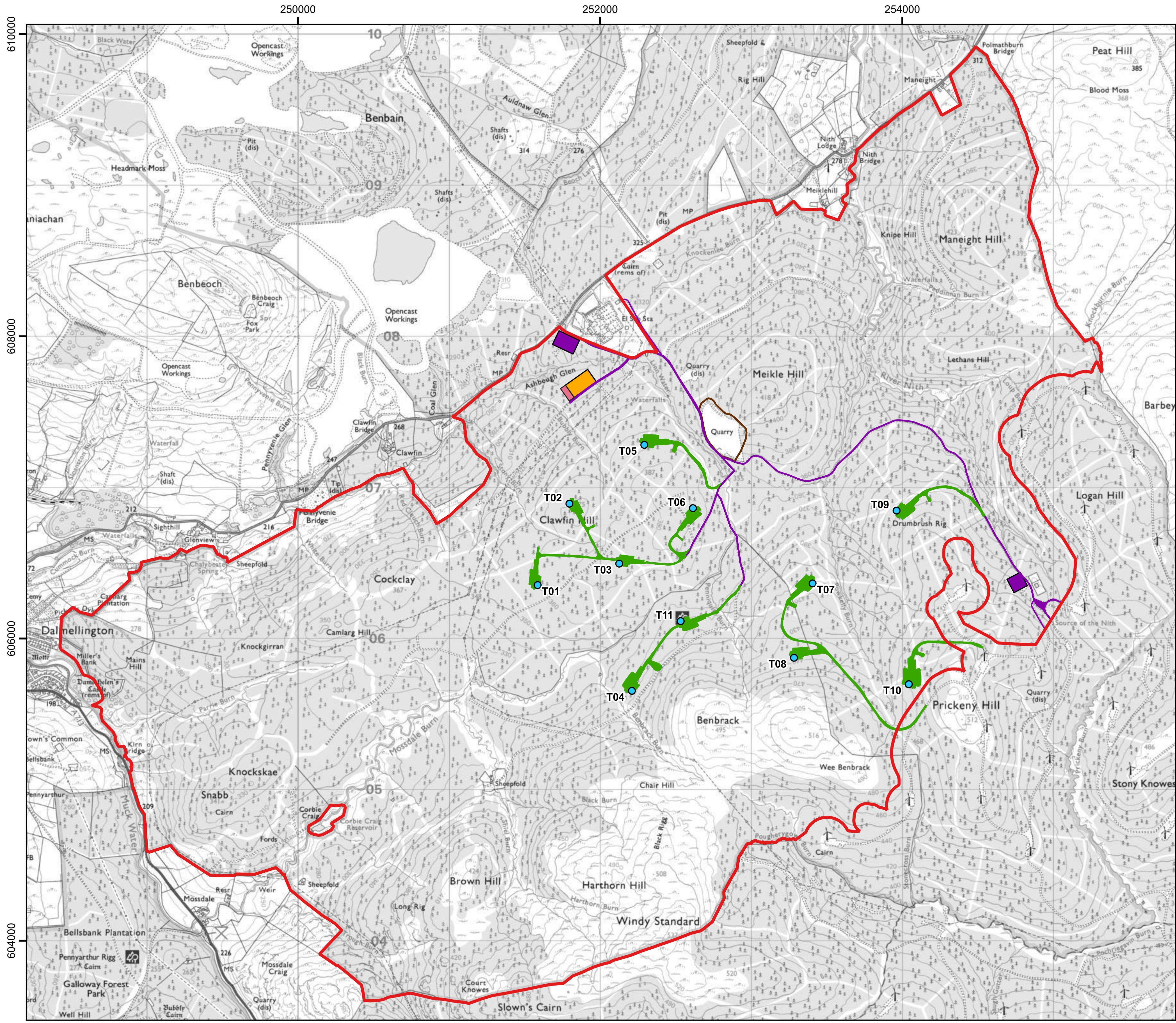
Drawing Title:

FIGURE 1 - WIND TURBINE AND NOISE ASSESSMENT LOCATIONS

Scale:	Original Size:	Spatial Reference:
1:75,000	A3	British National Grid

Drawing Number:

14797-009



Project:

South Kyle II Wind Farm, East Ayrshire

Title:

11 WTG Site Layout

Key

- Site boundary
- Proposed turbine
- Proposed South Kyle II track and hardstanding
- Existing track
- Proposed substation
- Proposed battery storage
- South Kyle II borrow pit
- South Kyle II temporary construction compound

Scale @ A3: 1:25,000

Coordinate System: British National Grid

0 0.25 0.5 0.75 1 km

N

Date: 19-02-24	Prepared by: DH	Checked by: SM
Ref: GB201396_M_116_G	Layout: 280923_11t_A	

Drawing by:

The Natural Power Consultants Limited
The Green House
Forrest Estate, Dalry
Castle Douglas, DG7 3XS, UK
Tel: +44 (0)1644 430008
Fax: +44 (0)845 299 1236
Email: sayhello@naturalpower.com
www.naturalpower.com

natural power

VATTENFALL

Economy and Skills
Chief Executive: Eddie Fraser
Governance
Head of Service: David Mitchell, Chief Governance Officer

East Ayrshire Council
Comhairle Siorrachd Àir an Ear

Tel. Environmental Health 01563 576790 (Option 1)

Regulatory Services
London Road Headquarters
KILMARNOCK KA3 7BU

Tel. Environmental Health 01563 576790 (option 1)
If telephoning or calling
please ask for: [redacted]

TNEI Services Ltd.
7th Floor West One
Forth Banks
Newcastle-Upon-Tyne
NE1 3PA

Your Ref: 14797-009-R0
Date: 26th June 2024

FAO Alex Dell and Gemma Clark

Dear Sir and Madam,

PROPOSED SOUTH KYLE II WIND FARM ON LAND SOUTHEAST OF THE B741, SOUTH OF DALMELLINGTON AND SOUTHWEST OF NEW CUMNOCK: NOISE ASSESSMENT

I refer to your letter dated 17th June 2024 sent by email to David Mitchell, Chief Governance Officer, East Ayrshire Council regarding the above.
I have now had the opportunity to review your proposals and would comment as follows:-

1. The rationale behind your proposed assessment and scoping out of the assessment certain elements relating to BESS operational noise and construction noise is accepted (these proposals are summarised by you on pages 4 and 5 of your letter) and agreed.
2. It is noted that you intend to rely on background noise levels measured in 2015 (and presented in 2015 within the Environmental Statement for the Enoch Hill windfarm development) for preparation of the Noise Assessment for operational noise from South Kyle 2, however I note from the map provided at Figure 1 in your letter does not identify the properties at Maneight Farm, Upper Beoch, Clawfin and Pennyvenie as having previously been considered. It would be useful if any modelling exercise using the 2015 data could be expanded to model background noise levels at the locations. The topography is such that Maneight, which sits at a higher level than Meiklehill and is in the prevailing wind direction from South Kyle 2 site could potentially be impacted by this new development. In relation to Upper Beoch, Clawfin and Pennyvenie, South Kyle 2 will be encroaching closer to these properties than previous developments and should be given consideration.

Should you wish to discuss any of the above matters please do not hesitate to contact me and we could perhaps arrange to discuss these issues via a Teams meeting. Please note I have no availability until Tuesday 2nd July 2024

Yours faithfully

[redacted]
Environmental Health Officer (Environmental Regulation)

Regulatory Services, Environmental Health Service
London Road Headquarters
KILMARNOCK, KA3 7BU

Annex 3 – Topographical Corrections/ Turbine Coordinates

Topographical (concave ground/ barrier) Adjustment Table and coordinates

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

Wind Farm	Hub	ID	Noise Senstive Receptor									X	Y	Turbine Considered
			1	2	3	4	5	6	7	8	9			
Afton	80	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	261940	605974	Gamesa G80, 2.0MW with Standard Blades
Afton	80	2	-2	-2	-2	-2	-2	-2	-2	-2	-2	261689	605862	Gamesa G80, 2.0MW with Standard Blades
Afton	80	3	-2	-2	-2	-2	-2	-2	-2	-2	3	261561	605561	Gamesa G80, 2.0MW with Standard Blades
Afton	80	4	-2	-2	-2	-2	-2	-2	-2	-2	-2	261875	605480	Gamesa G80, 2.0MW with Standard Blades
Afton	80	5	-2	-2	-2	-2	-2	-2	-2	-2	0	261551	605239	Gamesa G80, 2.0MW with Standard Blades
Afton	80	6	-2	-2	-2	-2	-2	-2	-2	-2	-2	261865	605055	Gamesa G80, 2.0MW with Standard Blades
Afton	80	7	-2	-2	-2	-2	-2	-2	-2	-2	0	261615	604919	Gamesa G80, 2.0MW with Standard Blades
Afton	80	8	-2	-2	-2	-2	-2	-2	-2	-2	-2	261673	604593	Gamesa G80, 2.0MW with Standard Blades
Afton	80	9	-2	-2	-2	-2	-2	-2	-2	-2	-2	261992	604635	Gamesa G80, 2.0MW with Standard Blades
Afton	80	10	-2	-2	-2	-2	-2	-2	-2	-2	-2	261849	604325	Gamesa G80, 2.0MW with Standard Blades
Afton	80	11	-2	-2	-2	-2	-2	-2	-2	-2	-2	262272	604470	Gamesa G80, 2.0MW with Standard Blades
Afton	80	12	-2	-2	-2	-2	-2	-2	-2	-2	-2	262139	604178	Gamesa G80, 2.0MW with Standard Blades
Afton	80	13	-2	-2	-2	-2	-2	-2	-2	-2	-2	262675	604385	Gamesa G80, 2.0MW with Standard Blades
Afton	80	14	-2	-2	-2	-2	-2	-2	-2	-2	-2	262341	603952	Gamesa G80, 2.0MW with Standard Blades
Afton	80	15	-2	-2	-2	-2	-2	-2	-2	-2	-2	262608	604063	Gamesa G80, 2.0MW with Standard Blades
Afton	80	16	-2	-2	-2	-2	-2	-2	-2	-2	-2	262559	603661	Gamesa G80, 2.0MW with Standard Blades
Afton	80	17	-2	-2	-2	-2	-2	-2	-2	-2	-2	262885	603710	Gamesa G80, 2.0MW with Standard Blades
Afton	80	18	-2	-2	-2	-2	-2	-2	-2	-2	-2	262743	603417	Gamesa G80, 2.0MW with Standard Blades
Afton	80	19	-2	-2	-2	-2	-2	-2	-2	-2	-2	262807	603100	Gamesa G80, 2.0MW with Standard Blades
Afton	60	20	-2	-2	-2	-2	-2	-2	-2	-2	-2	263250	602950	Gamesa G80, 2.0MW with Standard Blades
Afton	60	21	-2	-2	-2	-2	-2	-2	-2	-2	-2	263018	602789	Gamesa G80, 2.0MW with Standard Blades
Afton	60	22	-2	-2	-2	-2	-2	-2	-2	-2	-2	263346	602691	Gamesa G80, 2.0MW with Standard Blades
Afton	60	23	-2	-2	-2	-2	-2	-2	-2	-2	-2	263120	602530	Gamesa G80, 2.0MW with Standard Blades
Afton	80	24	-2	-2	-2	-2	-2	-2	-2	-2	-2	263380	602291	Gamesa G80, 2.0MW with Standard Blades
Afton	60	25	-2	-2	-2	-2	-2	-2	-2	-2	-2	263070	602210	Gamesa G80, 2.0MW with Standard Blades
Benbrack	82	26	-2	-2	-2	-2	-2	-2	-2	-2	0	253299	602043	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	27	-2	-2	-2	-2	-2	-2	-2	-2	0	253598	601809	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	28	-2	-2	-2	-2	-2	-2	-2	0	0	253107	601763	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	29	-2	-2	-2	-2	-2	-2	-2	-2	0	253573	601530	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	30	-2	-2	-2	-2	-2	-2	-2	0	0	253100	601447	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	31	-2	-2	-2	-2	-2	-2	-2	-2	0	253637	601189	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	32	-2	-2	-2	-2	-2	-2	-2	-2	0	253636	600906	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	72	33	-2	-2	-2	-2	-2	-2	-2	0	3	253146	601144	Vestas V117, 4.3 MW, Mode PO2-0S with Standard Blades
Benbrack	72	34	-2	-2	-2	-2	-2	-2	-2	0	3	253142	600841	Vestas V117, 4.3 MW, Mode PO2-0S with Standard Blades
Benbrack	82	35	-2	-2	-2	-2	-2	-2	-2	-2	0	253826	600559	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	36	-2	-2	-2	-2	-2	-2	-2	-2	0	254057	600787	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	37	-2	-2	-2	-2	-2	-2	-2	0	3	253322	600570	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	38	-2	-2	-2	-2	-2	-2	-2	-2	0	254150	600390	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	39	-2	-2	-2	-2	-2	-2	-2	0	0	253575	600305	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Benbrack	82	40	-2	-2	-2	-2	-2	-2	-2	-2	0	253981	600129	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	41	0	-2	-2	0	0	0	-2	-2	-2	255563	607866	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	42	0	-2	-2	-2	-2	-2	-2	-2	-2	255934	608200	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	43	-2	-2	-2	0	0	-2	-2	-2	-2	255716	607356	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	44	3	-2	-2	3	3	-2	-2	-2	-2	256142	606876	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	45	0	-2	-2	-2	-2	-2	-2	-2	-2	256373	608072	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	46	3	-2	-2	0	0	-2	-2	-2	-2	256490	607097	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	47	-2	-2	-2	0	-2	-2	-2	-2	-2	256621	606524	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	48	0	-2	-2	-2	-2	-2	-2	-2	-2	256651	607737	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	49	3	-2	-2	-2	-2	-2	-2	-2	-2	256920	607348	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	50	0	-2	-2	-2	-2	-2	-2	-2	-2	257209	607066	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	51	0	-2	-2	-2	-2	-2	-2	-2	-2	257160	607865	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	52	-2	-2	-2	-2	-2	-2	-2	-2	-2	257360	606678	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	53	0	-2	-2	-2	-2	-2	-2	-2	-2	257491	607348	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	54	0	-2	-2	-2	-2	-2	-2	-2	-2	257659	608057	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	55	0	-2	-2	0	-2	-2	-2	-2	-2	256028	607726	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	56	-2	-2	-2	0	-2	-2	-2	-2	-2	256400	606200	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	57	-2	-2	-2	-2	-2	-2	-2	-2	0	258449	606402	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Enoch Hill	81.9	58	-2	-2	-2	-2	-2	-2	-2	-2	3	258032	605796	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	59	3	3	3	3	-2	-2	-2	-2	-2	254451	613520	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	60	3	3	3	3	-2	-2	-2	-2	-2	254790	613380	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	61	3	3	3	3	-2	-2	-2	-2	-2	255080	613267	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	62	3	3	3	3	-2	-2	-2	-2	-2	254659	614237	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	63	3	3	3	3	-2	-2	-2	-2	-2	254751	613902	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	64	3	0	3	3	-2	-2	-2	-2	-2	255201	613618	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	65	3	3	3	3	-2	-2	-2	-2	-2	254511	614508	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	66	3	3	3	3	-2	-2	-2	-2	-2	255005	614269	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	67	3	3	3	3	-2	-2	-2	-2	-2	255167	613988	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	68	3	3	3	3	-2	-2	-2	-2	-2	255524	614005	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	69	3	3	3	3	-2	-2	-2	-2	-2	255743	614373	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	70	3	3	3	3	-2	-2	-2	-2	-2	256169	614416	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	71	3	3	3	3	-2	-2	-2	-2	-2	255710	615458	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	72	3	3	3	3	-2	-2	-2	-2	-2	255926	615148	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	73	3	3	3	3	-2	-2	-2	-2	-2	256161	614915	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Greenburn	82	74	3	3	3	3	-2	-2	-2	-2	-2	256479	614782	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Knockkippen	83.5	75	-2	-2	-2	-2	-2	-2	-2	-2	-2	243141	612095	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Knockkippen	83.5	76	-2	-2	-2	-2	-2	-2	3	-2	-2	243238	611612	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Knockkippen	83.5	77	-2	-2	-2	-2	-2	-2	3	-2	-2	243477	611231	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades

Wind Farm	Hub	ID	Noise Senstive Receptor									X	Y	Turbine Considered
			1	2	3	4	5	6	7	8	9			
Knockkippen	83.5	78	-2	-2	-2	-2	-2	-2	3	-2	-2	243802	610986	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Knockkippen	113.5	79	-2	-2	-2	-2	-2	-2	3	-2	-2	244180	610759	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Knockkippen	113.5	80	-2	-2	-2	-2	-2	-2	3	-2	-2	244653	610767	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Knockkippen	113.5	81	-2	-2	-2	-2	-2	-2	3	-2	-2	245179	610493	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Knockkippen	113.5	82	-2	-2	-2	-2	-2	0	3	-2	-2	244120	610246	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Knockkippen	113.5	83	-2	-2	-2	-2	-2	-2	3	-2	-2	244700	610333	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Knockkippen	113.5	84	-2	-2	-2	-2	-2	0	3	-2	-2	245069	610077	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Knockkippen	113.5	85	-2	-2	-2	-2	-2	0	3	-2	-2	244475	609880	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Knockkippen	113.5	86	-2	-2	-2	-2	-2	0	3	-2	-2	244789	609594	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
North Kyle	82	87	0	0	0	0	-2	-2	-2	-2	-2	254632	612390	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	88	3	3	3	3	-2	-2	-2	-2	-2	254215	613370	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	89	3	3	3	3	-2	-2	-2	-2	-2	253722	613001	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	90	3	0	0	3	-2	-2	-2	-2	-2	254054	612394	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	91	0	0	0	0	-2	-2	-2	-2	-2	254234	611892	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	92	3	3	3	3	-2	-2	-2	-2	-2	253789	611370	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	93	0	0	0	0	-2	-2	-2	-2	-2	253634	611903	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	94	3	0	0	0	-2	-2	-2	-2	-2	252893	612484	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	95	3	0	0	0	-2	-2	-2	-2	-2	252643	612926	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	96	3	3	3	3	-2	-2	-2	-2	-2	253168	613072	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	97	3	3	3	3	-2	-2	-2	-2	-2	253388	613754	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	98	3	0	0	3	-2	-2	-2	-2	-2	252968	614065	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	99	3	0	0	0	-2	-2	-2	-2	-2	252610	614415	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	100	3	0	0	0	-2	-2	-2	-2	-2	252798	613478	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	101	3	0	0	0	-2	-2	-2	-2	-2	252386	613883	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	102	3	-2	-2	-2	-2	-2	-2	-2	-2	251959	614176	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	103	3	-2	-2	-2	-2	-2	-2	-2	-2	251585	614507	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	104	0	-2	-2	-2	-2	-2	-2	-2	-2	251077	614351	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	105	3	-2	-2	-2	-2	-2	-2	-2	-2	251347	614000	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	106	3	-2	-2	-2	-2	-2	-2	-2	-2	251851	613588	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	107	3	0	0	0	-2	-2	-2	-2	-2	252244	613300	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	108	3	-2	-2	-2	-2	-2	-2	-2	-2	251449	613073	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	109	3	-2	-2	-2	-2	-2	-2	-2	-2	251263	613489	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	110	3	-2	-2	-2	-2	-2	-2	-2	-2	250397	613633	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	111	3	-2	-2	-2	-2	-2	-2	-2	-2	250273	613254	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	112	3	-2	-2	-2	-2	-2	-2	-2	-2	250538	612984	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	113	3	-2	-2	-2	-2	-2	-2	-2	-2	250479	612556	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	114	3	-2	-2	-2	-2	-2	-2	-2	-2	249835	612776	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	115	3	-2	-2	-2	-2	-2	-2	-2	-2	250026	612289	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	116	3	-2	-2	-2	-2	-2	-2	-2	-2	249420	612247	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	117	3	-2	-2	-2	-2	-2	-2	-2	-2	249055	611721	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	118	3	-2	-2	-2	-2	-2	-2	-2	-2	249780	611759	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	119	3	-2	-2	-2	-2	-2	-2	-2	-2	250299	611807	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	120	3	-2	-2	-2	-2	-2	-2	-2	-2	250487	611237	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	121	3	-2	-2	-2	-2	-2	-2	-2	-2	249943	611313	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	122	3	-2	-2	-2	-2	-2	-2	-2	-2	249330	611290	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	123	0	-2	-2	-2	-2	-2	-2	-2	-2	248691	611201	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	124	3	-2	-2	-2	-2	-2	-2	-2	-2	248330	610679	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	125	0	-2	-2	-2	-2	-2	-2	-2	-2	248918	610760	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	126	3	-2	-2	-2	-2	-2	-2	-2	-2	250004	610815	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	127	3	-2	-2	-2	-2	-2	-2	-2	-2	250660	610775	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	128	0	-2	-2	-2	-2	-2	-2	-2	-2	250416	610295	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	129	3	-2	-2	0	0	-2	-2	-2	-2	249829	610193	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	130	3	-2	-2	-2	-2	-2	-2	-2	-2	249313	610311	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	131	0	-2	-2	-2	-2	-2	-2	-2	-2	248678	610254	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	132	3	-2	-2	-2	-2	-2	-2	-2	-2	248855	609723	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	133	0	-2	-2	-2	-2	-2	-2	-2	-2	249387	609660	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	134	3	-2	-2	0	0	-2	-2	-2	-2	250055	609724	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
North Kyle	82	135	3	-2	-2	0	0	-2	-2	-2	-2	249657	609229	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Overhill	110	136	3	0	-2	-2	-2	-2	-2	-2	-2	251840	613355	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Overhill	110	137	0	-2	-2	-2	-2	-2	-2	-2	-2	251361	612758	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Overhill	110	138	3	-2	-2	-2	-2	-2	-2	-2	-2	251777	612871	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Overhill	110	139	0	-2	-2	-2	-2	-2	-2	-2	-2	251195	612283	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Overhill	110	140	3	-2	-2	-2	-2	-2	-2	-2	-2	251531	612430	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Overhill	110	141	3	0	0	0	-2	-2	-2	-2	-2	252790	612257	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Overhill	110	142	0	-2	-2	0	-2	-2	-2	-2	-2	251061	611770	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Overhill	110	143	3	-2	-2	0	-2	-2	-2	-2	-2	251461	611904	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Overhill	110	144	3	0	0	0	-2	-2	-2	-2	-2	251998	611990	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Overhill	110	145	3	0	0	0	-2	-2	-2	-2	-2	252423	612283	Nordex N133, 4.8MW, Mode 0 with Standard Blades
Pencloe	82.9	146	-2	-2	-2	-2	-2	-2	-2	-2	-2	261284	607224	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	147	-2	-2	-2	-2	-2	-2	-2	-2	-2	261240	606828	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	148	-2	-2	-2	-2	-2	-2	-2	-2	-2	261219	606412	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	149	-2	-2	-2	-2	-2	-2	-2	-2	-2	261572	606326	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	150	-2	-2	-2	-2	-2	-2	-2	-2	-2	261365	605944	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	151	-2	-2	-2	-2	-2	-2	-2	-2	3	260977	605598	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	152	-2	-2	-2	-2	-2	-2	-2	-2	0	261100	605193	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	153	-2	-2	-2	-2	-2	-2	-2	-2	-2	260686	605784	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	154	-2	-2	-2	-2	-2	-2	-2	-2	-2	260515	606055	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	155	-2	-2	-2	-2	-2	-2	-2	-2	-2	260253	606260	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	156	-2	-2	-2	-2	-2	-2	-2	-2	0	260182	606617	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	157	-2	-2	-2	-2	-2	-2	-2	-2	3	260008	606898	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	158	-2	-2	-2	-2	-2	-2	-2	-2	0	260382	607050	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	159	-2	-2	-2	-2	-2	-2	-2	-2	-2	259717	605357	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	160	-2	-2	-2	-2	-2	-2	-2	-2	3	259215	605384	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades

Wind Farm	Hub	ID	Noise Senstive Receptor									X	Y	Turbine Considered
			1	2	3	4	5	6	7	8	9			
Pencloe	82.9	161	-2	-2	-2	-2	-2	-2	-2	-2	3	259090	605686	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	162	-2	-2	-2	-2	-2	-2	-2	-2	3	259134	606033	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	163	-2	-2	-2	-2	-2	-2	-2	-2	3	259463	605922	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Pencloe	82.9	164	-2	-2	-2	-2	-2	-2	-2	-2	3	259740	605785	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades
Polquhairn	67	165	0	-2	-2	-2	-2	-2	-2	-2	-2	247104	613931	Enercon E115 E3, 4 MW, Mode 0
Polquhairn	69	166	-2	-2	-2	-2	-2	-2	-2	-2	-2	247550	614405	Enercon E82 E4, 3 MW, Mode 0
Polquhairn	59	167	-2	-2	-2	-2	-2	-2	-2	-2	-2	247388	614708	Enercon E82 E4, 3 MW, Mode 0
Polquhairn	67	168	0	-2	-2	-2	-2	-2	-2	-2	-2	247865	614659	Enercon E115 E3, 4 MW, Mode 0
Polquhairn	78	169	0	-2	-2	-2	-2	-2	-2	-2	-2	247686	614929	Enercon E82 E4, 3 MW, Mode 0
Polquhairn	67	170	0	-2	-2	-2	-2	-2	-2	-2	-2	247993	615131	Enercon E115 E3, 4 MW, Mode 0
Polquhairn	67	171	0	-2	-2	-2	-2	-2	-2	-2	-2	248195	614852	Enercon E115 E3, 4 MW, Mode 0
Polquhairn	67	172	-2	-2	-2	-2	-2	-2	-2	-2	-2	246882	614165	Enercon E115 E3, 4 MW, Mode 0
Polquhairn	87	173	-2	-2	-2	-2	-2	-2	-2	-2	-2	247230	614274	Enercon E115 E3, 4 MW, Mode 0
Sclenteuch	125	174	-2	-2	-2	-2	-2	0	-2	-2	-2	240561	606791	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Sclenteuch	125	175	-2	-2	-2	-2	-2	-2	-2	-2	-2	240421	607686	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Sclenteuch	125	176	-2	-2	-2	-2	-2	0	-2	-2	-2	240939	607242	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Sclenteuch	125	177	-2	-2	-2	-2	-2	0	-2	-2	-2	241459	606902	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Sclenteuch	105	178	-2	-2	-2	-2	-2	3	-2	-2	-2	240860	608277	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Sclenteuch	105	179	-2	-2	-2	-2	-2	3	-2	-2	-2	241367	607831	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Sclenteuch	105	180	-2	-2	-2	-2	-2	3	-2	-2	-2	242026	607321	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Sclenteuch	125	181	-2	-2	-2	-2	-2	3	-2	-2	-2	242038	606687	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
Sclenteuch	105	182	-2	-2	-2	-2	-2	3	3	-2	-2	242550	606977	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades
South Kyle	83.4	183	-2	-2	0	0	-2	-2	-2	-2	-2	255207	606182	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	184	-2	-2	0	0	0	-2	-2	-2	-2	255239	606789	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	185	-2	0	0	0	0	-2	-2	-2	-2	254791	607332	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	186	0	-2	-2	0	0	-2	-2	-2	-2	255214	607617	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	187	-2	-2	-2	0	0	-2	-2	-2	-2	255532	607199	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	188	-2	-2	-2	0	-2	-2	-2	-2	-2	255687	606616	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	189	-2	-2	-2	0	-2	-2	-2	-2	-2	256008	606236	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	190	-2	-2	-2	0	-2	-2	-2	-2	-2	256161	605790	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	191	-2	-2	-2	0	-2	-2	-2	-2	-2	255893	605390	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	192	-2	-2	-2	0	-2	-2	-2	-2	-2	255511	605098	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	193	-2	-2	-2	0	-2	-2	-2	-2	-2	255646	605884	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	194	-2	-2	-2	0	-2	-2	-2	-2	-2	255349	605547	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	195	-2	-2	-2	-2	-2	-2	-2	-2	-2	255739	604675	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	196	-2	-2	-2	-2	-2	-2	-2	-2	-2	256164	604896	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	197	-2	-2	-2	-2	-2	-2	-2	-2	-2	256526	604616	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	198	-2	-2	-2	-2	-2	-2	-2	-2	-2	256409	605293	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	199	-2	-2	-2	-2	-2	-2	-2	-2	-2	256811	605024	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	200	-2	-2	-2	-2	-2	-2	-2	-2	-2	257244	605408	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	201	-2	-2	-2	-2	-2	-2	-2	-2	3	257300	604934	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	202	-2	-2	-2	0	-2	-2	-2	-2	-2	257008	606293	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	203	-2	0	0	0	-2	-2	-2	-2	-2	254920	605734	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	204	-2	0	0	0	0	-2	-2	-2	-2	254544	605851	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	205	-2	0	0	0	0	-2	-2	-2	-2	254423	606315	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	206	-2	0	0	-2	-2	-2	-2	-2	-2	254045	604896	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	207	-2	0	-2	-2	-2	-2	-2	-2	-2	253473	604627	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	208	-2	0	0	0	0	-2	-2	-2	-2	254561	605382	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	209	-2	0	0	0	-2	-2	-2	-2	-2	254520	604909	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	210	-2	-2	0	0	-2	-2	-2	-2	-2	254975	605176	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	211	-2	-2	0	-2	-2	-2	-2	-2	-2	254849	604564	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	212	-2	-2	-2	-2	-2	-2	-2	-2	0	257142	602840	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	213	-2	-2	-2	-2	-2	-2	-2	-2	0	256793	602511	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	214	-2	-2	-2	-2	-2	-2	-2	-2	0	256416	602203	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	215	-2	-2	-2	-2	-2	-2	-2	-2	0	256279	601691	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	216	-2	-2	-2	-2	-2	-2	-2	-2	0	256782	601607	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	217	-2	-2	-2	-2	-2	-2	-2	-2	0	256977	602058	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	218	-2	-2	-2	-2	-2	-2	-2	-2	0	257322	602397	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	219	-2	-2	-2	-2	-2	-2	-2	-2	0	257473	601946	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	220	-2	-2	-2	-2	-2	-2	-2	-2	0	255461	603673	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	221	-2	-2	-2	-2	-2	-2	-2	-2	0	255835	603378	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	222	-2	-2	-2	-2	-2	-2	-2	-2	0	255104	603355	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	223	-2	-2	-2	-2	-2	-2	-2	-2	0	254661	603559	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	224	-2	-2	-2	-2	-2	-2	-2	-2	0	254732	603047	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	225	-2	-2	-2	-2	-2	-2	-2	0	0	254297	603242	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	226	-2	-2	-2	-2	-2	-2	-2	-2	0	254289	602751	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	227	-2	-2	-2	-2	-2	-2	-2	0	0	253952	603602	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	228	-2	-2	-2	-2	-2	-2	-2	0	0	253341	602958	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	229	-2	-2	-2	-2	-2	-2	-2	-2	0	255114	602705	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	230	-2	-2	-2	-2	-2	-2	-2	-2	0	254696	602479	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	231	-2	-2	-2	-2	-2	-2	-2	-2	0	254600	602019	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle	83.4	232	-2	-2	-2	-2	-2	-2	-2	-2	0	255097	602237	Nordex N133, 4.8MW, Mode 0 with Serrated Blades
South Kyle II	115	233	0	0	0	-2	0	0	-2	-2	-2	251586	606353	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	234	0	0	0	0	0	0	-2	-2	-2	251796	606892	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	235	0	0	0	-2	0	0	-2	-2	-2	252126	606495	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	236	0	-2	-2	-2	0	-2	0	-2	-2	252210	605653	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	237	0	0	0	0	0	0	-2	-2	-2	252292	607281	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	238	0	0	0	0	0	0	-2	-2	-2	252614	606862	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	239	0	0	0	0	0	-2	0	-2	-2	253406	606364	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	240	0	0	0	0	0	-2	0	-2	-2	253283	605872	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	241	0	0	0	0	0	0	0	-2	-2	253962	606846	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	242	-2	0	0	0	0	-2	0	-2	-2	254043	605697	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0
South Kyle II	115	243	0	0	-2	-2	0	-2	0	-2	-2	252533	606114	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0

Wind Farm	Hub	ID	Noise Senstive Receptor									X	Y	Turbine Considered
			1	2	3	4	5	6	7	8	9			
Windy Rig	67.5	244	-2	-2	-2	-2	-2	-2	-2	-2	-2	261351	599687	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	245	-2	-2	-2	-2	-2	-2	-2	-2	-2	261448	600266	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	246	-2	-2	-2	-2	-2	-2	-2	-2	-2	261931	600498	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	247	-2	-2	-2	-2	-2	-2	-2	-2	-2	261853	599888	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	248	-2	-2	-2	-2	-2	-2	-2	-2	-2	261645	600074	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	249	-2	-2	-2	-2	-2	-2	-2	-2	-2	262139	600301	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	250	-2	-2	-2	-2	-2	-2	-2	-2	-2	261537	599444	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	251	-2	-2	-2	-2	-2	-2	-2	-2	-2	261968	599618	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	252	-2	-2	-2	-2	-2	-2	-2	-2	-2	262250	600023	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	253	-2	-2	-2	-2	-2	-2	-2	-2	-2	261730	599221	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	254	-2	-2	-2	-2	-2	-2	-2	-2	-2	262605	599950	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Rig	67.5	255	-2	-2	-2	-2	-2	-2	-2	-2	-2	262305	599579	Nordex N100/3300, 3.3 MW with Standard Blades
Windy Standard I Repowering	119	256	-2	-2	-2	-2	-2	-2	-2	-2	0	260482	603904	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades
Windy Standard I Repowering	119	257	-2	-2	-2	-2	-2	-2	-2	-2	0	260864	603384	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades
Windy Standard I Repowering	119	258	-2	-2	-2	-2	-2	-2	-2	-2	-2	261887	601590	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades
Windy Standard I Repowering	119	259	-2	-2	-2	-2	-2	-2	-2	-2	-2	261460	601435	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades
Windy Standard I Repowering	119	260	-2	-2	-2	-2	-2	-2	-2	-2	3	260282	601985	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades
Windy Standard I Repowering	119	261	-2	-2	-2	-2	-2	-2	-2	-2	-2	261102	601698	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades
Windy Standard I Repowering	119	262	-2	-2	-2	-2	-2	-2	-2	-2	0	261332	602749	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades
Windy Standard I Repowering	119	263	-2	-2	-2	-2	-2	-2	-2	-2	-2	261643	602173	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades
Windy Standard II	68.5	264	-2	-2	-2	-2	-2	-2	-2	-2	-2	259048	600935	Vestas V90, 3 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	265	-2	-2	-2	-2	-2	-2	-2	-2	-2	259385	601229	Vestas V90, 3 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	266	-2	-2	-2	-2	-2	-2	-2	-2	-2	259145	601430	Vestas V90, 3 MW, Mode 0 with Standard Blades
Windy Standard II	59	267	-2	-2	-2	-2	-2	-2	-2	-2	-2	259580	601046	Vestas V90, 3 MW, Mode 0 with Standard Blades
Windy Standard II	59	268	-2	-2	-2	-2	-2	-2	-2	-2	-2	259491	601509	Vestas V90, 3 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	269	-2	-2	-2	-2	-2	-2	-2	-2	-2	259097	601729	Vestas V90, 3 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	270	-2	-2	-2	-2	-2	-2	-2	-2	-2	258844	601863	Vestas V90, 3 MW, Mode 0 with Standard Blades
Windy Standard II	59	271	-2	-2	-2	-2	-2	-2	-2	-2	-2	259707	601355	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	59	272	-2	-2	-2	-2	-2	-2	-2	-2	-2	259908	601172	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	59	273	-2	-2	-2	-2	-2	-2	-2	-2	-2	260044	600909	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	59	274	-2	-2	-2	-2	-2	-2	-2	-2	-2	260222	601199	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	59	275	-2	-2	-2	-2	-2	-2	-2	-2	-2	260410	600992	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	59	276	-2	-2	-2	-2	-2	-2	-2	-2	-2	260315	600727	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	59	277	-2	-2	-2	-2	-2	-2	-2	-2	-2	260536	601288	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	59	278	-2	-2	-2	-2	-2	-2	-2	-2	-2	260107	602568	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	59	279	-2	-2	-2	-2	-2	-2	-2	-2	-2	259871	602400	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	68.5	280	-2	-2	-2	-2	-2	-2	-2	-2	-2	259835	602723	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	68.5	281	-2	-2	-2	-2	-2	-2	-2	-2	-2	259728	602980	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	68.5	282	-2	-2	-2	-2	-2	-2	-2	-2	-2	259745	603319	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	68.5	283	-2	-2	-2	-2	-2	-2	-2	-2	-2	259449	603344	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	68.5	284	-2	-2	-2	-2	-2	-2	-2	-2	0	259646	603699	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	285	-2	-2	-2	-2	-2	-2	-2	-2	3	259286	603669	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	286	-2	-2	-2	-2	-2	-2	-2	-2	0	259235	603956	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	68.5	287	-2	-2	-2	-2	-2	-2	-2	-2	3	258956	603736	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	68.5	288	-2	-2	-2	-2	-2	-2	-2	-2	3	258849	604114	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	289	-2	-2	-2	-2	-2	-2	-2	-2	3	258538	604392	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	290	-2	-2	-2	-2	-2	-2	-2	-2	3	258186	604432	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	291	-2	-2	-2	-2	-2	-2	-2	-2	3	258544	604069	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	78.5	292	-2	-2	-2	-2	-2	-2	-2	-2	3	258214	604107	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard II	59	293	-2	-2	-2	-2	-2	-2	-2	-2	3	257923	604247	Vestas V80, 2 MW, Mode 0 with Standard Blades
Windy Standard III	121	294	-2	-2	-2	-2	-2	-2	-2	-2	0	257914	603241	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	295	-2	-2	-2	-2	-2	-2	-2	-2	0	258242	603181	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	296	-2	-2	-2	-2	-2	-2	-2	-2	0	257506	602943	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	297	-2	-2	-2	-2	-2	-2	-2	-2	0	257969	602832	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	298	-2	-2	-2	-2	-2	-2	-2	-2	0	258361	602734	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	299	-2	-2	-2	-2	-2	-2	-2	-2	0	257582	602518	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	300	-2	-2	-2	-2	-2	-2	-2	-2	0	258836	602706	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	301	-2	-2	-2	-2	-2	-2	-2	-2	0	258855	602384	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	302	-2	-2	-2	-2	-2	-2	-2	-2	0	258005	602391	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	303	-2	-2	-2	-2	-2	-2	-2	-2	0	258478	602316	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	304	-2	-2	-2	-2	-2	-2	-2	-2	0	258122	601993	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	121	305	-2	-2	-2	-2	-2	-2	-2	-2	-2	258299	601578	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	84	306	-2	-2	-2	-2	-2	-2	-2	-2	3	257773	600495	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	84	307	-2	-2	-2	-2	-2	-2	-2	-2	3	257370	600398	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	84	308	-2	-2	-2	-2	-2	-2	-2	-2	3	256887	600219	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	84	309	-2	-2	-2	-2	-2	-2	-2	-2	3	256780	599933	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	84	310	-2	-2	-2	-2	-2	-2	-2	-2	3	257214	599860	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	84	311	-2	-2	-2	-2	-2	-2	-2	-2	3	257538	600175	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	84	312	-2	-2	-2	-2	-2	-2	-2	-2	3	257964	600322	Siemens-SWT-3.2-113 with Standard Blades
Windy Standard III	84	313	-2	-2	-2	-2	-2	-2	-2	-2	-2	258500	600764	Siemens-SWT-3.2-113 with Standard Blades

Likely Effects Calculations

		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Maneight	Predicted Wind Turbine Noise L_{A90} Proposed Development	-	-	-	18.6	23.3	26.3	26.7	26.7	26.7	26.7	26.7	26.7
	Predicted Wind Turbine Noise L_{A90} Other Schemes	-	-	-	27.4	32.4	36.1	36.8	36.8	36.8	36.8	36.8	36.8
	Difference	-	-	-	-8.8	-9.1	-9.8	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1
NAL2 - Knockenlee	Predicted Wind Turbine Noise L_{A90} Proposed Development	-	-	-	20.8	25.6	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Predicted Wind Turbine Noise L_{A90} Other Schemes	-	-	-	25.7	30.7	34.5	35.1	35.2	35.2	35.2	35.2	35.2
	Difference	-	-	-	-4.9	-5.1	-6.0	-6.2	-6.3	-6.3	-6.3	-6.3	-6.3
NAL3 - Nith Lodge	Predicted Wind Turbine Noise L_{A90} Proposed Development	-	-	-	21.6	26.4	29.3	29.7	29.7	29.7	29.7	29.7	29.7
	Predicted Wind Turbine Noise L_{A90} Other Schemes	-	-	-	25.6	30.6	34.4	35.1	35.1	35.1	35.1	35.1	35.1
	Difference	-	-	-	-4.0	-4.2	-5.1	-5.4	-5.4	-5.4	-5.4	-5.4	-5.4
NAL4 - Meiklehill	Predicted Wind Turbine Noise L_{A90} Proposed Development	-	-	-	23.0	27.8	30.8	31.2	31.2	31.2	31.2	31.2	31.2
	Predicted Wind Turbine Noise L_{A90} Other Schemes	-	-	-	26.1	31.1	35.0	35.6	35.7	35.7	35.7	35.7	35.7
	Difference	-	-	-	-3.1	-3.3	-4.2	-4.4	-4.5	-4.5	-4.5	-4.5	-4.5
NAL5 - Clawfin	Predicted Wind Turbine Noise L_{A90} Proposed Development	-	-	-	27.1	31.8	34.8	35.2	35.2	35.2	35.2	35.2	35.2
	Predicted Wind Turbine Noise L_{A90} Other Schemes	-	-	-	22.8	27.8	31.6	32.4	32.4	32.4	32.5	32.5	32.5
	Difference	-	-	-	4.3	4.0	3.2	2.8	2.8	2.8	2.7	2.7	2.7
NAL6 - Pennyvenie	Predicted Wind Turbine Noise L_{A90} Proposed Development	-	-	-	20.7	25.5	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Predicted Wind Turbine Noise L_{A90} Other Schemes	-	-	-	21.1	26.0	29.8	30.6	30.7	30.7	30.7	30.7	30.7
	Difference	-	-	-	-0.4	-0.5	-1.3	-1.7	-1.8	-1.8	-1.8	-1.8	-1.8
NAL7 - Mossdale Farm	Predicted Wind Turbine Noise L_{A90} Proposed Development	-	-	-	17.0	21.7	24.7	25.1	25.1	25.1	25.1	25.1	25.1
	Predicted Wind Turbine Noise L_{A90} Other Schemes	-	-	-	19.9	24.8	28.6	29.5	29.6	29.6	29.6	29.6	29.6
	Difference	-	-	-	-2.9	-3.1	-3.9	-4.4	-4.5	-4.5	-4.5	-4.5	-4.5
NAL8 - Glenmuck	Predicted Wind Turbine Noise L_{A90} Proposed Development	-	-	-	14.1	18.9	21.9	22.3	22.3	22.3	22.3	22.3	22.3
	Predicted Wind Turbine Noise L_{A90} Other Schemes	-	-	-	26.5	31.3	35.1	36.1	36.2	36.2	36.2	36.2	36.2
	Difference	-	-	-	-12.4	-12.4	-13.2	-13.8	-13.9	-13.9	-13.9	-13.9	-13.9
NAL9 - Brownhill	Predicted Wind Turbine Noise L_{A90} Proposed Development	-	-	-	13.1	17.9	20.8	21.2	21.2	21.2	21.2	21.2	21.2
	Predicted Wind Turbine Noise L_{A90} Other Schemes	-	-	-	33.5	38.7	42.8	43.6	43.7	43.7	43.7	43.7	43.7
	Difference	-	-	-	-20.4	-20.8	-22.0	-22.4	-22.5	-22.5	-22.5	-22.5	-22.5

Annex 4 – Summary of Wind Turbine Noise Source Data

Wind Turbine Noise Data assumptions

Table A4.1: Sound Power Level Data

Wind Farm	Wind Turbine	Hub height of source data (Modelled hub heights are presented in Annex 3)	Uncertainty added	Reference Wind Speed (ms^{-1}) Standardised to 10 m Height									
				3	4	5	6	7	8	9	10	11	12
Afton	Gamesa G80, 2.0MW with Standard Blades	70	2	-	97.5	102.3	104.9	105.1	105.1	105.1	105.1	105.1	105.1
Benbrack	Vestas V117, 4.3 MW, Mode PO2-0S with Standard Blades	91.5	2	97.2	101.2	105.3	108.7	110.4	110.5	110.5	110.5	110.5	110.5
Enoch Hill 1 & 2, North Kyle, Greenburn, Pencloe, Knokkippen, Benbrack	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades	82	2	93.4	96.6	101.4	105.2	105.9	105.9	105.9	105.9	105.9	105.9
Polquahairn	Enercon E115 E3, 4 MW, Mode 0	87	2	-	-	100.4	104.5	106.6	107.3	107.9	108.0	108.0	108.0
Polquahairn	Enercon E82 E4, 3 MW, Mode 0	84	2	-	-	99.0	103.0	106.0	107.0	107.0	107.0	107.0	107.0
Sclenteuch	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades	105	2	94.8	98.2	102.5	106.0	106.8	106.9	106.9	106.9	106.9	106.9
South Kyle & Overhill	Nordex N133, 4.8MW, Mode 0 with Standard Blades	83	2	96.5	97.7	103.2	107.4	108.0	108.0	108.0	108.0	108.0	108.0
South Kyle II	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0	Restricted data, available on request. Maximum modelled sound power level is 108 dB.											
South Kyle II	Siemens-Gamesa SG6.6-170, 6.6MW, Mode N2	Restricted data, available on request. Maximum modelled sound power level is 106.5 dB.											
South Kyle II	Siemens-Gamesa SG6.6-170, 6.6MW, Mode N3	Restricted data, available on request. Maximum modelled sound power level is 105 dB.											
Windy Rig	Nordex N100/3300, 3.3 MW with Standard Blades	67.5	2	-	98.4	100.4	104.4	106.2	106.9	107.4	107.5	107.5	107.5
Windy Standard I Repowering	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades	Restricted data, available on request. Maximum modelled sound power level is 106.8 dB.											
Windy Standard II	Vestas V90, 3 MW, Mode 0 with Standard Blades	80	2	-	99.9	102.9	106.2	108.1	109.0	109.0	109.0	109.0	109.0
Windy Standard II	Vestas V80, 2 MW, Mode 0 with Standard Blades	74.5	2	-	95.2	100.6	104.7	106.3	107.0	107.0	107.0	107.0	107.0
Windy Standard III	Siemens-SWT-3.2-113 with Standard Blades	74.5	2	92.4	96.6	101.2	106.0	108.0	108.0	108.0	108.0	108.0	108.0
Windy Standard III	Siemens-SWT-2.3-82 VS with Standard Blades	80	2	90.1	93.5	100.0	104.7	106.5	106.5	106.5	106.5	106.5	106.5

Table A4.2: Octave Band Data

Wind Farm	Wind Turbine	Reference Wind Speed (m/s)	Octave Band (Hz)								
			63	125	250	500	1000	2000	4000	8000	Overall
Afton	Gamesa G80, 2.0MW with Standard Blades	7	85.3	92.5	97.5	100.1	99.5	96.1	90.0	80.2	105.1
Benbrack	Vestas V117, 4.3 MW, Mode PO2-0S with Standard Blades	6	88.6	96.0	100.9	103.3	103.1	100.4	95.2	87.5	108.6
Enoch Hill 1 & 2, North Kyle, Greenburn, Pencloe, Knokkippen, Benbrack	Vestas V136, 4.0 MW, Mode 0 with Serrated Blades	7	86.5	93.4	98.0	100.3	100.2	97.9	93.3	86.4	105.9
Polquahairn	Enercon E115 E3, 4 MW, Mode 0	8	90.8	96.7	99.7	101.8	101.6	99.0	90.6	70.2	107.3
Polquahairn	Enercon E82 E4, 3 MW, Mode 0	8	91.6	98.2	102.5	101.9	97.7	94.0	86.3	81.0	107.0
Sclenteuch	Vestas V150, 6.0 MW, Mode PO6000 with Serrated Blades	8	88.0	95.6	100.3	102.0	100.9	96.8	89.8	79.8	106.9
South Kyle & Overhill	Nordex N133, 4.8MW, Mode 0 with Serrated Blades	7	88.0	95.1	99.9	102.3	102.9	100.4	92.9	80.6	108.0
South Kyle II	Siemens-Gamesa SG6.6-170, 6.6MW, Mode AM0	Restricted data, available upon request.									
South Kyle II	Siemens-Gamesa SG6.6-170, 6.6MW, Mode N2	Restricted data, available upon request.									
South Kyle II	Siemens-Gamesa SG6.6-170, 6.6MW, Mode N3	Restricted data, available upon request.									
Windy Rig	Nordex N100/3300, 3.3 MW with Standard Blades	10	85.6	92.3	94.9	99.0	103.1	102.5	96.7	82.1	107.5
Windy Standard I Repowering	Vestas V162, 6.2 MW, Mode PO6200 with Serrated Blades	Restricted data, available upon request.									
Windy Standard II	Vestas V90, 3 MW, Mode 0 with Standard Blades	8	93.9	96.0	99.3	101.6	103.8	102.5	98.7	88.7	109.0
Windy Standard II	Vestas V80, 2 MW, Mode 0 with Standard Blades	7	86.6	95.9	101.2	101.9	99.3	97.9	93.5	79.2	107.0
Windy Standard III	Siemens-SWT-3.2-113 with Standard Blades	8	93.9	96.5	99.8	100.4	102.0	101.1	97.7	88.8	108.0
Windy Standard III	Siemens-SWT-2.3-82 VS with Standard Blades	8	87.0	95.9	98.2	100.3	100.6	98.0	96.1	90.3	106.5