A specialist energy consultancy

Technical Appendix 10.2

Operational Noise Report

Neshion Energy Park

Neshion Ltd

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Executive Summary

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

The Scottish Government's online Onshore Wind: Policy Statement 2022 (in Section 3.7) states 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*.' The guidance contained within ETSU-R-97 and current good practice guidance has been used to assess the potential operational noise impact of the Proposed Development.

The guidance contained within ETSU-R-97 and current good practice guidance including the Institute of Acoustics (IOA) A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise (IOA GPG) 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) deriving the Total ETSU-R-97 Noise Limits (which are applicable to noise from all wind turbines in the area operating concurrently) at noise sensitive receptors;
2) predicting the likely effects (undertaking a cumulative noise assessment where required) to determine whether noise immission at noise sensitive receptors would meet the Total ETSU-R-97 Noise Limits; and
3) deriving Site Specific Noise Limits for the Proposed Development (taking account of the noise limit that has already been allocated to/could realistically be used by other schemes) and undertaking predictions against those limits.

Background noise monitoring was undertaken at five noise sensitive receptors. The monitoring locations were considered to be representative of the noise sensitive receptors located closest to the Proposed Development.

A total of fifteen noise sensitive receptors were chosen as Noise Assessment Locations (NALs). For the assessment locations where no background noise measurements were undertaken, noise data collected at proxy locations deemed representative of the expected background noise environment was used to assess the wind turbine noise impact at those receptors.

Wind speed data was measured using a LiDAR unit. The wind data measured at 100 m and 120 m height was used to calculate hub height wind speeds (at 114 m). These hub height wind speeds were then standardised to a height of 10 m in accordance with current good practice. Analysis of the measured data has been undertaken in accordance with ETSU-R-97 and current good practice to determine the pre-existing background noise environment and to establish the daytime and night-time noise limits at each of the NALs.

Based on the guidance in ETSU-R-97 and to reflect the presence of existing wind turbines in the area, the daytime Total ETSU-R-97 Noise Limit was set at 40 dBA or background plus 5 dB whichever is the greater. The night-time Total ETSU-R-97 Noise Limit has been set at 43 dBA or background plus 5 dB whichever is the greater. The daytime Site Specific Noise Limits associated with the Proposed Development has been set such that it never exceeds 40 dBA or background plus 5 dB, whichever is the greater. This represents the higher 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 dBA 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 occurs where a property occupier has a financial involvement in the wind farm development where the fixed minimum limit can be increased to 45 dBA 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 property financially involved with 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 Vestas V172 7.2 MW with serrated trailing edges and a hub height of 114 m. This wind turbine model has been chosen as it is considered to be representative of the type of turbine that could be installed at the Site. Whatever the final turbine choice is, the Proposed Development would have to meet the noise limits determined and contained within any condition applied as part of the consent.

Modelling was undertaken using the ISO 9613: 2024 Acoustics – Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors noise prediction model which accords with current good practice and is considered to provide a realistic impact assessment. For the other scheme (the proposed Sullom Voe Oil Terminal Wind Turbines), predictions have been undertaken using sound power level data for the installed turbines or a suitable candidate.

A cumulative assessment was undertaken at the NALs. The likely cumulative assessment shows that the Proposed Development can operate concurrently with the proposed Sullom Voe Oil Terminal Turbines, whilst still meeting the Total ETSU-R-97 Noise Limits at the receptors.

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

Predicted noise levels indicate that at all noise assessment locations wind turbine noise immission were below the Site Specific Noise Limits when considering the Vestas V172 as a candidate turbine.

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

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

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

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1 Introduction

1.1 Brief

1.1.1 TNEI was commissioned by the Applicant to undertake an operational noise assessment for the Proposed Development. The following steps summarise the noise assessment process:

- Measure existing background noise levels and present the noise data in accordance with 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;
- Determine the Total ETSU-R-97 Noise Limits applicable to all wind farms in the area. Noise from the combined operation of all turbines in the area should not exceed the Total ETSU-R-97 Noise Limits;
- Undertake a cumulative noise assessment, where required, to take account of other in-planning, consented or operational schemes near to the Proposed Development;
- Derive Site Specific Noise Limits for the Proposed Development, suitable for inclusion in a noise related planning condition. The Site Specific Noise Limits are set taking account of the proportion of the Total ETSU-R-97 Noise Limit which has been allocated to, and can realistically be used by, other consented or proposed wind farms;
- Undertake predictions of the operational wind turbine noise immission from the Proposed Development that would be incident at neighbouring noise sensitive receptors (NSRs);
- Compare the predictions of operational wind turbine noise from the Proposed Development against the Site Specific Noise Limits; and
- Assess the impact of noise from the Proposed Development in accordance with ETSU-R-97 and the IOA GPG (current good practice).

1.2 Background

1.2.1 The Proposed Development is located on land ('the Site') east of Sullom Voe Oil Terminal (SVT) and the Shetland Gas Plant in Shetland, Scotland. The Proposed Development is shown on **Figure A1.1: Operational Noise Study Area** in **Annex 1** and is described in **Chapter 2: Proposed Development (EIAR Volume 2)**.

1.2.2 In the absence of a confirmed turbine model, this noise assessment models a candidate turbine, the Vestas V172 7.2 MW with serrated trailing edge blades and a hub height of 114 m. This turbine has been selected as it is representative of the turbine type which could be installed at the Site.

1.2.3 It is noted that there are several other wind turbine developments located in Shetland and these were considered at the scoping stage of the Proposed Development. However, they were scoped out from the cumulative assessment as they are more than 10 km from the Proposed Development and would not be considered to materially impact the Proposed Development with regard to cumulative noise.

1.2.4 There is one wind turbine development that was identified for consideration within the assessment which is the proposed development at SVT as shown in **Table 1.1**. There are no other wind turbine developments in the area.

Table 1.1 Cumulative Wind Farm/ Turbine Development

Wind Farm/ Wind Turbine	Number of Turbines	Status	Make and Model of Turbine considered in Modelling
Sullom Voe Oil Terminal	2	In Planning	Nordex N133 4.8 MW standard blade

1.2.5 **Figure A1.1: Operational Noise Study Area** in **Annex 1** shows the location of the above development relative to the Proposed Development.

1.2.6 The Site Specific Noise Limits presented in this report for the Proposed Development have taken into account the noise limits that have already been allocated to, or could potentially be used by, the proposed Sullom Voe Oil Terminal Turbines.

1.2.7 For the purposes of assessing the above scheme 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.

1.2.8 Note that in this report, the term 'noise emission' relates to the sound power level 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 dBA 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 sections consider guidance and policy documents used to inform this report:

- National Planning Policy;
- Local Planning Policy;
- Planning Advice Note PAN 1/2011: Planning and Noise;
- 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).

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 under Section 36 of the Electricity Act 1989 (3). In such cases the Planning Authority is a statutory consultee in the development management process and procedures.

2.2.2 In determining an application for Section 36 consent, the Scottish Ministers must 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) (4) 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 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 outlines 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 published its Onshore Wind Policy Statement on 21 December 2022. The statement outlines Scotland's commitment to the continued development and deployment of onshore wind as a key component of its transition to net zero and tackling the climate emergency. The Scottish Government's online Onshore Wind: Policy Statement 2022 (5) (in Section 3.7) states 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.'

2.2.6 The statement goes on to recognise A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IOA GPG) as a useful tool which supports the use of ETSU-R-97, stating:

'*The Institute of Acoustics (IOA) Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise was published in May 2013 to support the use of ETSU-R-97 when designing potential windfarm schemes, and the monitoring of noise levels from generating sites. The Scottish Government recognises this guide as a useful tool which developers can use in conjunction with ETSU-R-97'.*

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

2.3.1 PAN 1/2011 (6) 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.'

2.3.2 Whilst the web-based planning advice for onshore wind turbines has now been withdrawn, the Technical Advice Note (TAN) on the Assessment of Noise (7) that is associated with PAN 1/2011 notes that ETSU-R-97 is used throughout the UK to assess wind farm noise in planning applications. It goes on to provide relevant parameters for wind farm noise modelling as identified in an IOA Bulletin article in March 2009, although this has been superseded by the introduction of the IOA GPG in May 2013.

2.4 Local Policy

The Shetland Islands Council (SIC) Local Development Plan (LDP)

2.4.1 The Shetland Island Council (SIC) Local Development Plan (LDP) (8), adopted in September 2014, provides the overarching spatial strategy and policy framework for land-use planning across the region. The LDP sets out the vision for sustainable development, identifies key development areas, and establishes general policies that guide decision-making. A suite of supplementary guidance documents accompanies the LDP, including topic-specific guidance on onshore wind energy.

2.4.2 Policy GP11 of the SIC LDP relates to sustainable energy developments. The policy is generally supportive of renewable energy proposals where it can be demonstrated that the

development will not result in unacceptable impacts on environmental amenity. In considering proposals for wind energy development, SIC would have regard to potential effects on residential amenity, including the likely effects of operational noise on noise-sensitive receptors such as residential properties.

2.4.3 Policy GP12 of the SIC LDP relates to amenity and noise. This policy states that development proposals that are likely to generate significant levels of noise would only be permitted where it can be demonstrated that the impact on existing or proposed noise sensitive development is acceptable. Applicants are therefore expected to provide sufficient information, including noise assessments where appropriate, to demonstrate that potential noise impacts can be appropriately managed or mitigated.

2.4.4 Renewable energy proposals are further informed by SIC's Onshore Wind Energy Supplementary Guidance, which sets out criteria for assessing siting, design and environmental impacts, including effects on noise sensitive receptors.

The SIC Onshore Wind Energy Supplementary Guidance

2.4.5 The SIC Onshore Wind Energy Supplementary Guidance (9) provides the detailed framework for how onshore wind energy proposals are to be assessed. The guidance includes a dedicated section on noise and sets out the assessment methods and key principles that should underpin noise evaluations for wind turbine developments. Consistent with national good practice, the guidance states that noise assessments for medium and large scale wind turbine proposals should be undertaken in accordance with ETSU-R-97 and the IOA GPG.

2.4.6 The guidance also notes the importance of protecting residential amenity in the relatively quiet rural environment of Shetland. As such, SIC expects noise limits for wind energy developments to be derived in accordance with ETSU-R-97 and associated guidance, taking into account the existing background noise environment and the character of the receiving area.

2.4.7 With regard to cumulative effects, the supplementary guidance advises that where more than one wind energy development may contribute to noise levels at a noise sensitive location, the cumulative impact should be assessed in accordance with best practice. This includes consideration of noise from operational, consented and proposed wind turbine developments to ensure that combined noise levels remain within acceptable limits at nearby receptors.

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

2.5.1 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).

2.5.2 The WGNWT comprised a number of interested parties including, amongst others, Environmental Health Officers (EHOs), 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.'

2.5.3 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), hereafter referred to as ETSU-R-97.

2.5.4 The basic aim of the WGNWT in arriving at the ETSU-R-97 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.'

2.5.5 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.'

2.5.6 Where noise immission levels at the nearest residential Noise Sensitive Receptors (NSRs) is limited to an $L_{A90,10min}$ of 35 dBA up to wind speeds of 10 ms^{-1} at a height of 10 m, then it does not need to be considered any further through a noise assessment, as protection of the amenity of these receptors 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 dBA 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.'

2.5.7 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 NSRs. 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 speeds that should be considered range 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 m measurement height.

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

2.5.9 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).

2.5.10 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 dBA 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 dBA the criterion curve is set at a fixed level in the range 35 - 40 dBA. The precise choice of criterion curve level within the range 35 - 40 dBA 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.'

Although the limits are set based on the quiet daytime baseline data, the daytime limits apply to the entire daytime period: 07:00 – 23:00.

2.5.11 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 dBA above the best fit curve over the 0 - 12 ms^{-1} wind speed range, with a fixed minimum limit of 43 dB L_{A90}.

2.5.12 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. In this regard, 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 dBA 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.'

2.5.13 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.

2.6 Current Good Practice

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

2.6.1 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.

2.6.2 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.'

2.6.3 The guidance document was endorsed, on behalf of Scottish Government by the Cabinet Secretary for Finance, Employment and Sustainable Growth (10). Accordingly, the recommendations included in the IOA GPG have been considered and applied throughout this noise assessment for the Proposed Development.

2.6.4 The IOA GPG refers to six supplementary guidance notes and where applicable these have also been considered in this report.

2.6.5 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.

2.7 WSP BEIS Report

2.7.1 In February 2023, WSP published A review of noise guidance for onshore wind turbines (11) ('WSP BEIS report'). The report, which was subsequently re-issued as version 5 in September 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.

2.7.2 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.'

2.7.3 A series of recommendations are made within the document 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'

2.7.4 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.'

2.7.5 In June 2024, the UK Government Department for Energy Security and Net Zero (DESNZ) awarded a contract to Noise Consultants Limited to update ETSU-R-97. A draft update of new guidance Assessment and Rating of Wind Turbine Noise (2025) was published for consultation on 4th July 2025, with the closing date being the 29th August 2025. Given the draft status of the guidance and the potential for any final update to differ, the consultation draft has not been considered further in this assessment. There is no confirmed date for the publication of final guidance.

2.7.6 In relation to the guidance that should be used to assess the Proposed Development, 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.'

2.7.7 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 (12).

3.2 Infrasound, Low Frequency Noise (LFN) and Vibration

3.2.1 The term infrasound can be defined as the frequency range below 20 Hz, while low frequency noise (LFN) is typically in the frequency range 20 – 200 Hz (13). An average young healthy adult has an audible range from 20 Hz to 20,000 Hz, although the sensitivity of the ear varies with frequency and is most sensitive to sounds with frequencies between 500 Hz and 4,000 Hz. Wind turbines do produce low frequency sounds (14), but our threshold of hearing at such low frequencies is relatively high and they therefore go unnoticed. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.

3.2.2 In 2004, the former DTI commissioned The Hayes McKenzie Partnership to report on claims that infrasound or LFN emitted by wind turbine generators (WTGs) were causing health effects. Of the 126 wind farms operating in the UK, five had reported LFN problems, therefore, such complaints are an exception, rather than a general problem that exists for all wind farms. Hayes McKenzie investigated the effects of infrasound and LFN at three wind farms for which complaints had been received, and the results were reported in May 2006 (15). The report concluded that:

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

3.2.3 The Applied and Environmental Geophysics Research Group at Keele University was commissioned by the Ministry of Defence (MOD), the DTI and the British Wind Energy Association (BWEA) to undertake microseismic and infrasound monitoring of LFN and vibrations from wind farms for the purposes of siting wind farms in the vicinity of Eskdalemuir in Scotland. Whilst the testing showed that vibration can be detected several kilometres away from wind turbines, the levels of vibration from wind turbines were so small that only the most sophisticated instrumentation can reveal their presence, and they are almost impossible to detect. Nevertheless, the Renewable Energy Foundation alleged potential adverse health effects and when that story was picked up in the popular press, notably the Scotsman, the report's authors expressed concern over the way in which their work had been misinterpreted and issued a rebuttal statement (16) in August 2005:

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

3.2.4 In response to concerns that wind turbines emit infrasound and cause associated health problems, Dr Geoff Leventhall, Consultant in Noise Vibration and Acoustics and author of the Department for Environment, Food & Rural Affairs (Defra) Report called Low Frequency Noise and its Effects, said in the article in the Scotsman ('Wind farm noise rules 'dated'- James Reynolds, 5 August 2005') (17):

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

3.2.5 An article (18) published in the IOA Bulletin (March/April 2009) concluded that there is no robust evidence that either low frequency noise (including 'infrasound') or ground-borne vibration from wind farms, has an adverse effect on wind farm neighbours.

3.2.6 Work (19) by Dr Leventhall looked at infrasound levels within the ear compared to external sources and concluded:

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

3.2.7 More recently, during a planning appeal (PPA-310-2028, Clydeport Hunterston Terminal Facility, 9 Jan 2018), the health impacts related to LFN associated with wind turbines were considered at length by the appointed Reporter. The Reporter considered evidence from Health Protection Scotland and the National Health Service (NHS). In addition, he also considered LFN surveys undertaken by the Appellant and the Local Authority, both of which demonstrated compliance with planning conditions and did not identify any problems

attributable to the turbine operations; some periods with highest levels of low frequency noise were in fact recorded when the turbines were not operating.

3.2.8 The Reporter concluded that:

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

3.2.9 The WSP BEIS Report notes on page 115 that:

'Several studies have investigated the claimed links between adverse health symptoms and infrasound emissions from wind turbines. Although some experimental studies have linked infrasonic signals with activation of physiological sensory processing, these have tended to be based on signals that are not representative of wind turbine infrasound. There remains no compelling evidence of adverse health effects associated with wind turbine infrasound exposure at sound frequencies and levels expected to be present at noise-sensitive receptor locations in the vicinity of wind farms'

3.2.10 The WSP BEIS Report goes on to note on page 116 that:

3.2.11 *'Overall, the findings from the existing evidence base indicate that infrasound from wind turbines at typical exposure levels has no direct adverse effects on physical or mental health, and reported symptoms of ill-health are more likely to be psychogenic in origin.'*

3.2.12 It is noted that research into infrasound is ongoing but the WSP BEIS report concluded that:

3.2.13 *'It is expected that further evidence from ongoing studies into wind turbine infrasound effects will emerge soon, in particular from the NHMRC studies in Australia. However, based on the existing scientific evidence, it does appear probable that the above findings will not be contradicted by newer evidence.'*

3.2.14 Since the publication of the WSP BEIS report, the National Health and Medical Research Council of Australia (NHMRC) study was presented in the Environmental Health Perspectives (EHP) journal, which is published by the United States National Institute of Environmental Health. The study (20) aimed to test the effect of exposure to 72 hours of infrasound (designed to simulate a wind turbine infrasound signature) exposure on human physiology, particularly sleep. The study concluded that:

3.2.15 *'Our findings did not support the idea that infrasound causes WTS*[1]*. High level, but inaudible, infrasound did not appear to perturb any physiological or psychological measure tested in these study participants.'*

[1] WTS stands for Wind Turbine Syndrone which is a term for adverse human health effected related to the proximity of wind turbines.

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

3.3 Amplitude Modulation of Aerodynamic Noise (AM)

3.3.1 In the context of wind turbine noise, amplitude modulation (AM) 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. AM of aerodynamic noise is an inherent characteristic of wind turbine noise and was noted in ETSU-R-97, on page 68:

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

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

3.3.2 In recent times the acoustics community has sought to make a distinction between the AM discussed within ETSU-R-97, which is expected at most wind farms and as such may be considered as 'Normal Amplitude Modulation' (NAM), compared to the unusual AM that has sometimes been heard at a small number of 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 has also been referred to as 'Excess Amplitude Modulation' (EAM). It should be noted that the noise assessment and rating procedure detailed in ETSU-R-97 fully takes into account the presence of the intrinsic level of NAM when setting acceptable noise limits for wind farms.

3.3.3 On 16 December 2013, RenewableUK (RUK) released six technical papers (21) 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 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 IOA.

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

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

condition, and the IOA will review the results later in the year. Until that time, the IOA cautions the use of the proposed planning condition.'

3.3.5 Research regarding AM continued. In April 2015, the IOA issued a discussion document entitled '*Methods for Rating Amplitude Modulation in Wind Turbine Noise*' (22). The document presented three methods that can be used to quantify the level of AM at a given measurement location. After extensive consultation a preferred method of measuring OAM, which provides a framework for practitioners to measure and rate AM, was recommended by the IOA.

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

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

3.3.7 Their report (23), 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 would 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 (EHOs) based on the duration and frequency of occurrence.

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

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

planning condition should be recommended based on the available evidence, and supplemented with professional experience'.

3.3.9 The report 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 bin-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, i.e. the night-time period (this addition would not apply to situations in which other planning conditions dictate the limits to be set as lower for night-time than for daytime);*
- *Professional judgement should be used for planning enforcement of the AM condition in terms of frequency and duration of breaches identified; and*
- *The condition is only designed for upwind, 3-bladed turbines with rotational speeds up to approximately 32 RPM. Further research is needed for turbines with higher rotational speeds or greater numbers of blades.'*

3.3.10 AM was also considered in the WSP BEIS report (11). 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 206 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 should be considered as a starting point.'

3.3.11 Until such a 'further study' is completed and additional guidance is published, the approach set out in the IOA GPG remains valid, which states (paragraph 7.2.1):

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

3.3.12 In February 2025, the Scottish Government published a set of standard consent conditions (24) to be attached to proposals granted consent under Section 36 of the Electricity Act 1989. The operational noise condition which forms Condition 32 does not include AM. Whilst these conditions are intended for use in Scotland only, the majority of UK-based wind farm planning applications in the last 10 years have been in Scotland, and the choice by the Scottish Government to omit an AM related condition is based on the best currently available science and aligns with the text included in the IOA GPG.

3.3.13 The SIC stated in their Scoping Opinion for the Proposed Development that:

3.3.14 *'there is currently no advice from Scottish Government requiring the assessment of noise out with the scope of ETSU-R-97. Therefore specific assessments for low-frequency noise and amplitude modulation can be scoped out.'*

3.3.15 On that basis, AM has not been considered further in this assessment.

4 Methodology

4.1 Assessing Operational Noise Impact

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

- Specify the location of the wind turbines for the Proposed Development;
- Measure the background noise levels as a function of on-site wind speed at a selection of representative Noise Monitoring Locations (NMLs);
- Identify the locations of all nearby NSRs and select a sample of relevant Noise Assessment Locations (NALs). For each NAL, identify the most representative measured background noise data;
- Establish the Total ETSU-R-97 Noise Limits for each NAL on analysis of the measured background noise levels;
- Specify the likely noise emission levels 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, or 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 the Total ETSU-R-97 Noise Limits (which are applicable to noise from all wind turbines in the area operating concurrently) at the NALs;
- 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 these limits.

4.1.3 There are a range of turbine makes and models that may be appropriate for the Proposed Development, therefore, the assessment is based upon an appropriate candidate model only (the Vestas V172 7.2 MW, with a hub height of 114 m and with serrated trailing edge blades). The final selection of turbine would follow a competitive tendering process, so the final turbine model may differ from that upon which this assessment has been based. However, the final choice of turbine would still be required to comply with the noise limits that have been established for the Site.

4.2 Consultation

Consultation with SIC EHO (February 2025)

4.2.1 Prior to the commencement of the noise impact assessment for the Proposed Development, direct consultation was undertaken with the EHO at SIC to agree the approach to the noise assessment and the NMLs. In addition, a representative from the Environmental Health Department was also invited to attend the installation of the noise monitoring equipment.

4.2.2 An EHO from SIC responded to the email agreeing with the proposed noise monitoring locations, and the assessment methods outlined, which included the use of BS 5228, BS 4142:2014+A1:2019, ETSU-R-97 and the IOA GPG.

4.2.3 Other aspects proposed within the consultation letter included the use of upper daytime fixed minimum limits of 40 dBA, and 43 dBA during the night-time, as well as scoping out decommissioning noise. Both fixed minimum limits and scoping out of decommissioning noise was agreed by the EHO, with the suggestion to include a planning condition for decommissioning works.

4.2.4 A copy of the original consultation letter and SIC's response is included in **Annex 2**.

Scoping Opinion (dated June 2025)

4.2.5 Within the Scoping Report, it was proposed that the following elements were scoped in to the assessment:

- Operational wind turbine noise;
- Operational noise from BESS and substation (subject to separation distance); and
- Construction noise,

4.2.6 The following elements were scoped out of the assessment:

- Decommissioning noise;
- Construction vibration;
- LFN; and
- AM.

4.2.7 In the Scoping Opinion, the Energy Consents Unit (ECU) stated the following:

4.2.8 *'The noise assessment should be carried out in line with relevant legislation and standards as detailed in section 9 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".'*

4.2.9 The noise assessment has considered all of the items listed in Table 6.1 of the IOA GPG.

4.2.10 In relation to topics not already covered by the EHO consultation letter that are outlined within the Scoping Opinion, text related to vibration stated:

4.2.11 *'It is likely this will be scoped out, however vibration may need to be considered if blasting is required. If blasting is required, this will need to be considered in the CEMP.'*

4.2.12 No blasting is anticipated to occur as part of the construction process of the Proposed Development.

4.2.13 In relation to other operational noise, SIC stated:

4.2.14 *'I agree that a BS4142 assessment should be undertaken, dependant on separation distances.'*

4.2.15 Further consultation was undertaken regarding assessment of the BESS and substation operational noise, as detailed in the chapter.

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

Background Noise Levels and Wind Shear

4.3.1 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.

4.3.2 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 would inform the turbine control system, influence the turbine operation and ultimately, determine the noise emitted by the wind turbine. 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.

4.3.3 The IOA GPG states that one of three methods to account for wind shear may be adopted (A, B or C). For this assessment, 'Method A' of section 2.6.3 of the IOA GPG was used to fully take account of wind shear. The details are described below in Section 5.

Noise Impact Criteria in ETSU-R-97

4.3.4 Analysis of the measured data has been undertaken in accordance with ETSU-R-97 and the IOA GPG to determine the pre-existing background noise environment and to establish, for each NAL, the daytime and night-time Total ETSU-R-97 Noise Limits, which would apply for the cumulative operation of all wind turbines in the area. The Total ETSU-R-97 Noise Limits for the daytime have been set at 40 dBA or background plus 5 dB, whichever is the greater; and the Total ETSU-R-97 Noise Limits at night-time have been set at 43 dBA or background plus 5 dB, whichever is the greater. This 'Total' limit relates to noise from all wind farm developments in the area. The limit was chosen with due regard to the guidance in ETSU-R-97.

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

4.3.6 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 and under certain wind conditions, wind turbine noise could be audible for a proportion of the time. Acceptable limits for wind turbine operational noise, however, are clearly defined for all time periods by the application of the ETSU-R-97 methodology and consequently, the test applied to operational noise is whether or not the predicted wind turbine noise immission levels lie below the ETSU-R-97 noise limits, rather than whether or not they are 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 each of the NSRs proximate to the Proposed Development and the proposed Sullom Voe Oil Terminal Wind Turbines, to determine whether the wind turbine noise immission from the Proposed Development were within 10 dB of the immission levels 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 cumulative impact, however, if wind turbine immission were more than 10 dB apart, a cumulative noise assessment was not required.

Noise Predictions/Propagation Model

4.4.3 Modelling was undertaken using the methodology presented in ISO 9613:2024 Acoustics – Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors (25).

4.4.4 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.

4.4.5 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.

4.4.6 There is currently no standard approach to specifying error bands for wind turbine noise predictions, however, Table 4 of ISO 9613-2 suggests an estimation of accuracy for downwind conditions of ± 3 dBA for calculations of up to 1000 m for broadband noise levels.

4.4.7 The ISO 9613-2 noise model is intended for the modelling of many noise source types and was not written specifically for the modelling of wind turbine noise, however, a number of studies have been undertaken to determine the standard's accuracy for wind turbine noise predictions and some amendments to the propagation model have been widely adopted for the modelling of wind turbine noise in the UK, primarily through the incorporation of recommendations in the IOA GPG.

4.4.8 In 1998, a European Commission (EC) research project into wind farm noise propagation over large distances, published 'Development of a Wind Farm Noise Prediction Model,' JOULE project JOR3-CT95-0051, which identified a simplified version of ISO 9613-2 as the most suitable prediction method at that time (26).

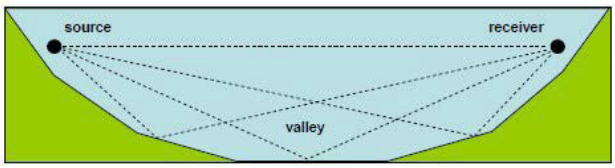
4.4.9 Additional wind farm specific studies have also been undertaken to validate the use of the standard and these are referenced in Section 4 of the IOA GPG, which goes on to conclude that: *'The outcome of this research has demonstrated that the ISO 9613-2 standard in particular, which is widely used 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.'*

4.4.10 It should be noted that the IOA GPG references the 1996 version of the 9613 standard, which was updated in 2024, however, use of either version when adopting the IOA GPG amendments to the noise model, results in negligible differences in predicted noise levels.

4.4.11 TNEI's experience of undertaking compliance monitoring for operational wind farms also indicates that noise predictions undertaken using ISO 96-13-2, whilst following the guidance in the IOA GPG, show a good correlation with measured noise levels, with predicted levels usually slightly higher than measured levels.

4.4.12 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 wind turbine noise on flat terrain (27). With due regard to this study, 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

4.4.13 A formula from the aforementioned JOULE Project is suggested for determining whether the +3 dB correction is required.

$$hm \geq 1.5 \times (abs\ (hs - hr) / 2)$$

4.4.14 Where hm 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 hs and hr are the heights above local ground level of the source and receiver respectively).

4.4.15 The calculation of hm 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.

4.4.16 The IOA GPG also discusses the potential for topographical screening effects of the terrain between a wind farm and nearby NSRs (barrier attenuation), and although screening from barriers in ISO 9613-2 can provide attenuation 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 should be applied.

4.4.17 All of the modelling parameters used in this assessment are detailed in Section 6.3.

4.5 Setting the Site Specific Noise Limits (Stage 3)

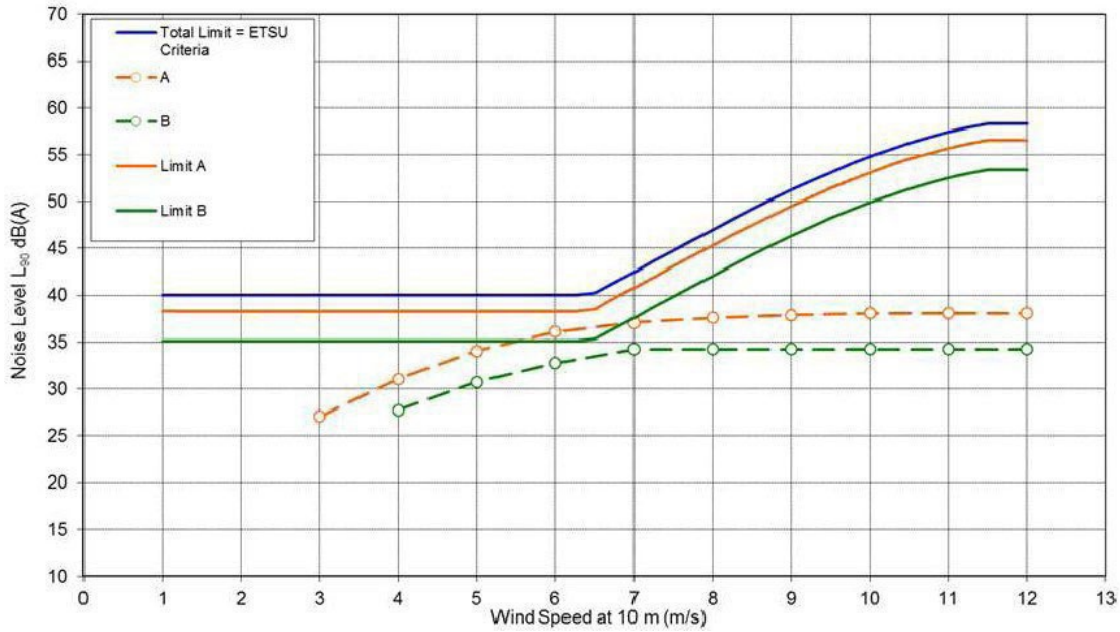
4.5.1 Summary Box 21 of the IOA GPG states:

'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), apportionment of the Total ETSU-R-97 Limit 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 ETSU-R-97 Noise Limit (shown in blue) is shared between wind farm A and wind farm B. The two site specific wind farm noise limits for a given receptor (the solid orange and green lines), when added together, equal the Total ETSU-R-97 Noise Limit, and the predicted levels for each wind farm (the dashed lines), meet the Site Specific Limits 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, and 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.

4.5.7 Detailed information on the approach to apportionment per NAL is provided in Section 6.6 below.

5 Baseline

5.1 Identification of Potential Noise Receptors

5.1.1 The properties identified for noise monitoring were selected following a detailed review of the area using aerial photography to identify receptors that would be suitably representative of other nearby properties. Where possible, locations were selected that were subject to minimal influence from other local noise sources, such as watercourses, operational wind turbines and vegetation.

5.1.2 The IOA GPG notes that *'noise-sensitive receptors*, [are] *principally houses (existing or for which planning consent is being sought / has been given) and any building used for long-term residential purposes (such as a nursing home)'.* Following a review of NSRs surrounding the Proposed Development, all of the closest receptors were found to be residential properties.

5.2 Background Noise Survey

5.2.1 Background noise monitoring was undertaken within the period 26th February 2025 – 30th April 2025 at five NMLs. It should be noted that the second survey period for NML1 ended prematurely (15th April) due to battery charge running out. However, the data collected meets the data set size requirements stipulated within the IOA GPG at all five NMLs.

5.2.2 Details of the exact monitoring periods, the rationale behind the exact kit location, and the dominant noise sources observed at each of the NMLs, are detailed in the Noise Monitoring Records, included in **Annex 3**.

5.2.3 The NMLs along with the location that the sound level meter was sited at each property, are shown on **Figure A1.1: Operational Noise Study Area** (**Annex 1**) and summarised in **Table 5.1** below. All coordinates presented herein are British National Grid (BNG).

Table 5.1 Noise Monitoring Locations

NML - Receptor Name	Easting	Northing
NML1 - Norden	443594	1176969
NML2 - Quoy Lee	443495	1176560
NML3 - No.7 Maidenfield	444840	1175035
NML4 - Laxobiggin	441452	1173220
NML5 - Garth Farmhouse	440606	1174452

5.3 Noise Monitoring Equipment

5.3.1 Section 2.4 of the IOA GPG includes information on the type and specification of noise monitoring equipment that should be used for background noise surveys and states:

'Noise measurement equipment and calibrators used on site should comply with Class 1/Type 1 of the relevant standard(s). Enhanced microphone windscreens should be used. Standard

windshields of a diameter of less than 100 mm cannot be relied upon to provide sufficient reduction of wind noise in most circumstances.'

5.3.2 The noise monitoring equipment used for the background noise survey meets with the requirements of the IOA GPG. Details of the noise monitoring equipment used, the calibration drift recorded and photographs at each NML are detailed in the Noise Monitoring Record included in **Annex 3**. The IOA GPG states that for calibration drift greater than 1 dB, the measurements should be discarded. The maximum calibration drift recorded during the noise survey was +/- 0.6 dB at NML1 during the second survey period as detailed in the Noise Monitoring Record (included in **Annex 3**) therefore no correction has been applied to the noise data. Since this drift is greater than 0.5 dB, it is important to note that this meter has since been deployed and has displayed no anomalous results, nor does the time history exhibit any anomalies, and therefore the recorded data from this meter is still valid.

5.3.3 Copies of the calibration/conformance certificates for the sound level meters and sound level calibrator used for the noise survey are included in **Annex 4**. All sound level meters conform to Class 1/Type 1.

5.3.4 The microphones were all mounted between 1.2 m and 1.5 m above local ground level, situated at least 3.5 m from the dwelling and were located *'in an area frequently used for rest and relaxation'* (Section 2.5.1 of IOA GPG), where appropriate, away from obvious local sources of noise such as boiler flues, fans and running water. The sound level meters were situated as far away from hard reflective surfaces such as fences and walls as practicable.

5.3.5 All measurement systems were set to log the L_{A90} and L_{Aeq} noise levels over the required ten minute intervals continuously over the deployment period.

5.4 Meteorological Data

5.4.1 ETSU-R-97 states on Page 84 that:

'background noise measurements should be correlated with wind speed measurements performed at the proposed site, such that the actual operating noise levels from the turbines may be compared with the noise levels that would otherwise be experienced at a dwelling.'

5.4.2 The preferred methodologies for measuring or calculating wind shear are detailed in Section 4.3.1.

5.4.3 For the Proposed Development, concurrent wind speed/direction was recorded using a LiDAR unit located within the Site. The meteorological data was collected and provided by the Applicant. The installation report and calibration information for the LiDAR can be provided upon request.

5.4.4 Two tipping bucket rain gauges were installed for the duration of the noise survey to record periods of rainfall, time synchronised to the sound measurements. At collection on 30th April, the rain gauge located at NML5 was found to be clogged, however, data from the other rain gauge was complete for the whole period. As per the recommendations in Section 3.1.9 of the IOA GPG, the rain data was analysed by TNEI and the 10 minute periods that contained registered rainfall events from either of the two rain gauges, plus the preceding 10 minute period were excluded as a conservative approach. All excluded rainfall periods are shown on **Figures A1.2: Wind Conditions and Regression Analysis** (**Annex 1**) as blue crosses.

5.4.5 Wind speed and direction data were collected over the same time-scale, and averaged over the same ten minute periods as the noise data, to provide the analysis of the measured background noise as a function of wind speed and direction.

5.4.6 In accordance with the IOA GPG, methodology A was adopted for this assessment, which involved using data collected at heights of 100 m to 120 m by the LiDAR to calculate hub height wind speed (114 m), which was then standardised to a height of 10 m above the ground.

5.5 Influence of Existing Turbines on Background Measurements

5.5.1 ETSU-R-97 states that background noise levels should be determined such that they are not influenced by existing turbine noise. ETSU-R-97 states that background noise levels should be determined such that they are not influenced by existing turbine noise. The IOA GPG details that, in situations where measurement locations are potentially influenced by existing turbine noise, the following approaches can be adopted:

1. The existing wind turbines can be switched off (assuming the Applicant has control of those turbines and noting that there would be associated cost implications);
2. The contribution of the wind turbines can be accounted for by filtering the measured data by direction (only including background data when a receptor is upwind of the wind turbines) or by subtracting predicted turbine noise from the measured levels;
3. Limits can be set using 'proxy' datasets measured at location(s) outside of the influence of the wind turbines; or
4. Limits can be set using data collected as part of previous background noise assessments undertaken before the wind turbines were operational, providing the equipment and both noise and meteorological data obtained are appropriate.

5.5.2 No operational wind farms were in the vicinity of the NMLs, and so there was no need to account for any influence of existing turbines on background measurements.

5.6 Analysis of Measured Data

5.6.1 Analysis of the measured data has been undertaken in accordance with the recommendations in ETSU-R-97 and the IOA GPG.

5.6.2 The proximity to the sea for NMLs 1-3 instigated analysis of the influence of sea noise on the measured data. The NSRs represented by these NMLs would be downwind of the sea in the opposite direction to the Proposed Development. As such, any influence of sea noise on the background noise level would be expected to be less when the NSRs are downwind of the Proposed Development which is when the noise levels from the Proposed Development would be expected to be at their maximum. The IOA GPG recommends that the influence of any noise sources from the opposite direction to the Proposed Development should be removed in these circumstances so that the background noise levels represent the wind directions when the receptor would be downwind of the wind turbines.

5.6.3 In accordance with the IOA GPG, filtering at these NMLs was undertaken to check whether sea noise had influenced the measured data. It was determined that noise from easterly directions was louder than noise from the westerly directions, such that sea noise was having an impact at NML1, and hence filtering was incorporated for this location. However, at NMLs

2-3, filtering for sea noise did not vary the background noise levels materially, and even raised the background noise levels at various wind speeds, so it was deemed not necessary to include.

5.6.4 At NML4, watercourses were within 150 m of the noise monitoring kit, but was not audible during installation, maintenance and collection despite wet conditions. The measured sound level at this location was considered to be representative of the acoustic environment and at the neighbouring properties.

5.6.5 At NML5, the soundscape is highly influenced by noise from the SVT. However, the SVT is deemed an established part of the local soundscape and the data influenced is considered appropriate to include. Furthermore, the NSRs represented by this NML would be downwind of SVT in the same wind directions as the Proposed Development, when the worst case noise levels due to the Proposed Development are predicted to be experienced. Also, is not known how the future baseline is likely to alter. It is anticipated that development will evolve at SVT, whether that would result in lower or higher noise levels is impossible to determine, as no plans are known at this time. The data collected at NML5 has not been utilised to represent any NSR other than the location it was recorded at. Similarly at NML4, recorded background noise levels influenced by SVT have been left in.

5.6.6 Noise from SVT was less influential at the other NMLs despite similar distances away as NML4, likely due to there being no line of sight, and proximity to the sea.

5.6.7 Time series graphs are provided in **Annex 5**, which show the variation in measured wind speed, wind direction and noise level over the monitoring period.

5.7 Prevailing Background Noise Level

5.7.1 **Table 5.2** and **Table 5.3** summarise the prevailing background noise levels measured during the noise monitoring period, after filtering of the individual datasets as discussed above.

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

NML	Prevailing Background Noise Level $L_{A90,10\ min}$											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1 - Norden	23.2	23.8	24.7	25.9	27.3	29.0	30.9	32.9	35.1	37.3	39.6	41.8
NML2 - Quoy Lee	29.5	29.7	30.3	31.3	32.5	34.0	35.8	37.7	39.9	42.1	44.4	46.8
NML3 - No.7 Maidenfield	20.6	22.3	24.2	26.2	28.3	30.5	32.8	35.1	37.4	39.8	42.2	44.6
NML4 - Laxobiggin	34.9 *	34.9 *	34.9	35.0	35.5	36.5	37.8	39.3	41.2	43.2	45.4	47.6

NML	Prevailing Background Noise Level $L_{A90,10\ min}$											
	1	2	3	4	5	6	7	8	9	10	11	12
NML5 - Garth Farmhouse	45.1	45.2	45.5	46.0	46.6	47.3	48.1	49.1	50.1	51.2	52.4	53.7

**flatlined where derived minimum occurs at higher wind speeds, see Section 5.7.4.*

Table 5.3 Summary of Prevailing Background Noise Levels during Night-time Periods (dBA)

NML	Prevailing Background Noise Level $L_{A90,10\ min}$											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1 - Norden	23.2	23.9	24.9	26.0	27.3	28.8	30.3	32.1	33.9	35.8	37.8	39.8
NML2 - Quoy Lee	28.8 *	28.8	28.8	29.3	30.4	31.8	33.6	35.7	38.0	40.4	43.0	45.5
NML3 - No.7 Maidenfield	17.8	20.2	22.5	24.8	27.0	29.3	31.5	33.7	35.9	38.2	40.4	42.7
NML4 - Laxobiggin	33.9 *	33.9 *	33.9	34.3	35.1	36.1	37.5	39.1	40.8	42.7	44.8	46.8
NML5 - Garth Farmhouse	32.9	37.4	41.1	44.0	46.3	48.0	49.3	50.2	50.9	51.4	51.8	52.4

**flatlined where derived minimum occurs at higher wind speeds, see Section 5.7.4.*

5.7.2 A series of graphs are presented for each of the NMLs as **Figures A1.2: Wind Conditions and Regression Analysis** (**Annex 1**). For each of the NMLs, a graph shows the range of wind speeds and directions recorded during the survey, and a second graph shows the 10 minute average wind speeds plotted against the recorded $L_{A90,\ 10min}$ noise levels, along with a calculated 'best fit' polynomial regression line for the quiet daytime and night-time periods. Each figure also includes a table with the number of recorded data points per integer wind speed bin, and the prevailing background noise levels.

5.7.3 The prevailing background noise levels have been calculated using a best fit polynomial regression line of no more than a fourth order through the measured $L_{A90,\ 10min}$ noise data, as required by ETSU-R-97 and the IOA GPG.

5.7.4 In line with the recommendations included in Section 3.1.21 of the IOA GPG, where relevant, the polynomial background curve for low wind speed conditions has been flatlined at the

lower wind speeds where the derived minimum value occurs. This is presented on the Figures A1.2a-e as follows:

- the final regression analysis curve, inclusive of any flat-lining correction, is shown as a continuous black line; and
- the original polynomial line of best fit is shown as a dashed black line.

5.7.5 Section 2.9.5 of the IOA GPG recommends that no fewer than 200 valid data points should be recorded in each of the quiet daytime and night-time periods, with no fewer than 5 valid data points in any 1 ms^{-1} wind speed bin. Where the background noise data has been filtered by wind direction the IOA GPG (Section 2.9.6) recommends that 100 data points and 3 per wind speed bin may be appropriate. These criteria were fulfilled at all NMLs.

5.7.6 A summary of the analysis applied to the individual datasets is included in **Table 5.4** below.

Table 5.4 Analysis of Measured Datasets

NML	Quiet Daytime	Night-Time
NML1 - Norden	No adjustments required	No adjustments required
NML2 - Quoy Lee	No adjustments required	Flatlined below 2 ms^{-1} (minimum level recorded)
NML3 - No.7 Maidenfield	No adjustments required	No adjustments required
NML4 - Laxobiggin	Flatlined below 3 ms^{-1} (minimum level recorded)	Flatlined below 3 ms^{-1} (minimum level recorded)
NML5 - Garth Farmhouse	No adjustments required	No adjustments required

6 Noise Assessment Results

6.1 Noise Assessment Locations

6.1.1 NALs refer to the position on the curtilage denoted by the blue house symbol on **Figure A1.1: Operational Noise Study Area** (**Annex 1**). A total of fifteen noise sensitive receptors were chosen as representative NALs. The operational wind farm NALs were defined at an early stage of the project before the wind turbine layout and Site was fixed. The NALs were selected considering initial noise level predictions based on early feasibility studies, the scoping layout, and the potential for that layout to evolve i.e. considering the potential for wind turbines to be located elsewhere within the Site. As such, there are now more NALs than are strictly required for the assessment, however, the NALs have remained the same throughout the evolution of the layout design to maintain consistency throughout the project timeline, and are useful to demonstrate the operational noise impacts for all dwellings in the local area i.e. not just those that are the closest. Predictions of wind turbine noise have been made at each of the NALs as detailed in **Table 6.1**.

6.1.2 This approach ensures that the assessment considers the worst case (highest) noise immission level expected at each group of NSRs, as, generally speaking, sound levels decrease with distance (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)	Distance to Nearest Neshion Turbine* (m)	NML Used
NAL1 - The Brough	443628	1177378	26	1399 (T7)	1
NAL2 - Norden	443591	1176955	40	1238 (T7)	1
NAL3 - Whitehouse	443365	1176504	30	1035 (T7)	2
NAL4 - Lighthouse Cottage	443454	1176169	8	1245 (T7)	2
NAL5 - Fort	444868	1175640	16	2747 (T7)	3
NAL6 - Bankhead Straits	444901	1175470	25	2851 (T7)	3
NAL7 - Hillgrind	444936	1175309	33	2958 (T7)	3
NAL8 - 15 Maidenfield	444835	1175155	52	2952 (T7)	3
NAL9 - Linga	444876	1174856	57	3159 (T7)	3
NAL10 - 10 Leaside	444431	1174228	30	3278 (T7)	3

Noise Assessment Location (NAL)	Easting (m)	Northing (m)	Elevation (m AOD)	Distance to Nearest Neshion Turbine* (m)	NML Used
NAL11 – The Old School	443946	1173993	44	3198 (T7)	3
NAL12 - Moorfield	442489	1172689	69	3875 (T8)	3
NAL13 - Laxobiggin	441471	1173229	12	3299 (T8)	4
NAL14 - Millburn	441177	1173712	7	2872 (T8)	4
NAL15 - Garth Farmhouse**	440630	1174434	18	2310 (T1)	5

** Please note the approximate 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), not the dwelling.*

*** The occupiers are financially involved with the Proposed Development.*

6.2 Noise Emission Characteristics of the Wind Turbines

6.2.1 There are a range of wind turbine models that may be suitable for installation at the Proposed Development. This assessment considers the Vestas V172 7.2 MW with serrated trailing edge blades and a hub height of 114 m.

6.2.2 A detailed list of all of the wind turbine developments considered in the noise predictions are included in **Annex 6**. Details of the sound power level, octave data and measurement uncertainty used for the turbines considered in this assessment are included in **Annex 7**.

6.2.3 The data for the Proposed Development candidate turbine has not been included due to data confidentiality, however, the detailed noise data could be made available upon request, subject to the signing of the appropriate Non-Disclosure Agreement.

6.2.4 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.

6.2.5 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 the other turbine development is summarised in **Annex 6**.

6.2.6 The location of the Proposed Development and cumulative wind turbines are shown on **Figure A1.1: Operational Noise Study Area** in **Annex 1** and grid references are included in **Annex 6**.

6.3 Noise Propagation Parameters

6.3.1 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-efficient based on a temperature

of 10°C and 70% relative humidity. The modelling parameters reflect current good practice as detailed within the IOA GPG.

6.3.2 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 dBA from the calculated $L_{Aeq,10\ minute}$ levels.

6.3.3 A topographical assessment has been undertaken between each NAL and wind turbine location to determine whether any concave ground profiles exist between the source and receiver. Analysis undertaken using a combination of CadnaA (28) 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. These corrections are detailed in **Annex 6**.

6.3.4 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 NAL it was found that a barrier correction of -2 dB could be applied for some turbine/receptor combinations. This is also detailed in **Annex 6**.

6.3.5 In reality, there is significant screening at some of the locations, so more attenuation may occur in practice, and the use of a 2 dB value is considered to be conservative.

6.3.6 The need to include the above concave ground or screening corrections may change, depending on the final location of the turbines (following micrositing) and the final turbine hub height. Nevertheless, turbine noise levels would have to meet the noise limits detailed in planning conditions regardless of any difference in noise propagation caused by topography and the need to apply a concave slope correction would need to be considered again by the Applicant, prior to the final selection of a turbine model for the Proposed Development.

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

6.3.8 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'. This increased level of attenuation is frequency dependent, with the lowest frequencies experiencing the least amount of attenuation. Relating this to the earlier NASA studies, Hubbard noted that the distance from the source to the edge of the shadow zone is related to the wind speed gradient and the elevation of the source, which for a typical turbine source was calculated to be approximately 5 times the source height.

6.3.9 This observation was adopted in the IOA GPG, which states (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*'. Section 4.4.3 of the IOA GPG provides graphical examples of increasing broadband directivity with increasing tip height scaling, for both flat and hilly terrain, without qualifying either of those designations.

6.3.10 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 detailed in **Table 6.2**. These are based upon the examples given in the IOA GPG (Section 4.4.2), using interpolation where required, to adopt 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, dBA	-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, dBA	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 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 dBA (daytime) or 43 dBA (Night-time) or background plus 5 dBA.

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 - The Brough	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.3	44.6	46.8
NAL2 - Norden	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.3	44.6	46.8
NAL3 - Whitehouse	40.0	40.0	40.0	40.0	40.0	40.0	40.8	42.7	44.9	47.1	49.4	51.8
NAL4 - Lighthouse Cottage	40.0	40.0	40.0	40.0	40.0	40.0	40.8	42.7	44.9	47.1	49.4	51.8
NAL5 - Fort	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
NAL6 - Bankhead Straits	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
NAL7 - Hillgrind	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6

Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL8 - 15 Maidenfield	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
NAL9 - Linga	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
NAL10 - 10 Leaside	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
NAL11 – The Old School	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
NAL12 - Moorfield	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
NAL13 - Laxobiggin	40.0	40.0	40.0	40.0	40.5	41.5	42.8	44.3	46.2	48.2	50.4	52.6
NAL14 - Millburn	40.0	40.0	40.0	40.0	40.5	41.5	42.8	44.3	46.2	48.2	50.4	52.6
NAL15 - Garth Farmhouse*	50.1	50.2	50.5	51.0	51.6	52.3	53.1	54.1	55.1	56.2	57.4	58.7

**Financially Involved with the Proposed Development*

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 - The Brough	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.8
NAL2 - Norden	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.8
NAL3 - Whitehouse	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.0	50.5
NAL4 - Lighthouse Cottage	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.0	50.5
NAL5 - Fort	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
NAL6 - Bankhead Straits	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
NAL7 - Hillgrind	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
NAL8 - 15 Maidenfield	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
NAL9 - Linga	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
NAL10 - 10 Leaside	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
NAL11 – The Old School	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
NAL12 - Moorfield	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7

Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL13 - Laxobiggin	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.8	47.7	49.8	51.8
NAL14 - Millburn	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.8	47.7	49.8	51.8
NAL15 - Garth Farmhouse*	45.0	45.0	46.1	49.0	51.3	53.0	54.3	55.2	55.9	56.4	56.8	57.4

**Financially Involved with the Proposed Development*

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 noise immission levels from the Proposed Development alongside all other schemes to determine whether predictions are within 10 dB of each other. All turbines have been assumed to be operating in unconstrained operating modes. **Table 6.5** summarises the results and details 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 - The Brough	NO	NO
NAL2 - Norden	NO	NO
NAL3 - Whitehouse	NO	NO
NAL4 - Lighthouse Cottage	NO	NO
NAL5 - Fort	NO	NO
NAL6 - Bankhead Straits	NO	NO
NAL7 - Hillgrind	NO	NO
NAL8 - 15 Maidenfield	NO	NO
NAL9 - Linga	NO	NO
NAL10 - 10 Leaside	NO	NO
NAL11 – The Old School	NO	NO
NAL12 - Moorfield	YES	YES
NAL13 - Laxobiggin	YES	YES
NAL14 - Millburn	YES	YES
NAL15 - Garth Farmhouse	YES	YES

6.5.2 A cumulative noise assessment is required at NAL12-NAL15, though all other NALs have been included within the assessment for completeness. A summary of the noise prediction comparisons are included in **Annex 6**.

6.5.3 The results of the cumulative noise assessment are summarised in **Table 6.6** and **Table 6.7**, which show that the predicted cumulative wind turbine noise immission levels meet the Total ETSU-R-97 Noise Limits under all conditions at all NALs.

6.5.4 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 data as per Section 4.2 of the IOA GPG. The uncertainty level added is generally +2 dB but this can vary depending on the turbine manufacturer data available for each turbine.

6.5.5 **Figures A1.3: Noise Assessment** (**Annex 1**) show predictions from the Proposed Development and 'cumulative (including Proposed Development)' against the Total ETSU-R-97 Noise Limits. The individual contribution 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 - The Brough	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.3	44.6	46.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	27.8	31.6	35.2	36.4	36.4	36.4	36.4	36.4	36.4
	Exceedance Level	-	-	-	-12.2	-8.4	-4.8	-3.6	-3.6	-3.7	-5.9	-8.2	-10.4
NAL2 - Norden	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.3	44.6	46.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	28.2	32.0	35.5	36.8	36.8	36.8	36.8	36.8	36.8
	Exceedance Level	-	-	-	-11.8	-8.0	-4.5	-3.2	-3.2	-3.3	-5.5	-7.8	-10.0
NAL3 - Whitehouse	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.8	42.7	44.9	47.1	49.4	51.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	29.6	33.4	37.0	38.2	38.2	38.2	38.2	38.2	38.2
	Exceedance Level	-	-	-	-10.4	-6.6	-3.0	-2.6	-4.5	-6.7	-8.9	-11.2	-13.6
NAL4 - Lighthouse Cottage	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.8	42.7	44.9	47.1	49.4	51.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	28.0	31.9	35.4	36.6	36.6	36.6	36.6	36.6	36.6
	Exceedance Level	-	-	-	-12.0	-8.1	-4.6	-4.2	-6.1	-8.3	-10.5	-12.8	-15.2
NAL5 - Fort	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.8	24.6	28.2	29.4	29.4	29.4	29.4	29.4	29.4
	Exceedance Level	-	-	-	-19.2	-15.4	-11.8	-10.6	-10.7	-13.0	-15.4	-17.8	-20.2
NAL6 - Bankhead Straits	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.4	24.2	27.8	29.0	29.0	29.0	29.0	29.0	29.0
	Exceedance Level	-	-	-	-19.6	-15.8	-12.2	-11.0	-11.1	-13.4	-15.8	-18.2	-20.6

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 - Hillgrind	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	19.3	23.2	26.8	28.0	28.0	28.0	28.0	28.0	28.0
	Exceedance Level	-	-	-	-20.7	-16.8	-13.2	-12.0	-12.1	-14.4	-16.8	-19.2	-21.6
NAL8 - 15 Maidenfield	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	22.1	25.9	29.5	30.7	30.7	30.7	30.7	30.7	30.7
	Exceedance Level	-	-	-	-17.9	-14.1	-10.5	-9.3	-9.4	-11.7	-14.1	-16.5	-18.9
NAL9 - Linga	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.8	24.6	28.2	29.4	29.4	29.4	29.4	29.4	29.4
	Exceedance Level	-	-	-	-19.2	-15.4	-11.8	-10.6	-10.7	-13.0	-15.4	-17.8	-20.2
NAL10 - 10 Leaside	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.3	21.2	24.8	26.0	26.0	26.0	26.0	26.0	26.0
	Exceedance Level	-	-	-	-22.7	-18.8	-15.2	-14.0	-14.1	-16.4	-18.8	-21.2	-23.6
NAL11 – The Old School	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.7	21.6	25.2	26.4	26.4	26.4	26.4	26.4	26.4
	Exceedance Level	-	-	-	-22.3	-18.4	-14.8	-13.6	-13.7	-16.0	-18.4	-20.8	-23.2
NAL12 - Moorfield	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	18.4	22.5	26.2	27.3	27.3	27.3	27.3	27.3	27.3
	Exceedance Level	-	-	-	-21.6	-17.5	-13.8	-12.7	-12.8	-15.1	-17.5	-19.9	-22.3

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13 - Laxobiggin	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.5	41.5	42.8	44.3	46.2	48.2	50.4	52.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.3	24.4	28.1	29.2	29.2	29.2	29.2	29.2	29.2
	Exceedance Level	-	-	-	-19.7	-16.1	-13.4	-13.6	-15.1	-17.0	-19.0	-21.2	-23.4
NAL14 - Millburn	Total Noise Limit: ETSU-R-97 L_{A90}	40.0	40.0	40.0	40.0	40.5	41.5	42.8	44.3	46.2	48.2	50.4	52.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	21.8	26.0	29.7	30.8	30.8	30.8	30.8	30.8	30.8
	Exceedance Level	-	-	-	-18.2	-14.5	-11.8	-12.0	-13.5	-15.4	-17.4	-19.6	-21.8
NAL15 - Garth Farmhouse	Total Noise Limit: ETSU-R-97 L_{A90}	50.1	50.2	50.5	51.0	51.6	52.3	53.1	54.1	55.1	56.2	57.4	58.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	23.5	27.7	31.5	32.5	32.5	32.5	32.5	32.5	32.5
	Exceedance Level	-	-	-	-27.5	-23.9	-20.8	-20.6	-21.6	-22.6	-23.7	-24.9	-26.2

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 - The Brough	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	44.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	27.8	31.6	35.2	36.4	36.4	36.4	36.4	36.4	36.4
	Exceedance Level	-	-	-	-15.2	-11.4	-7.8	-6.6	-6.6	-6.6	-6.6	-6.6	-8.4
NAL2 - Norden	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	44.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	28.2	32.0	35.5	36.8	36.8	36.8	36.8	36.8	36.8
	Exceedance Level	-	-	-	-14.8	-11.0	-7.5	-6.2	-6.2	-6.2	-6.2	-6.2	-8.0
NAL3 - Whitehouse	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	45.4	48.0	50.5
	Predicted Wind Turbine Noise L_{A90}	-	-	-	29.6	33.4	37.0	38.2	38.2	38.2	38.2	38.2	38.2
	Exceedance Level	-	-	-	-13.4	-9.6	-6.0	-4.8	-4.8	-4.8	-7.2	-9.8	-12.3
NAL4 - Lighthouse Cottage	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	45.4	48.0	50.5
	Predicted Wind Turbine Noise L_{A90}	-	-	-	28.0	31.9	35.4	36.6	36.6	36.6	36.6	36.6	36.6
	Exceedance Level	-	-	-	-15.0	-11.1	-7.6	-6.4	-6.4	-6.4	-8.8	-11.4	-13.9
NAL5 - Fort	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	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.8	24.6	28.2	29.4	29.4	29.4	29.4	29.4	29.4
	Exceedance Level	-	-	-	-22.2	-18.4	-14.8	-13.6	-13.6	-13.6	-13.8	-16.0	-18.3
NAL6 - Bankhead Straits	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	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.4	24.2	27.8	29.0	29.0	29.0	29.0	29.0	29.0
	Exceedance Level	-	-	-	-22.6	-18.8	-15.2	-14.0	-14.0	-14.0	-14.2	-16.4	-18.7

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 - Hillgrind	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	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	19.3	23.2	26.8	28.0	28.0	28.0	28.0	28.0	28.0
	Exceedance Level	-	-	-	-23.7	-19.8	-16.2	-15.0	-15.0	-15.0	-15.2	-17.4	-19.7
NAL8 - 15 Maidenfield	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	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	22.1	25.9	29.5	30.7	30.7	30.7	30.7	30.7	30.7
	Exceedance Level	-	-	-	-20.9	-17.1	-13.5	-12.3	-12.3	-12.3	-12.5	-14.7	-17.0
NAL9 - Linga	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	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.8	24.6	28.2	29.4	29.4	29.4	29.4	29.4	29.4
	Exceedance Level	-	-	-	-22.2	-18.4	-14.8	-13.6	-13.6	-13.6	-13.8	-16.0	-18.3
NAL10 - 10 Leaside	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	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.3	21.2	24.8	26.0	26.0	26.0	26.0	26.0	26.0
	Exceedance Level	-	-	-	-25.7	-21.8	-18.2	-17.0	-17.0	-17.0	-17.2	-19.4	-21.7
NAL11 – The Old School	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	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.7	21.6	25.2	26.4	26.4	26.4	26.4	26.4	26.4
	Exceedance Level	-	-	-	-25.3	-21.4	-17.8	-16.6	-16.6	-16.6	-16.8	-19.0	-21.3
NAL12 - Moorfield	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	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	18.4	22.5	26.2	27.3	27.3	27.3	27.3	27.3	27.3
	Exceedance Level	-	-	-	-24.6	-20.5	-16.8	-15.7	-15.7	-15.7	-15.9	-18.1	-20.4

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13 - Laxobiggin	Total Noise Limit: ETSU-R-97 L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.8	47.7	49.8	51.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.3	24.4	28.1	29.2	29.2	29.2	29.2	29.2	29.2
	Exceedance Level	-	-	-	-22.7	-18.6	-14.9	-13.8	-14.9	-16.6	-18.5	-20.6	-22.6
NAL14 - Millburn	Total Noise Limit: ETSU-R-97 L_{A90}	43	43	43	43	43	43	43	44.1	45.8	47.7	49.8	51.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	21.8	26	29.7	30.8	30.8	30.8	30.8	30.8	30.8
	Exceedance Level	-	-	-	-21.2	-17	-13.3	-12.2	-13.3	-15	-16.9	-19	-21
NAL15 - Garth Farmhouse	Total Noise Limit: ETSU-R-97 L_{A90}	45	45	46.1	49	51.3	53	54.3	55.2	55.9	56.4	56.8	57.4
	Predicted Wind Turbine Noise L_{A90}	-	-	-	23.5	27.7	31.5	32.5	32.5	32.5	32.5	32.5	32.5
	Exceedance Level	-	-	-	-25.5	-23.6	-21.5	-21.8	-22.7	-23.4	-23.9	-24.3	-24.9

6.6 Derivation of Site Specific Noise Limits (Stage 3)

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

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

6.6.2 As detailed in Section 4.3.5 above, the daytime Site Specific Noise Limits (SSNLs) have been derived based on the upper Fixed Minimum Noise Limits as detailed within ETSU-R-97. This assumes that all in planning turbines are built.

6.6.3 The apportionment options provided in the IOA GPG were considered to determine the most appropriate option for each NAL. **Table 6.8** summarises the approach adopted at each NAL to derive the Site Specific Noise Limits.

Table 6.8 Limit Derivation Strategy

NAL	Limit Derivation Strategy
NALs 1 – 15	The likely predicted levels from the other scheme was found to be greater than 10 dB below the Total ETSU-R-97 Noise Limits at all windspeeds. As such, the whole available Site Specific Noise Limit (the greater of the fixed minimum limit or background plus 5 dB) has been allocated to the Proposed Development.

6.6.4 **Table 6.9** and **Table 6.10** show the daytime and night-time Site Specific Noise Limits, noise predictions for the Proposed Development and the exceedance level. A negative exceedance demonstrates compliance with the Site Specific Noise Limits.

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

6.6.6 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 A1.4: Site Specific Noise Predictions** (**Annex 1**). Two graphs are provided for each NAL (daytime and night-time), which show the Total ETSU-R-97 Noise Limit (solid red line), the prevailing background noise level (black line), the Site Specific Noise Limit (dashed red line with triangles) and the predicted wind turbine noise from the Proposed Development (solid blue line).

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 - The Brough	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.3	44.6	46.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	27.8	31.6	35.2	36.4	36.4	36.4	36.4	36.4	36.4
	Exceedance Level	-	-	-	-12.2	-8.4	-4.8	-3.6	-3.6	-3.7	-5.9	-8.2	-10.4
NAL2 - Norden	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.3	44.6	46.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	28.1	32.0	35.5	36.7	36.7	36.7	36.7	36.7	36.7
	Exceedance Level	-	-	-	-11.9	-8.0	-4.5	-3.3	-3.3	-3.4	-5.6	-7.9	-10.1
NAL3 - Whitehouse	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.8	42.7	44.9	47.1	49.4	51.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	29.5	33.4	36.9	38.1	38.1	38.1	38.1	38.1	38.1
	Exceedance Level	-	-	-	-10.5	-6.6	-3.1	-2.7	-4.6	-6.8	-9.0	-11.3	-13.7
NAL4 - Lighthouse Cottage	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.8	42.7	44.9	47.1	49.4	51.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	28.0	31.8	35.4	36.6	36.6	36.6	36.6	36.6	36.6
	Exceedance Level	-	-	-	-12.0	-8.2	-4.6	-4.2	-6.1	-8.3	-10.5	-12.8	-15.2
NAL5 - Fort	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.7	24.5	28.1	29.3	29.3	29.3	29.3	29.3	29.3
	Exceedance Level	-	-	-	-19.3	-15.5	-11.9	-10.7	-10.8	-13.1	-15.5	-17.9	-20.3
NAL6 - Bankhead Straits	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.4	24.2	27.7	29.0	29.0	29.0	29.0	29.0	29.0
	Exceedance Level	-	-	-	-19.6	-15.8	-12.3	-11.0	-11.1	-13.4	-15.8	-18.2	-20.6

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 - Hillgrind	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	19.2	23.1	26.6	27.8	27.8	27.8	27.8	27.8	27.8
	Exceedance Level	-	-	-	-20.8	-16.9	-13.4	-12.2	-12.3	-14.6	-17.0	-19.4	-21.8
NAL8 - 15 Maidenfield	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	22.0	25.9	29.4	30.6	30.6	30.6	30.6	30.6	30.6
	Exceedance Level	-	-	-	-18.0	-14.1	-10.6	-9.4	-9.5	-11.8	-14.2	-16.6	-19.0
NAL9 - Linga	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.7	24.6	28.1	29.3	29.3	29.3	29.3	29.3	29.3
	Exceedance Level	-	-	-	-19.3	-15.4	-11.9	-10.7	-10.8	-13.1	-15.5	-17.9	-20.3
NAL10 - 10 Leaside	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.2	21.0	24.5	25.8	25.8	25.8	25.8	25.8	25.8
	Exceedance Level	-	-	-	-22.8	-19.0	-15.5	-14.2	-14.3	-16.6	-19.0	-21.4	-23.8
NAL11 – The Old School	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.6	21.4	25.0	26.2	26.2	26.2	26.2	26.2	26.2
	Exceedance Level	-	-	-	-22.4	-18.6	-15.0	-13.8	-13.9	-16.2	-18.6	-21.0	-23.4
NAL12 - Moorfield	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.1	42.4	44.8	47.2	49.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.7	21.5	25.1	26.3	26.3	26.3	26.3	26.3	26.3
	Exceedance Level	-	-	-	-22.3	-18.5	-14.9	-13.7	-13.8	-16.1	-18.5	-20.9	-23.3

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13 - Laxobiggin	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.5	41.5	42.8	44.3	46.2	48.2	50.4	52.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	19.4	23.2	26.8	28.0	28.0	28.0	28.0	28.0	28.0
	Exceedance Level	-	-	-	-20.6	-17.3	-14.7	-14.8	-16.3	-18.2	-20.2	-22.4	-24.6
NAL14 - Millburn	Site Specific Noise Limit L_{A90}	40.0	40.0	40.0	40.0	40.5	41.5	42.8	44.3	46.2	48.2	50.4	52.6
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.8	24.6	28.2	29.4	29.4	29.4	29.4	29.4	29.4
	Exceedance Level	-	-	-	-19.2	-15.9	-13.3	-13.4	-14.9	-16.8	-18.8	-21.0	-23.2
NAL15 - Garth Farmhouse	Site Specific Noise Limit L_{A90}	50.1	50.2	50.5	51.0	51.6	52.3	53.1	54.1	55.1	56.2	57.4	58.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	22.3	26.2	29.7	30.9	30.9	30.9	30.9	30.9	30.9
	Exceedance Level	-	-	-	-28.7	-25.4	-22.6	-22.2	-23.2	-24.2	-25.3	-26.5	-27.8

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 - The Brough	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	44.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	27.8	31.6	35.2	36.4	36.4	36.4	36.4	36.4	36.4
	Exceedance Level	-	-	-	-15.2	-11.4	-7.8	-6.6	-6.6	-6.6	-6.6	-6.6	-8.4
NAL2 - Norden	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	44.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	28.1	32.0	35.5	36.7	36.7	36.7	36.7	36.7	36.7
	Exceedance Level	-	-	-	-14.9	-11.0	-7.5	-6.3	-6.3	-6.3	-6.3	-6.3	-8.1
NAL3 - Whitehouse	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.0	50.5
	Predicted Wind Turbine Noise L_{A90}	-	-	-	29.5	33.4	36.9	38.1	38.1	38.1	38.1	38.1	38.1
	Exceedance Level	-	-	-	-13.5	-9.6	-6.1	-4.9	-4.9	-4.9	-7.3	-9.9	-12.4
NAL4 - Lighthouse Cottage	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.0	50.5
	Predicted Wind Turbine Noise L_{A90}	-	-	-	28.0	31.8	35.4	36.6	36.6	36.6	36.6	36.6	36.6
	Exceedance Level	-	-	-	-15.0	-11.2	-7.6	-6.4	-6.4	-6.4	-8.8	-11.4	-13.9
NAL5 - Fort	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.7	24.5	28.1	29.3	29.3	29.3	29.3	29.3	29.3
	Exceedance Level	-	-	-	-22.3	-18.5	-14.9	-13.7	-13.7	-13.7	-13.9	-16.1	-18.4
NAL6 - Bankhead Straits	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.4	24.2	27.7	29.0	29.0	29.0	29.0	29.0	29.0
	Exceedance Level	-	-	-	-22.6	-18.8	-15.3	-14.0	-14.0	-14.0	-14.2	-16.4	-18.7

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 - Hillgrind	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	19.2	23.1	26.6	27.8	27.8	27.8	27.8	27.8	27.8
	Exceedance Level	-	-	-	-23.8	-19.9	-16.4	-15.2	-15.2	-15.2	-15.4	-17.6	-19.9
NAL8 - 15 Maidenfield	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	22.0	25.9	29.4	30.6	30.6	30.6	30.6	30.6	30.6
	Exceedance Level	-	-	-	-21.0	-17.1	-13.6	-12.4	-12.4	-12.4	-12.6	-14.8	-17.1
NAL9 - Linga	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.7	24.6	28.1	29.3	29.3	29.3	29.3	29.3	29.3
	Exceedance Level	-	-	-	-22.3	-18.4	-14.9	-13.7	-13.7	-13.7	-13.9	-16.1	-18.4
NAL10 - 10 Leaside	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.2	21.0	24.5	25.8	25.8	25.8	25.8	25.8	25.8
	Exceedance Level	-	-	-	-25.8	-22.0	-18.5	-17.2	-17.2	-17.2	-17.4	-19.6	-21.9
NAL11 – The Old School	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.6	21.4	25.0	26.2	26.2	26.2	26.2	26.2	26.2
	Exceedance Level	-	-	-	-25.4	-21.6	-18.0	-16.8	-16.8	-16.8	-17.0	-19.2	-21.5
NAL12 - Moorfield	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2	45.4	47.7
	Predicted Wind Turbine Noise L_{A90}	-	-	-	17.7	21.5	25.1	26.3	26.3	26.3	26.3	26.3	26.3
	Exceedance Level	-	-	-	-25.3	-21.5	-17.9	-16.7	-16.7	-16.7	-16.9	-19.1	-21.4

Location		Wind Speed (ms^{-1}) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13 - Laxobiggin	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.8	47.7	49.8	51.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	19.4	23.2	26.8	28.0	28.0	28.0	28.0	28.0	28.0
	Exceedance Level	-	-	-	-23.6	-19.8	-16.2	-15.0	-16.1	-17.8	-19.7	-21.8	-23.8
NAL14 - Millburn	Site Specific Noise Limit L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.8	47.7	49.8	51.8
	Predicted Wind Turbine Noise L_{A90}	-	-	-	20.8	24.6	28.2	29.4	29.4	29.4	29.4	29.4	29.4
	Exceedance Level	-	-	-	-22.2	-18.4	-14.8	-13.6	-14.7	-16.4	-18.3	-20.4	-22.4
NAL15 - Garth Farmhouse	Site Specific Noise Limit L_{A90}	45.0	45.0	46.1	49.0	51.3	53.0	54.3	55.2	55.9	56.4	56.8	57.4
	Predicted Wind Turbine Noise L_{A90}	-	-	-	22.3	26.2	29.7	30.9	30.9	30.9	30.9	30.9	30.9
	Exceedance Level	-	-	-	-26.7	-25.1	-23.3	-23.4	-24.3	-25.0	-25.5	-25.9	-26.5

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

6.6.8 In the event that consent is granted for the Proposed Development it would be appropriate to set noise limits within the planning conditions that are equal to the Site Specific Noise Limits contained in **Table 6.9** and **Table 6.10**.

6.7 Choice of Daytime Fixed Minimum Noise Limit (35 – 40 dBA)

6.7.1 Having due regard to the guidance in ETSU-R-97 and considering the total fixed minimum limit allocated to other wind farm schemes in Shetland, and agreed limits with the EHO, a cumulative daytime total fixed minimum limit of 40 dBA has been adopted.

6.7.2 Whilst a cumulative daytime Total ETSU-R-97 Noise Limit of 40 dBA is proposed, the Proposed Development's Site Specific Noise Limit are set separately and can be established using a value between 35 and 40 dBA. For the Proposed Development, the Site Specific Noise Limits have been derived based upon the upper fixed minimum limit of 40 dBA or background plus 5 dB during the daytime period and 43 dBA or background plus 5 dB during the night-time.

6.7.3 The choice of daytime fixed minimum limit depends on three factors which are discussed on page 65 of ETSU-R-97 and in Section 3.2.4 of the IOA GPG. The IOA GPG notes that:

'It can be argued that assessing these factors do not represent an acoustic consideration but ultimately a planning consideration, and therefore are difficult for noise consultants to fully determine.'

6.7.4 Commentary on each of the three factors discussed in ETSU-R-97 and the IOA GPG are included within Table 6.11 below to justify the fixed minimum limit adopted for the Proposed Development.

Table 6.11 Consideration of Guidance provided on Choice of FML for the Site Specific Noise Limits

Factor	Guidance in ETSU-R-97	Guidance in IOA GPG	Commentary for the Proposed Development
1) The number of noise affected properties	*'The planning process is trying to balance the benefits arising out of the development of renewable energy sources against the local environmental impact. The more dwellings that are in the vicinity of a wind farm the tighter the limits should be as the total environmental impact will be greater. Conversely if only a*	*'The number of neighbouring properties will depend on the nature of the area, (rural, semi-rural, urban) and is sometimes considered in relation to the size of the scheme and study area. The predicted 35 dB LA90 contour (at maximum noise output up to 12 m/s) can provide a guide to the*	The Site is located in a rural area with a low number of dwellings which surround the Site. Of the 15 NALs identified, only 4 are predicted to experience noise levels of greater than 35 dB due to the Proposed Development. The number of properties is considered to be particularly low in the context of the size of the

Factor	Guidance in ETSU-R-97	Guidance in IOA GPG	Commentary for the Proposed Development
	few dwellings are affected, then the environmental impact is less and noise limits towards the upper end of the range may be appropriate. Developers still have to consider the interests of individuals as protected under the Environmental Protection Act 1990.'	*dwellings to be considered in this respect.'*	Proposed Development (estimated to be over 50 MW based on the candidate turbine modelled in this assessment). Consideration of this test suggests that a Site Specific Noise Limit towards the upper end of the range permitted in ETSU-R-97 would be appropriate.
2) The effect of using tighter limits on the potential power output of the wind farm.	*'Similar arguments can be made when considering the effect of noise limits on uptake of wind energy. A single wind turbine causing noise levels of 40dBA at several nearby residences would have less planning merit (noise considerations only) than 30 wind turbines also causing the same amount of noise at several nearby residences.'*	*'This is in practice mainly based on the relative generating capacity of the development, as larger schemes have relatively more planning merit (for noise) according to the description in ETSU-R-97. In cases when the amenity fixed limit has little or no impact on the generating capacity (i.e. noise is not a significant design constraint) then a reduced limit may be applied.'*	The Proposed Development, if approved, would represent a medium-large sized onshore wind farm in the context of the UK, which would generate a significant amount of renewable energy. If the Site Specific Noise Limit was derived based on a lower FML of 35 dB it would result in the derivation of lower Site Specific Noise Limits and exceedances of the noise limits would occur based on the candidate turbine type. Consideration of this test suggests that a Site Specific Noise Limit towards the middle/upper end of the range permitted in ETSU-R-97 would be appropriate.

Factor	Guidance in ETSU-R-97	Guidance in IOA GPG	Commentary for the Proposed Development
3) The duration of exposure of these properties.	*'The proportion of the time at which background noise levels are low and how low the background noise level gets are both recognised as factors which could affect the setting of an appropriate lower limit. For example, a property which experienced background noise levels below 30dBA for a substantial proportion of the time in which the turbines would be operating could be expected to receive tighter noise limits than a property at which the background noise levels soon increased to levels above 35dBA. This approach is difficult to formulate precisely and a degree of judgement should be exercised.'*	*'This last test is more difficult to formulate. But ETSU-R-97 notes that the likely excess of turbine noise relative to background noise levels should be a relevant consideration. In rural areas, this will often be determined by the sheltering of the property relative to the wind farm site. Account can also be taken of the effects of wind directions (including prevailing ones at the site) and likely directional effects. For cumulative developments, in some cases the effective duration of exposure may increase because of cumulative effects.'*	As noted above, the level of exposure is low (<35 dB) for 11 of the NALs when considering the predicted noise levels due to the Proposed Development. In terms of duration of exposure, whilst the 4 NALs with predicted noise levels of greater than 35 dB are located to the east of the Proposed Development such that they would be downwind of the turbines when the wind is from the west (which typically the predominant wind direction for the UK), the noise levels at these NALs would be less when the wind is blowing from other directions. Background noise levels vary across the NMLs but in general the daytime noise levels are relatively low and are broadly consistent with levels measured at rural locations in the UK, aside from NMLs 4-5. Consideration of this test suggests a Site Specific Noise Limit towards the middle or upper end of the range permitted in ETSU-R-97 would be appropriate.

6.8 Micrositing

6.8.1 A 100 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 would 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 would 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 residents of nearby residential receptors. The guidance contained within ETSU-R-97 and current good practice (IOA GPG) has been used to assess the potential noise impact of the Proposed Development.

7.1.2 Background noise monitoring was undertaken by TNEI at five NSRs neighbouring the Proposed Development. A total of fifteen noise sensitive receptors were chosen as NALs. The assessment locations were chosen to represent the NSRs located closest to the Proposed Development.

7.1.3 Wind speed data was collected using a LiDAR unit located within the Site. The data collected at heights of 100 m and 120 m were used to calculate hub height wind speeds (114 m) which were then standardised to 10 m height, in accordance with current good practice.

7.1.4 Analysis of the measured data was undertaken in accordance with ETSU-R-97 and current good practice to determine the pre-existing background noise environment and to establish the daytime and night-time noise limits for each of the assessment locations. A Total ETSU-R-97 Noise Limit of 40 dBA daytime or background plus 5 dB (whichever is the greater) and 43 dBA night-time or background plus 5 dB (whichever is the greater) was used for this assessment.

7.1.5 There is one proposed wind farm in proximity to the Proposed Development. A cumulative assessment was undertaken at all NALs for completeness. The results show that the predicted cumulative wind farm noise immission levels would meet the Total ETSU-R-97 Noise Limits at all NALs during both the daytime and night-time periods.

7.1.6 Site Specific Noise Limits have been derived based on a daytime fixed minimum limit of 40 dBA or background plus 5 dB, and a night-time limit of 43 dBA or background plus 5 dB.

7.1.7 The wind turbine noise immission levels from the Proposed Development were predicted to be below the Site Specific Noise Limits at all NALs, when considering the Vestas V172 7.2 MW with serrated trailing edge blades, as a candidate turbine.

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

8 Glossary of Terms

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

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

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

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

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

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.

dBA: 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 dBA. The dBA 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 dBA is just perceptible;
- a change of 5 dBA is clearly perceptible;
- a change of 10 dBA 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 10 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.

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Annex 1 – Figures

LEGEND

- Application Boundary
- ? Proposed Turbines
- ? Sullom Voe Oil Terminal Turbines
- ! Noise Monitoring locations (NMLs)
- × Noise Assessment Locations (NALs)

Re	Date	Details	Drawn	Approved
2	29/04/2026	SECOND REVIEW COMMENTS	MR	AB
1	13/03/2026	FIRST REVIEW COMMENTS	MR	AB
0	03/03/2026	FIRST ISSUE	MR	AB

tnei

Client: RAMBOLL

Drawing Status: FOR INFORMATION

Project Title: NESHION ENERGY PARK

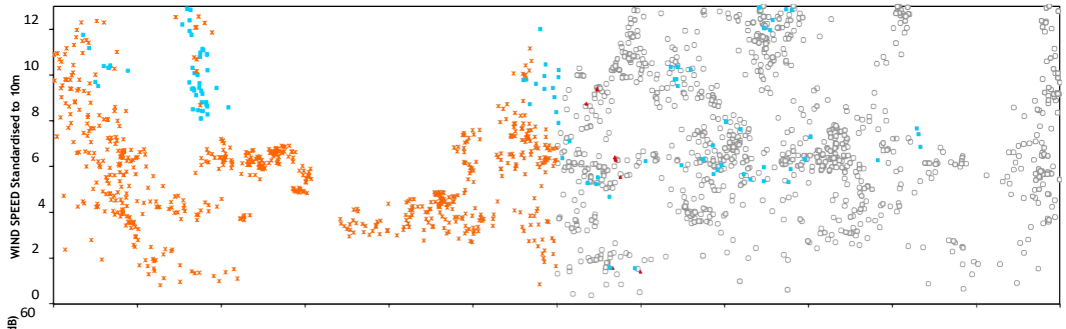
Drawing Title: FIGURE A1.1: OPERATIONAL NOISE STUDY AREA

Scale:	Original Size:	Spatial Reference:
1:22,500	A3	British National Grid

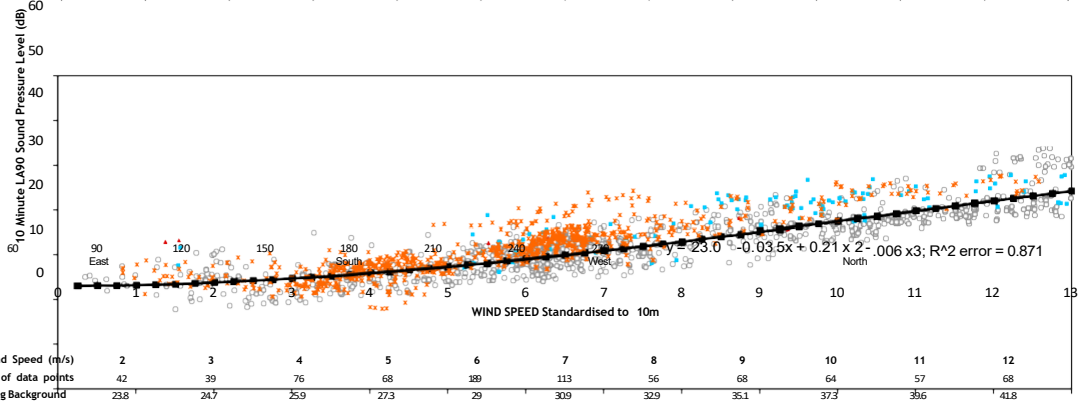
Drawing Number: 16430-010

ETSU-R-97 QUIET DAYTIME - NML1-Norden

Wind Conditions Quiet Daytime



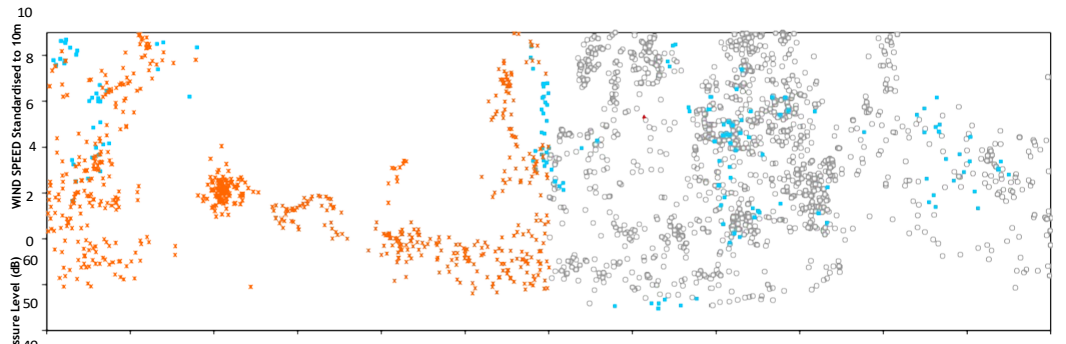
Regression Analysis Quiet Daytime



Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	42	39	76	68	189	113	56	68	64	57	68	840
Prevailing Background	23.8	24.7	25.9	27.3	29	30.9	32.9	35.1	37.3	39.6	41.8	

ETSU-R-97 NIGHT-TIME - NML1-Norden

Wind Conditions Night-Time



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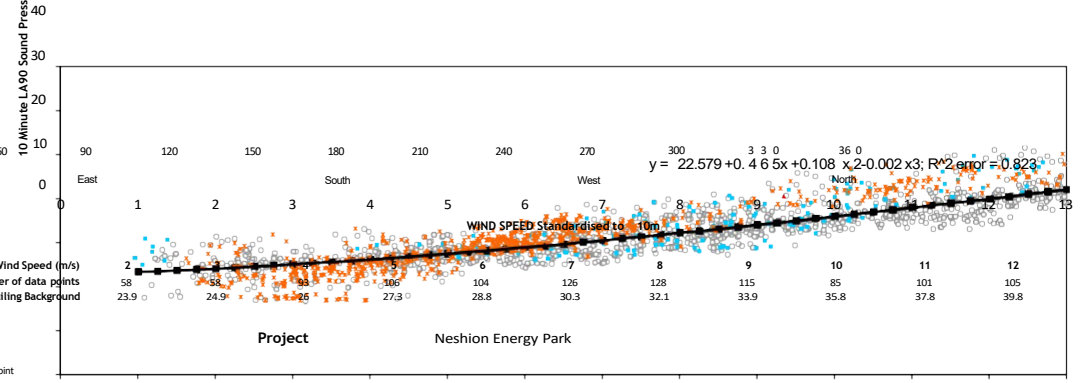


Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	58	88	93	106	104	126	128	115	85	101	105	1079
Prevailing Background	23.9	24.9	26	27.3	28.8	30.3	32.1	33.9	35.8	37.8	39.8	

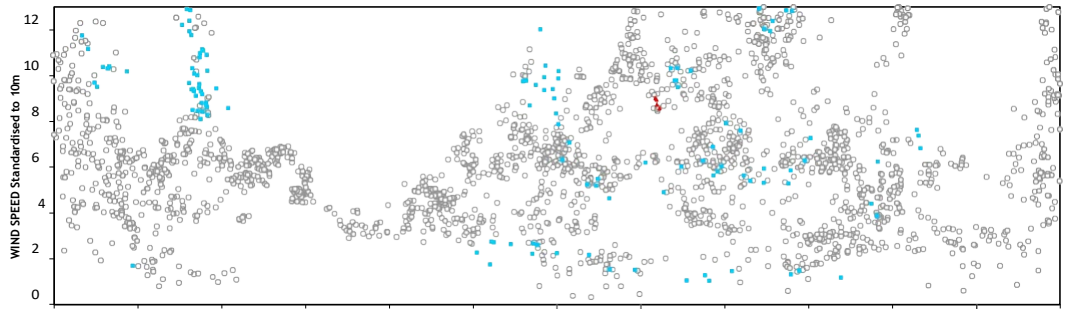
Legend:

- 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
- Excluded Data-Filtered Wind Direction

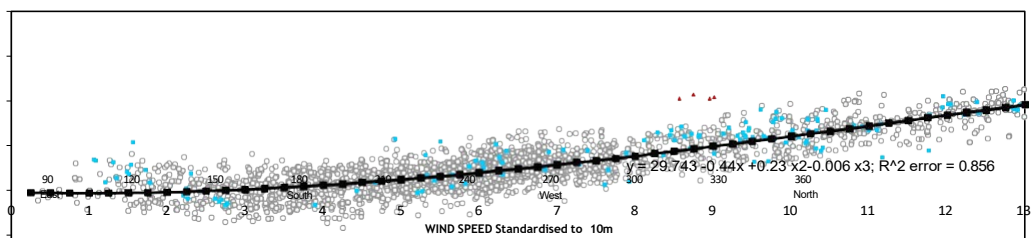
Project	Neshion Energy Park
Client	Neshion Ltd
Title	Wind Conditions&Regression Analysis
Figure Number	A1.2a
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430-Models

ETSU-R-97 QUIET DAYTIME - NML2-Quoy Lee

Wind Conditions Quiet Daytime



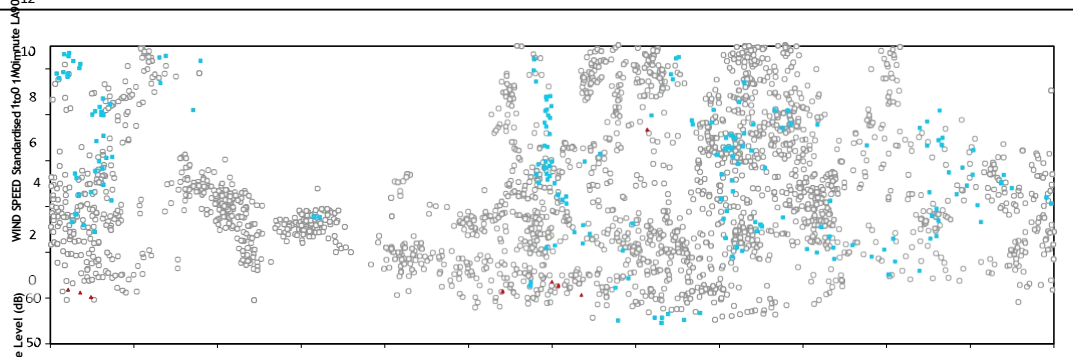
Regression Analysis Quiet Daytime



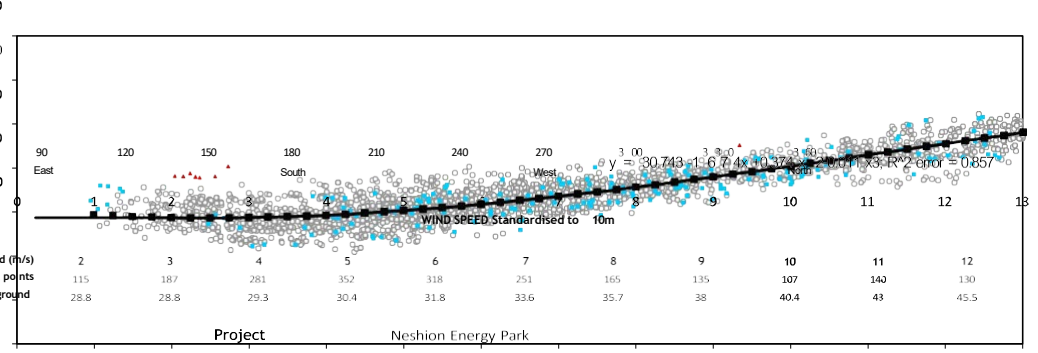
Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	106	184	241	257	433	288	125	105	100	82	78	1999
Prevailing Background	29.7	30.3	31.3	32.5	34	35.8	37.7	39.9	42.1	44.4	46.8	

ETSU-R-97 NIGHT-TIME - NML2-Quoy Lee

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	115	187	281	352	318	251	165	135	107	140	130	2181
Prevailing Background	28.8	28.8	29.3	30.4	31.8	33.6	35.7	38	40.4	43	45.5	

Legend:

L_{A90} 10 Minute Measurement Point

Line of best fit

Line of best fit flat lined where appropriate(Prevailing Background)

Excluded Data-Manual exclusion

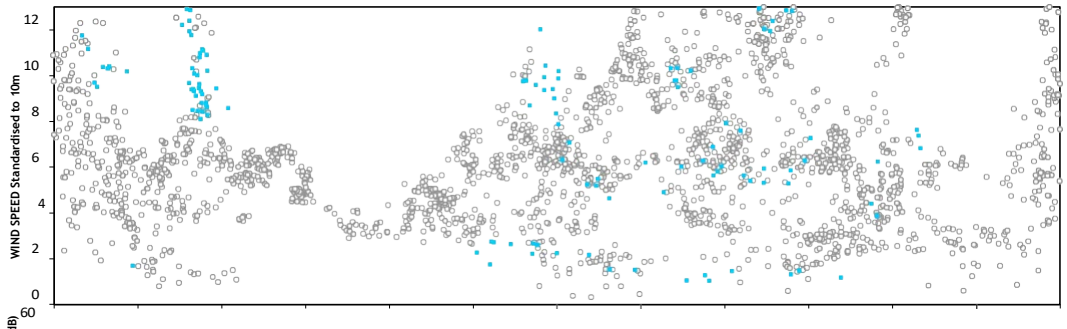
Excluded Data-Rain

Excluded Data-Filtered Wind Direction

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Wind Conditions&Regression Analysis
Figure Number	A1.2b
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430-Models

ETSU-R-97 QUIET DAYTIME - NML3-No.7 Maidenfield

Wind Conditions Quiet Daytime



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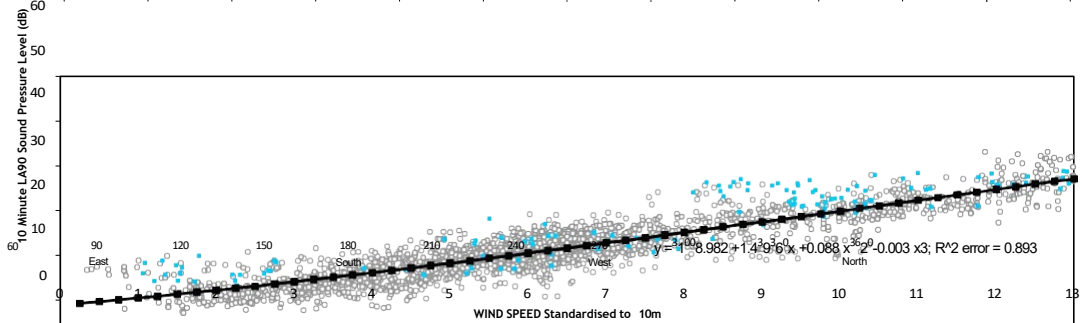


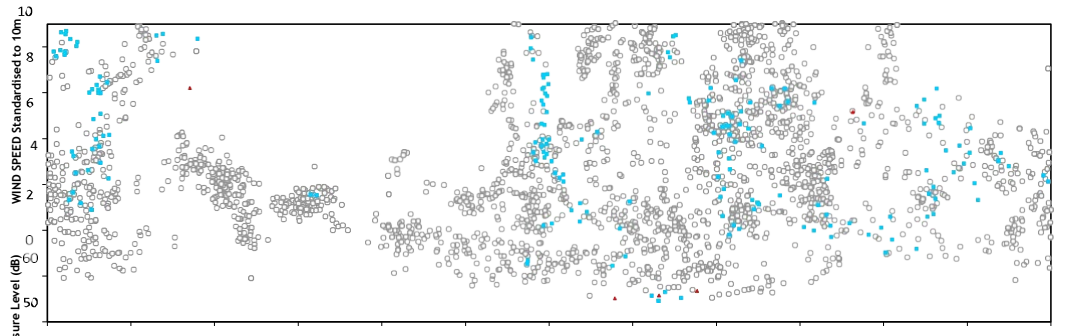
Wind direction (Degrees)

70

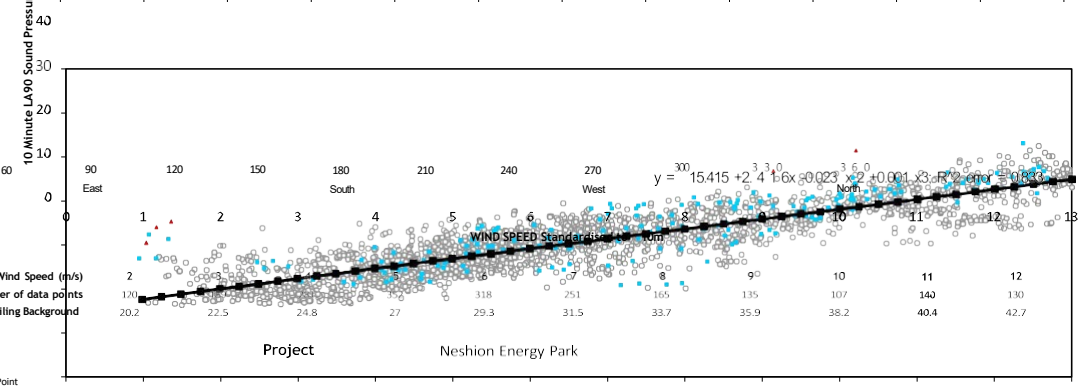
Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	106	184	241	257	433	288	125	109	100	82	78	2003
Prevailing Background	22.3	24.2	26.2	28.3	30.5	32.8	35.1	37.4	39.8	42.2	44.6	

ETSU-R-97 NIGHT-TIME - NML3-No.7 Maidenfield

Wind Conditions Night-Time



Regression Analysis Night-Time



Wind direction (Degrees)

70

Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	120	318	251	165	135	107	140	130	2188			
Prevailing Background	20.2	22.5	24.8	27	29.3	31.5	33.7	35.9	38.2	40.4	42.7	

Legend:

L_{A90} 10 Minute Measurement Point

Line of best fit

Line of best fit flat lined where appropriate (Prevailing Background)

Excluded Data-Manual exclusion

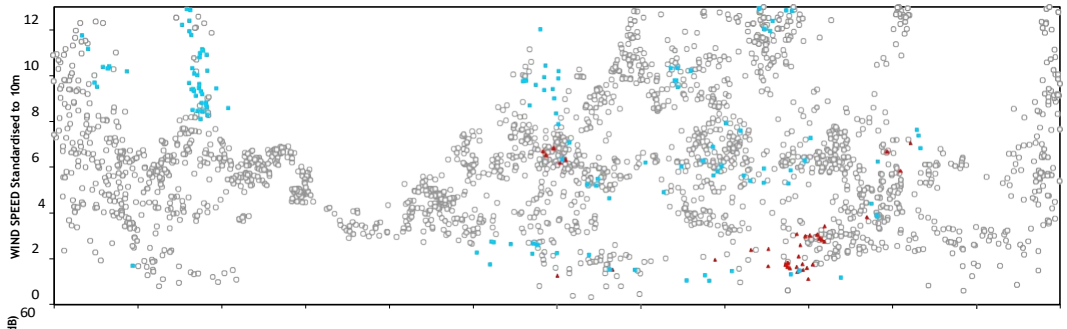
Excluded Data-Rain

Excluded Data-Filtered Wind Direction

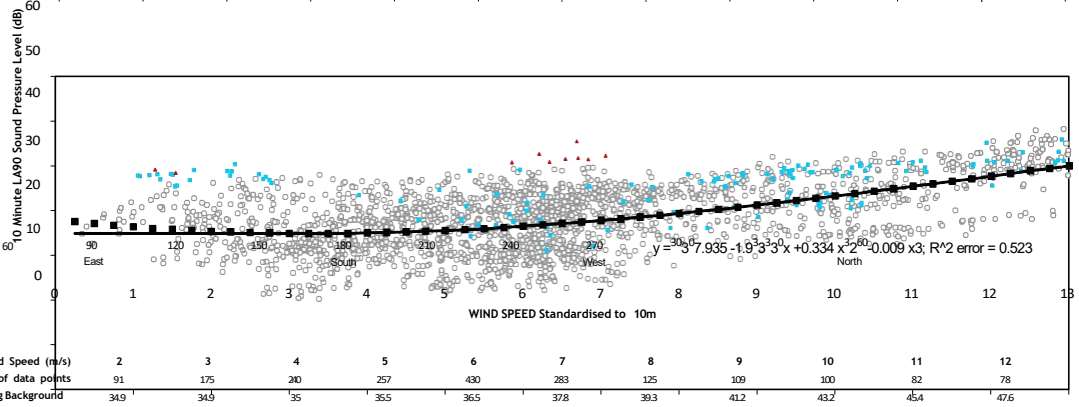
Project	Neshion Energy Park
Client	Neshion Ltd
Title	Wind Conditions&Regression Analysis
Figure Number	A1.2c
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430-Models

ETSU-R-97 QUIET DAYTIME - NML4-Laxobiggin

Wind Conditions Quiet Daytime



Regression Analysis Quiet Daytime

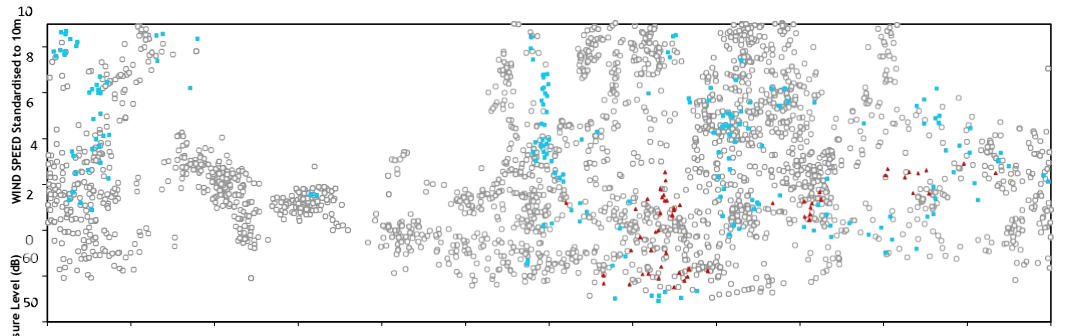


0 30 60
North
Wind direction (Degrees)
70

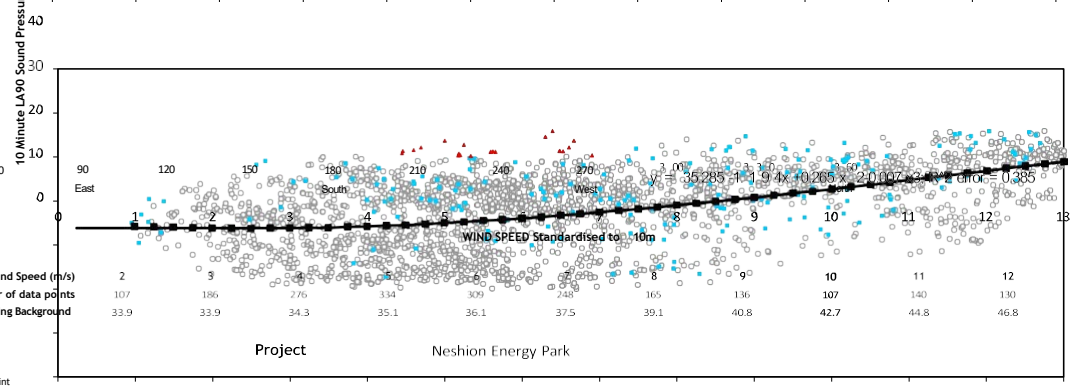
Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	91	175	240	257	430	283	125	109	100	82	78	1970
Prevailing Background	34.9	34.9	35	35.5	36.5	37.8	39.3	41.2	43.2	45.4	47.6	

ETSU-R-97 NIGHT-TIME - NML4-Laxobiggin

Wind Conditions Night-Time



Regression Analysis Night-Time



0 30 60
North
Wind direction (Degrees)
70

Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	107	186	276	334	309	248	165	136	107	140	130	2138
Prevailing Background	33.9	33.9	34.3	35.1	36.1	37.5	39.1	40.8	42.7	44.8	46.8	

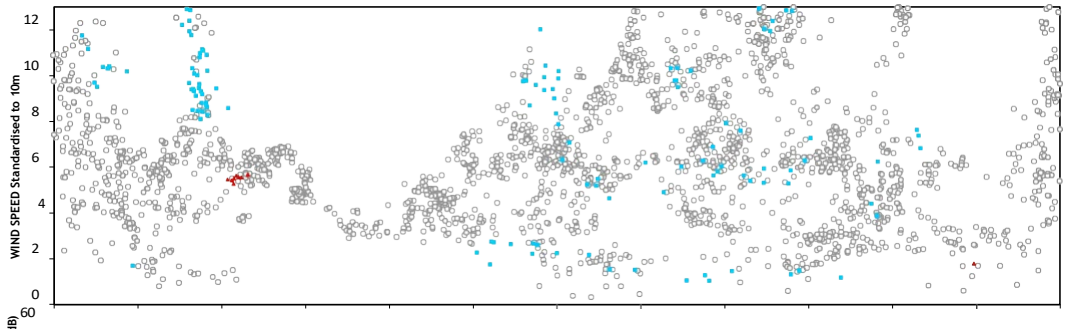
Legend:

- 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
- Excluded Data-Filtered Wind Direction

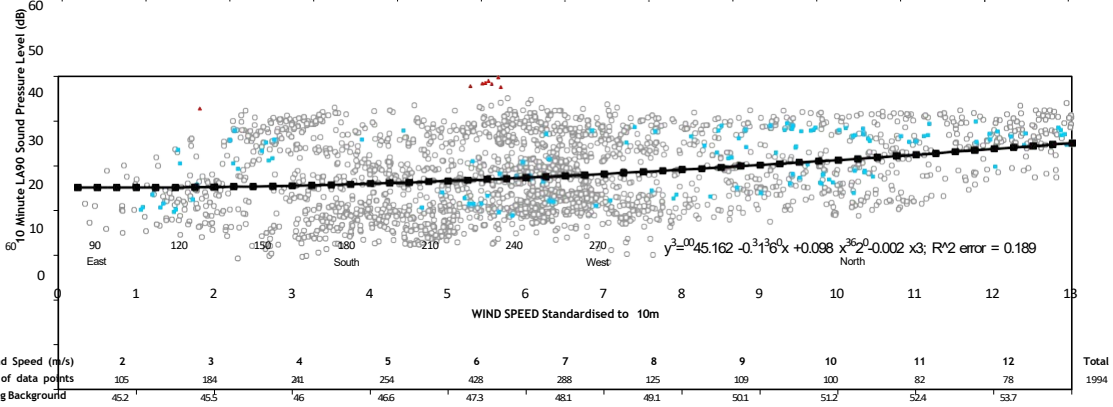
Project	Neshion Energy Park
Client	Neshion Ltd
Title	Wind Conditions&Regression Analysis
Figure Number	A1.2d
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430-Models

ETSU-R-97 QUIET DAYTIME - NML5-Garth Farmhouse

Wind Conditions Quiet Daytime



Regression Analysis Quiet Daytime



Wind direction (Degrees)

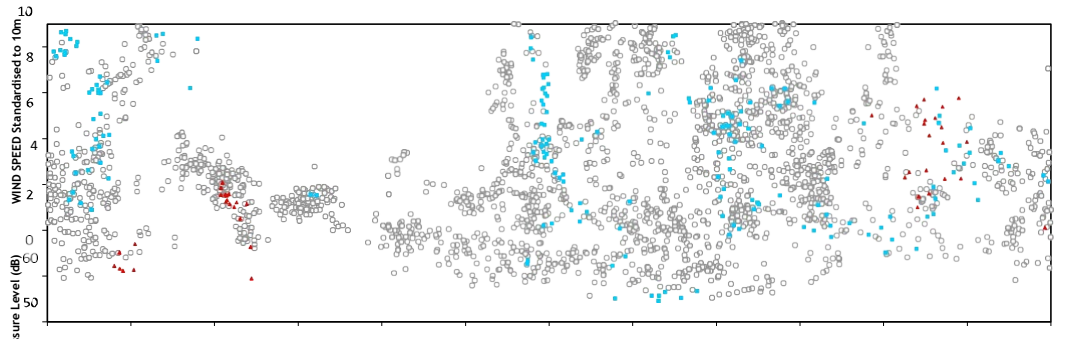
70

Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	105	184	241	254	428	288	125	109	100	82	78	1994
Prevailing Background	45.2	45.5	46	46.6	47.3	48.1	49.1	50.1	51.2	52.4	53.7	

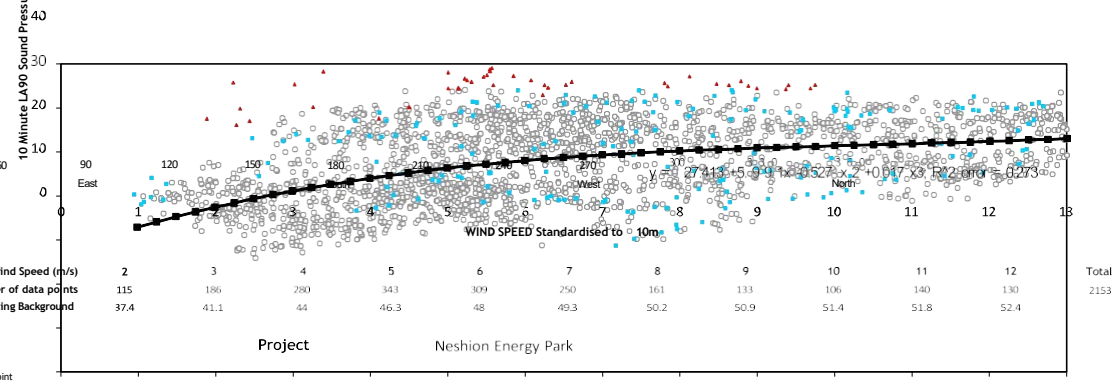
ETSU-R-97 NIGHT-TIME - NML5-Garth Farmhouse

12												

Wind Conditions Night-Time



Regression Analysis Night-Time



Wind direction (Degrees)

70

Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	115	186	280	343	309	250	161	133	106	140	130	2153
Prevailing Background	37.4	41.1	44	46.3	48	49.3	50.2	50.9	51.4	51.8	52.4	

Legend:

L_{A90} 10 Minute Measurement Point

Line of best fit

Line of best fit flat lined where appropriate(Prevailing Background)

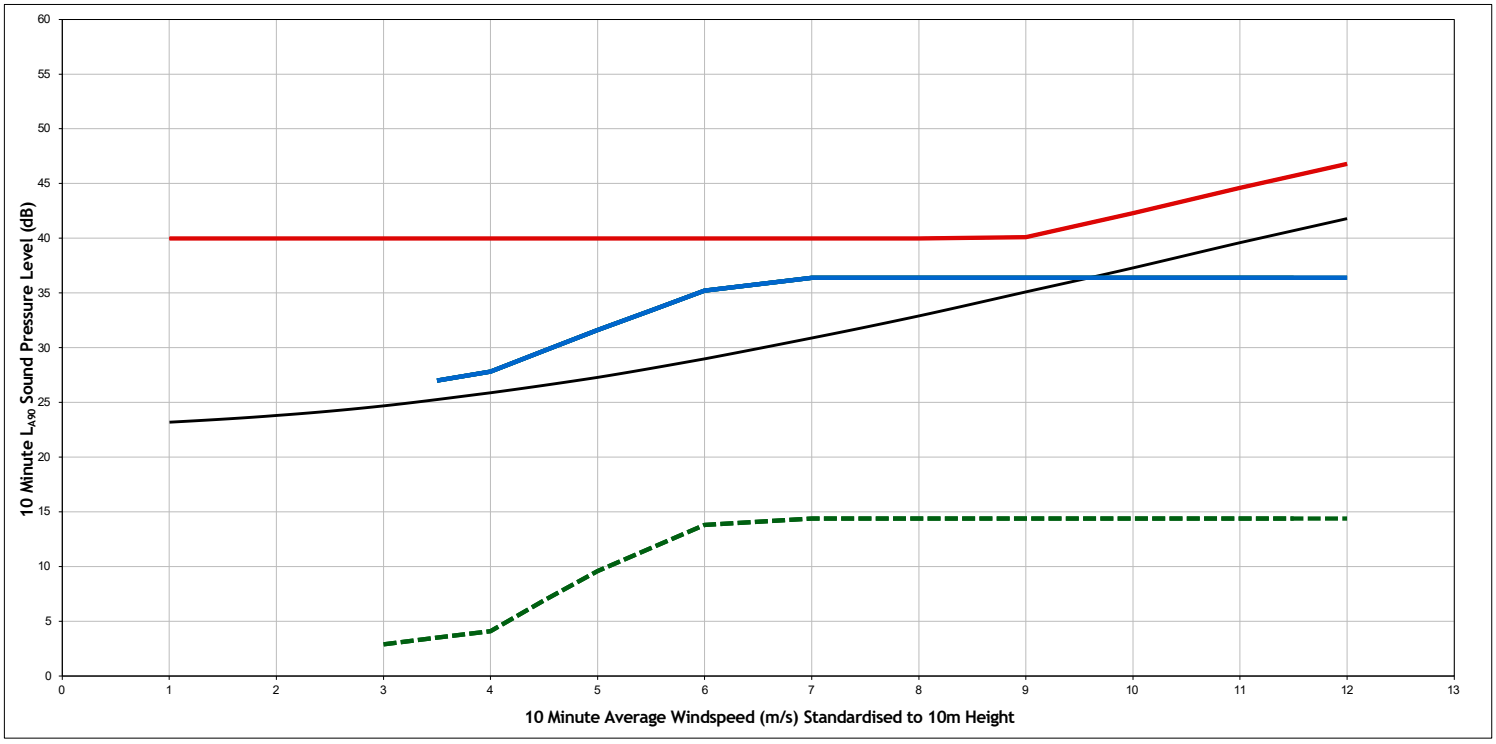
Excluded Data-Manual exclusion

Excluded Data-Rain

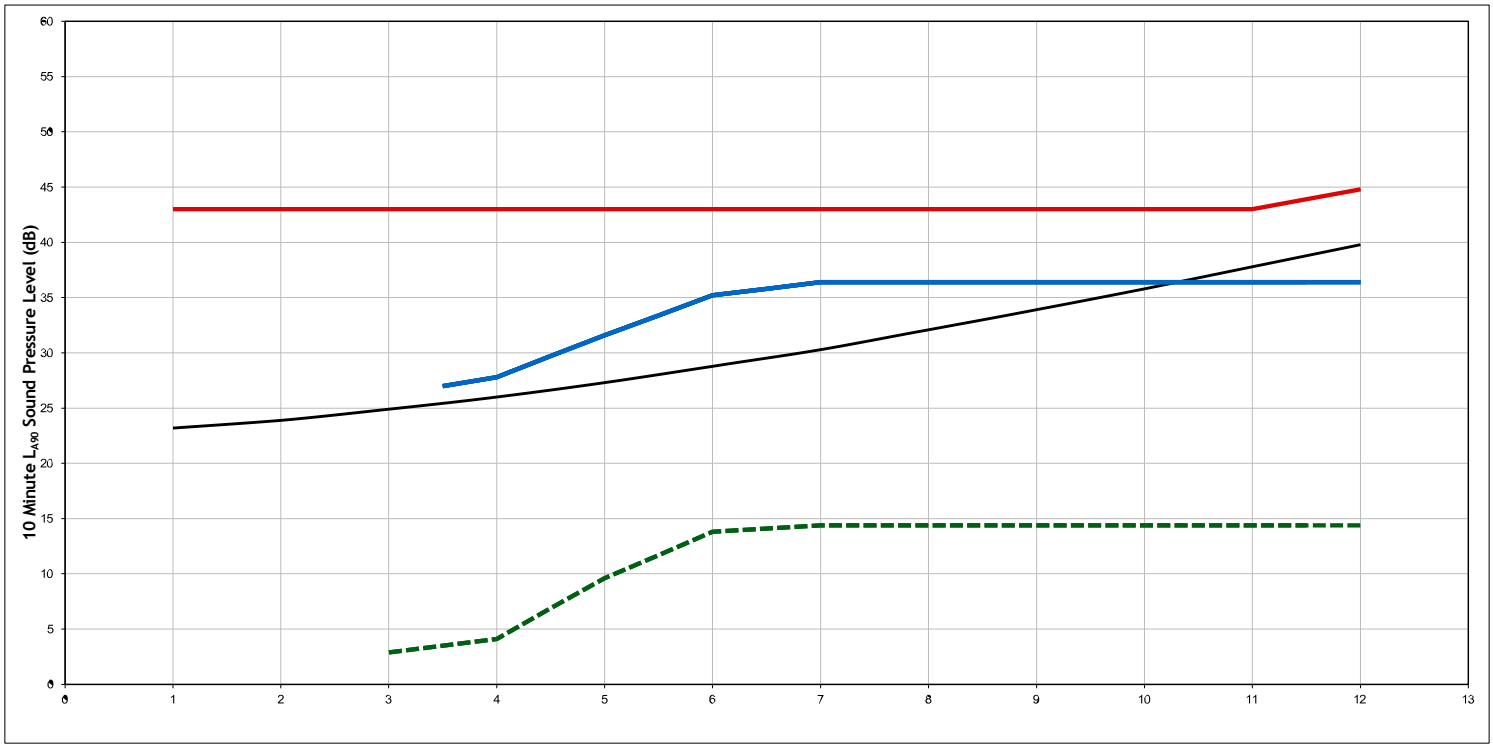
Excluded Data-Filtered Wind Direction

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Wind Conditions&Regression Analysis
Figure Number	A1.2e
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430-Models

Daytime - The Brough (NAL1)



Night Time - The Brough (NAL1)

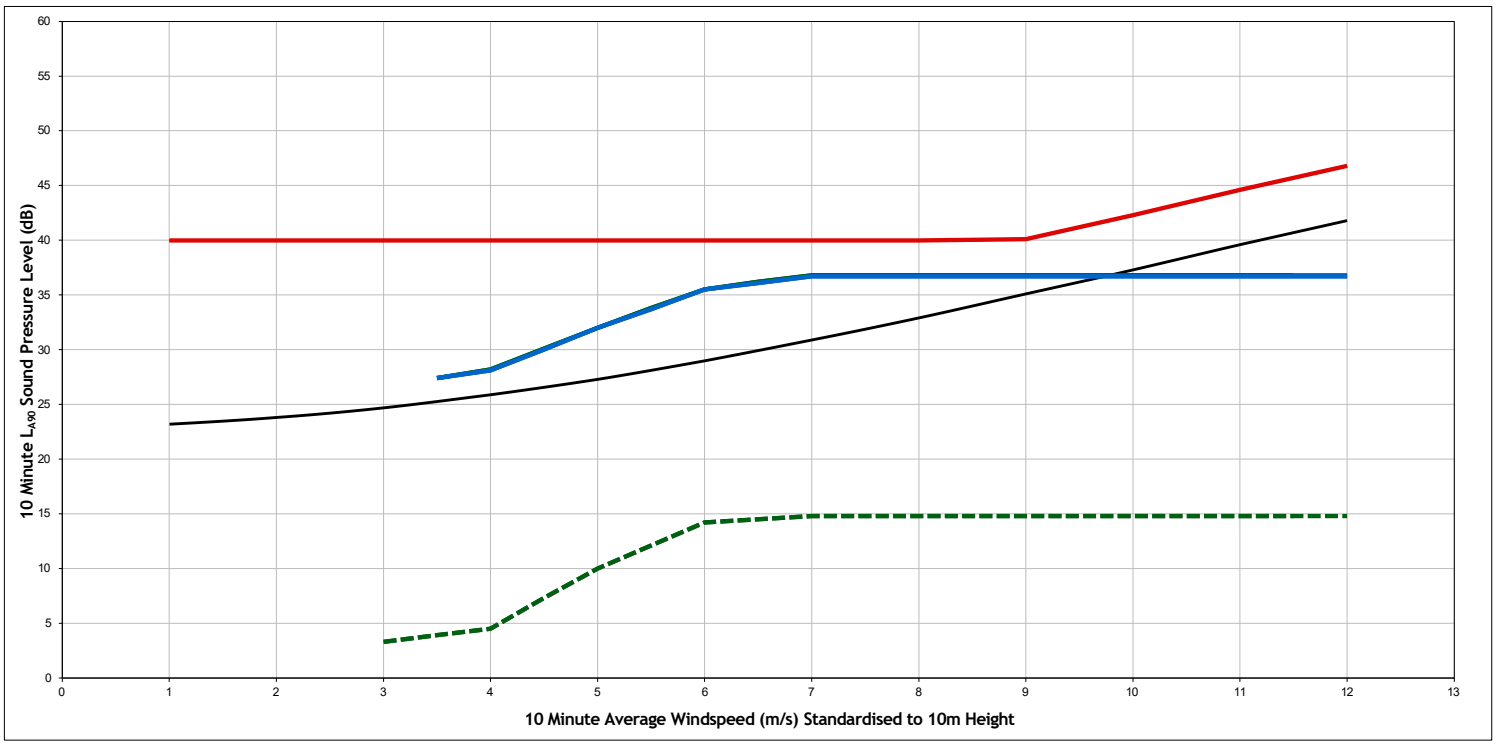


Legend:

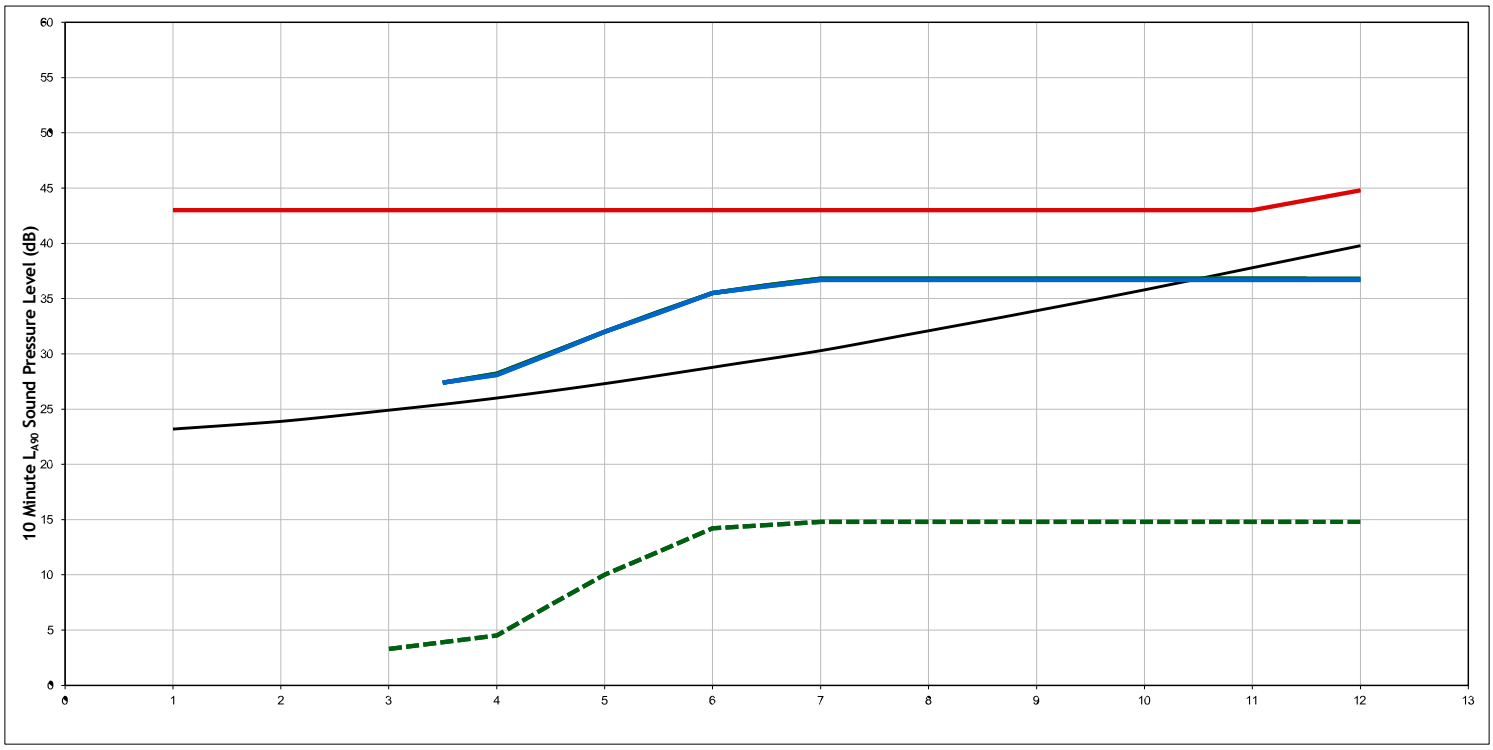
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment The Brough (NAL1)
Figure Number	Figure A1.3a
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Norden (NAL2)



Night Time - Norden (NAL2)



Legend:

- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment Norden (NAL2)
Figure Number	Figure A1.3b
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

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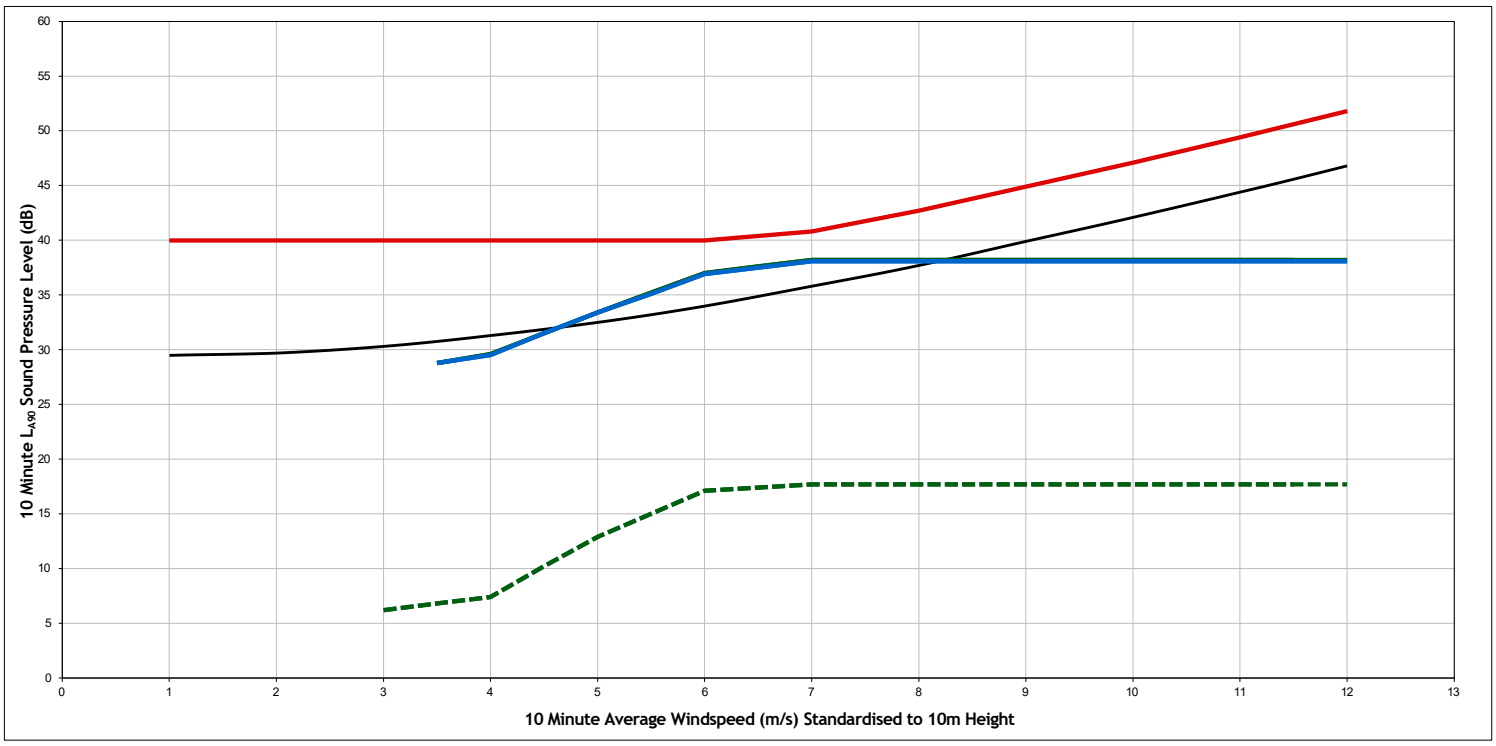
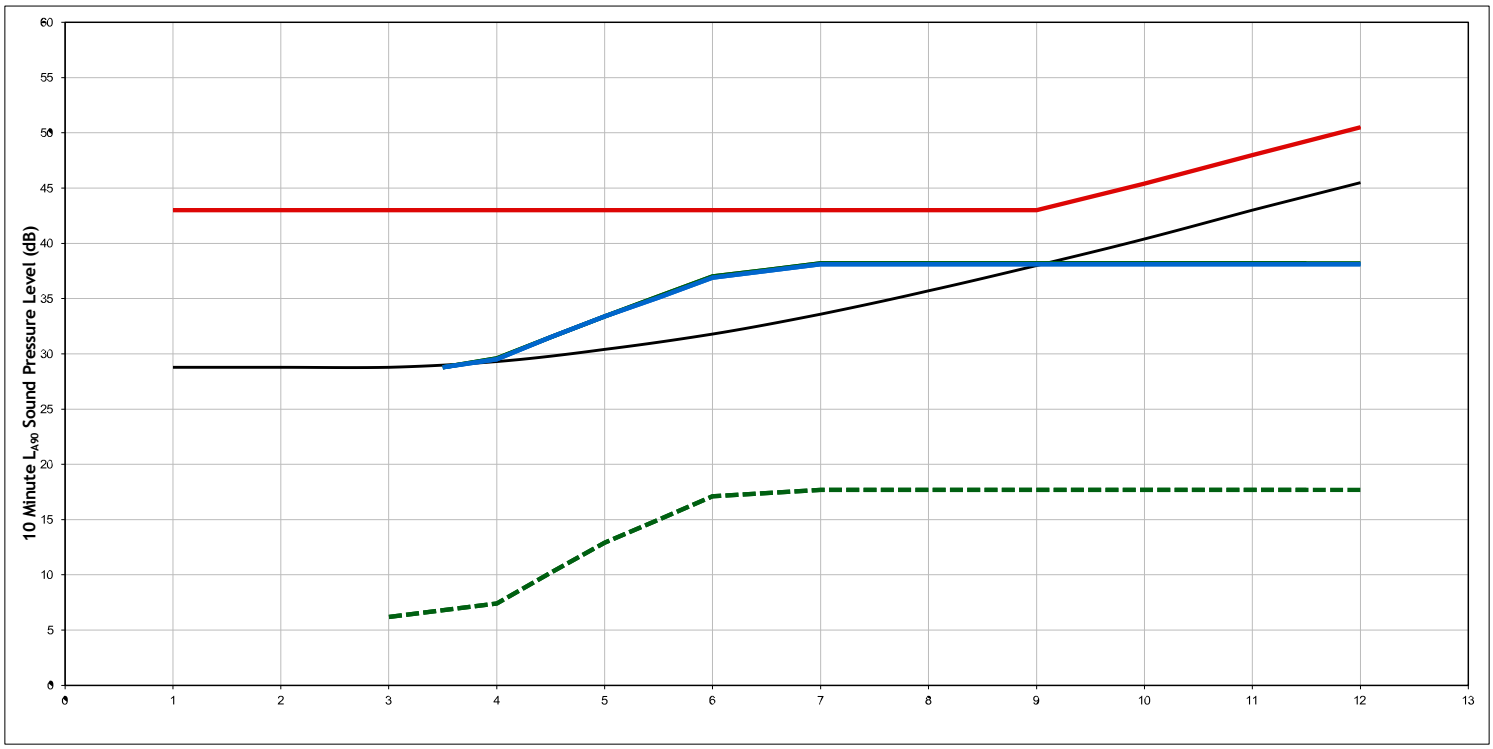
Daytime - Whitehouse (NAL3)



Night Time - Whitehouse (NAL3)



Legend:

- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment Whitehouse (NAL3)
Figure Number	Figure A1.3c
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

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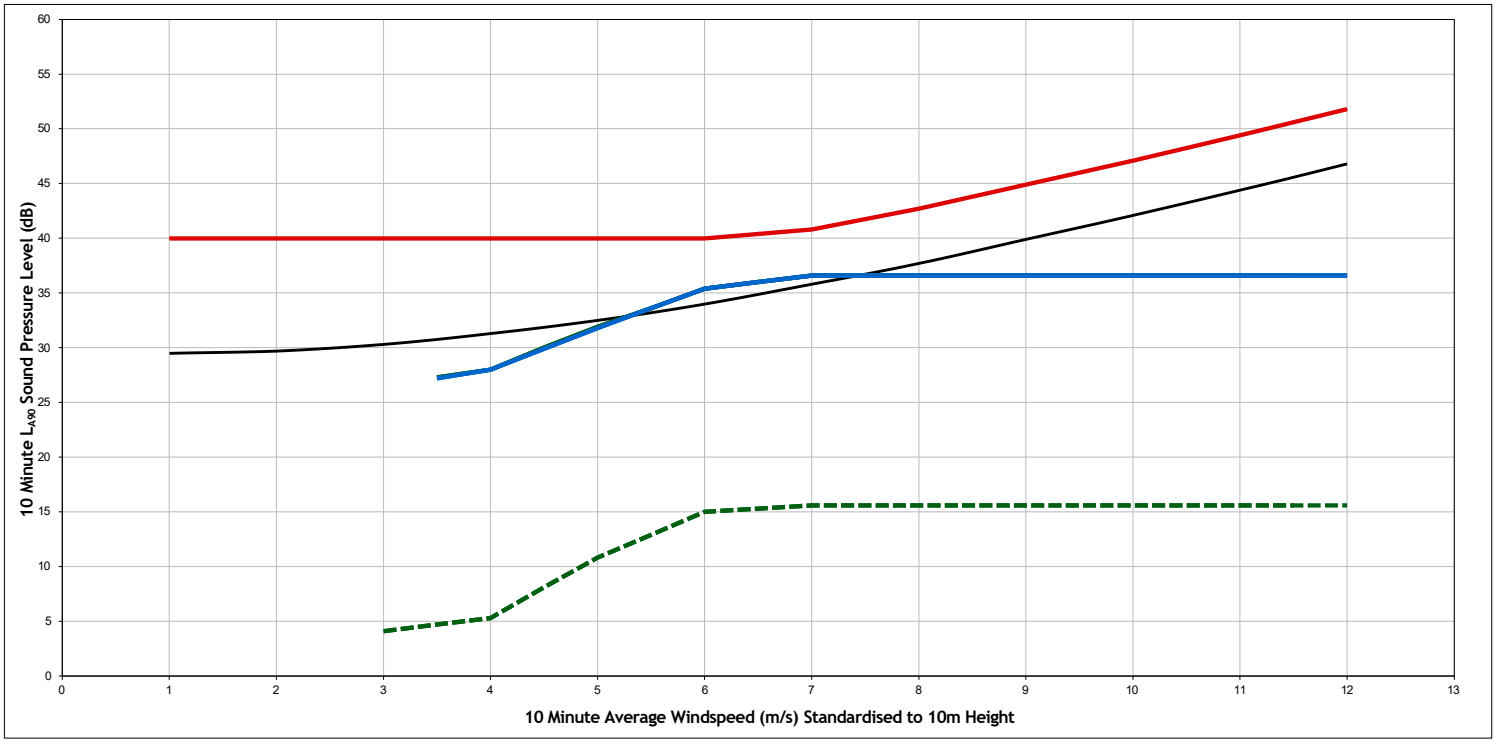
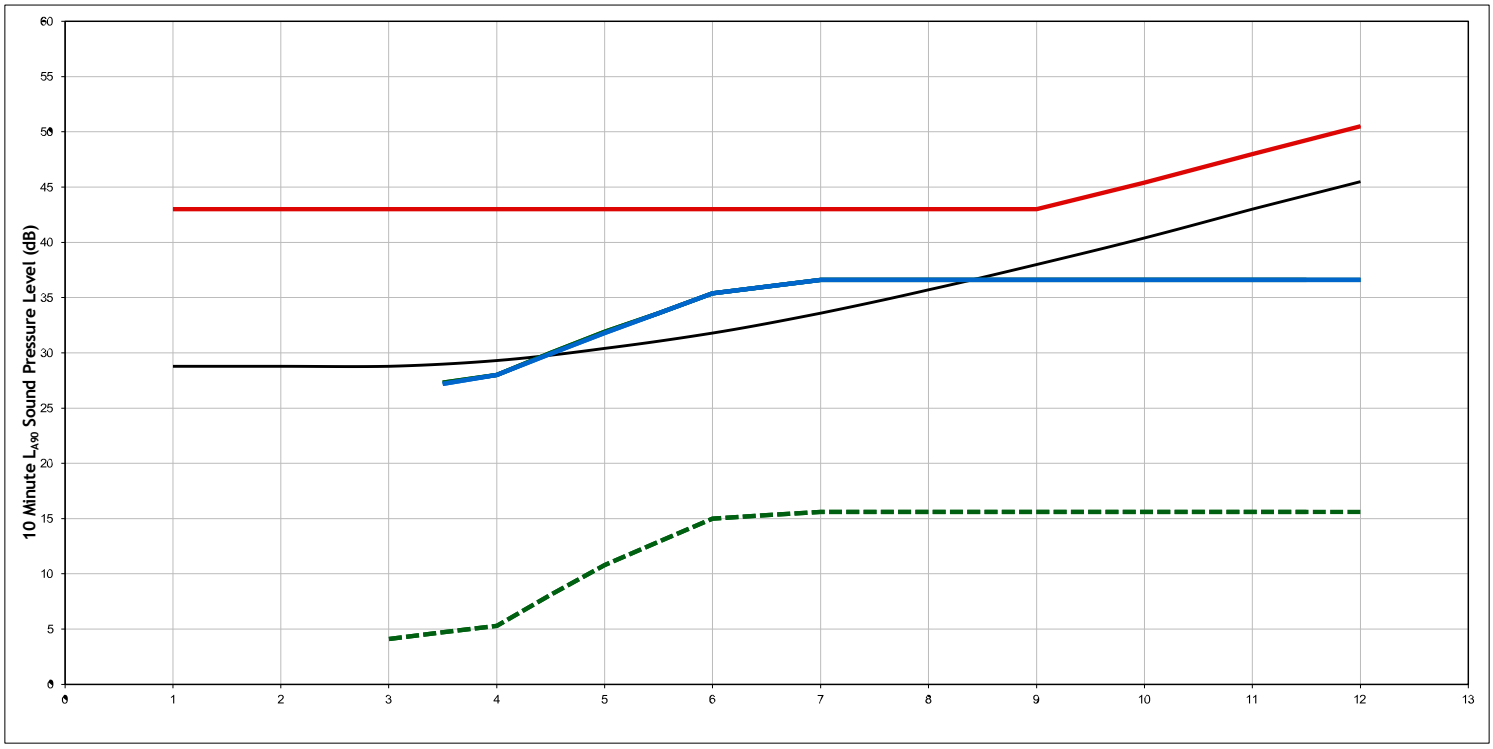
Daytime - Lighthouse Cottage (NAL4)



Night Time - Lighthouse Cottage (NAL4)

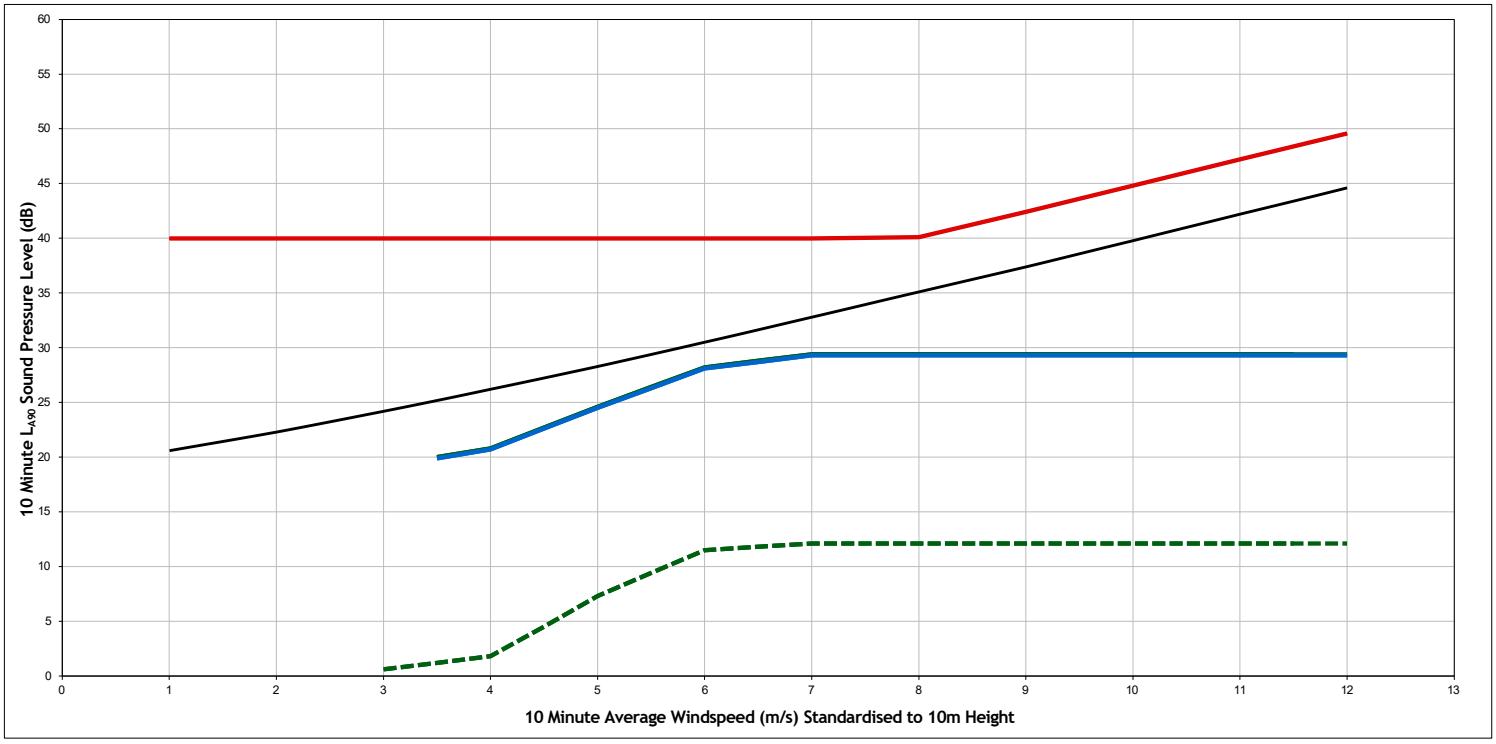


Legend:

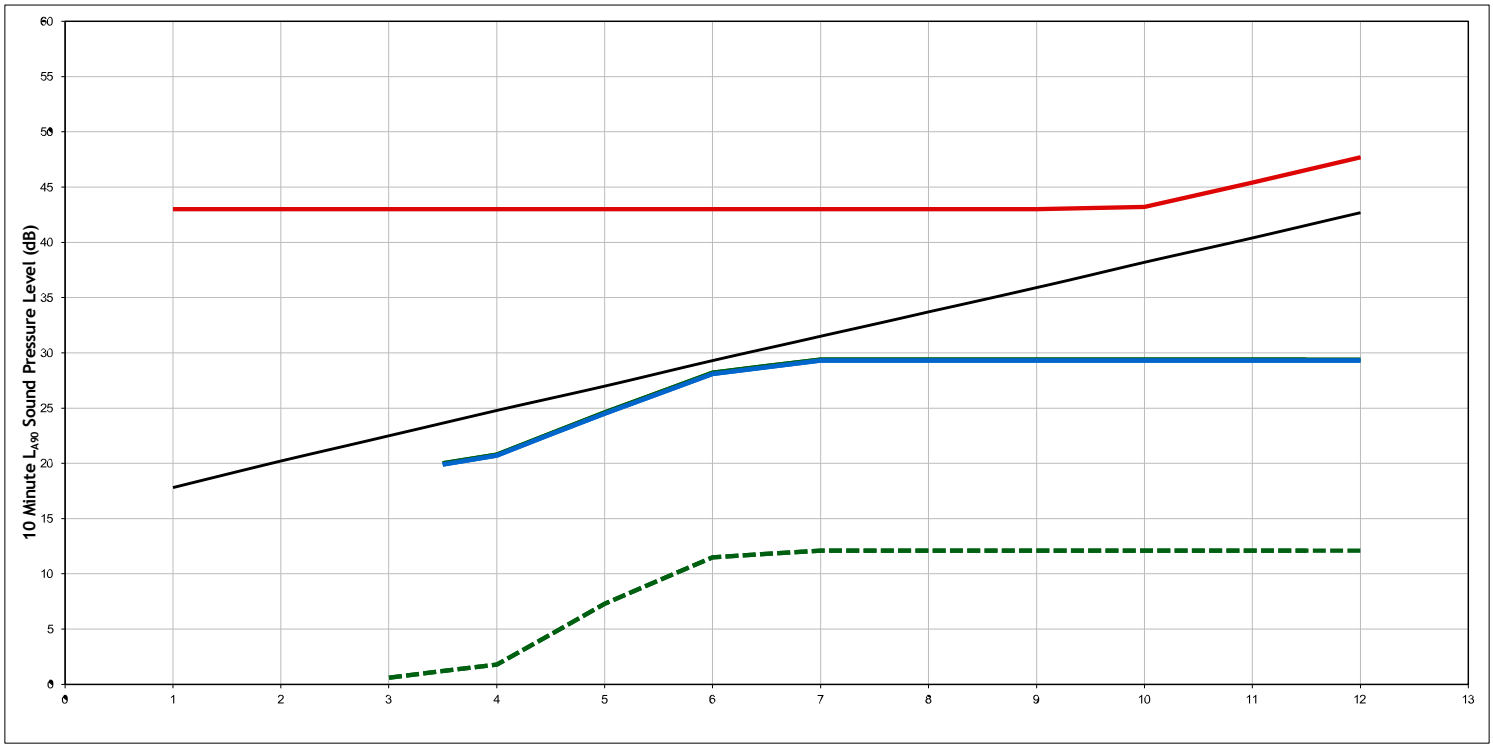
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment Lighthouse Cottage (NAL4)
Figure Number	Figure A1.3d
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - NAL05 (NAL5)



Night Time - NAL05 (NAL5)

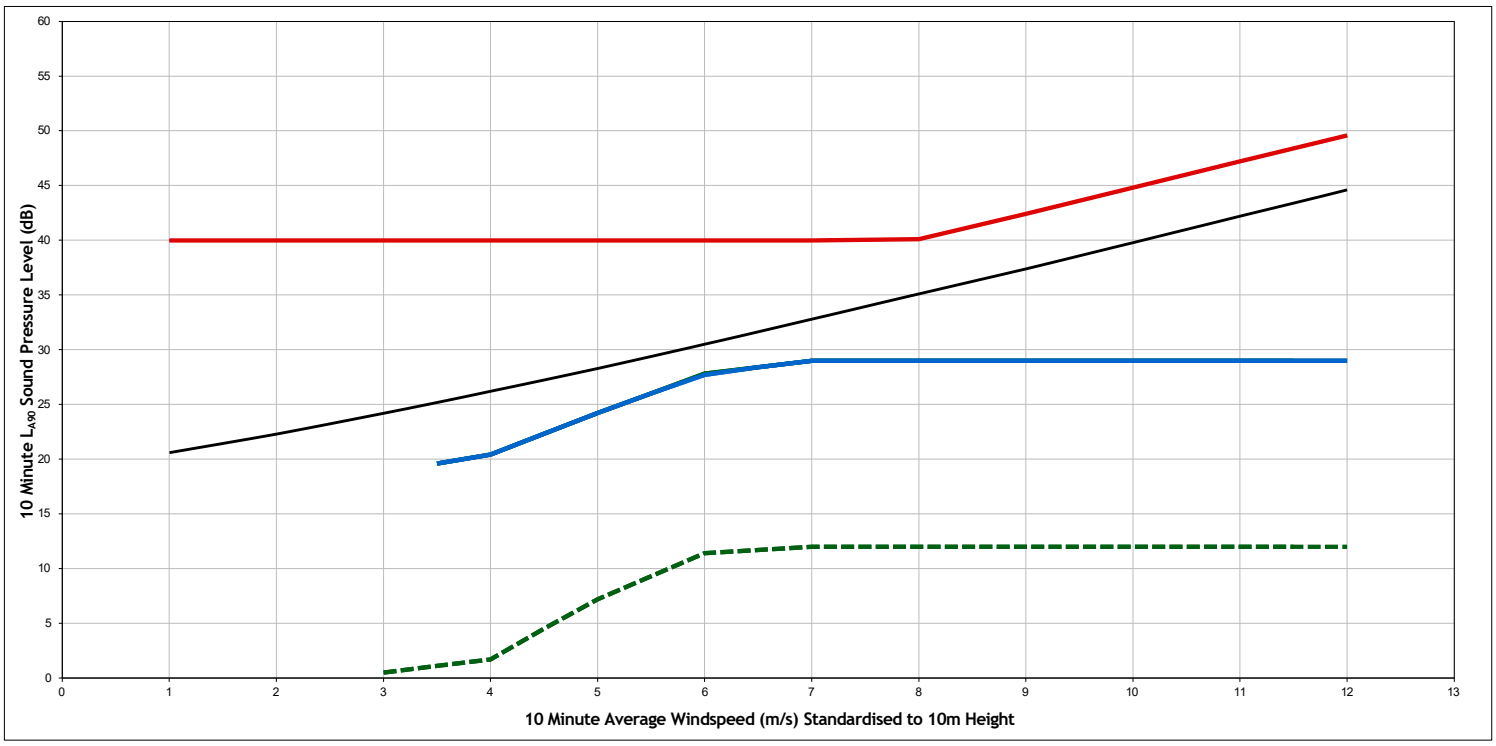


Legend:

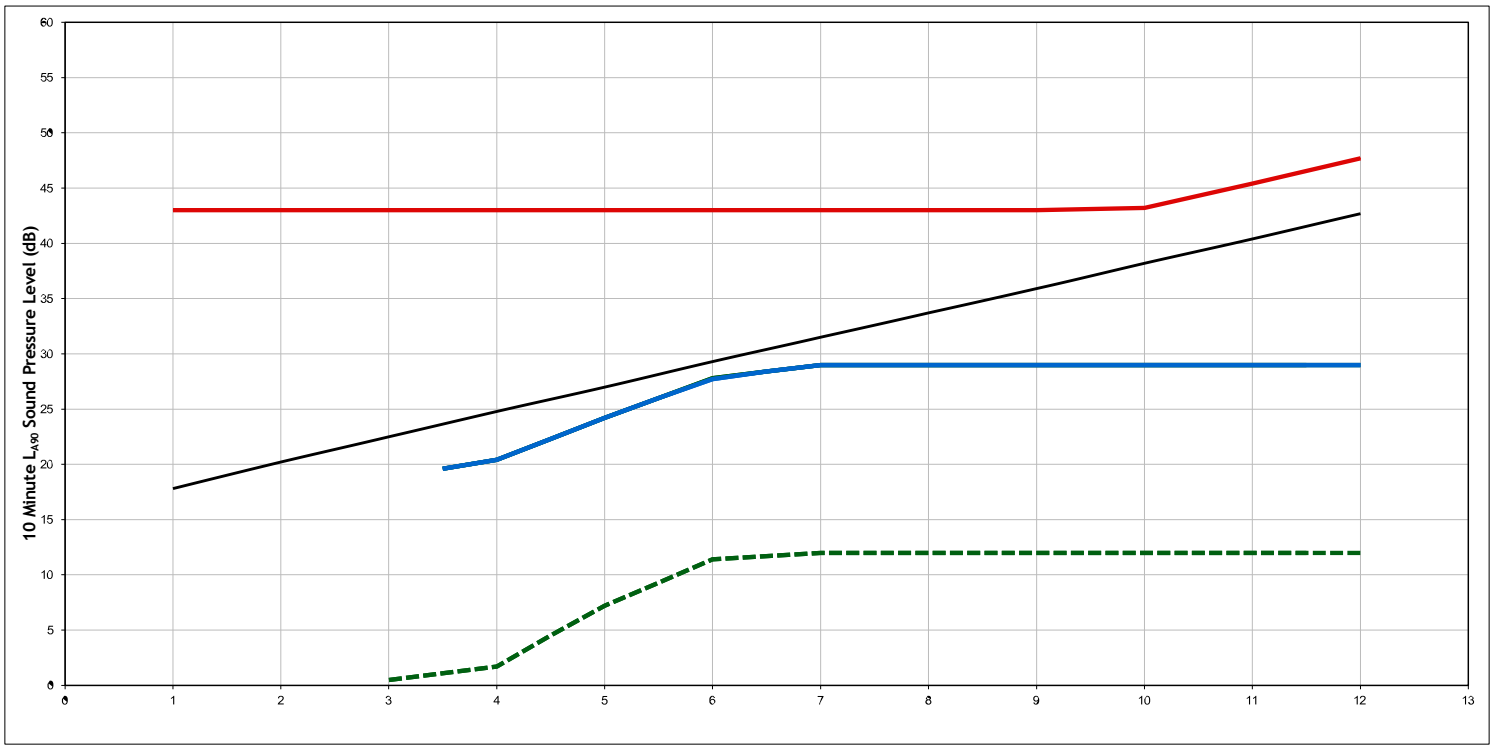
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment
	NAL05 (NAL5)
Figure Number	Figure A1.3e
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Bankhead Straits (NAL6)



Night Time - Bankhead Straits (NAL6)

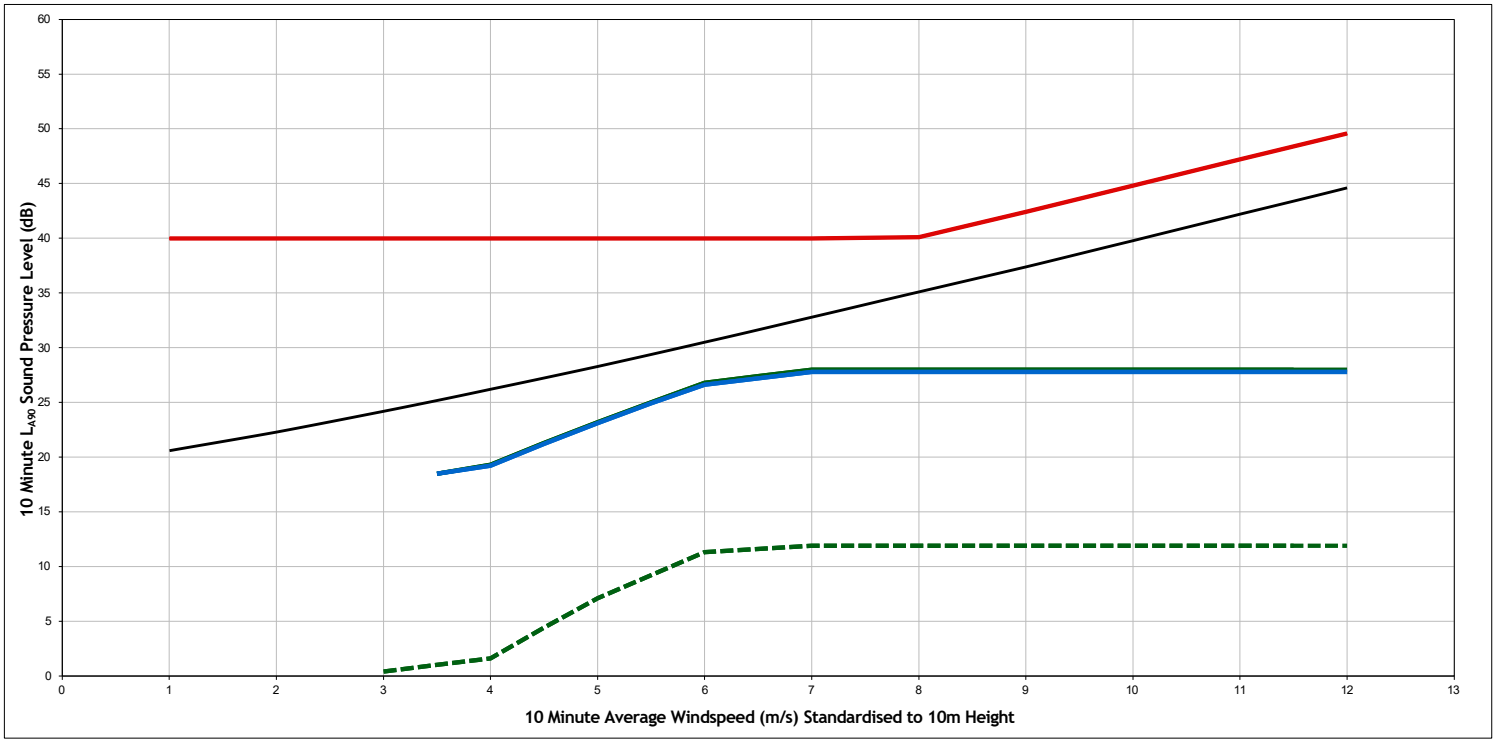


Legend:

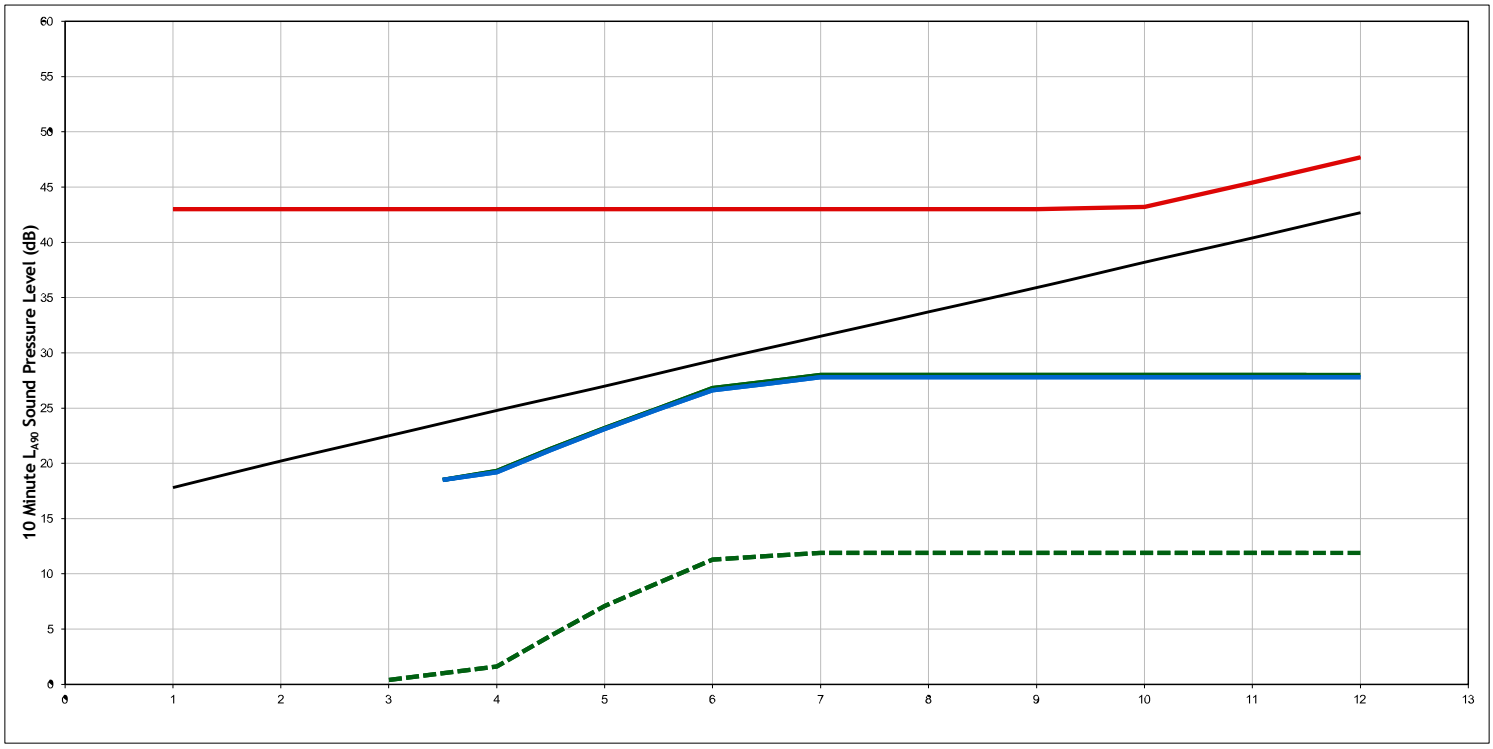
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment Bankhead Straits (NAL6)
Figure Number	Figure A1.3f
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - NAL07 (NAL7)



Night Time - NAL07 (NAL7)

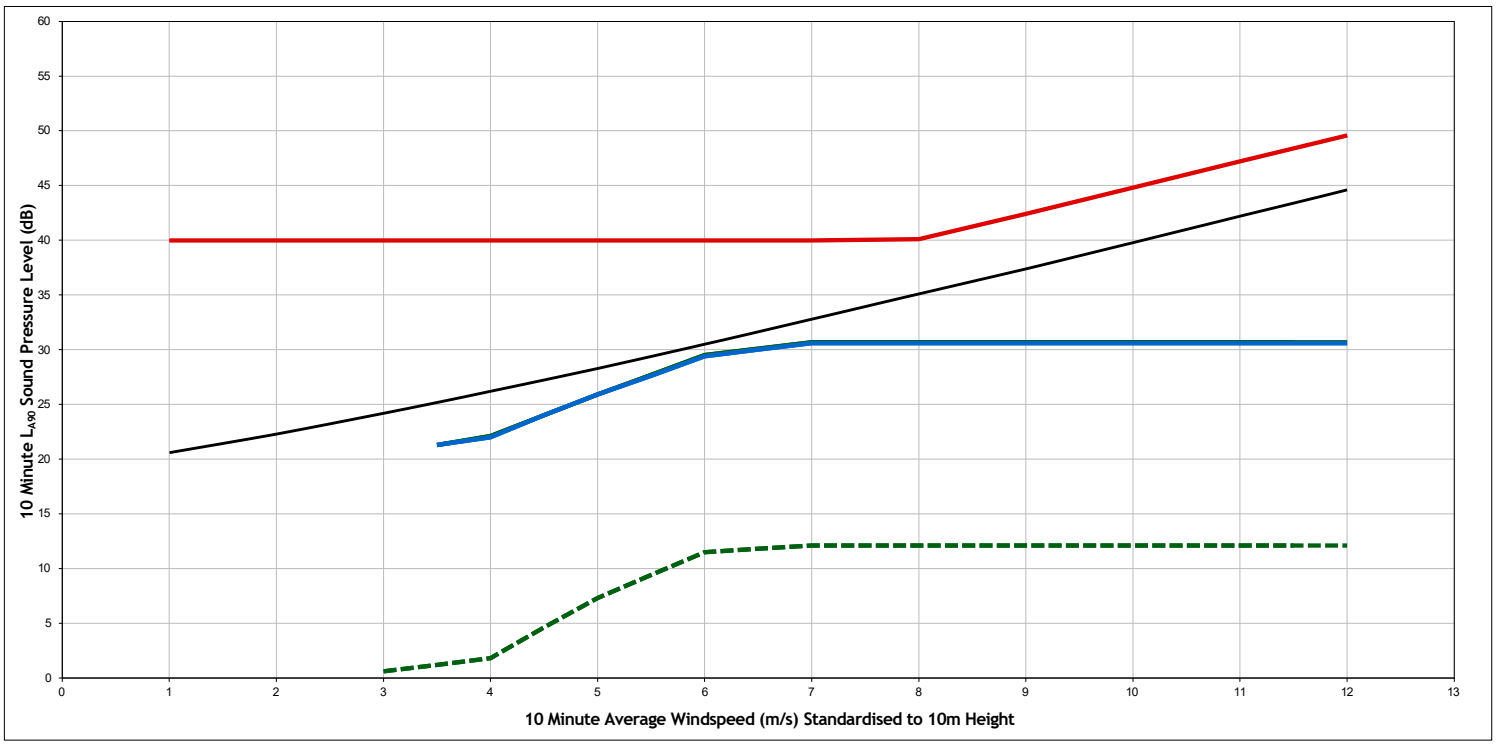


Legend:

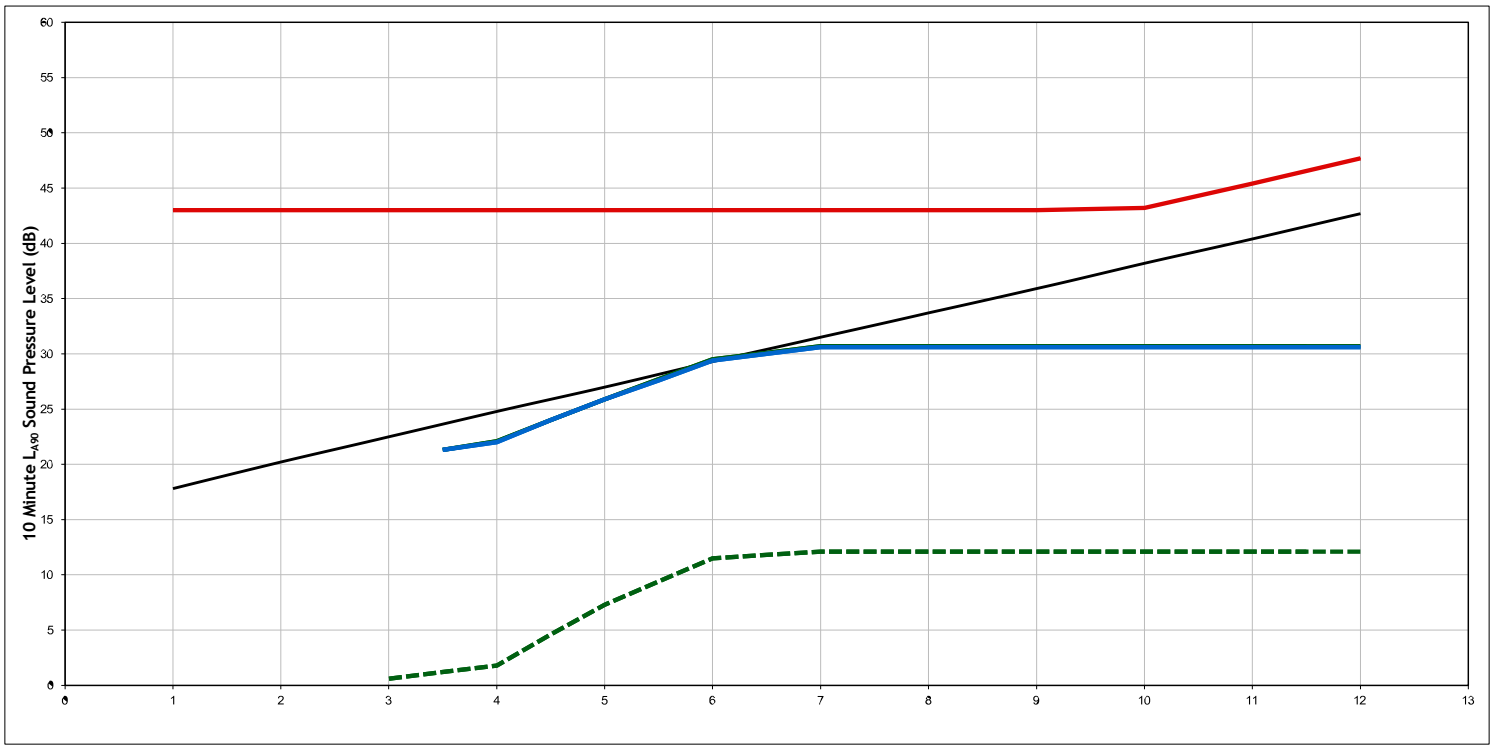
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment NAL07 (NAL7)
Figure Number	Figure A1.3g
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - 15 Maidenfield (NAL8)



Night Time - 15 Maidenfield (NAL8)

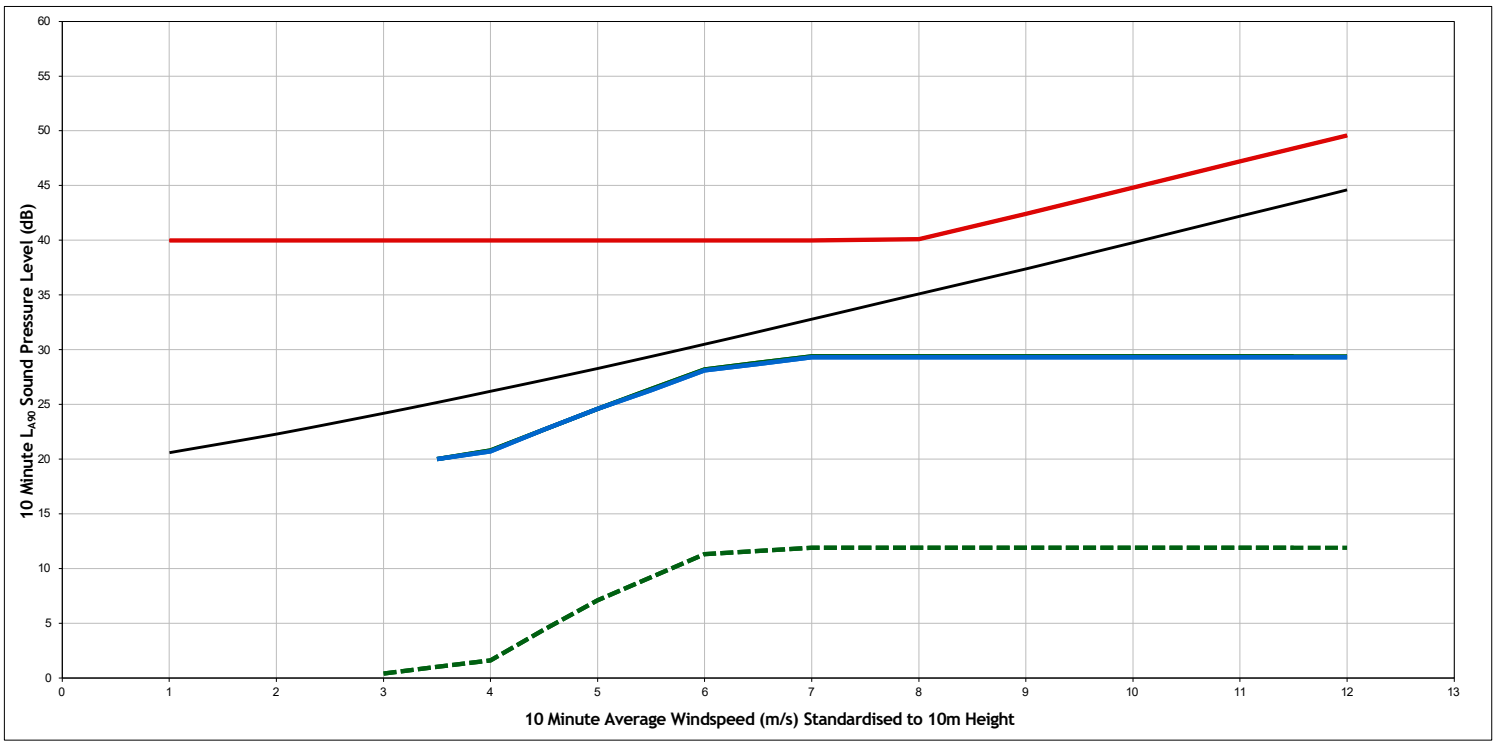


Legend:

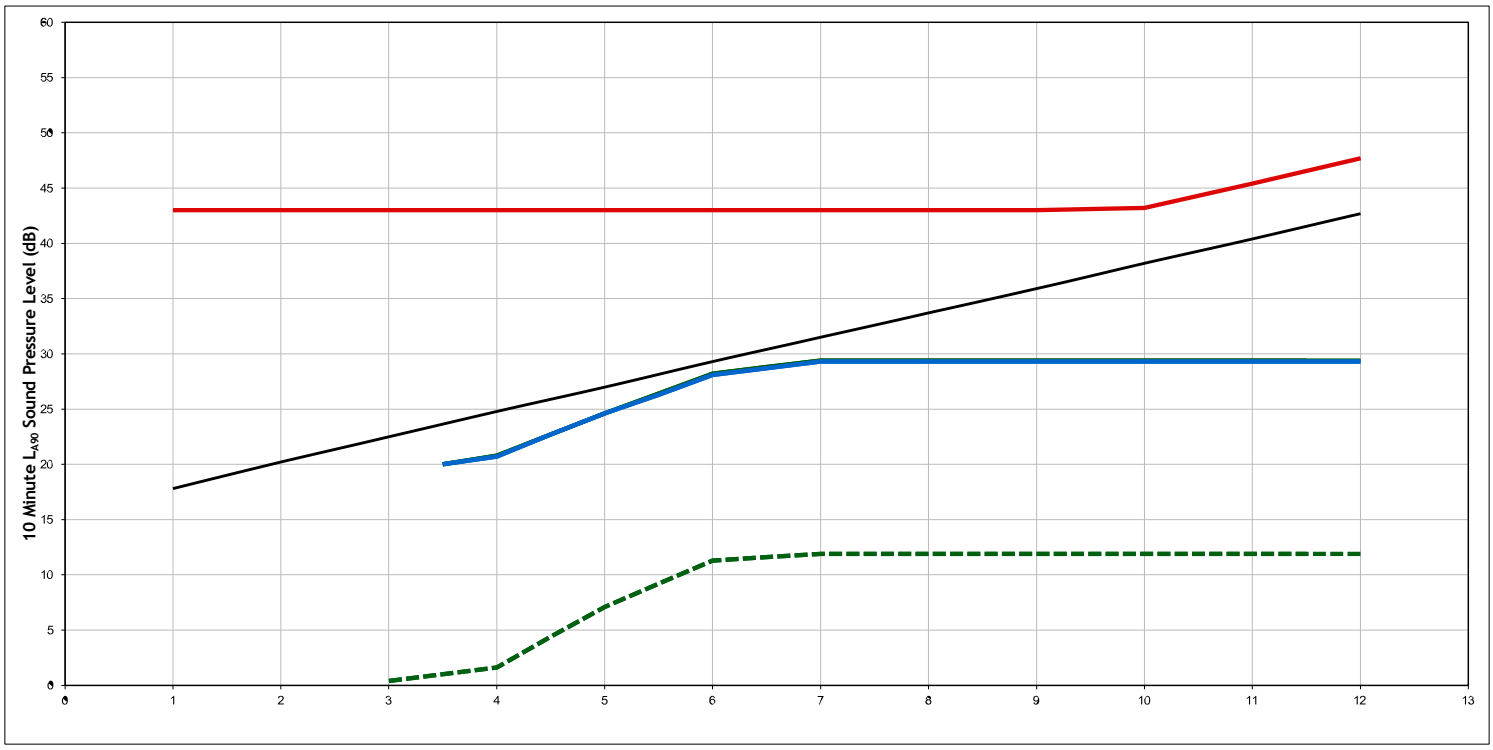
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment 15 Maidenfield (NAL8)
Figure Number	Figure A1.3h
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - NAL09 (NAL9)



Night Time - NAL09 (NAL9)

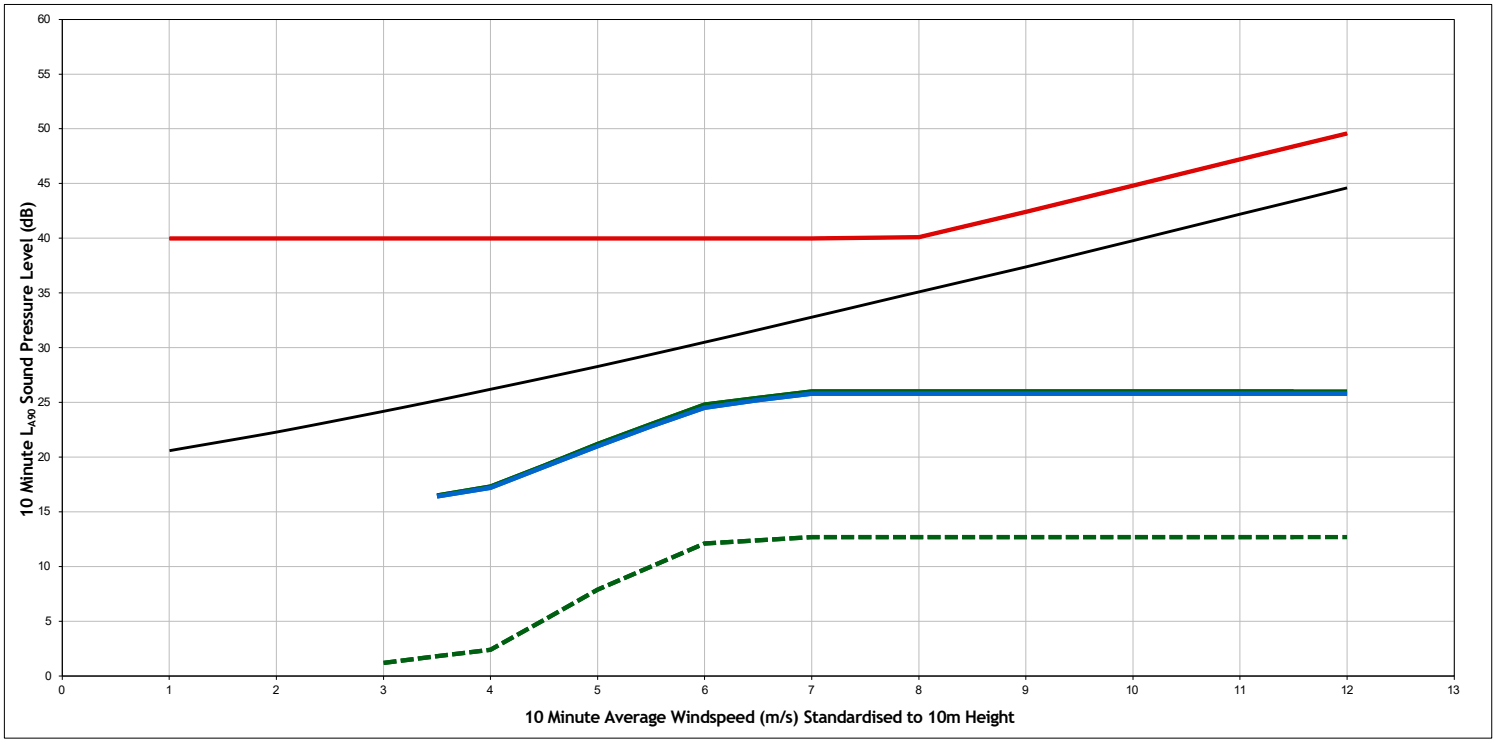


Legend:

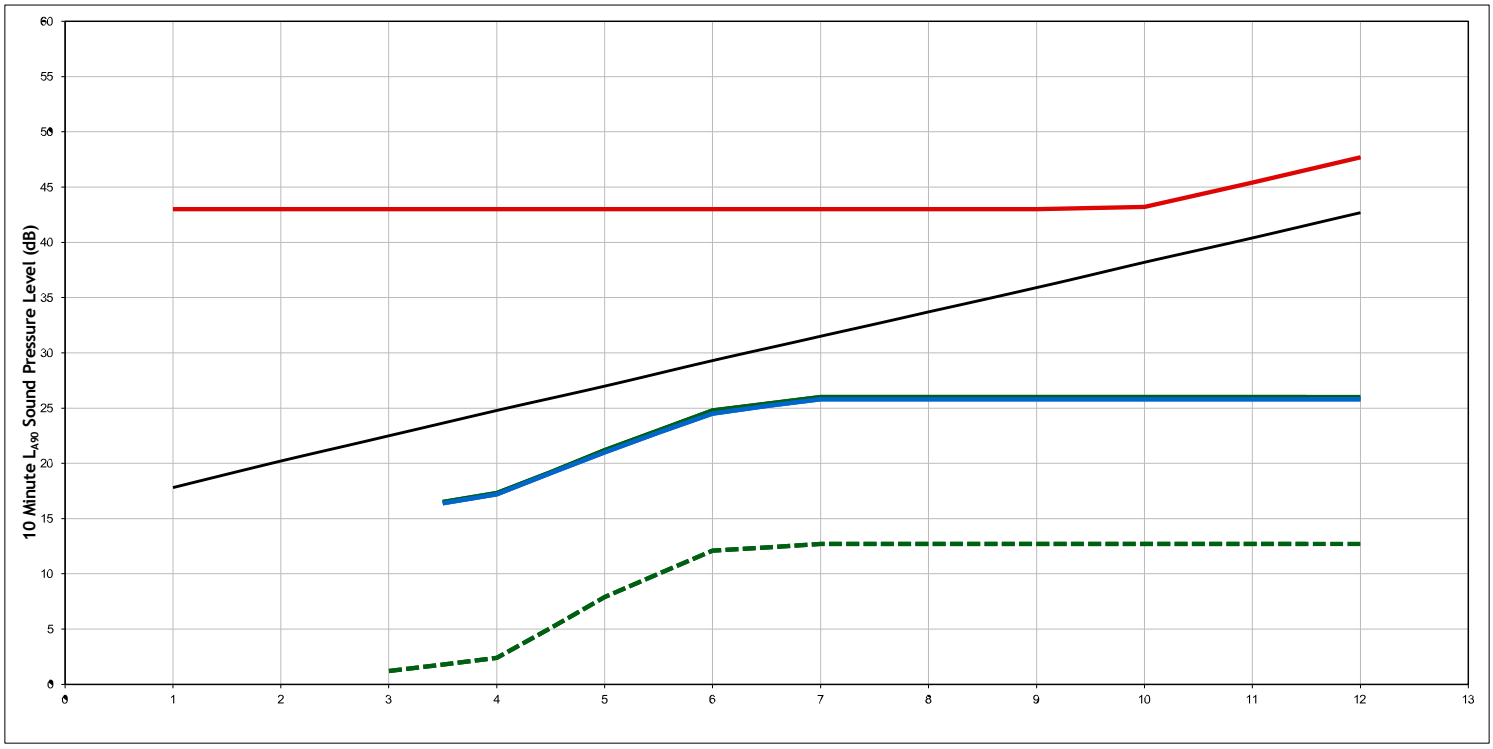
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment
	NAL09 (NAL9)
Figure Number	Figure A1.3i
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - 10 Leaside (NAL10)



Night Time - 10 Leaside (NAL10)

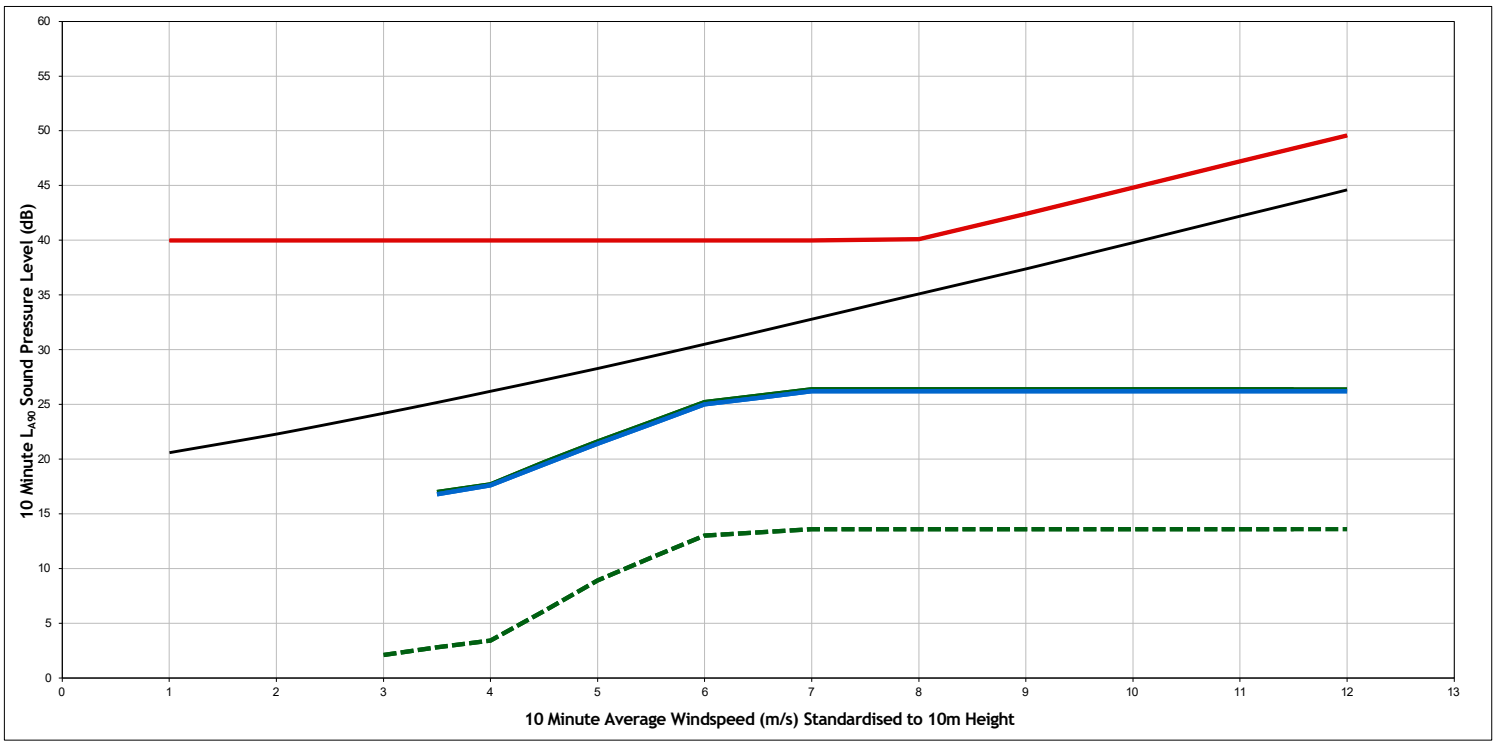


Legend:

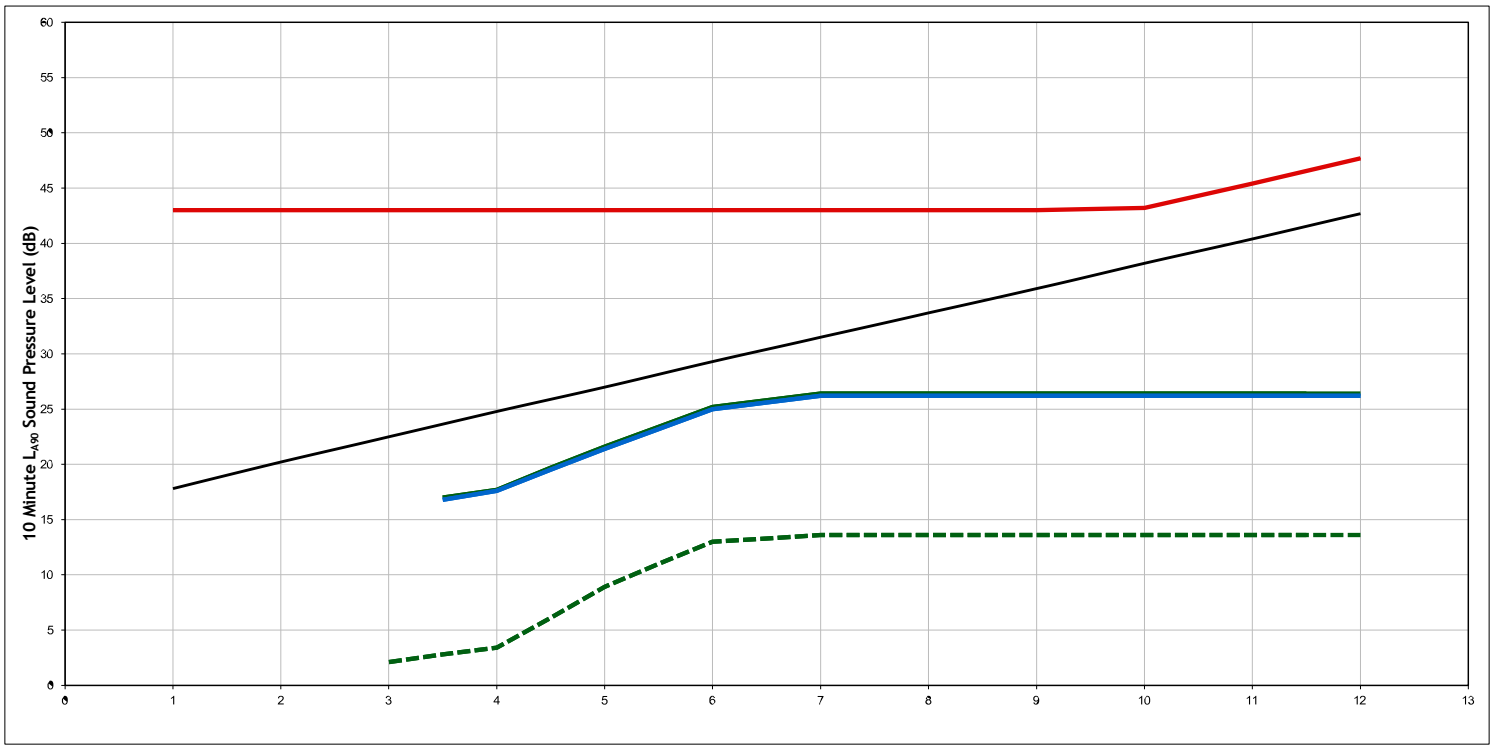
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment 10 Leaside (NAL10)
Figure Number	Figure A1.3j
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - NAL11 (NAL11)



Night Time - NAL11 (NAL11)

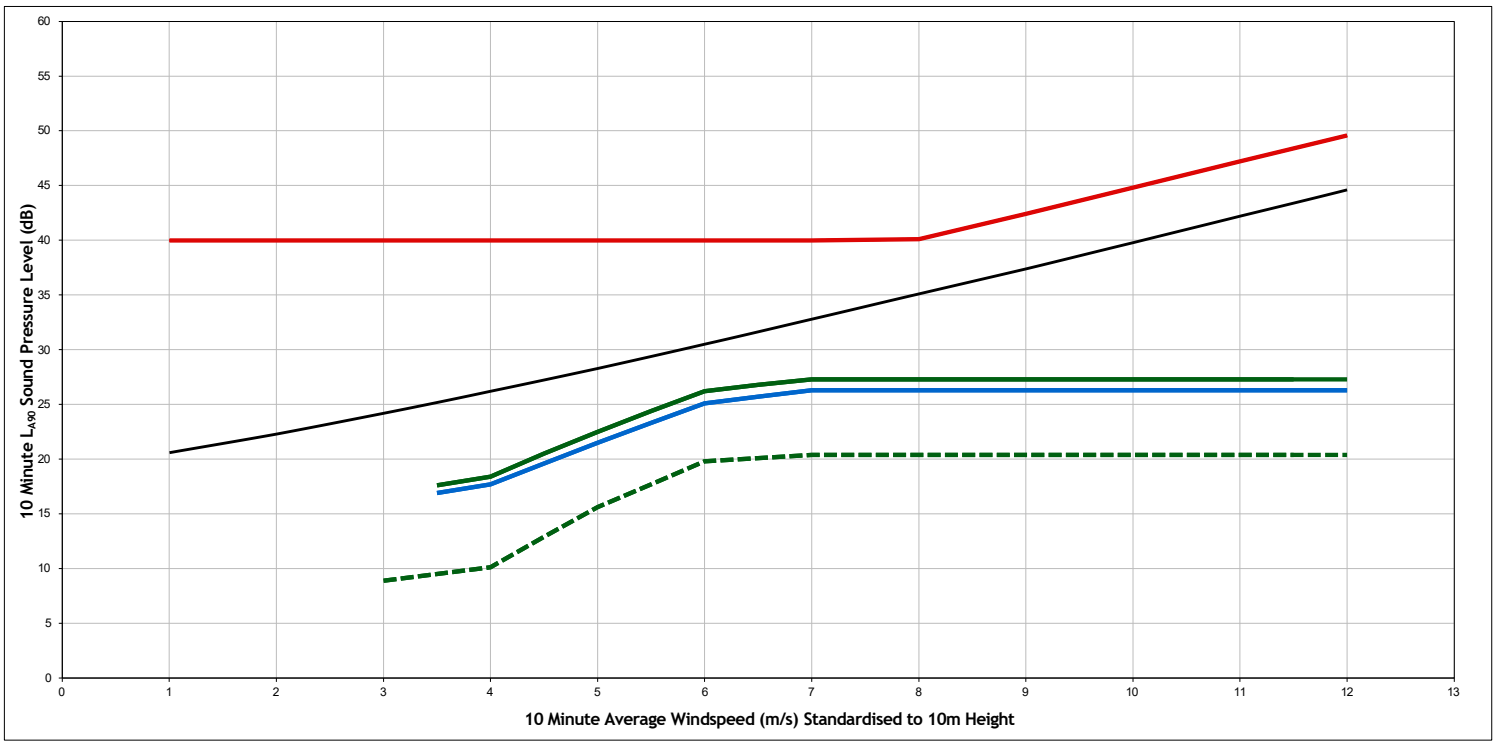


Legend:

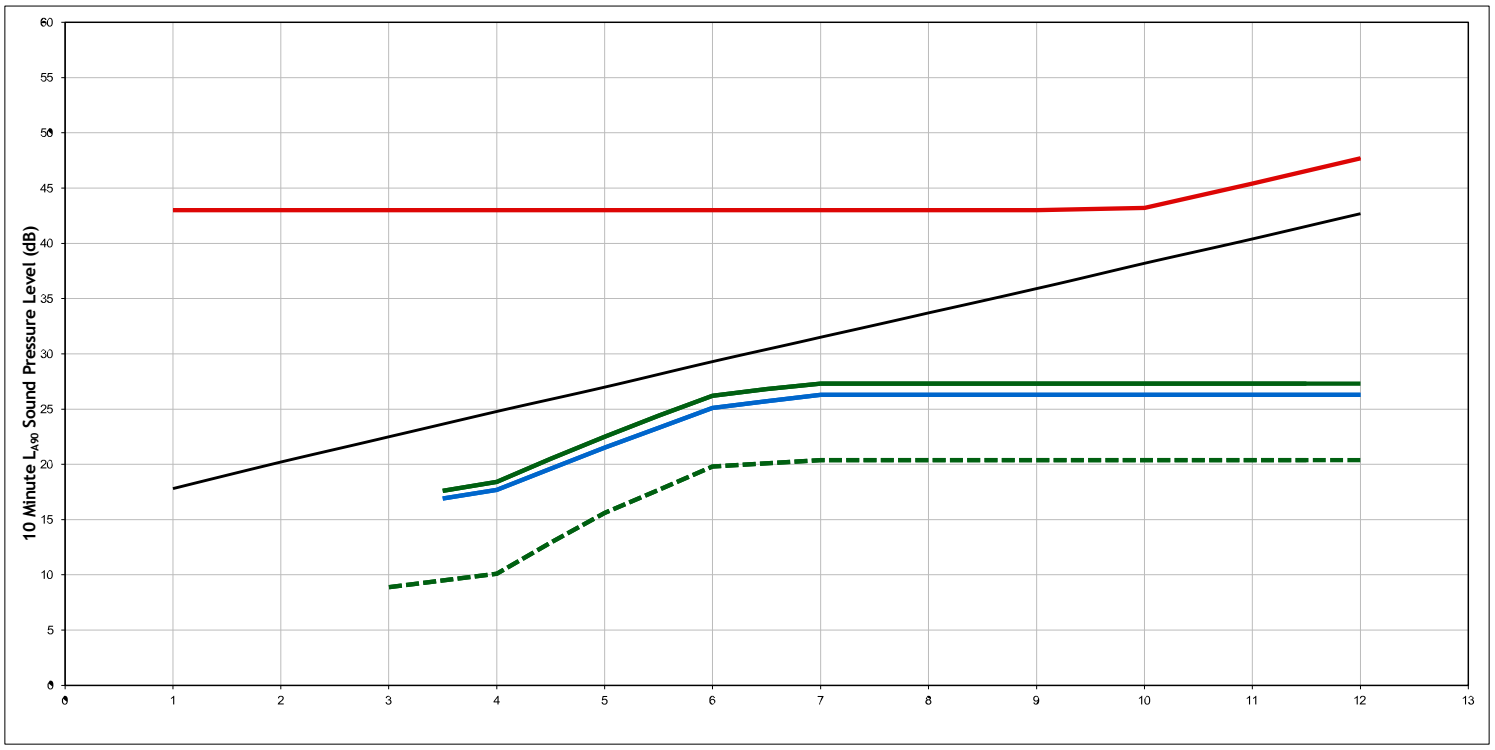
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment
	NAL11 (NAL11)
Figure Number	Figure A1.3k
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Moorfield (NAL12)



Night Time - Moorfield (NAL12)

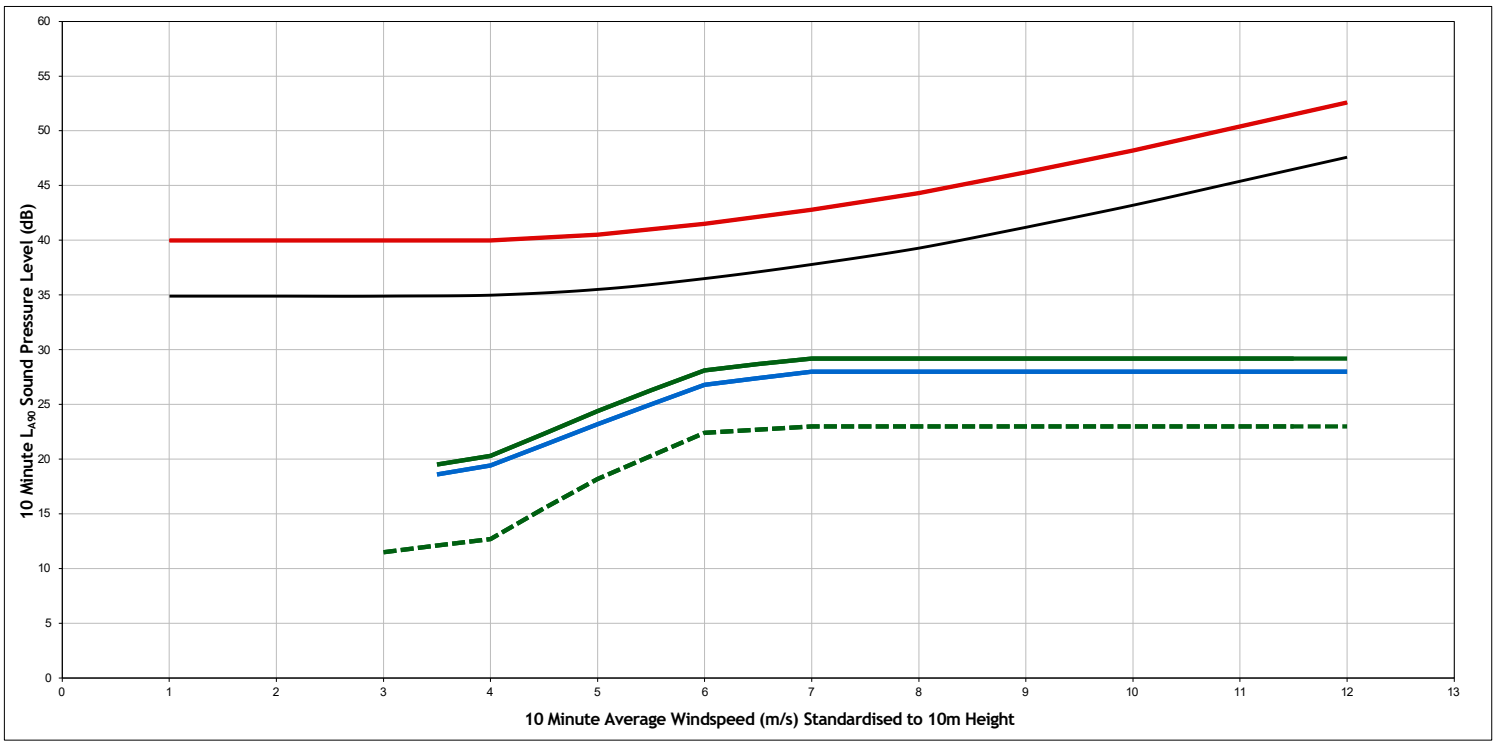


Legend:

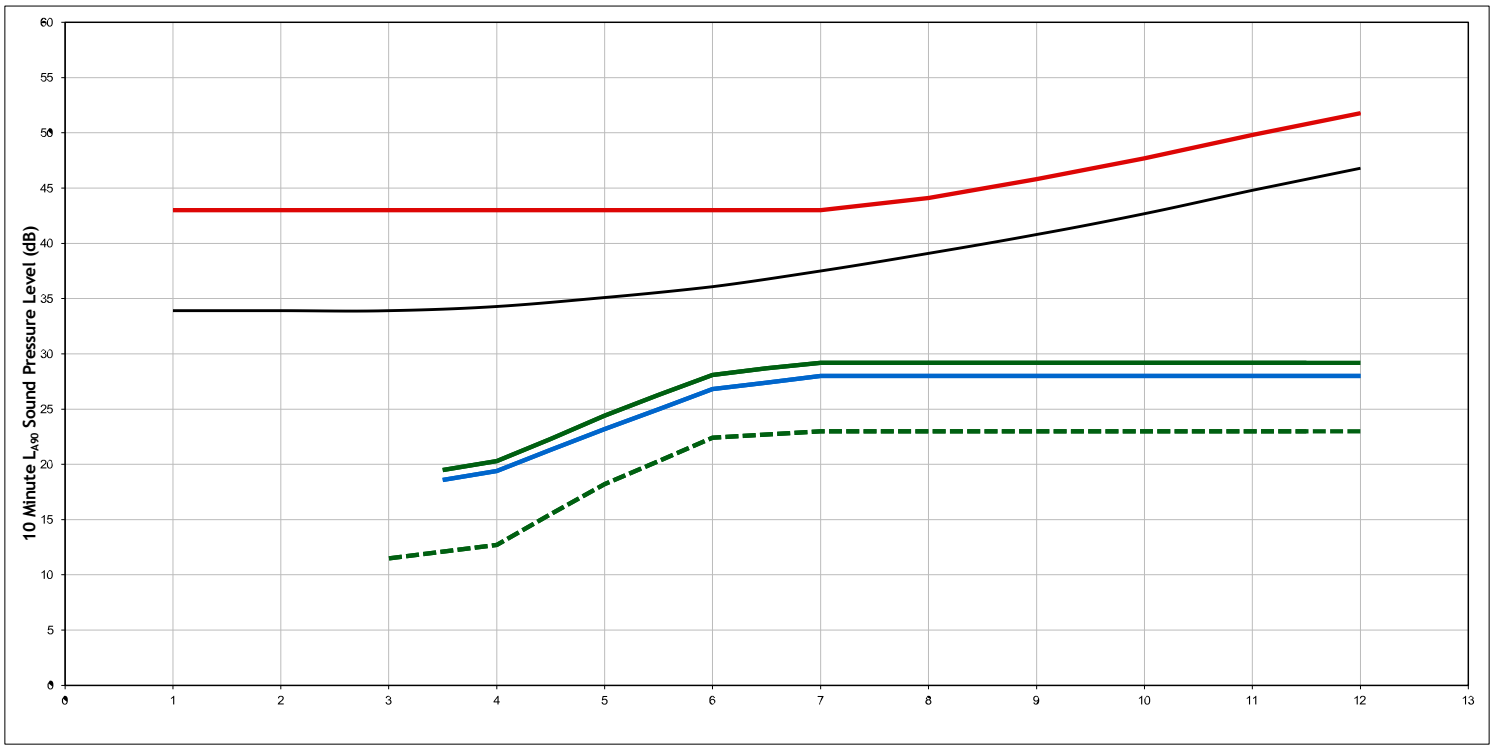
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment Moorfield (NAL12)
Figure Number	Figure A1.3l
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Laxobigging (NAL13)



Night Time - Laxobigging (NAL13)

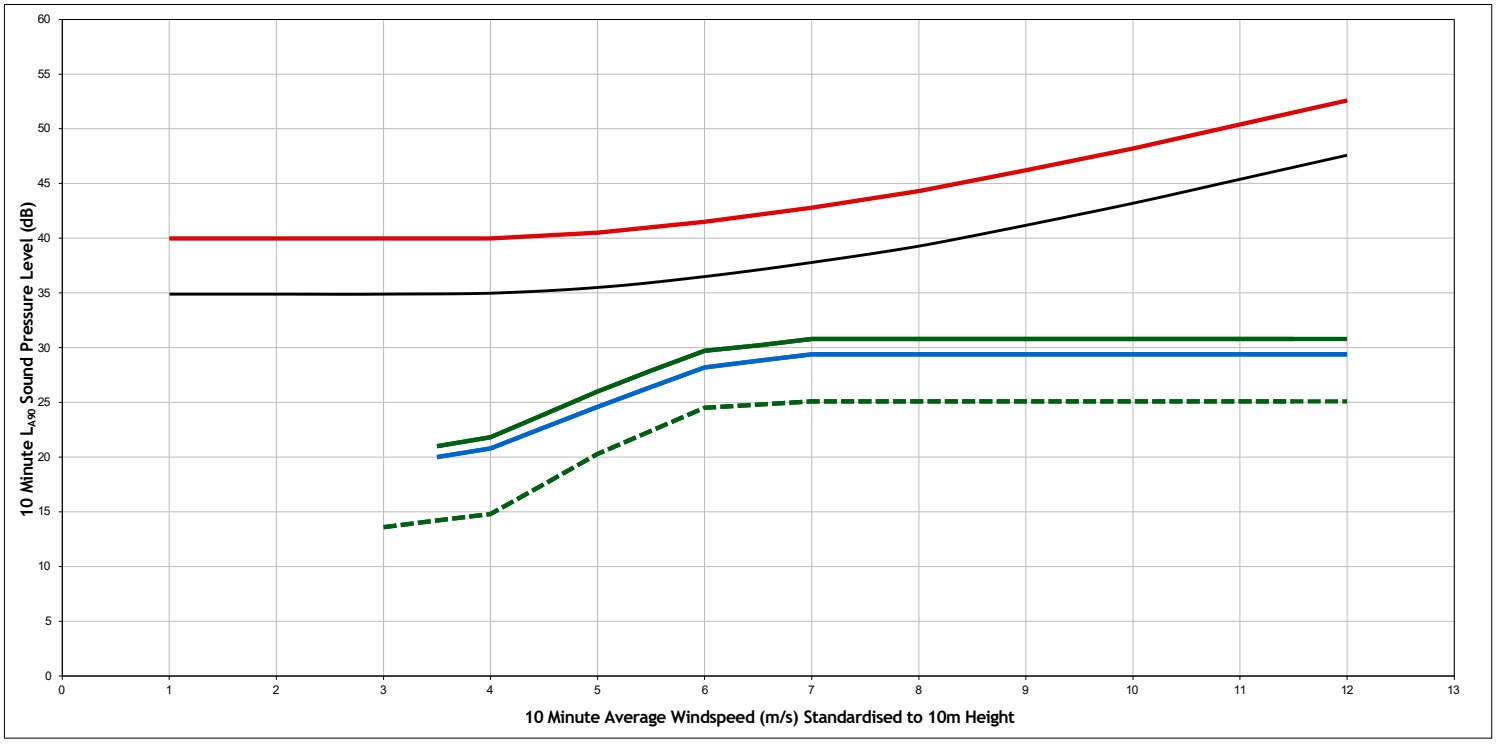


Legend:

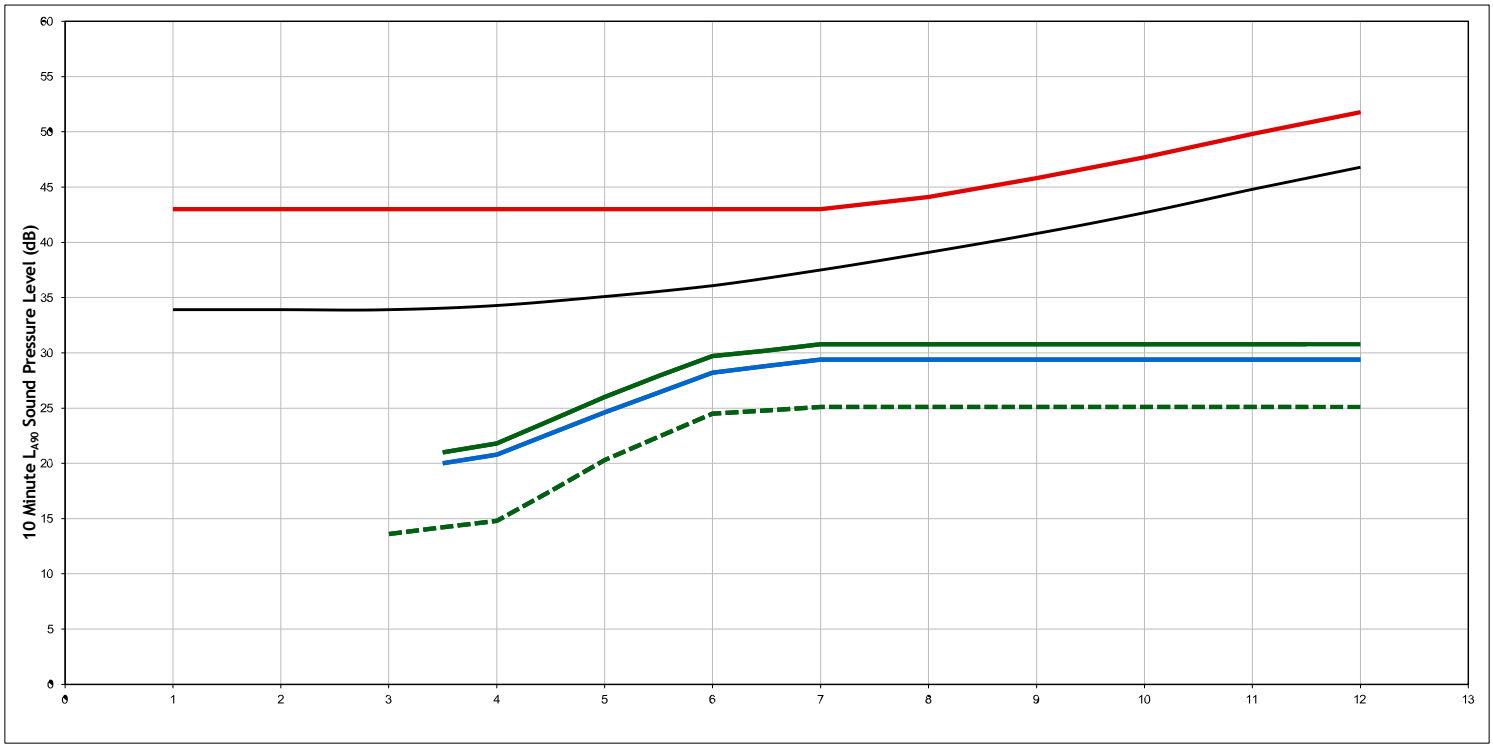
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment Laxobigging (NAL13)
Figure Number	Figure A1.3m
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Millburn (NAL14)



Night Time - Millburn (NAL14)

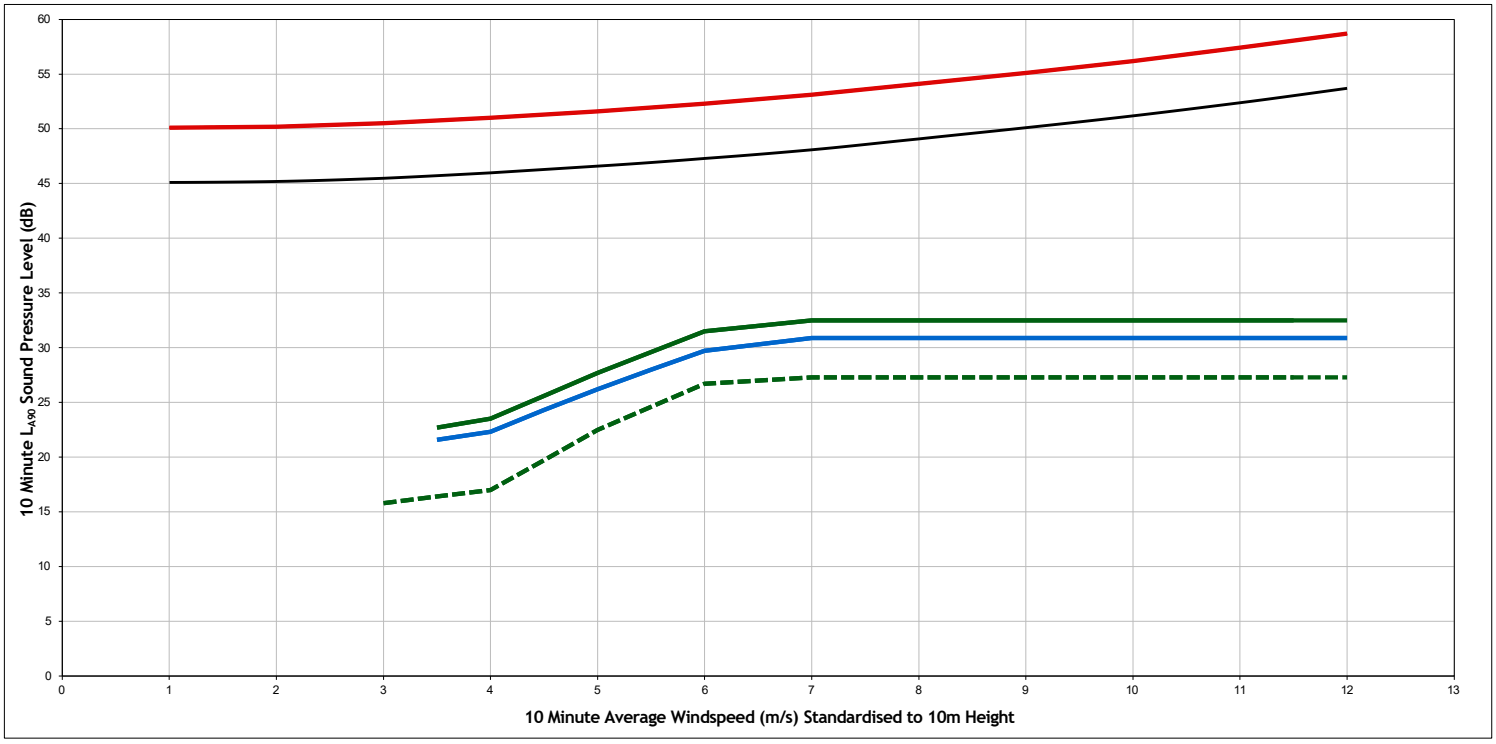


Legend:

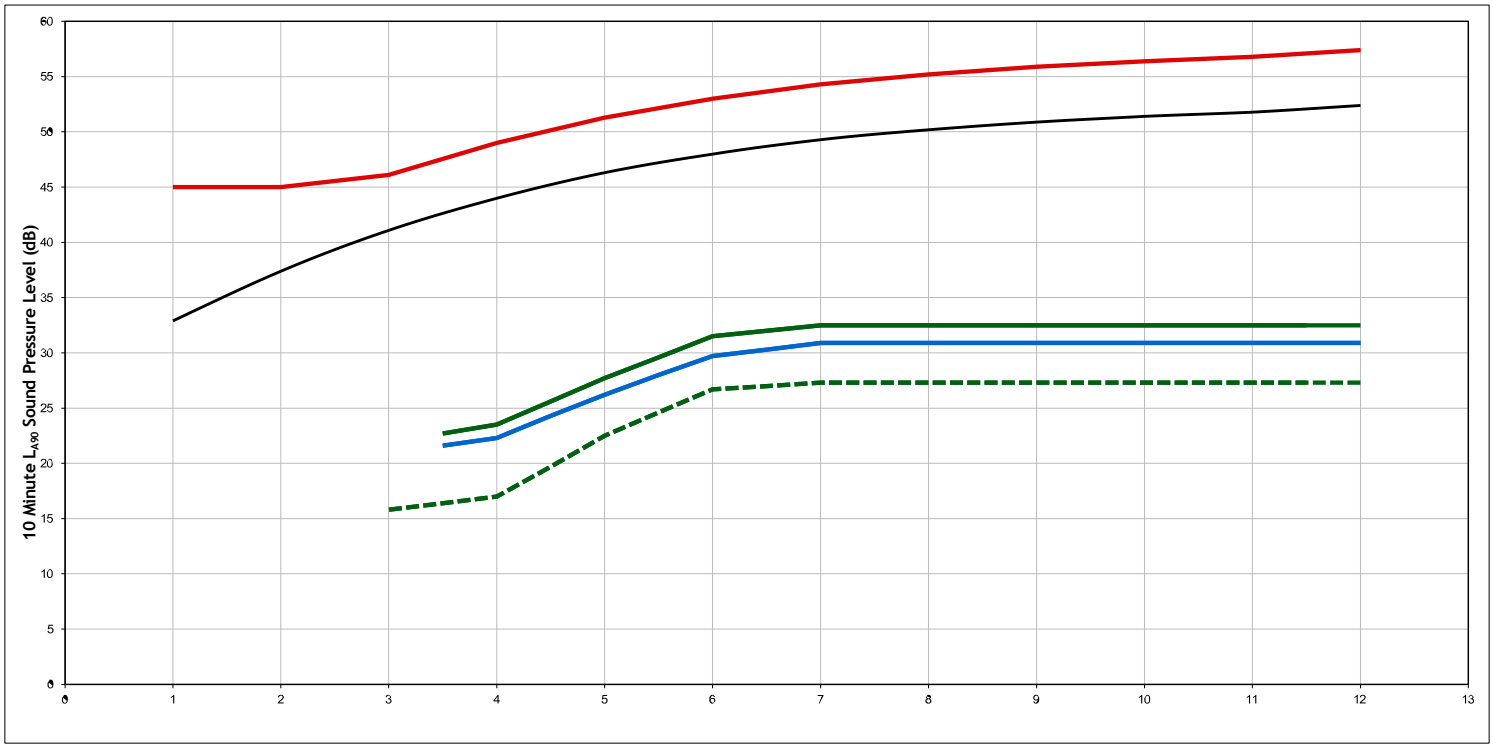
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment Millburn (NAL14)
Figure Number	Figure A1.3n
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Garth Farmhouse (NAL15)



Night Time - Garth Farmhouse (NAL15)

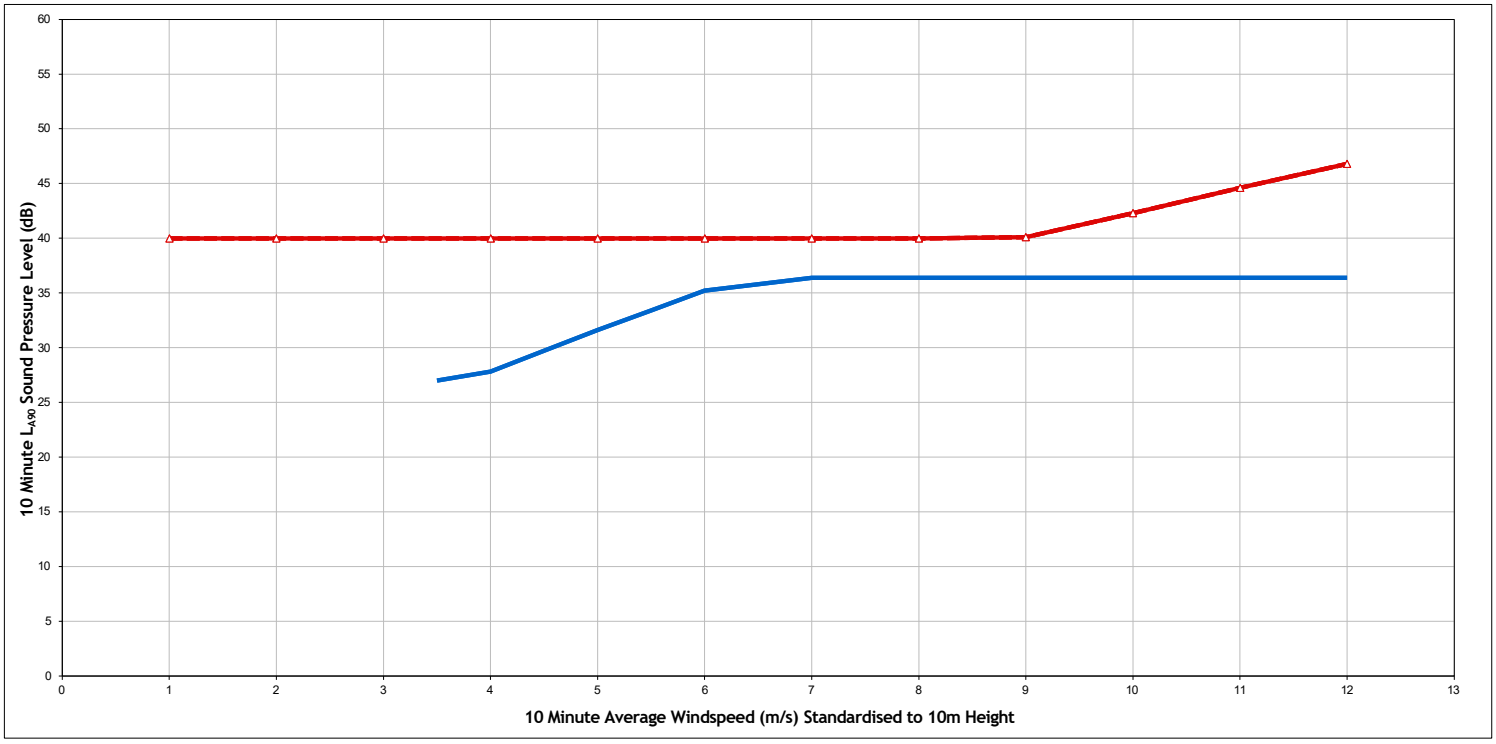


Legend:

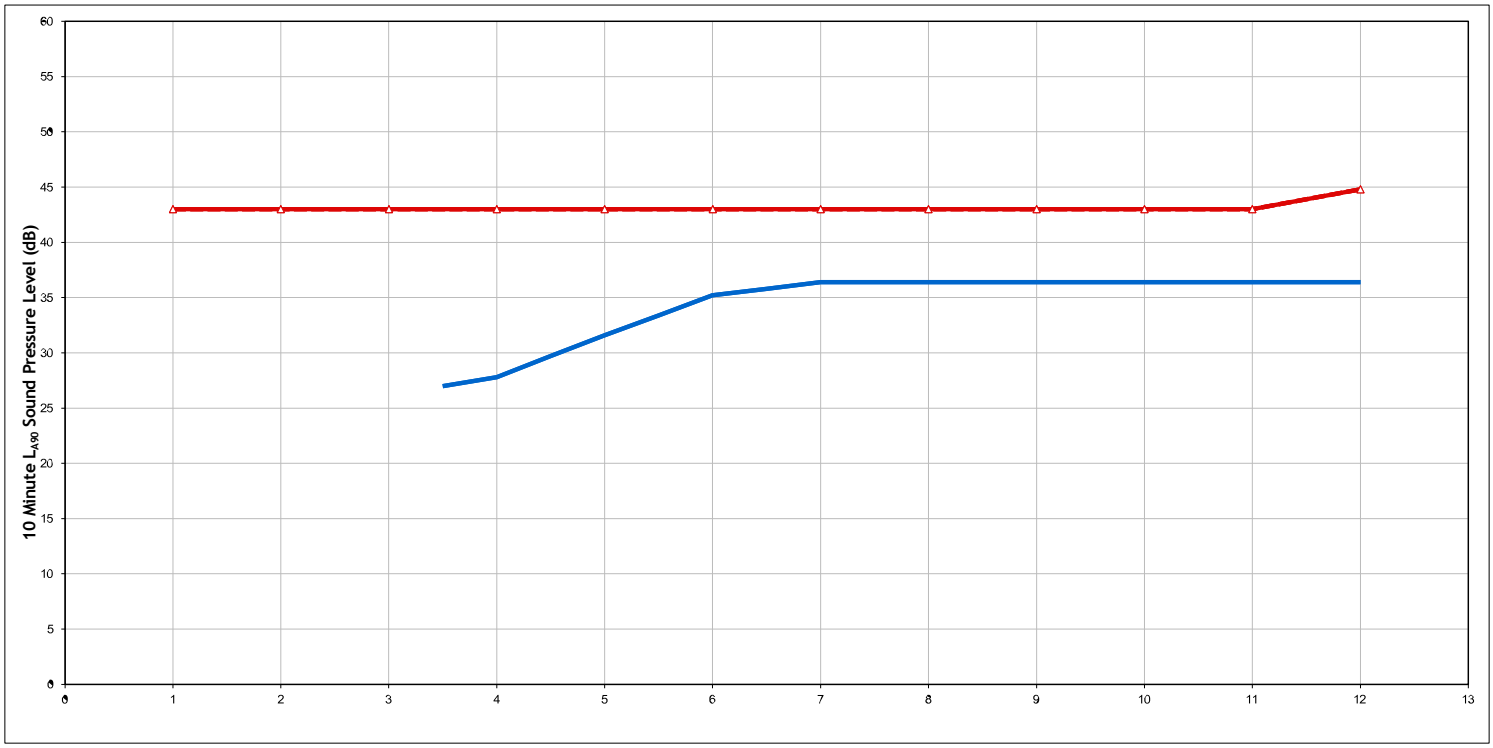
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative (including Proposed Development)
- Sullom Voe Terminal Wind Turbines
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Noise Assessment Garth Farmhouse (NAL15)
Figure Number	Figure A1.3o
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - The Brough (NAL1)



Night Time - The Brough (NAL1)

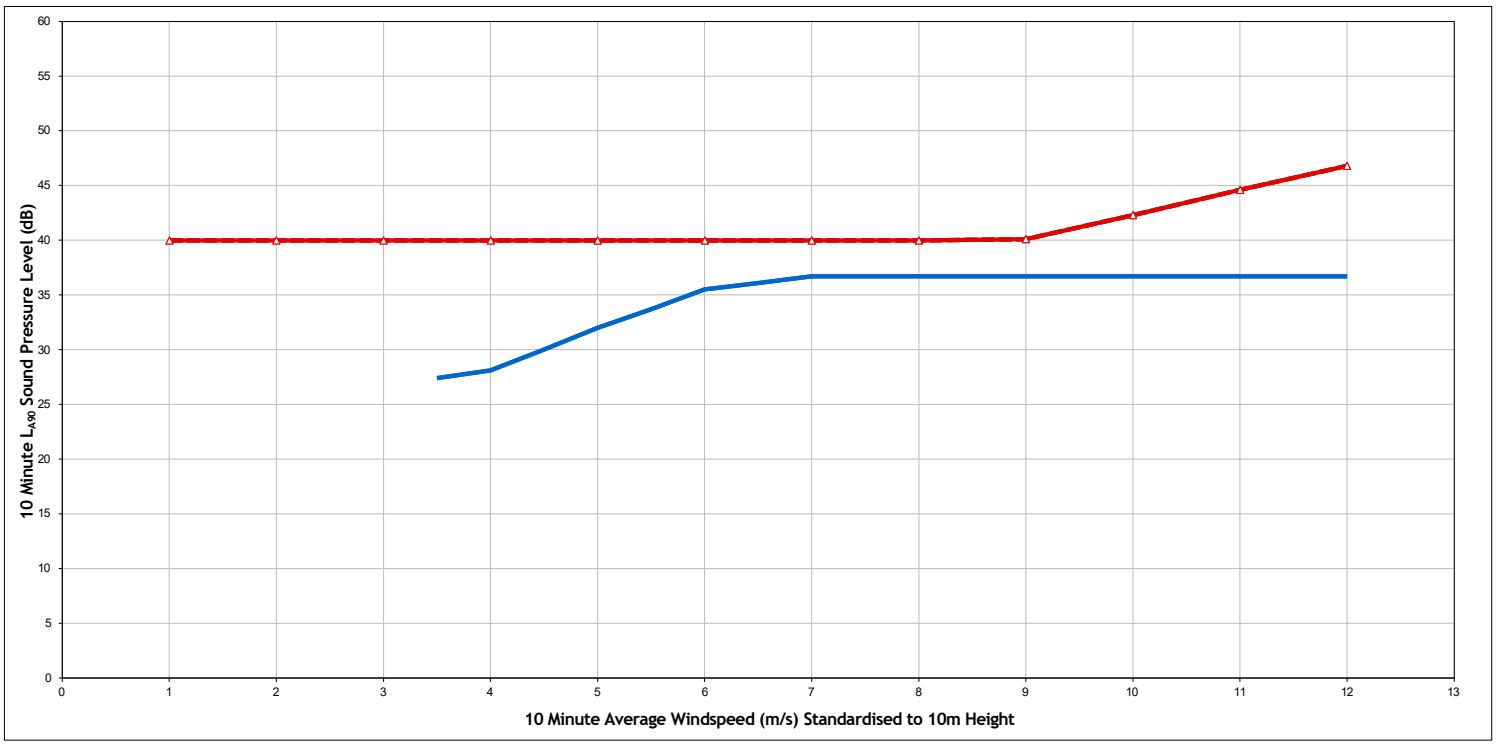


Legend:

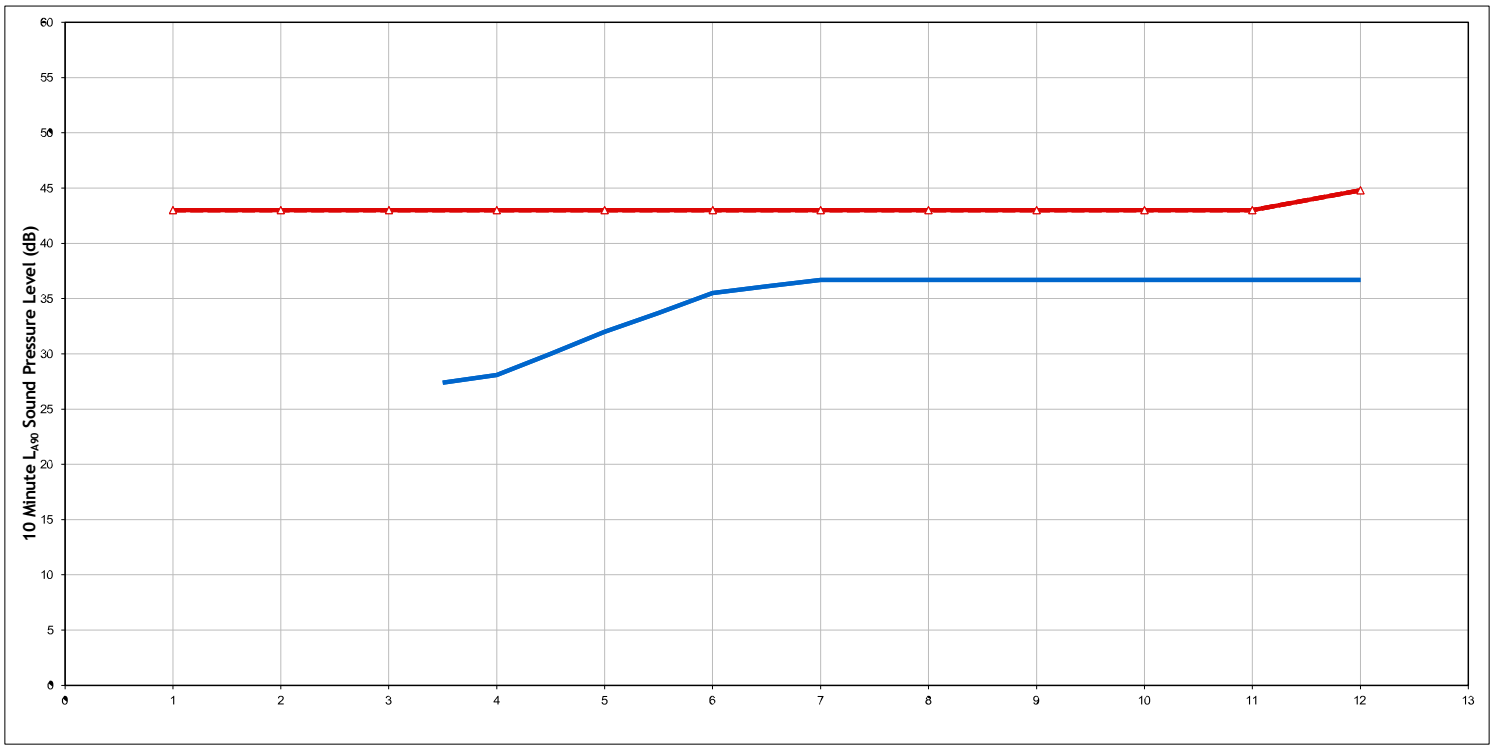
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions The Brough (NAL1)
Figure Number	Figure A1.4a
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Norden (NAL2)



Night Time - Norden (NAL2)

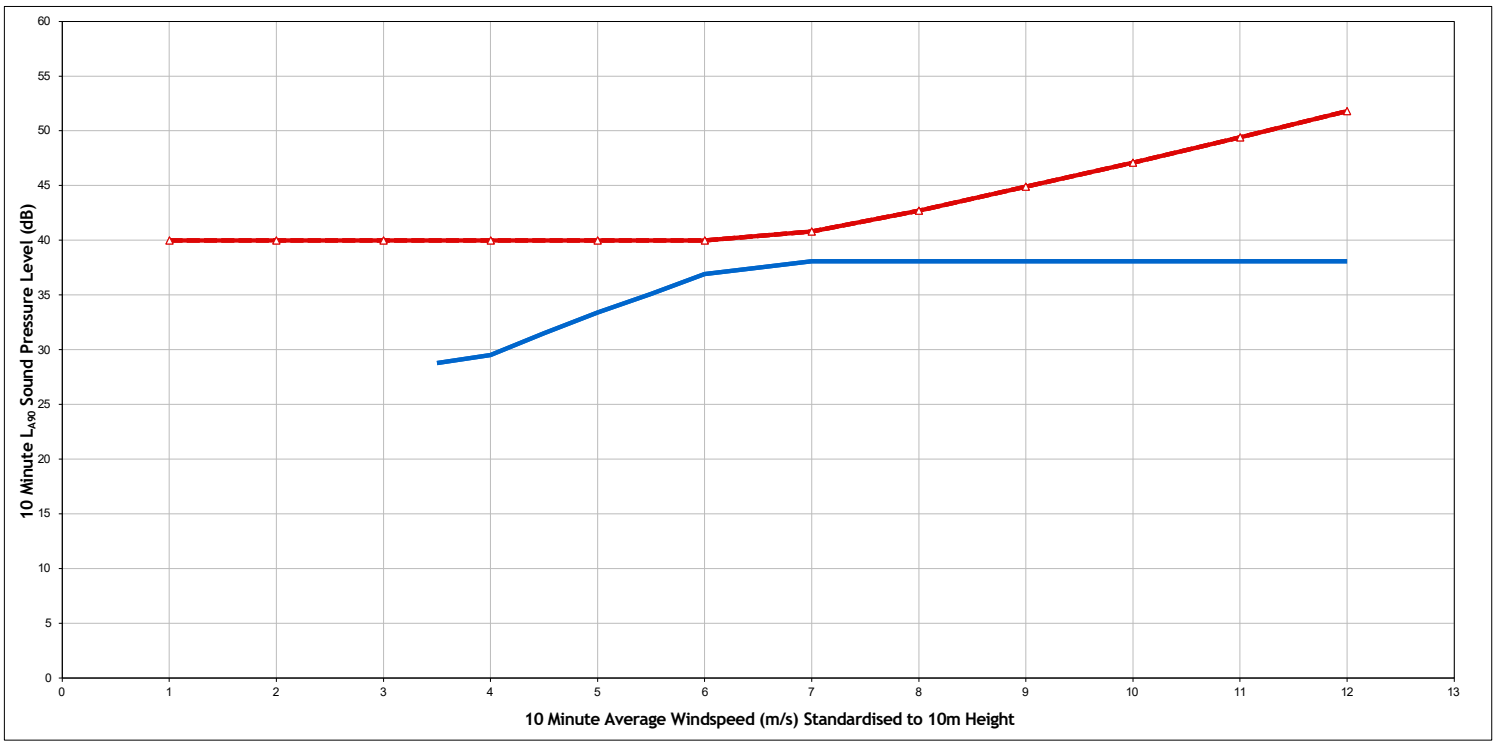


Legend:

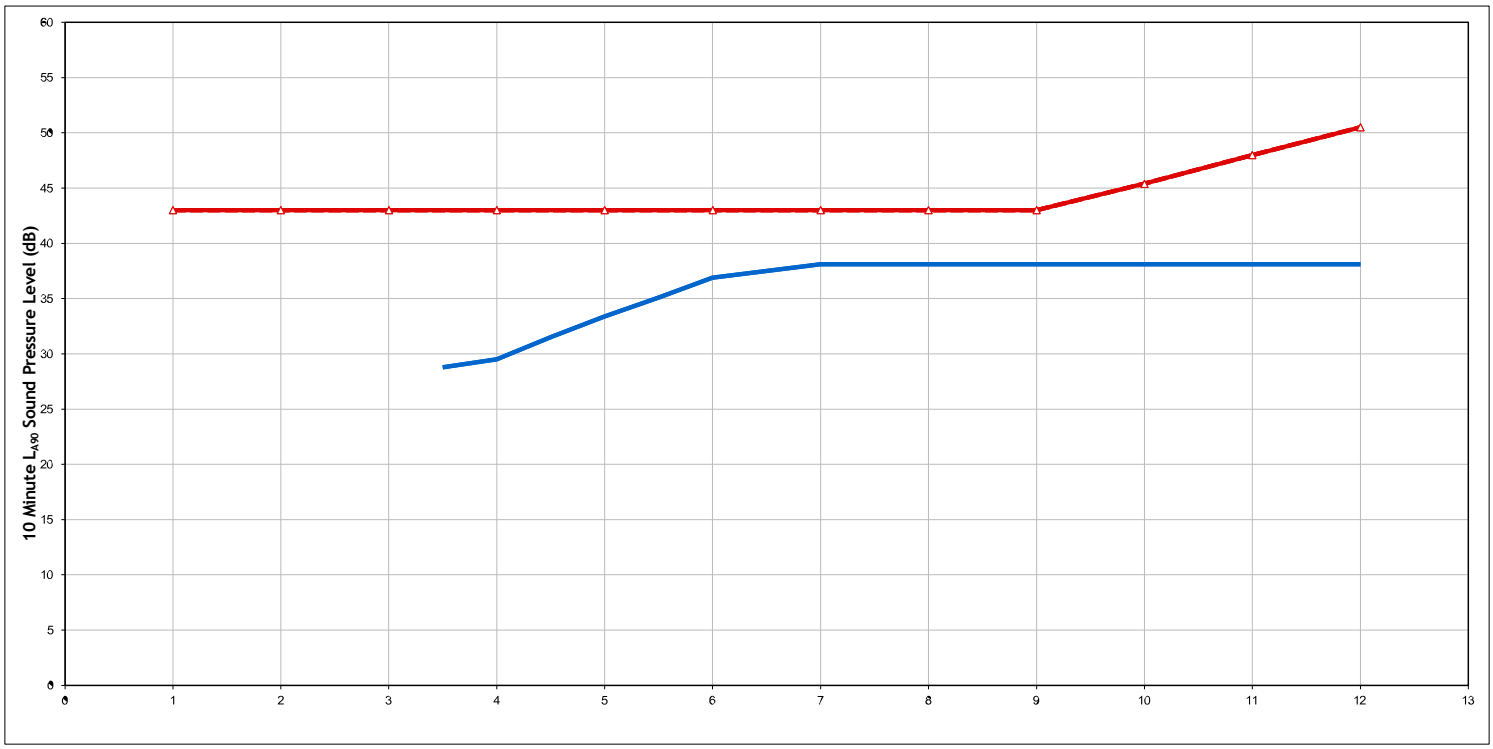
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions Norden (NAL2)
Figure Number	Figure A1.4b
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Whitehouse (NAL3)



Night Time - Whitehouse (NAL3)

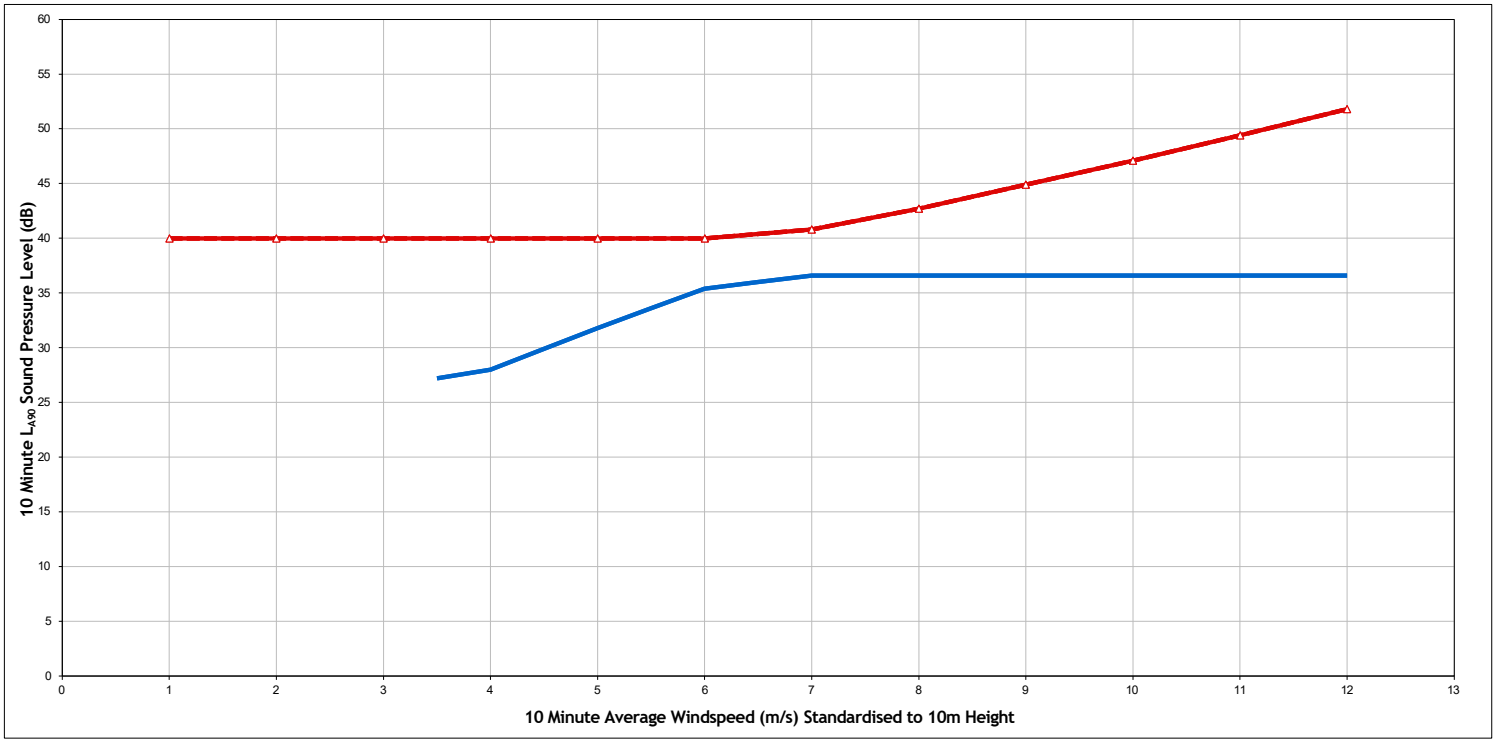


Legend:

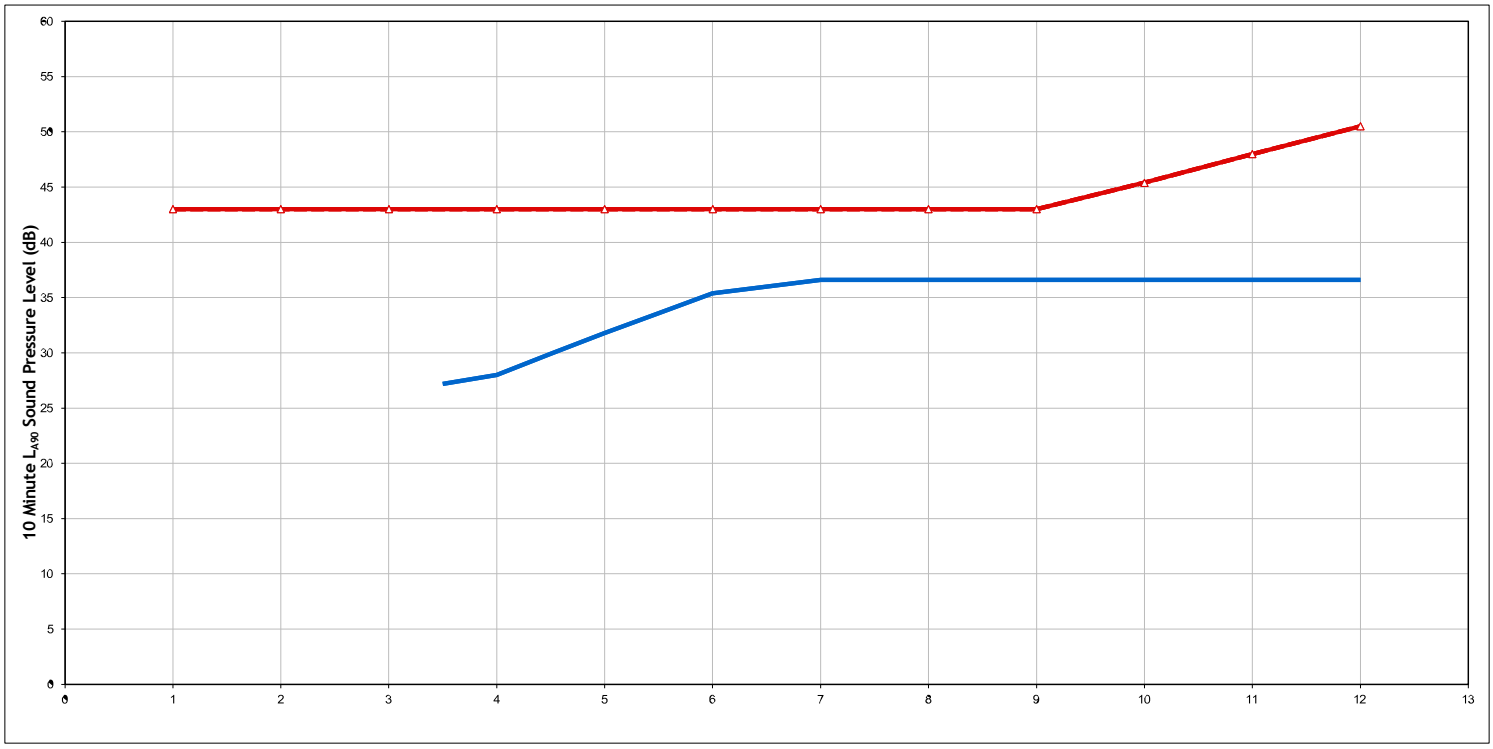
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions Whitehouse (NAL3)
Figure Number	Figure A1.4c
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Lighthouse Cottage (NAL4)



Night Time - Lighthouse Cottage (NAL4)



Legend:

- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions Lighthouse Cottage (NAL4)
Figure Number	Figure A1.4d
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

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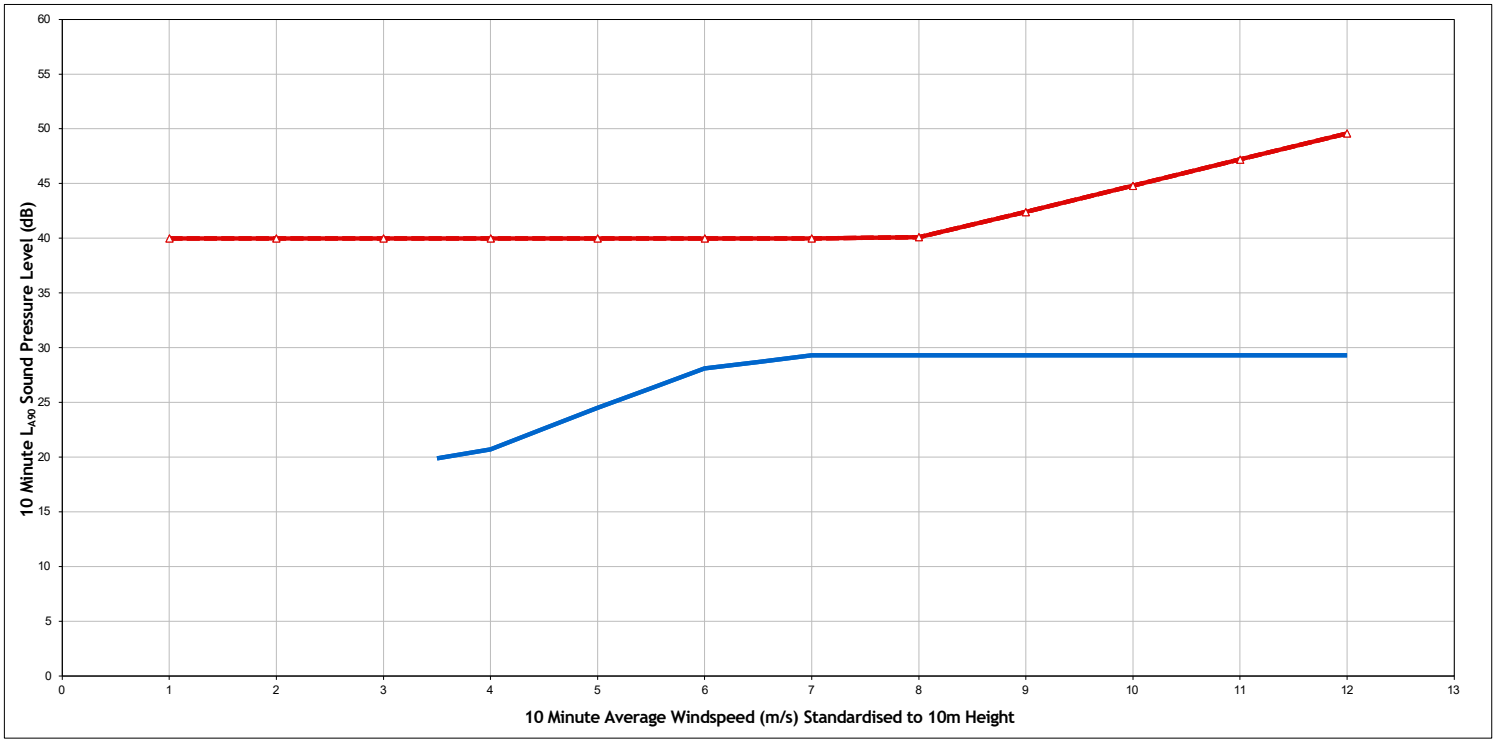
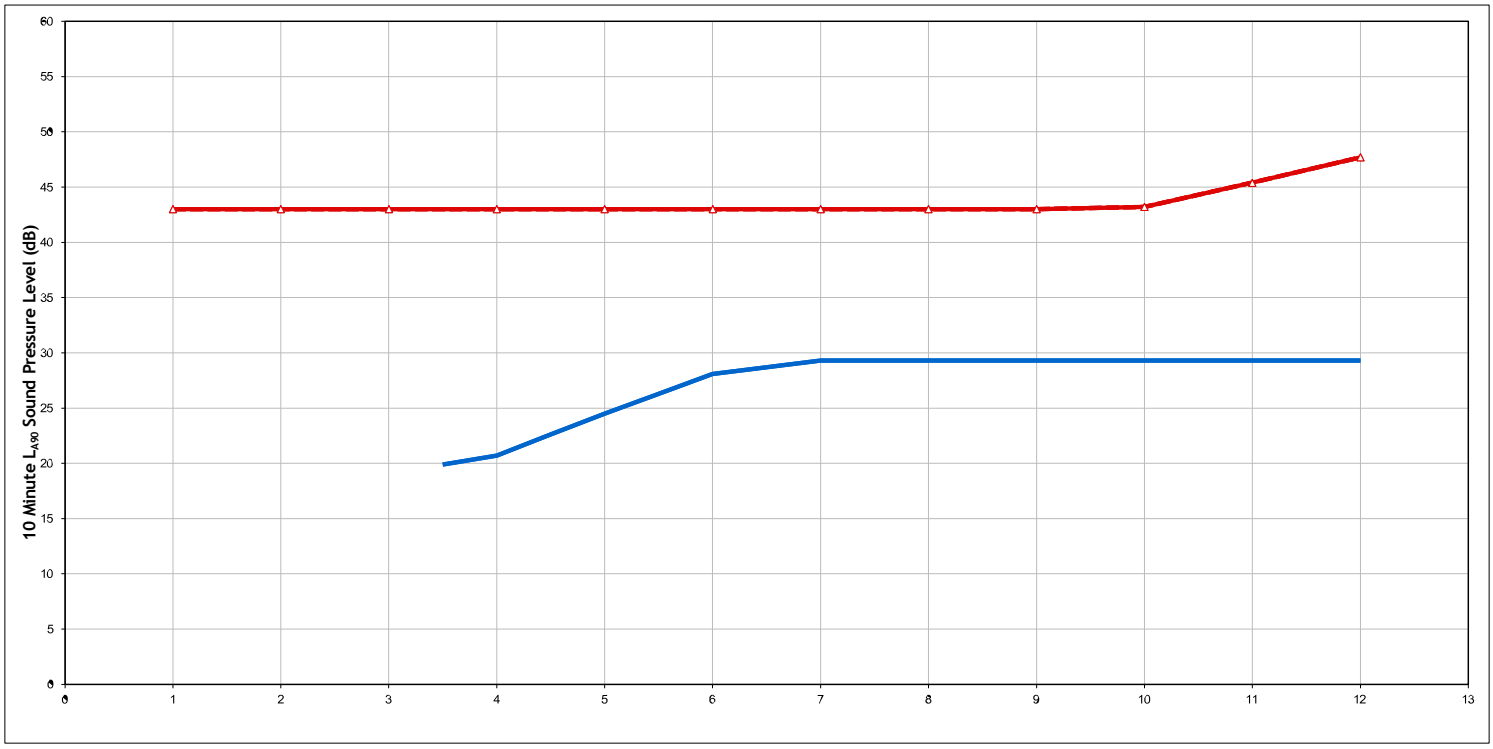
Daytime - NAL05 (NAL5)



Night Time - NAL05 (NAL5)

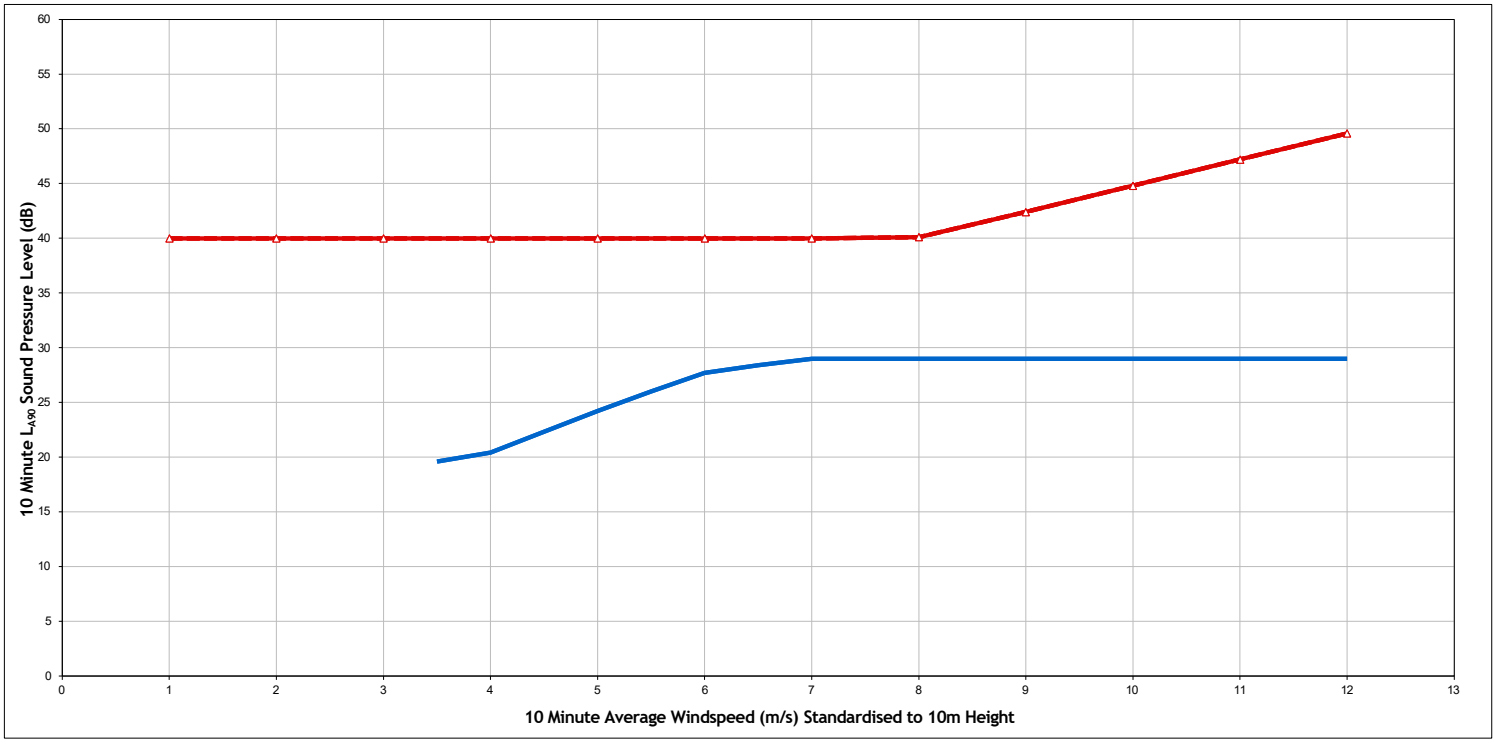


Legend:

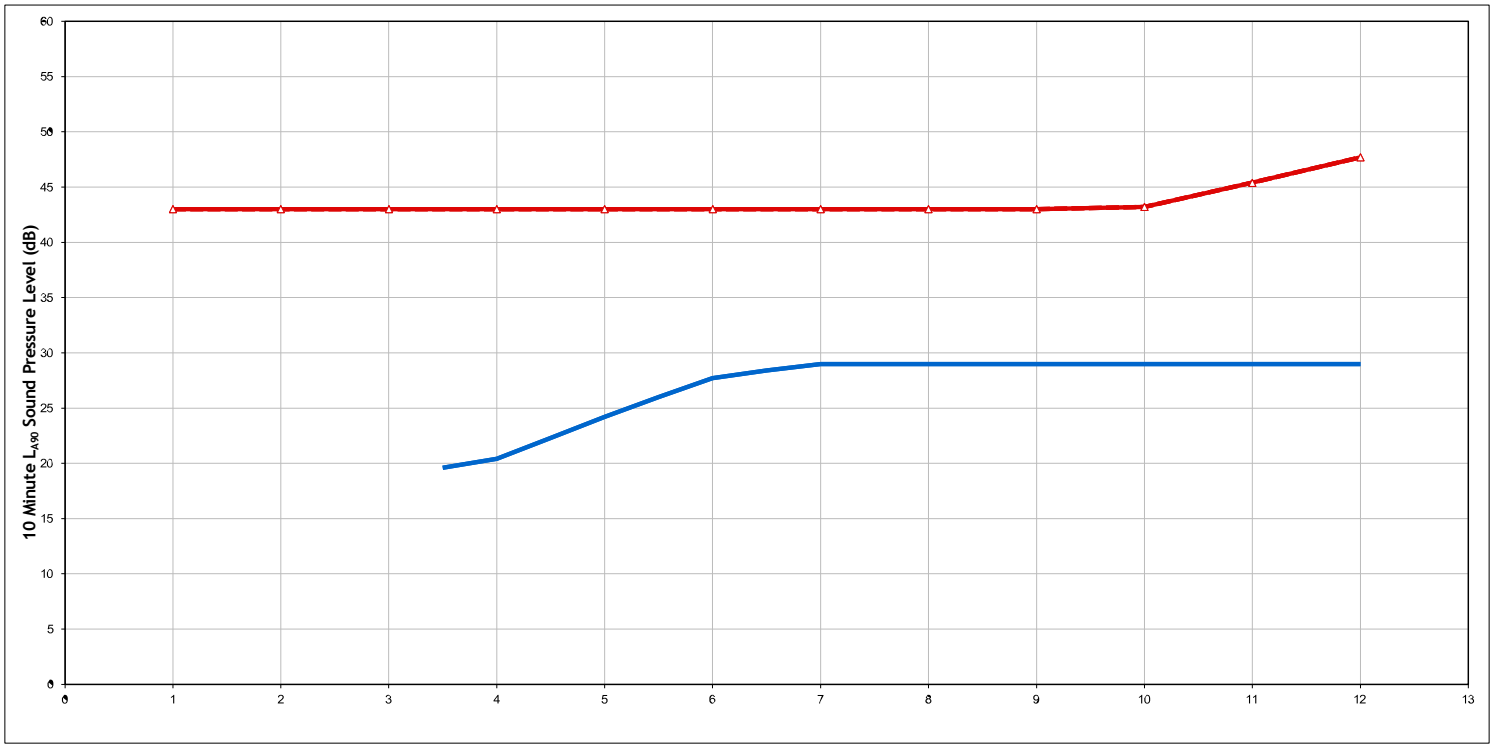
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions NAL05 (NAL5)
Figure Number	Figure A1.4e
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Bankhead Straits (NAL6)



Night Time - Bankhead Straits (NAL6)

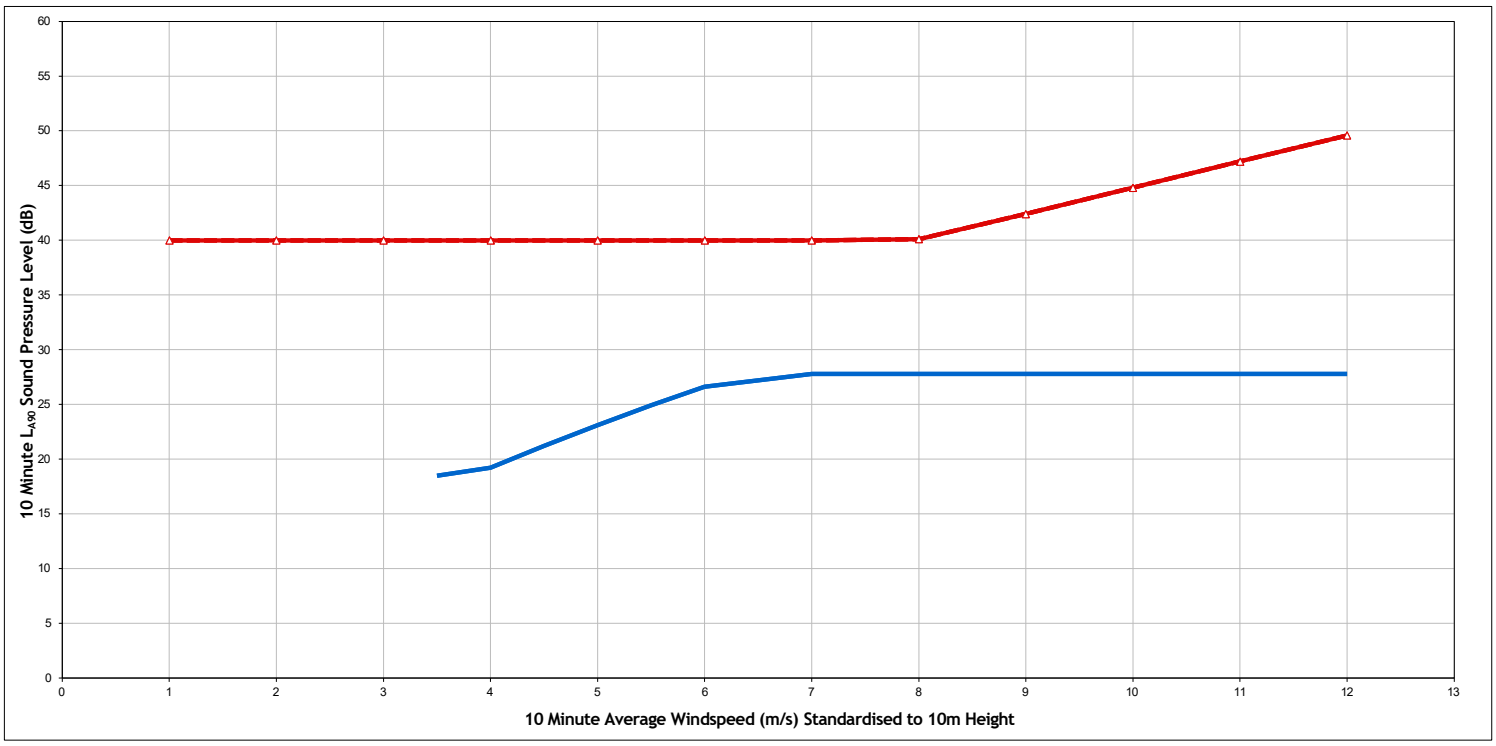


Legend:

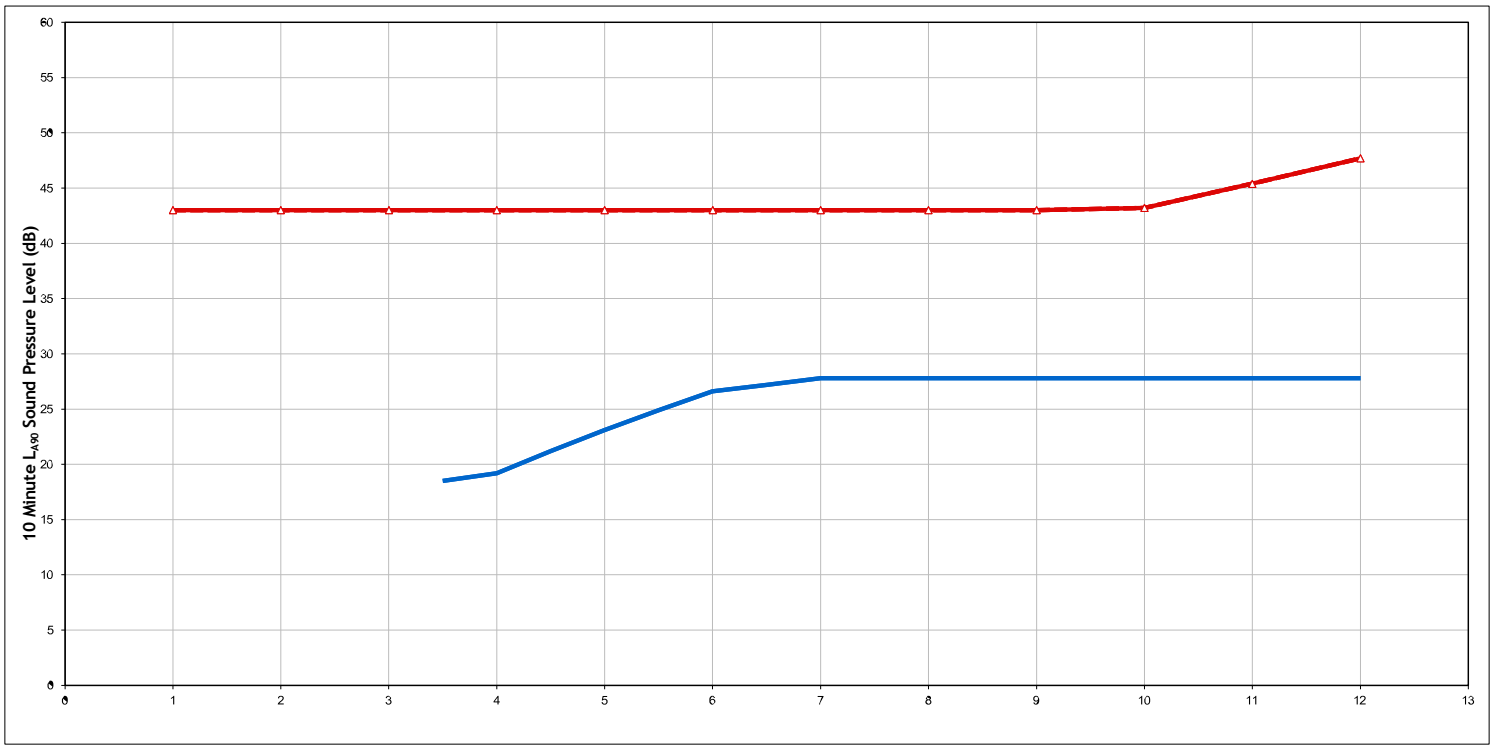
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions Bankhead Straits (NAL6)
Figure Number	Figure A1.4f
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - NAL07 (NAL7)



Night Time - NAL07 (NAL7)

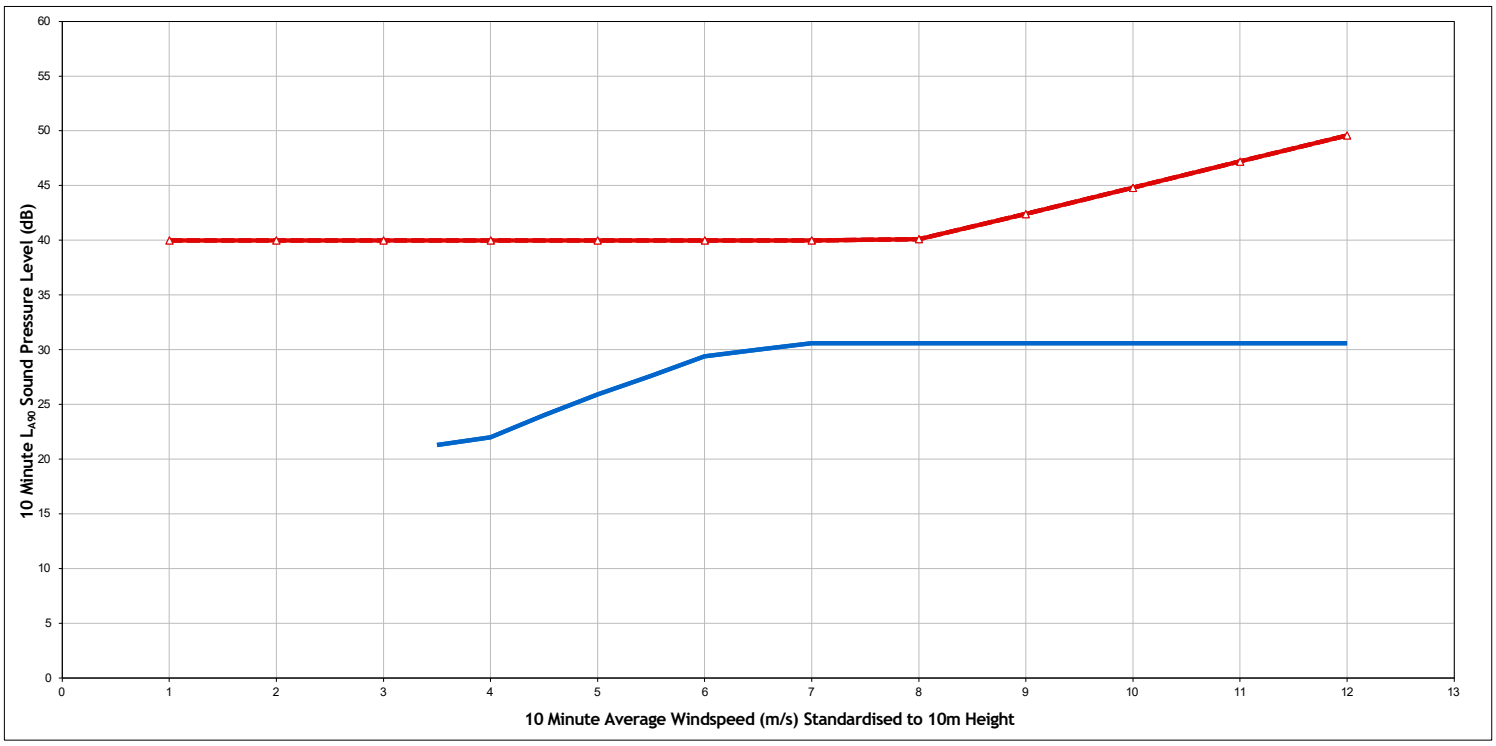


Legend:

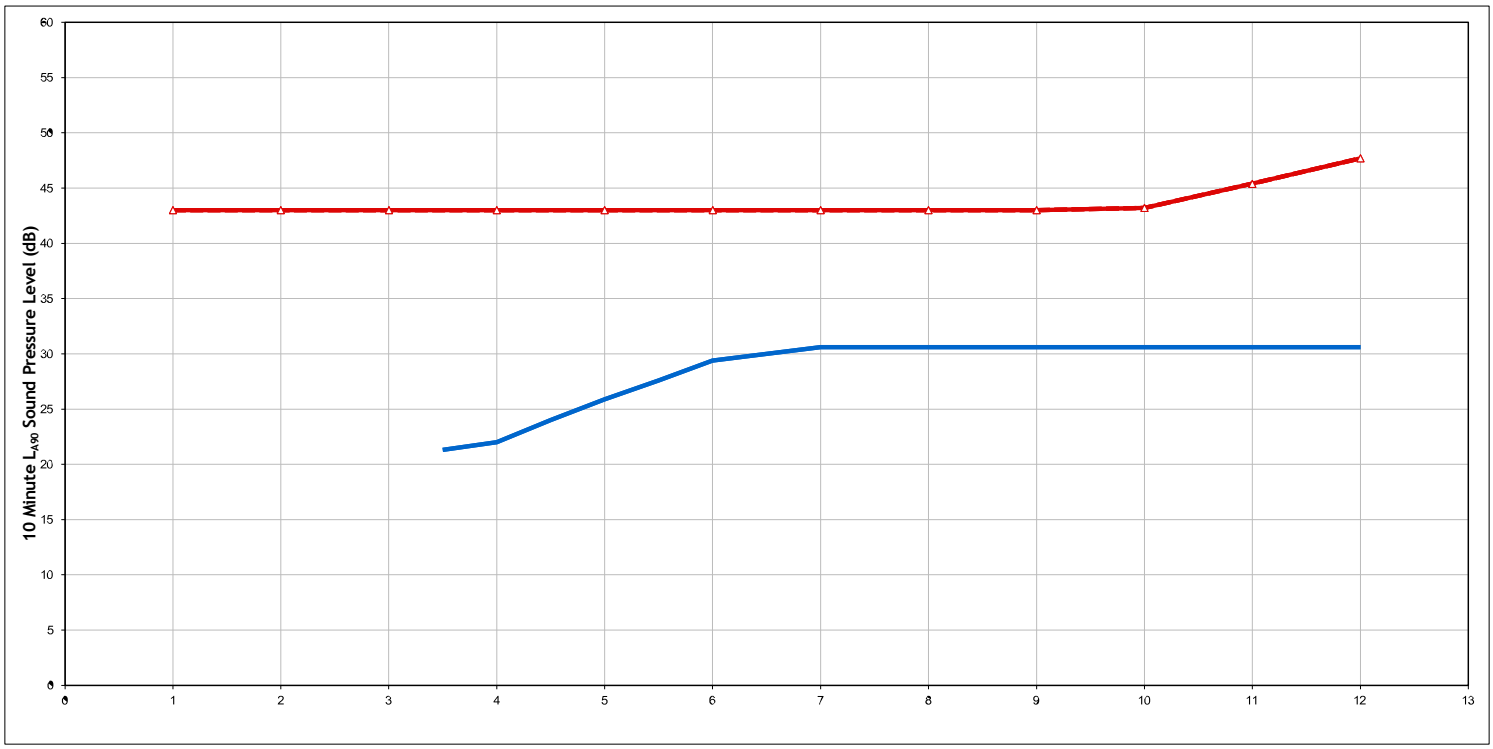
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions NAL07 (NAL7)
Figure Number	Figure A1.4g
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - 15 Maidenfield (NAL8)



Night Time - 15 Maidenfield (NAL8)

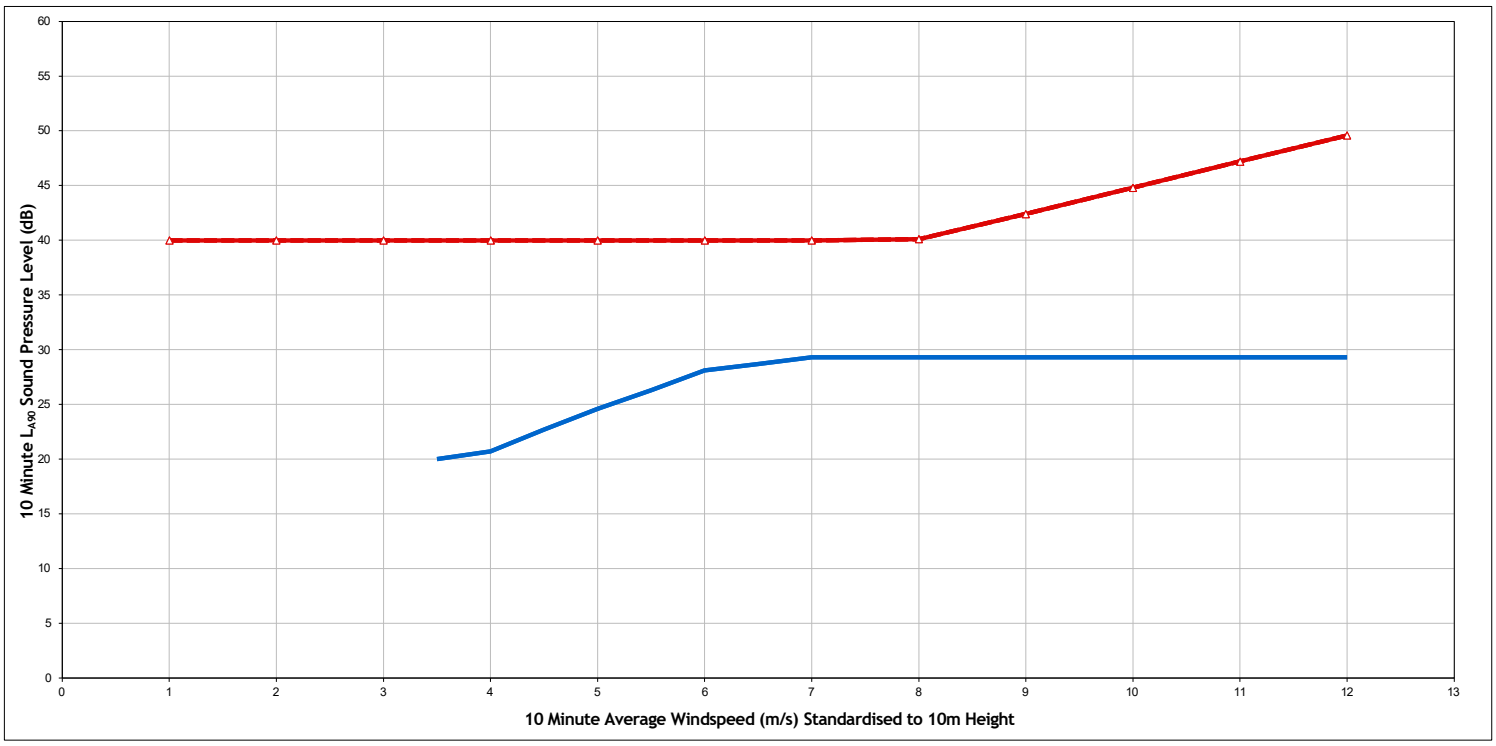


Legend:

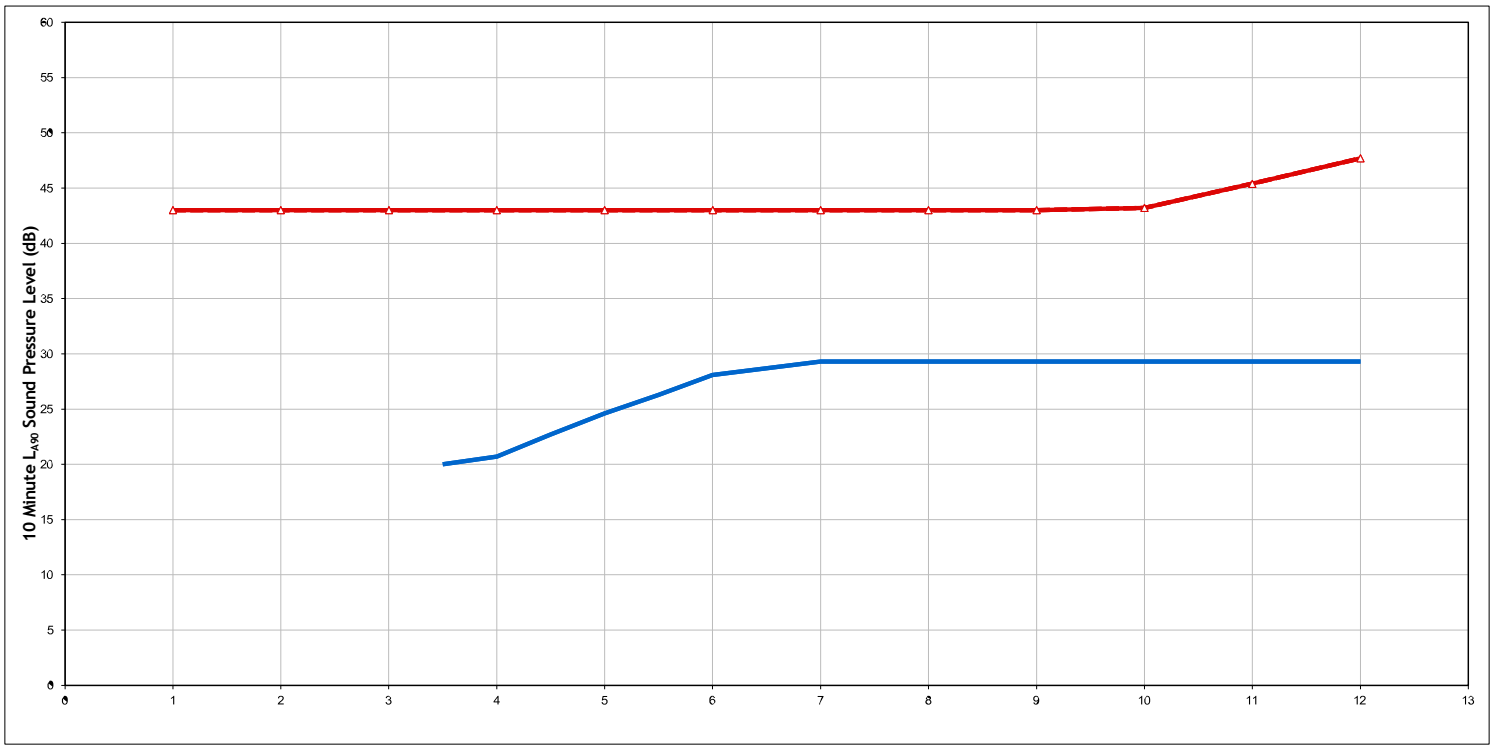
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions 15 Maidenfield (NAL8)
Figure Number	Figure A1.4h
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - NAL09 (NAL9)



Night Time - NAL09 (NAL9)

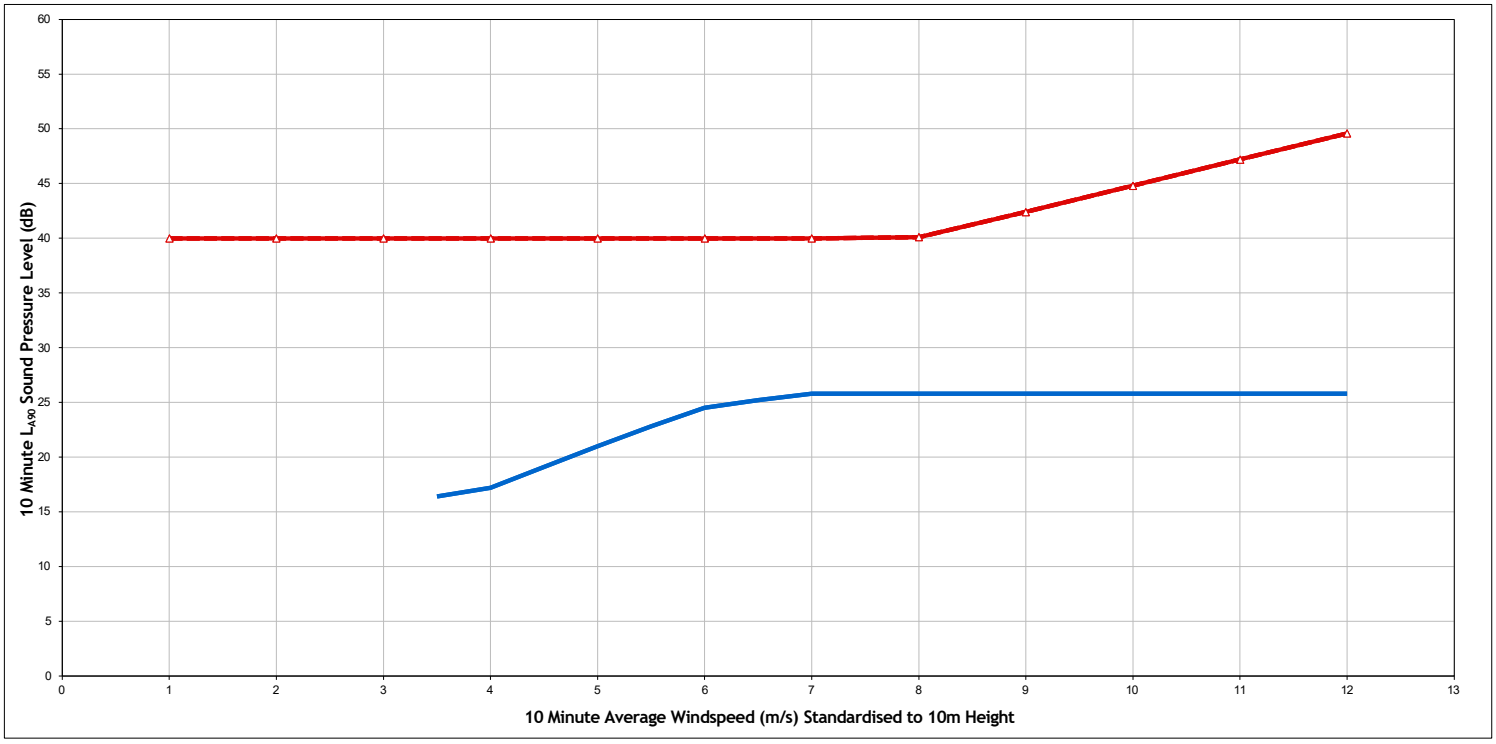


Legend:

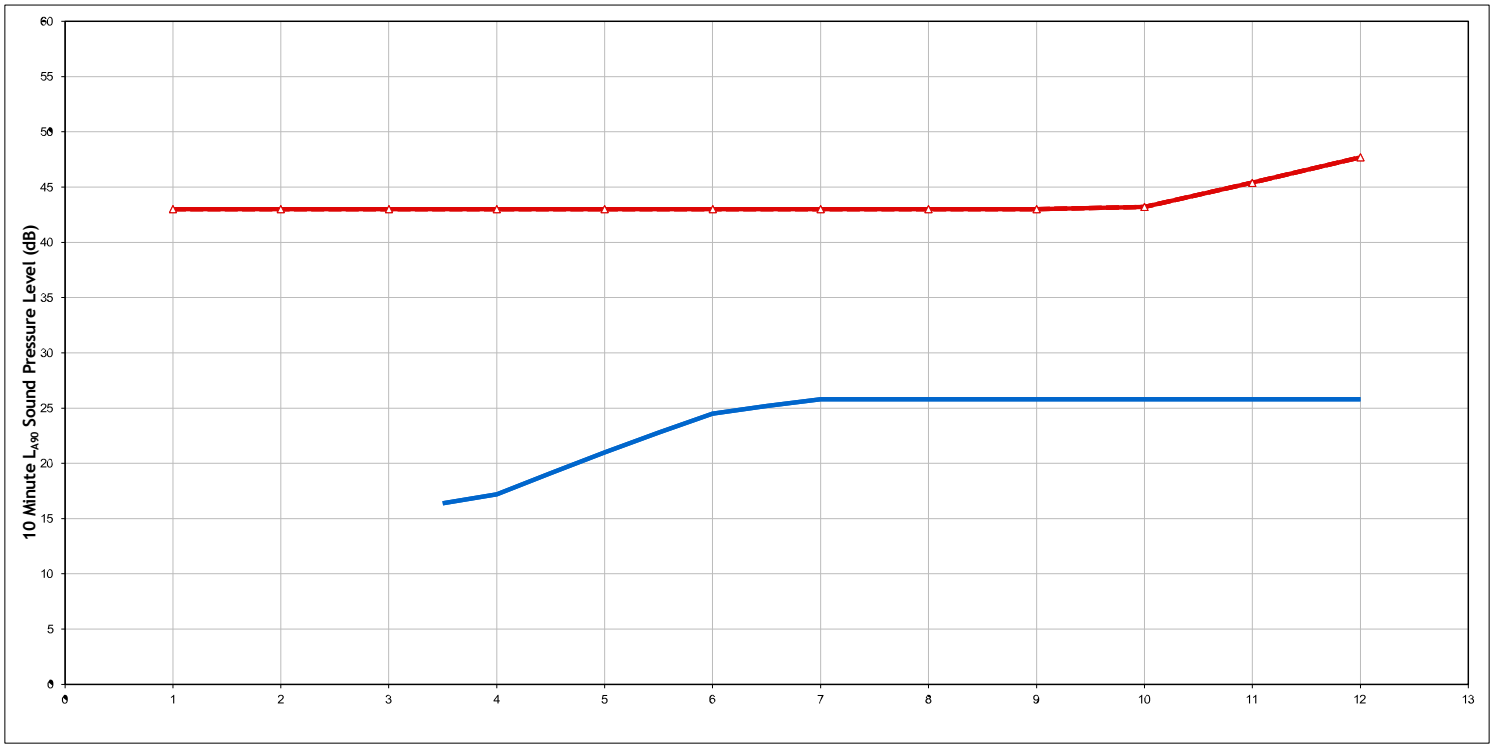
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions NAL09 (NAL9)
Figure Number	Figure A1.4i
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - 10 Leaside (NAL10)



Night Time - 10 Leaside (NAL10)

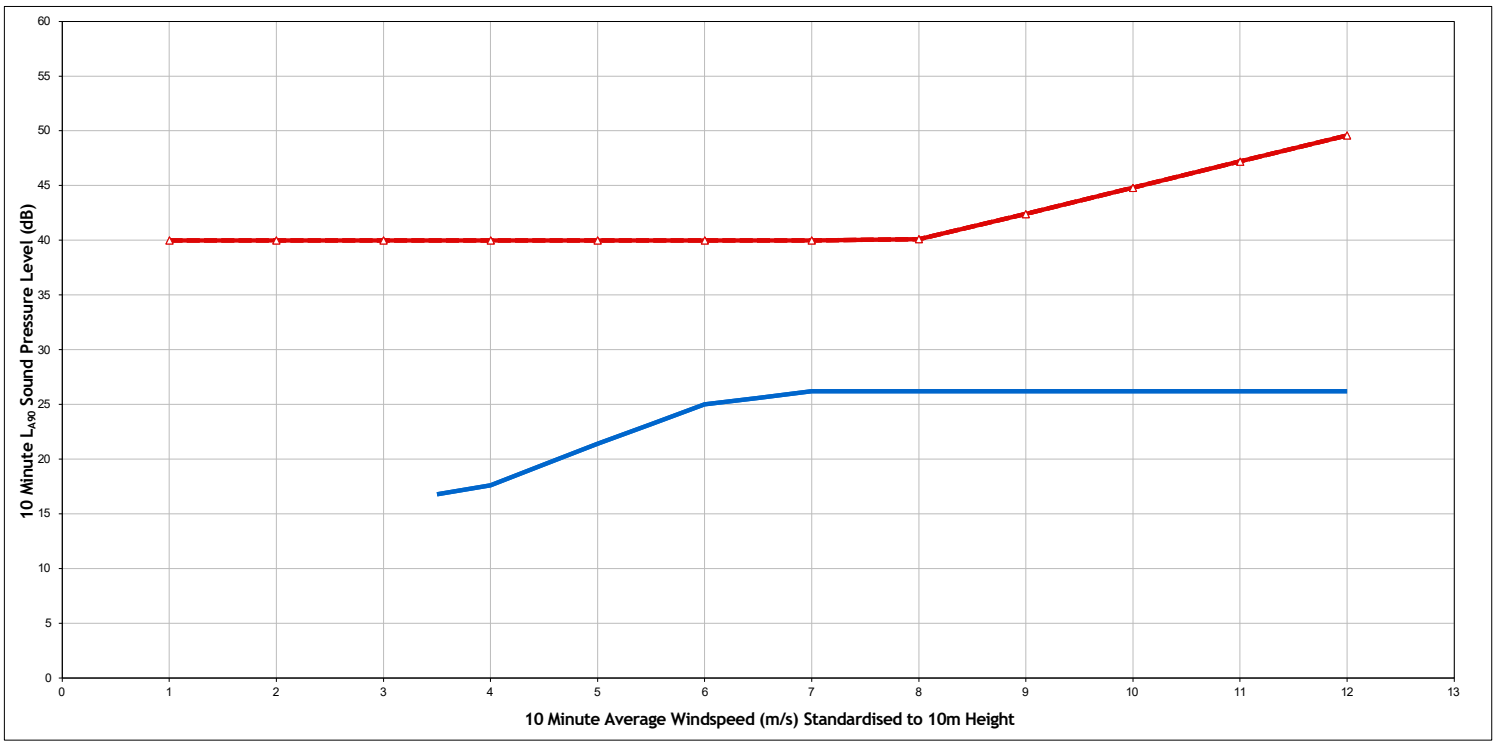


Legend:

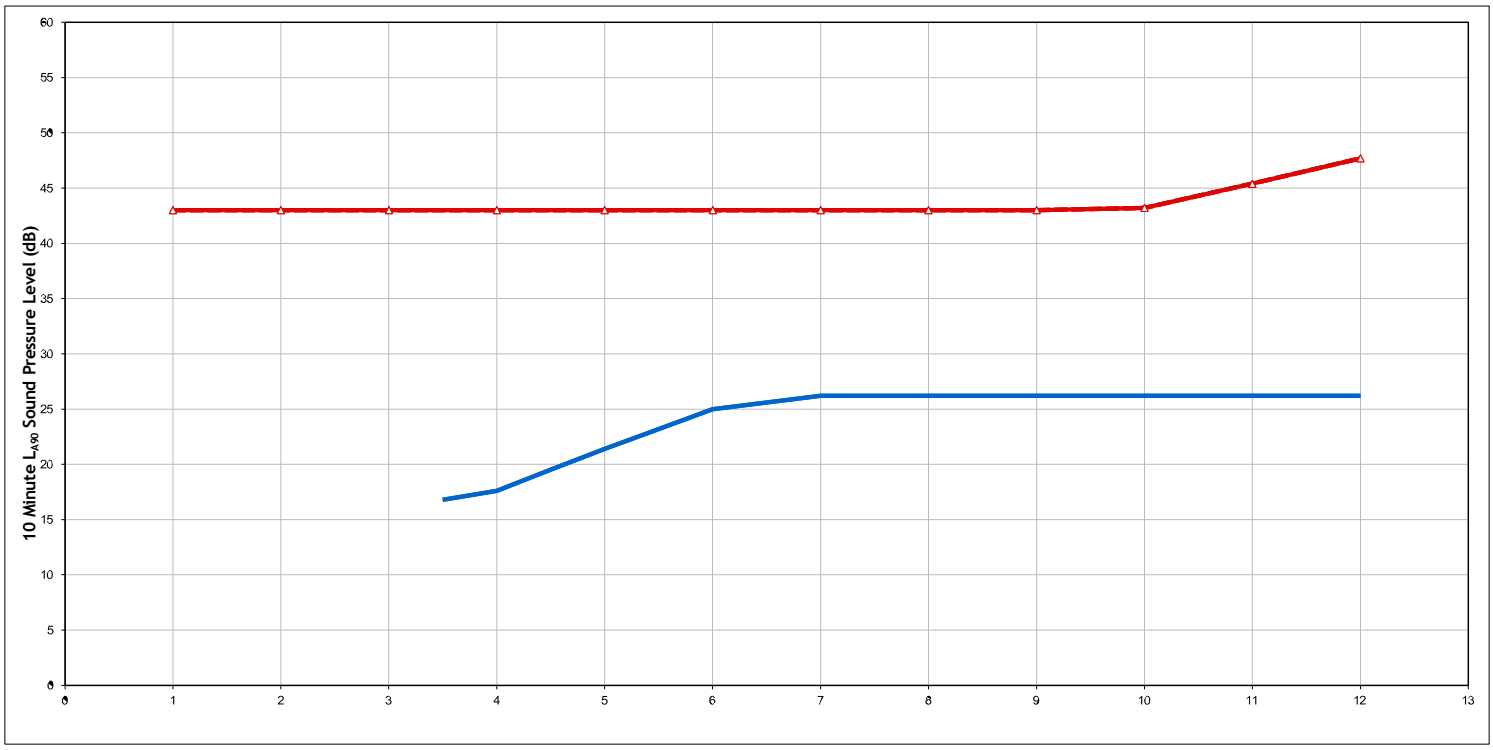
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions 10 Leaside (NAL10)
Figure Number	Figure A1.4j
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - NAL11 (NAL11)



Night Time - NAL11 (NAL11)

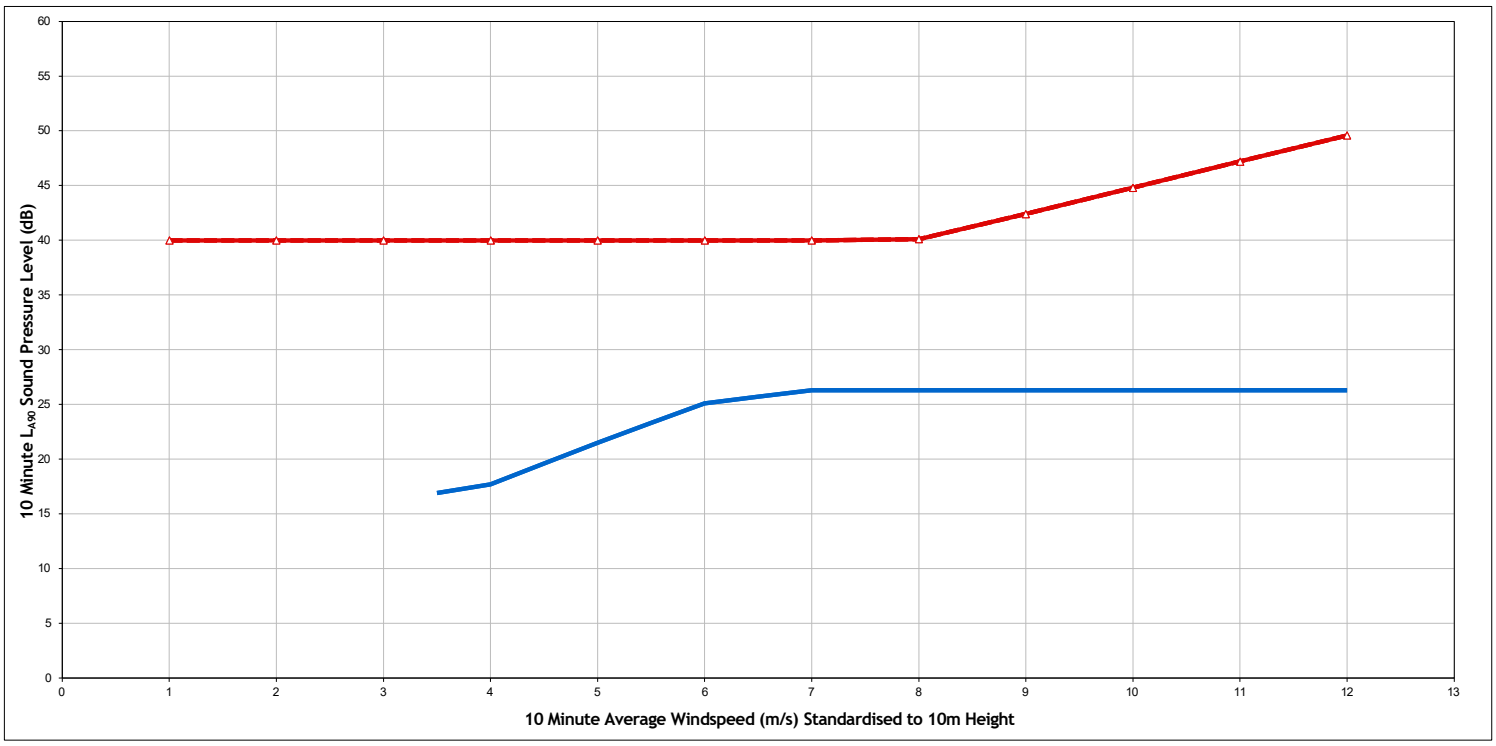


Legend:

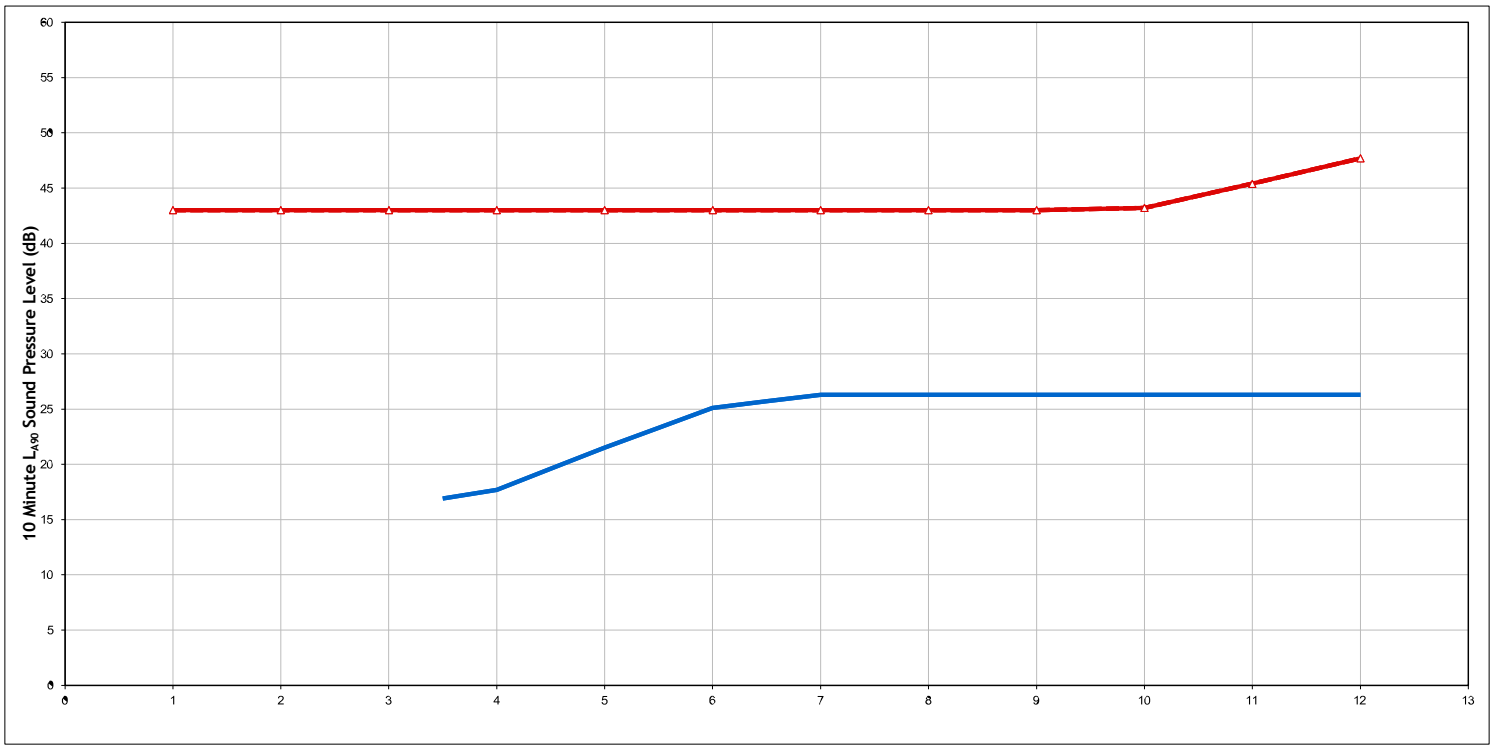
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions NAL11 (NAL11)
Figure Number	Figure A1.4k
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Moorfield (NAL12)



Night Time - Moorfield (NAL12)

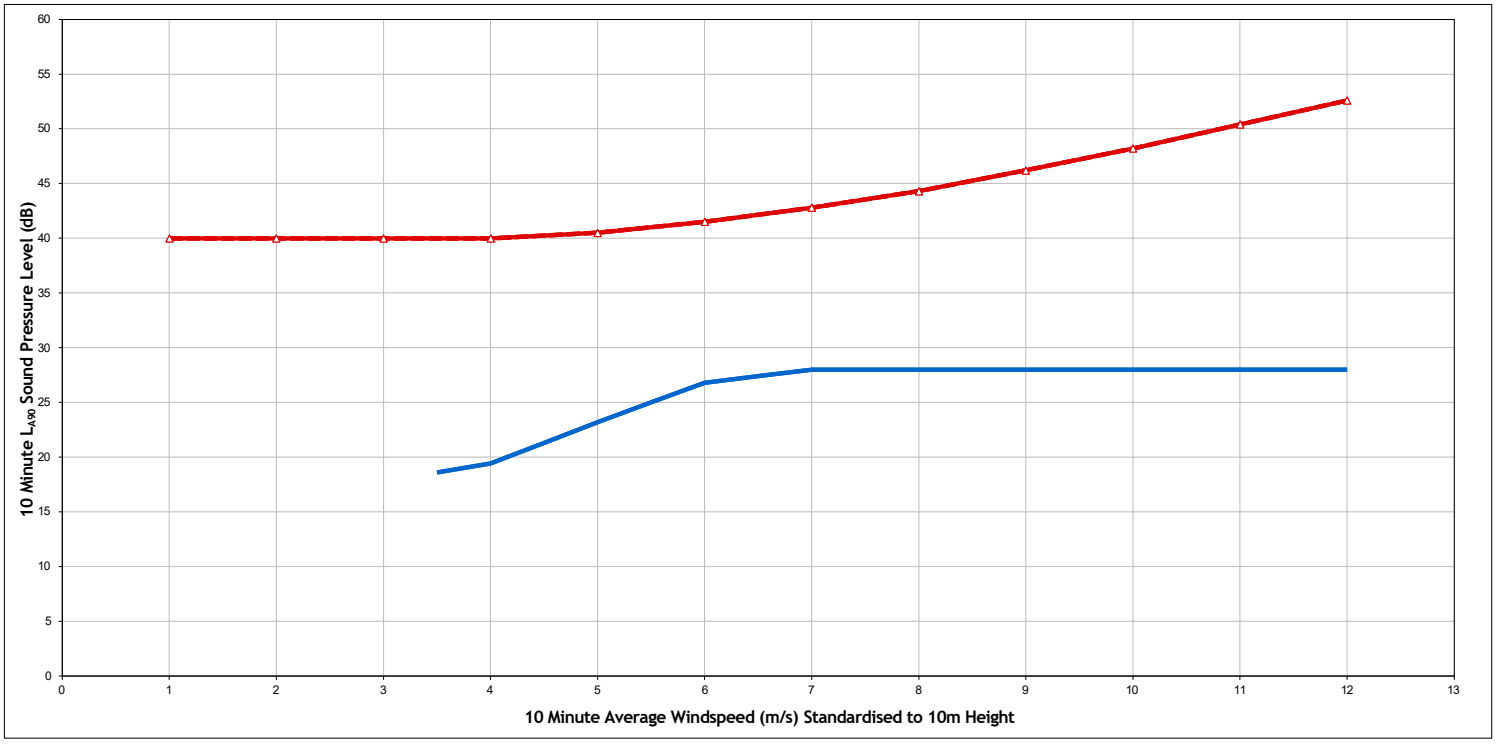


Legend:

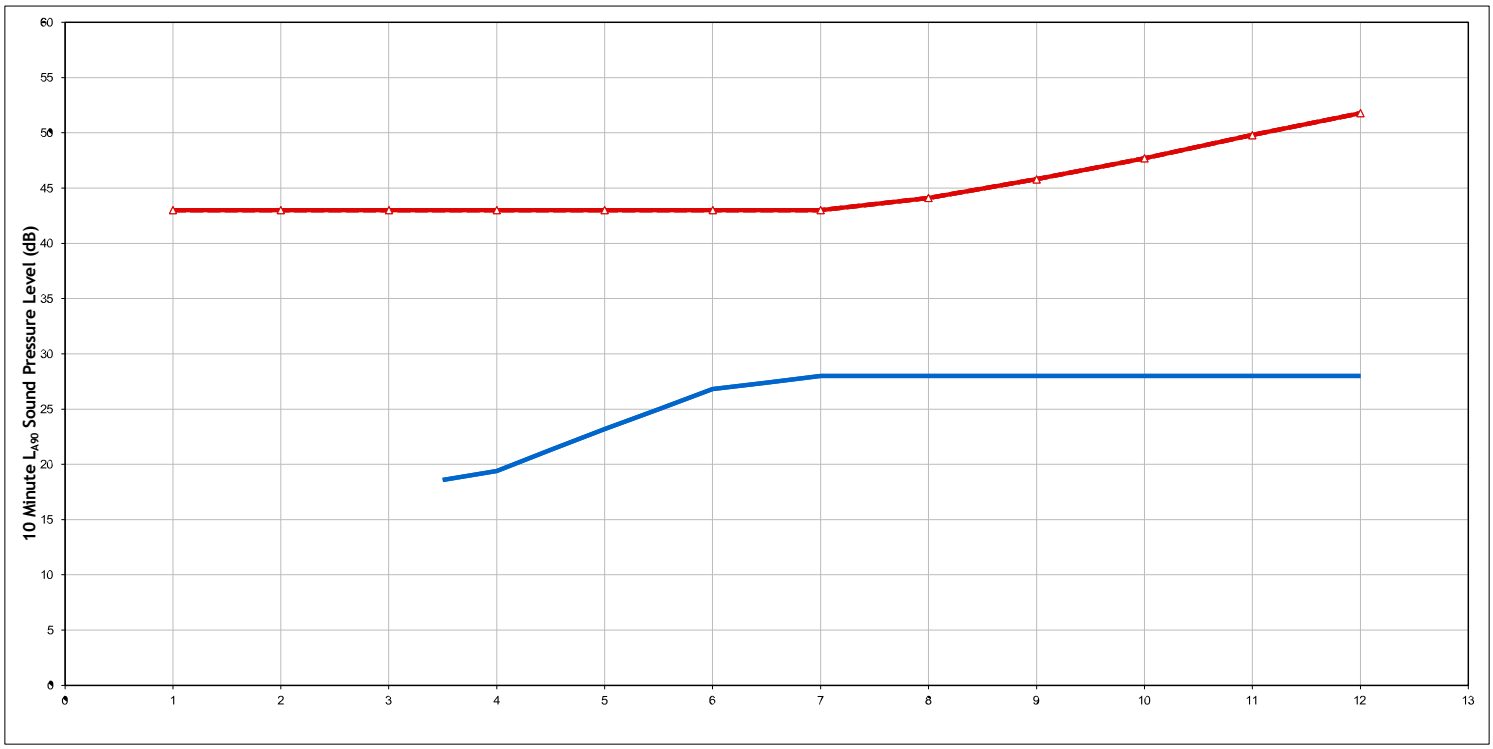
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions Moorfield (NAL12)
Figure Number	Figure A1.4l
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Laxobigging (NAL13)



Night Time - Laxobigging (NAL13)

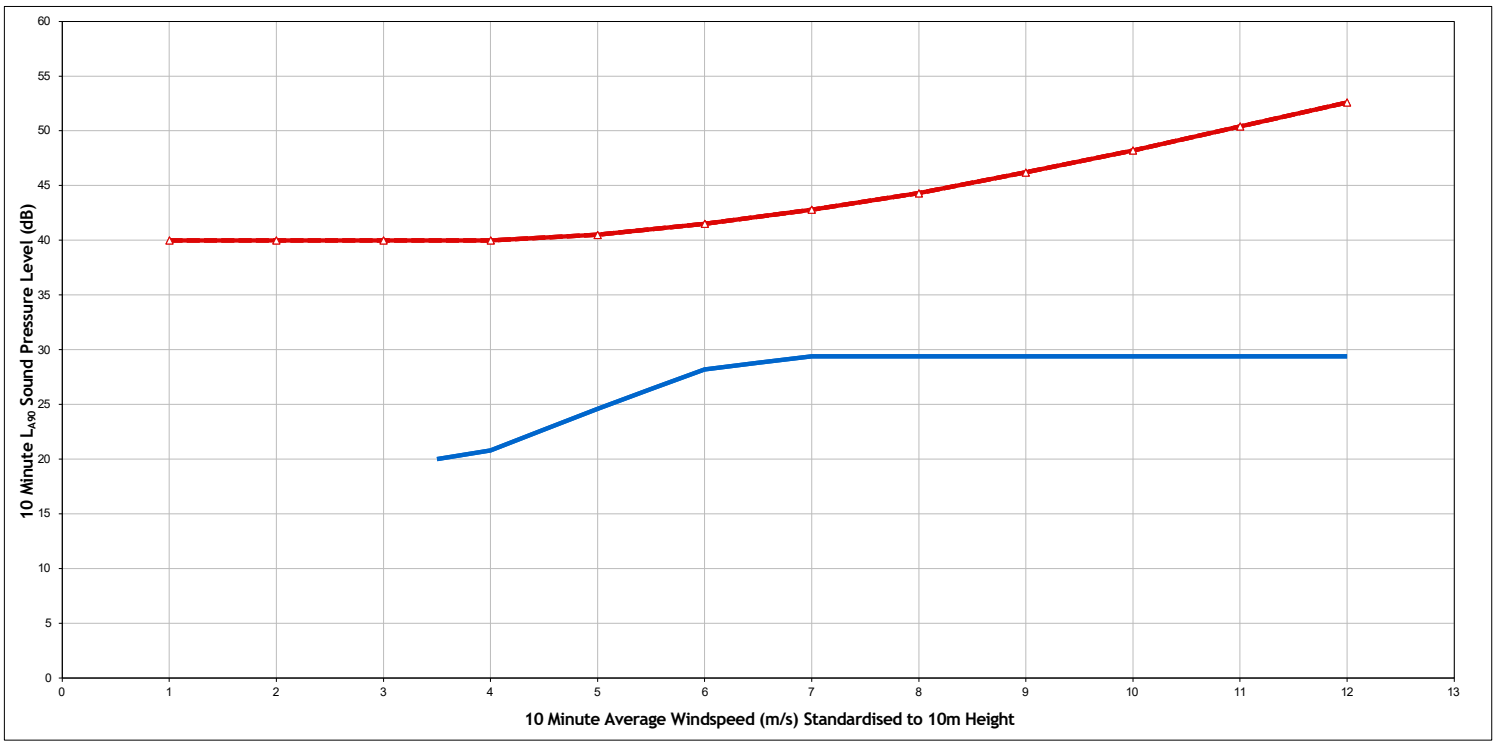


Legend:

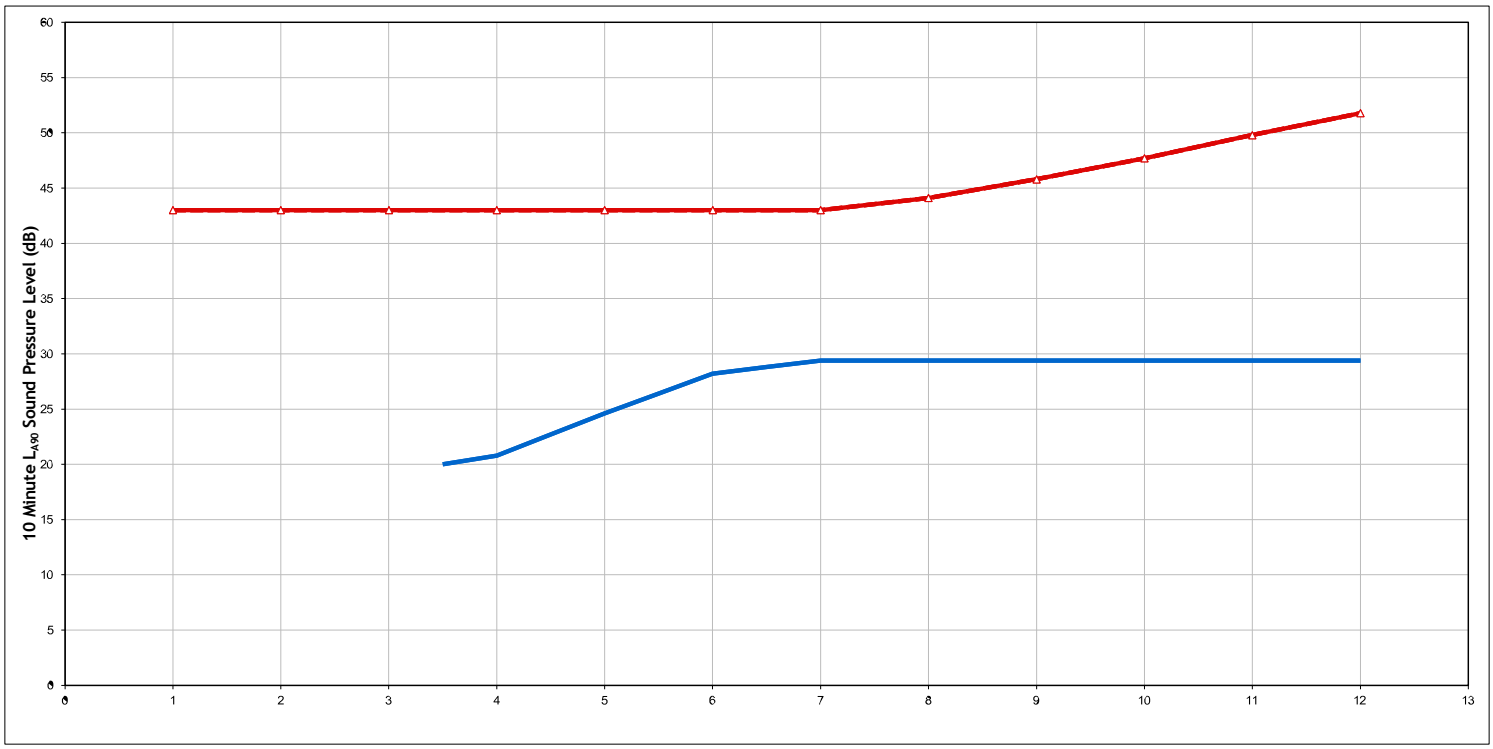
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions Laxobigging (NAL13)
Figure Number	Figure A1.4m
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Millburn (NAL14)



Night Time - Millburn (NAL14)

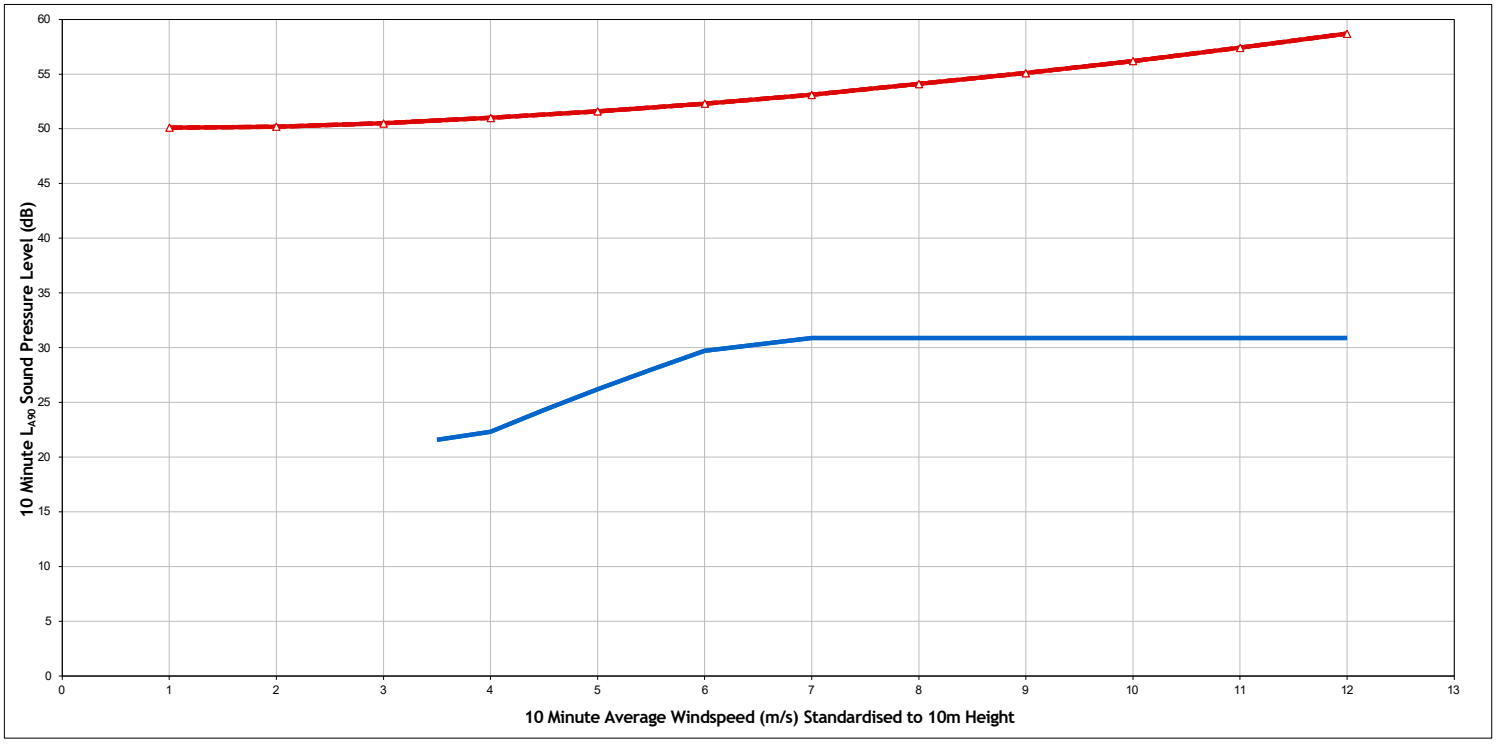


Legend:

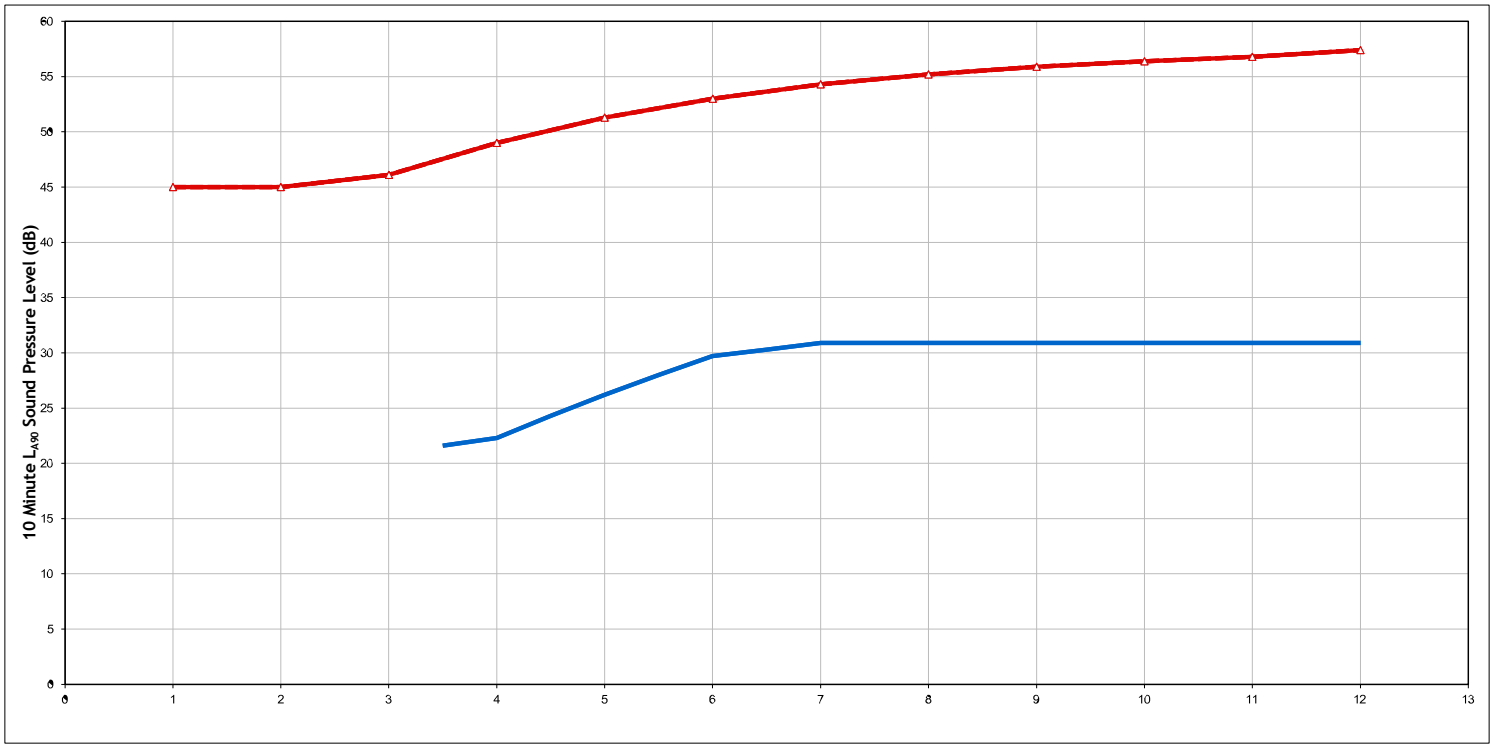
- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions Millburn (NAL14)
Figure Number	Figure A1.4n
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Daytime - Garth Farmhouse (NAL15)



Night Time - Garth Farmhouse (NAL15)



Legend:

- Total ETSU-R-97-Limit
- Site Specific Noise Limits
- Proposed Development

Project	Neshion Energy Park
Client	Neshion Ltd
Title	Site Specific Noise Predictions Garth Farmhouse (NAL15)
Figure Number	Figure A1.4o
Scale	NTS
Drawn	MR
Checked	AB
Date	29/04/2026
Document Reference	16430 - Models

Annex 2 – Correspondence with the Environmental Health Department at the Council

6 February, 2025

Ref: 16430-005 RO

Copy: Sent by email only

[redacted]
Environmental Health Officer
Environmental Health & Trading Standards
Shetland Islands Council
InfrastructureServices
Gutters Hut
7 North Ness
Lerwick
ZEI 0LXZ

Dear [redacted]

Proposed Neshion Wind Farm on land to the west of Toft, Shetland - Noise Impact Assessment

Further to initial correspondence, Neshion Ltd ('the Applicant') is proposing to construct and operate Neshion Wind Farm ('the proposed development') on land located approximately 1 km west of Toft. An indicative turbine layout, consisting of 10 turbines, is shown on the enclosed Figure 1. The proposed development may also accommodate a 25 MW battery energy storage system (BESS) and ancillary infrastructure, which is expected to only take a small amount of land towards the western and southern part of the site boundary, although the exact location is still subject to confirmation.

Noise would be emitted from the proposed development during the construction, operation and decommissioningphases. 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 from the wind turbines 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. Similar, a set of operational noise limits will need to be defined for the BESS, if progressed as part of the development.

TNEI Services Ltd (TNEI) has been appointed by Ramboll on behalf of the Applicant to undertake the Noise Impact Assessment (NIA) for the proposed development, and prior to commencing the noise assessment we would like to agree with you the noise assessment methodology and proposed background noise monitoring locations.

Construction Noise

Construction noise will be assessed through the modelling of typical construction activities based on an indicative construction timetable and comparing the predicted noise levels to the threshold levels set out in BS 5228-1:2009+AI:2014. Noise level predictions will consider how noise levels may vary across the construction timetable and consider both the absolute noise level and duration of exposure.

We do not propose to undertake an assessment of decommissioningnoise.

Newcastle
7th Floor, West One
ForthBanks
Newcastle Upon Tyne
NE13PA
Tel:+44(0)191 2111400

VATReg.GB2390146 20 I Company Reg.03891836

Operational Wind Turbine 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 lOA 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). Garth Farmhouse, located to the south of the Sullom Voe Terminal, is a financially involved property.

The choice of daytime fixed minimum limits should be considered in light of the guidance contained within ETSU-R-97 and the IOA GPG. Extracts of the guidance contained within ETSU-R-97 and the IOA GPG are included in Annex 1. 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'.

TNEI propose to set the Total ETSU-R-97 Noise Limits based on the upper daytime fixed minimum noise limit of 40 dB, in line with other consented wind turbine developments in Shetland. A Site Specific Noise Limit would then be derived taking account of the noise limits already allocated to, or the limit that may be used by, other wind farm developments in the area. We would be very keen to work with Shetland Islands Council with a view to agreeing suitable daytime fixed minimum limits at an early stage to ensure the development can be designed accordingly.

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. We would welcome the opportunity to discuss the choice of Site Specific daytime fixed minimum limits with you once background noise data becomes available to ensure that the scheme is designed appropriately in light of data measured at the site.

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. This requires the installation of noise monitoring equipment at representative properties surrounding the site as well as the installation of wind monitoring equipment on the site itself.

It is proposed that a LIDAR unit will be in place on-site for the duration of the noise survey, which will be used to collect wind speed and direction data at various heights. Data from the LIDAR will be used to determine the wind speed at turbine hub height which will then be adjusted to a height of 10 m using a standardised roughness length of 0.05 m to derive 'wind speed as standardised to 10 m height'. Wind speed as standardised to 10 m height will be used in the assessment. This is consistent with method A or B as outlined in the IOA GPG (on page 10 of 40). At least one rain logger will be installed at one (or more) of the noise monitoring locations to record any periods of rainfall. A series of simultaneous ten-minute measurements will be taken by each piece of equipment over a period of at least two weeks.

Background noise levels will be monitored at a height of between 1.2 m and 1.5 m above ground, in line with the ETSU-R-97 / IOA GPG guidance. The noise monitoring equipment will be located in a free-field position at least 3.5 m away from hard reflective surfaces where practicable and within the residential amenity area.

The following steps summarise the proposed entire noise assessment process for this scheme:

- measure the background noise levels at each receptor. This will involve the continuous logging of the $L_{A90,\ 10min}$ values at each receptor for a minimum period of two weeks;
- obtain simultaneous ten minute average wind speed data from the proposed development site;
- filter baseline noise data to remove any unrepresentative readings (such as periods of rainfall) and split the data into night-time and quiet daytime hours;
- determine the daytime and night-time criterion curves (i.e. Total ETSU-R-97 noise limits) from the measured background noise levels at the nearest neighbours using regression analysis and recommendations within ETSU-R-97 and the IOA GPG;

- specify the type and noise emission characteristics of all existing / proposed wind farms using candidate / operational wind turbine data, and undertake predictions and compare the total cumulative predicted noise levels to the Total ETSU-R-97 Noise Limits;
- undertake a cumulative noise assessment (if required) and derive suitable Site Specific Noise Limits for the proposed development using the guidance in the IOA GPG; and
- compare the predicted wind farm noise immission levels for the proposed development with the Site Specific Noise Limit.

We have undertaken some initial modelling based on a 10 turbine layout, which will shortly be presented within a Scoping Report. Noise predictions were done in line with current good practice, assume mixed ground conditions and use data for a candidate turbine, the Vestas V172 7.2 MW with serrated trailing edges. This was chosen to be representative of the turbine that could be installed at the site. Figure 1 shows the neighbouring properties to the proposed development that may fall within the 35 dB(A) L_{90} contour. It should be noted that the predictions shown on the contour plot do not account for topography, which could decrease the predicted level (if the landform blocks the path from the turbines to receptors) or could increase the level (if any concave ground profiles exist). Topographical corrections will be considered in detail and included in the final noise assessment where required.

Prior to commencing the noise survey we would like to agree suitable locations at which to monitor background noise levels in order to provide a representative dataset for the area. Figure 1 shows the predicted noise contours from the proposed development based on the most current layout and the proposed background noise monitoring locations.

We believe noise monitoring equipment installed at six dwellings would provide a sufficient sample of representative background noise data for the area. The proposed monitoring locations are also detailed in Table 1 below.

Table 1 - Proposed Noise Monitoring Locations (NMLs) for the Proposed Development

Property/Location	Justification
NML1 – Norden (443606, 1176965)	One of the nearest receptors to the east of the proposed development
NML2 – Quoy Lee (443508, 1176564)	One of the nearest receptors to the east of the proposed development
NML3 – No.7 Maidenfield (444836, 1175146)	Chosen to represent the receptors to the south east of the proposed development.
NML4 – Moorfield (444864, 1175146)	Nearest receptor directly south of the redline boundary
NML5 – Laxobigging (441472, 1173176)	One of the nearest receptor to the south west with distinct soundscape due to watercourses
NML6 – Garth Farmhouse (440615, 1174423)	One of the nearest receptors to the south west of the redline boundary and proposed BESS location.

Monitoring at the locations listed in Table 1 would be subject to consent from the owners/occupiers, as well as on-site observations of the noise environment, to ensure the properties proposed are suitable and representative. If we are unable to gain access to monitor at the proposed properties, or identify problematic noise conditions (for example, the presence of atypical noise sources)

representative alternative locations will be selected and we will inform you of the alternative locations.

The properties identified for the assessment will be the closest ones to the site in each direction. Hence, it can be assumed that if noise limits can be achieved at these locations then limits will also be achieved at other properties located at greater distances from the wind farm.

Cumulative Wind Turbine Noise Assessment

On review of other proposed / operational schemes in the area, it was found that the closest schemes (Beaw Field Wind Farm, and Viking Wind Farm) are in excess of 10 km from the proposed development site and would not be considered to materially impact the proposed development with regards to cumulative noise.

It is noted that a screening request was submitted to SIC on the 22nd October 2024 for the proposed development of two wind turbines. Should that application be taken further, a cumulative noise assessment will be undertaken.

We would be grateful if you could bring to our attention any other wind farm/ turbine developments that you are aware of in the area that may merit consideration within the cumulative noise assessment.

If possible, we would be very keen for you or one of your colleagues to attend the installation of the noise monitoring equipment in order for you to agree the exact noise monitoring locations.

Operational Battery Storage and Substation Noise

In respect to operational noise from the non-wind components of the development, such as the possible BESS and substation, these would be assessed (if required) in accordance with BS 4142:2014+A1:2019 *'Methods for Rating and Assessing Industrial and Commercial Sound*' unless you have an alternative approach that you would like us to adopt.

The need for such an assessment, however, would be dependent on the final location of the substation and the battery storage facility. Should we feel that an assessment is not necessary, for example, due to significant separation distances between noise source and receptors, then we would seek to agree this with you prior to submission of the EIAR.

Summary

To enable us to progress the assessment I would be very grateful if you confirm whether:

- You are happy with the proposed assessment methods outlined above (use of BS 5228, BS 4142:2014+A1:2019, ETSU-R-97 and the IOA GPG);
- You agree that decommissioning noise can be scoped out of the EIAR;
- You agree to the use of Total ETSU-R-97 Noise Limits based on the upper daytime fixed minimum noise limit of 40 dB and a fixed limit of 43dB during the night;
- 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;
- You agree with the general monitoring locations proposed (subject to exact siting);

- Confirm whether you or one of your colleagues would like to attend the noise kit installation which it is anticipated to take place sometime in late February/ early March (depending on noise equipment availability); and

  If the Council is aware of any schemes which should be included in the cumulative noise assessment or any other dwellings which should be considered in the assessment of noise impacts.

We are proposing to install the noise monitoring equipment in late February/ early March therefore, we would appreciate a response to this letter at your earliest convenience. If you have any immediate concerns or queries, please do not hesitate to contact me or my colleague Jim Singleton. We look forward to hearing from you soon.

Yours sincerely,

[redacted]

Mathew Robinson
BEng, MSc, TechIOA

Technical Consultant

[redacted]

Reviewed and approved by:

[redacted]

Jim Singleton
BSc, IOA Dip, MIOA

Principal Consultant

[redacted]

Enc. Figure 1- Noise Contour Plot

Annex 1 - Determining the Fixed Part of the Daytime Amenity Noise Limit

Annex 1: Determining the Fixed Part of the Daytime Amenity Noise Limit

In relation to determining the fixed part of the Daytime Amenity Noise Limit the ETSU-R-97 notes (on page 65) that:

"The actual value chosen for the daytime lower limit, within the range of 35-40 dB(A), should depend upon a number of factors:

• Number of dwellings in the neighbourhood of the wind farm.

The planning process is trying to balance the benefits arising out of the development of renewable energy sources against the local environmental impact. The more dwellings that are in the vicinity of a wind farm the tighter the limits should be as the total environmental impact will be greater. Conversely if only a few dwellings are affected, then the environmental impact is less and noise limits towards the upper end of the range may be appropriate. Developers still have to consider the interests of individuals as protected under the Environmental Protection Act 1990. lt is our belief however, in accordance with the report of the Welsh Affairs Committee {23}, that there have been no cases of complaints of noise at levels similar to those caused by wind farms leading to a successful prosecution as a statutory nuisance. lt should be noted however that the Welsh Affairs Committee also reports that although the noise may not be a statutory nuisance it can clearly be a cause for distress and disturbance, particularly if residents have been promised inaudibility and the noise has a particular quality leading to complaints.

• The effect of noise limits on the number of kWh generated.

Similar arguments can be made when considering the effect of noise limits on uptake of wind energy generated. A single wind turbine causing noise levels of 40 dB(A) at several nearby residences would have less planning merit (noise considerations only) than 30 wind turbines also causing the same amount of noise at several nearby residences.

• Duration and level of exposure.

The proportion of the time at which background noise levels are low and how low the background noise level gets are both recognised as factors which could affect the setting of an appropriate lower limit. For example, a property which experienced background noise levels below 30 dB(A) for a substantial proportion of the time in which the turbines would be operating could be expected to receive tighter noise limits than a property at which the background noise levels soon increased to levels above 35 dB(A). This approach is difficult to formulate precisely and a degree of judgement should be exercised."

The IOA GPG adds some further guidance:

"3.2.2 The day amenity noise limits have been set in ETSU-R-97 on the basis of protecting the amenity of residents whilst outside their dwellings in garden areas. The daytime amenity noise limits are formed in two parts: Part 1 is a simple relationship between the prevailing background noise level (with wind speed) with an allowance of +5 dB; Part 2 is a fixed limit during periods of quiet. ETSU-R-97 describes three criteria to consider when determining the fixed part of the limit in the range of 35 dB to 40 dB L_{A90}, all of which should be considered. They are:

1) the number of noise-affected properties;

2) the potential impact on the power output of the wind farm; and

3) the likely duration and level of exposure.

3.2.3 The rationale for a choice of this limit, or factors which would assist the determining authority in this respect should be set out in the assessment. lt is beneficial to the decision maker to display both sets of limits to illustrate the range available and/or the noise limit for the development if agreed previously with the LPA.

3.2.4 Current practice on the three criteria is as follows:

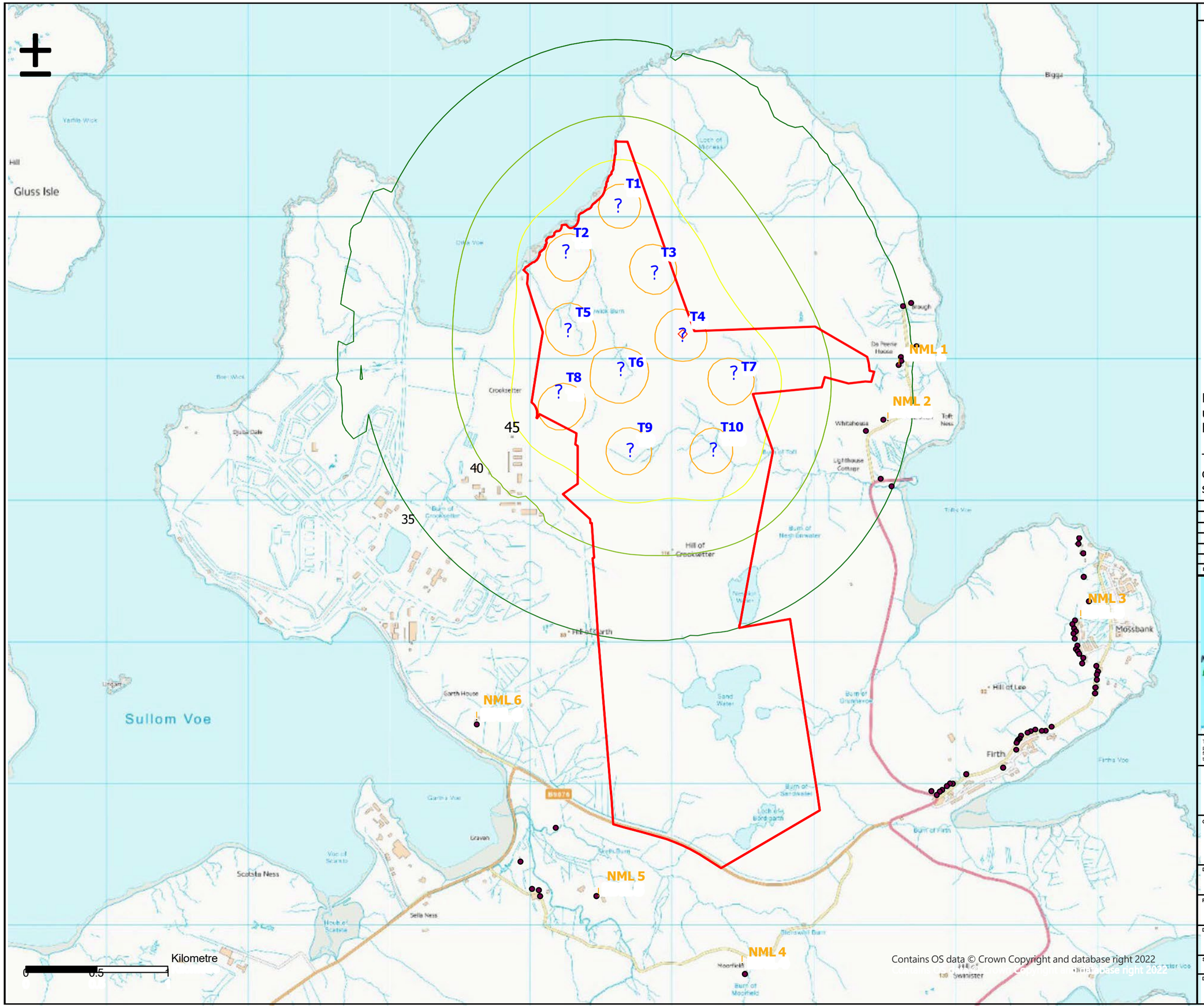
1. The number of neighbouring properties will depend on the nature of the area, (rural, semi-rural, urban) and is sometimes considered in relation to the size of the scheme and study area. The predicted 35 dB L_{A90} contour (at maximum noise output up to 12 m/s) can provide a guide to the dwellings to be considered in this respect.

2. This is in practice mainly based on the relative generating capacity of the development, as larger schemes have relatively more planning merit (for noise) according to the description in ETSU-R-97. ln cases when the amenity fixed limit has little or no impact on the generating capacity (i.e. noise is not a significant design constraint) then a reduced limit may be applied.

3. This last test is more difficult to formulate. But ETSU-R-97 notes that the likely excess of turbine noise relative to background noise levels should be a relevant consideration. ln rural areas, this will often be determined by the sheltering of the property relative to the wind farm site. Account can also be taken of the effects of wind directions (including prevailing ones at the site) and likely directional effects. For cumulative developments, in some cases the effective duration of exposure may increase because of cumulative effects.

3.2.5 lt can be argued that assessing these factors do not represent an acoustic consideration but ultimately a planning consideration, and therefore are difficult for noise consultants to fully determine. However this is described as part of ETSU-R-97 and therefore represents a relevant consideration when determining applicable noise limits. Furthermore, it is necessary, as part of the ElA process to evaluate the noise impacts, which is arguably not fully possible without a complete determination of the ETSU-R-97 limits. Finally, consideration of cumulative noise impacts may require the determination of partial noise limits which may be difficult to obtain unless the amenity noise limit is precisely determined.

3.2.6 Other planning considerations, such as the identification in local planning policy of areas of preferred wind farm development, may also influence or determine the choice of the absolute fixed amenity noise limit."



LEGEND

- Proposed Development Scoping Layout
- Noise Monitoring locations (NMLs)
- Noise Sensitive Receptors (NSRs)
- Site Boundary

Predicted Noise Level (dBA, LA90)

- 35
- 40
- 45
- 50
- 55

Noise predictions have been undertaken using mixed ground (G=0.5) at a receiver height of 4 m above ground.

The contour plot models the highest noise output predicted between 0 and 12 m/s, as standardised to 10 m height wind speed.

Rev	Date	Details	Drawn	Approved
0	29/01/2025	FIRST ISSUE	MR	JS

tnei

Client: RAMBOLL ENVIRON

Drawing Status: FOR INFORMATION

Project Title: NESHION ENERGY PARK

Drawing Title: FIGURE 1 - NOISE CONTOUR PLOT AND PROPOSED MONITORING LOCATIONS

Scale:	Original Size:	Spatial Reference:
1:25,000	A3	British National Grid

Drawing Number: 16430-006

Mathew Robinson

From: [redacted]

Sent: 03 March 2025 14:23
To: Mathew Robinson
Cc: [redacted]

Subject: RE: 16430 - Proposed Neshion Energy Park - Noise Consultation
Attachments: 16430-005 - Neshion Energy Park EHO Consultation Letter R0.pdf

Follow Up Flag: Follow up
Flag Status: Completed

Hi Mathew, thank you for consulting us at this early stage of the development. I am back from 4 weeks leave today, so apologies for my delayed response. I've copied in Development Management to keep them in the loop as well.
I am happy with the approach outlined in the consultation document. I have no issues with the proposals and I've answered the specific questions below.

- You are happy with the proposed assessment methods outlined above {use of BS 5228, BS 4142:2014+A1:2019, ETSU-R-97 and the IOA GPG); Yes
- Youagree that decommissioning noise can be scoped out of the EIAR; Yes - I would recommend this is added as a planning condition for the decommissioning works.
- Youagree to the use ofTotal ETSU-R-97 Noise Limits based on the upper daytime fixed minimum noise limit of 40dBanda fixed limit of 43dB during the night; Yes and 45dB for financially involved properties
- 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 willutilise available significant headroom with an appropriate margin +2 dB above predicted noise levels; Yes
- You agree with the general monitoring locations proposed (subject to exact siting); Yes
- Confirm whether you or one of your colleagues would like to attend the noise kit installation which it is anticipated to take place sometime in late February/ early March (depending on noise equipment availability); Yes, please contact me directly to arrange.
- If the Council is aware of any schemes which should be included in the cumulative noise assessment or any other dwellings which should be considered in the assessment of noise impacts. No additional schemes for cumulative assessment-e-mail confirmation from Development Management 23/01/2025. No other dwellings to be considered. The NM Ls are representative of the area.

Should you use a representativelocation for NML4, please include the rationale for the location selection in the finalreport.
I note that Garth Farmhouse is financially involved with the project (presumably the landowner). Evidence of this financial involvement must be submitted to Development Management showingthat the occupants are to be direct beneficiaries.This will allow an increase to the fixed limit noise levels to 45dB.

Please let me know if youhave any further questions.

Kind regards

[redacted]

From: Mathew Robinson [redacted]
Sent: 06 February 2025 11:19
[redacted]
Subject: 16430 - Proposed Neshion Energy Park - Noise Consultation

Dear-

Neshion Ltd are proposing to develop a wind farm on land to the east of Toft, on Mainland of Shetland Islands. TNEI have been commissioned to undertake the noise assessment work for the proposed development and would like to agree in advance the methodology proposed for the noise assessment.

Please find attached a consultation letter detailing our proposed methodology for your consideration.

Permission for NMLs 1, 2, 3, 5, and 6 have been secured. If we cannot get permission to monitor at NML4, we would seek to monitor at a location nearby, or use data from another site that we would deem representative of the property at NML4.

If you have any questions, require additional information, or would like a callto discuss any of the above, please do not hesitate to contact myself or my colleague Jim.

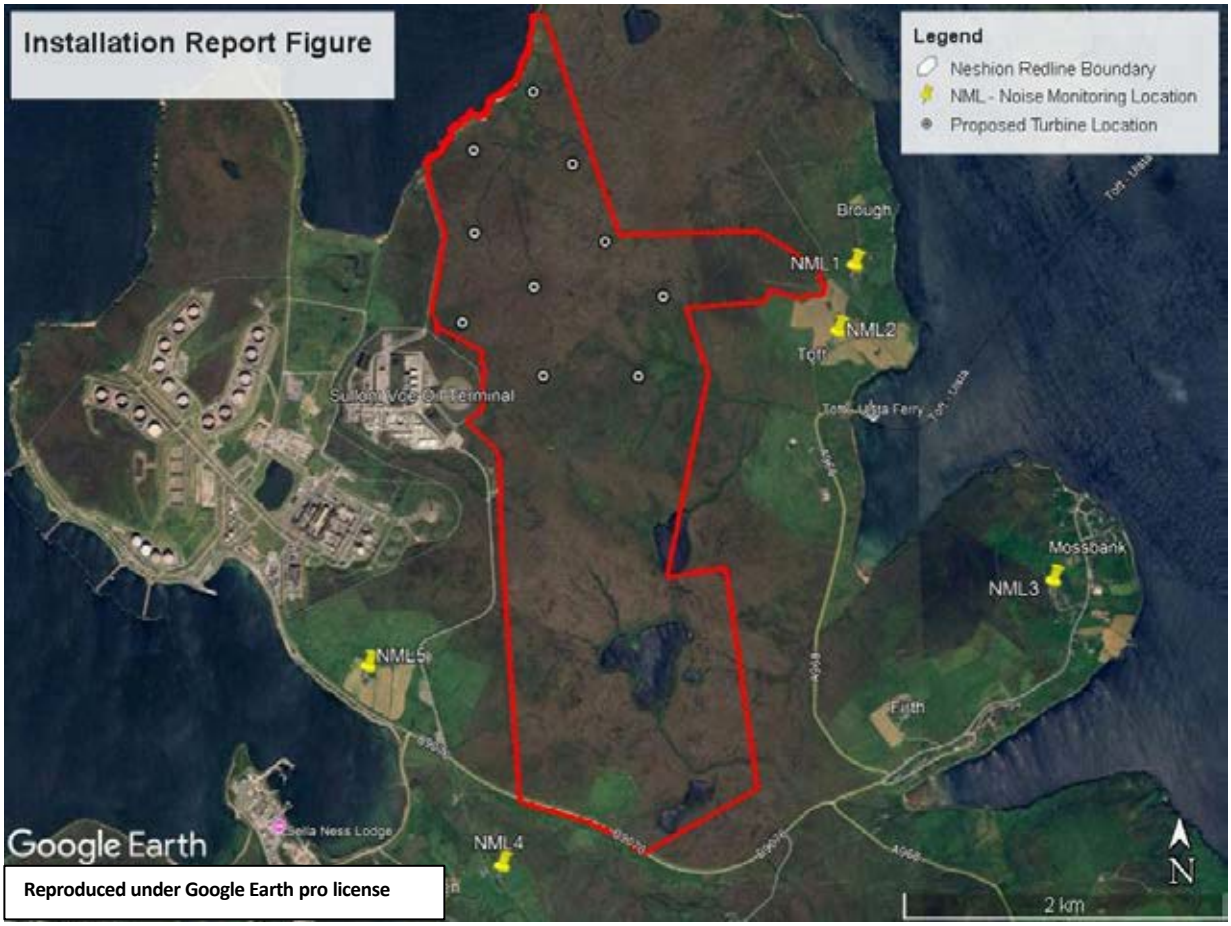
Kind regards,
Mathew

tnei
[redacted]
7th Floor, West One, Forth Banks, Newcastle, NEI 3PA, United Kingdom

twenty five tnei
Celebrating 25 years of **TNEI**

I work flexibly and may send emails outside normalworking hours. Your immediate response is not expected.

Neshion Energy Park Baseline Noise Survey – Noise Monitoring Locations installed on 26/02/2025



Reproduced under Google Earth pro license

Present during the installation:

- Mathew Robinson, Technical Consultant, TNEI Services Ltd
- Alvar Thomson, Operations Manager, Shetland Aerogenerators Ltd

Unless specified, all noise kits were installed at least 3.5 m from any hard-reflecting surface except the ground and less than 20 m from the dwelling and away from obvious noise sources, such as boiler flues.

Detailed installation information and images for each of the Noise Monitoring Locations (NMLs} are provided below. The original full-size images are available on request. Noise monitoring equipment was installed at five NMLs on 26th February 2025. The images shown were taken during installation.

Noise Monitoring Locations (NMLs)	Installation Location (BNG)
NML1 - Norden	443594, 1176969
NML2 – Quoy Lee	443495, 1176560
NML3 – No.7 Maidenfield	444840, 1175035
NML4 – Laxobiggin	441452, 1173220
NML5 – Garth Farmhouse	440606, 1174452

Out of the proposed six NMLs outlined in the EHO Consultation Letter, document reference 16430-005, five were installed at the proposed property.

No response was received from the letters sent to the occupant at the sixth location, Moorfield, and no person was present when the property was visited. Moorfield was originally chosen due to its proximity to the red line boundary (see image below}, however as it is a considerable distance away from the proposed turbine locations, TNEI deemed that it could be excluded from the survey and this was reported to Shetland Island Council, who agreed this was appropriate.

NMLl – Norden

Facing North

Facing East

Facing South

Facing West

Description of NML and Subjective Observations

The noise monitoring equipment was installed along the back fence of the rear garden approximately 23 m to the west of the property at NML1. This position was selected to avoid damp ground conditions and provided level ground to rest the kit on.

Noise from the direction of the Sullum Voe Oil Terminal was just audible at the property, but it could not be confirmed what the source was. There was occasional noise from passing traffic on the main road near Toft, and birdsong.

NML2 – Quoy Lee

Facing North

Facing East

Facing South

Facing West

Description of NML and Subjective Observations

The noise monitoring equipment at NML2 was installed in the front garden of the property, along the fence to the south. Although the proposed turbines would be installed to the rear of the property the front garden was selected as there were no reflecting surfaces within 3.5m, unlike the areas to the rear and side of the property.

The soundscape consisted of occasional road noise from vehicles on the main road to the south due to activity at the ferry terminal. As the ferry activity is not constant, the noise would generally be

quieter than what was observed. There was noise from ducks that were roaming in the adjacent field, and some wind induced noise.

NML3 – No.7 Maidenfield

Facing North

Facing East

Facing South

Facing West

Description of NML and Subjective Observations

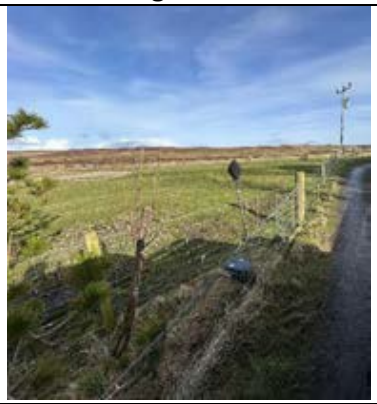
The noise monitoring equipment at NML3 was installed in the garden of the residential property at 7 Maidenfield.

Sounds observed at this location during the equipment installation was wind induced noise from foliage, with the occasional noise from passing vehicles along the road. No other significant sound sources were noted at this location.

NML4 – Laxobiggin

Facing North West

Facing North East



Facing South

Facing South West

Description of NML and Subjective Observations

The noise monitoring equipment at NML4 was installed to the north of the property, in a fenced off plot of land.

At the time of installation, the soundscape was generally quiet, with occasional noise from vehicles on the road to the south, and livestock in the nearby field. No noise was audible from the stream located to the south.

NMLS - Garth Farmhouse

Facing North East

Facing South East

Facing South

Facing West

Description of NML and Subjective Observations

The noise monitoring equipment at NMLS was installed towards the north of the residential property.

Road noise was the main noise source in what was generally a quiet soundscape. No noise was audible from the Sullom Voe Oil Terminal despite it being within sight. This included a flaring stack, which was visible but could not be heard at the time of installation.

Annex 3 – Noise Monitoring Records

Field Data Sheet - NML1

Project Title	Neshion Energy Park	**Project Number**	16430
Client	Neshion Energy Park Limited	**Surveyor(s)**	MR & EH

MONITORING LOCATION

Location Number	NML1
Location Name	Norden
Location Description	The noise monitoring kit was placed in the back garden of Norden. The equipment located in a position that was at least 3.5m away from nearby facades or reflective surfaces.
Latitude	60.474012
Longitude	-1.208761
Noise sources noted during installation, kit maintenance and removal	**Installation** - The main sources of noise during installation was birdsong, occasional distant road noise from the main road by Toft ferry station. Other noise that was noted was faint noise from the from west, which is in the direction of the Sullom VOe Oil Terminal, and noise from a airplane overhead. Weather conditions were sunny with a slight breeze and wet underfoot in the garden. **Kit Maintenance -** During battery change, the main noise source was birdsong. Weather conditions at the time was windy, cloudy at 8 oktas and wet underfoot. **Collection** - Wind induced noise and birdsong were dominant noise sources during collection. The weather conditions were windy with wind coming off the south, overcast with no rain and the garden was damp underfoot.

NOISE MONITORING EQUIPMENT DETAILS

	Number	Model	Serial Number	Last Calibrated/ Conformance Checked
Sound Level Meter	SLM 069	Rion NL-53	00230075	12/02/2024
Calibrator	CAL 002	Rion NC-74	34973250	14/11/2024

Weather Measurement	None
Equipment Notes	

NOISE MONITORING EQUIPMENT SETTINGS

	Frequency Weighting	Index	Interval	Time Weighting	Range	Audio Recording
Parameters Recorded	A	Leq, L90	10 Mins	Fast	20-110	No

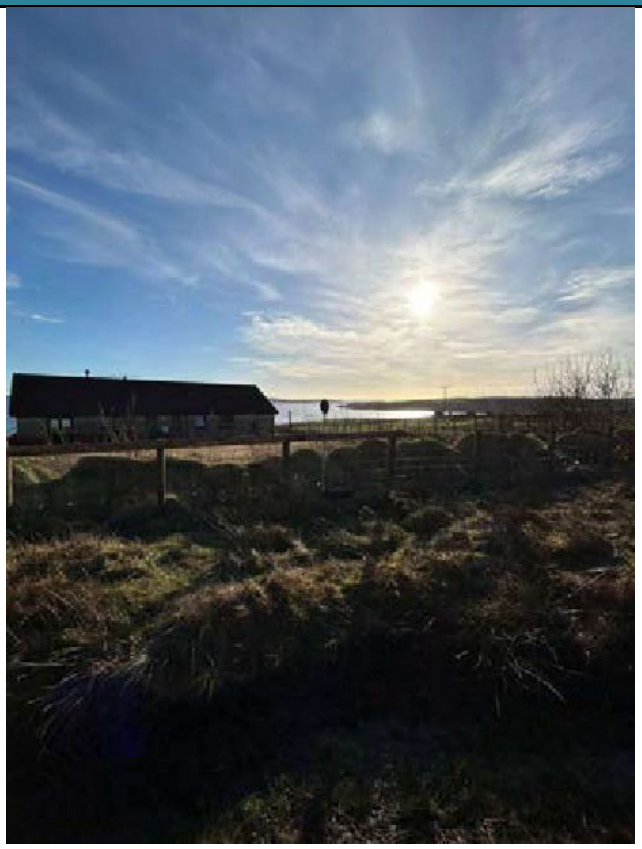
MEASUREMENTS

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0101	26/02/2025 10:00	25/03/2025 09:47	94.0	93.5	0.5	Cockerel intermittently, wind, 8 oktas, boggy under foot
0102	25/03/2025 10:00	30/04/2025 08:14	94.0	93.4	0.6	Wind induced noise and birdsong are the dominant sources of noise. The noise meter stopped recording on the 15th April. The SLM was dead upon arrival. Added new batteries into the back of SLM to record calibration. Weather conditions are windy, southwestern wind, overcast sky and no rain. Garden damp underfoot.

NML1 Photographs (Part 1)

North

East



NML1 Photographs (Part 2)

South

West

Field Data Sheet - NML2

Project Title	Neshion Energy Park	**Project Number**	16430
Client	Neshion Energy Park Limited	**Surveyor(s)**	MR & EH

MONITORING LOCATION

Location Number	NML2
Location Name	Quoy Lee
Location Description	The noise monitoring kit was placed in the front garden of residents house. Due to limited space and refelctive surfaces, the kit could not be placed in the back garden. The equipment located in a position that was at least 3.5m away from nearby facades or reflective surfaces.
Latitude	60.470419
Longitude	-1.210788
Noise sources noted during installation, kit maintenance and removal	**Installation** - The main sources of noise during installation was road noise, which was audible from the direction of the main road to the south, at the ferry station, and activity from the ferry arriving. There was occasional noise from a flock of ducks located in adjacent field, and there was also wind induced noise from foliage. Weather conditions were sunny with a slight breeze and wet underfoot in the garden. **Kit Maintenance** - During battery change, the main noise source was wind induced noise as the conditions were very windy. When the wind dropped, noise from nearby ducks could be heard. Other weather conditions at the time was cloudy at 8 oktas and wet underfoot. **Collection** - Dominant noise sources were wind induced noise, birdsong and sheep in the nearby field. Lambs were out, no sign of the ducks. There was also occasional boat noise from the Ulsa Ferry terminal.

NOISE MONITORING EQUIPMENT DETAILS

	Number	Model	Serial Number	Last Calibrated/ Conformance Checked
Sound Level Meter	SLM 074	Rion NL-53	00541098	14/08/2024
Calibrator	CAL 002	Rion NC-74	34973250	14/11/2024

Weather Measurement	Rain Gauge
Equipment Notes	RG-16 installed at this location

NOISE MONITORING EQUIPMENT SETTINGS

	Frequency Weighting	Index	Interval	Time Weighting	Range	Audio Recording
Parameters Recorded	A	Leq, L90	10 Mins	Fast	20-110	No

MEASUREMENTS

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0201	26/02/2025 10:40	25/03/2025 10:10	94.0	94.4	-0.4	Very windy, ducks quacking when wind dies down slightly, 8 oktas, ground damp underfoot
0202	25/03/2025 10:30	30/04/2025 08:40	94.0	94	0.0	Dominant noise sources were wind induced noise, birdsong and sheep in the nearby field. Lambs were out, no sign of the resident ducks. Occasional boat noise from the Ulsa Ferry terminal. Resident had trimmed the plants

NML2 Photographs (Part 1)

North

East

NML2 Photographs (Part 2)

South

West

Field Data Sheet - NML3

Project Title	Neshion Energy Park	**Project Number**	16430
Client	Neshion Energy Park Limited	**Surveyor(s)**	MR & EH

MONITORING LOCATION

Location Number	NML3
Location Name	No.7 Maidenfield
Location Description	The noise monitoring kit was placed in the back garden of residents property, along the fence line. The equipment located in a position that was at least 3.5m away from nearby facades or reflective surfaces.
Latitude	60.456572
Longitude	-1.186538
Noise sources noted during installation, kit maintenance and removal	**Installation** - The main sources of noise during installation was wind induced noise. Another noise source was the occasional vehicle passing along the road to the east. Weather conditions were sunny with a slight breeze and wet underfoot in the garden. **Kit Maintenance** - Similarly during kit maintenance, the main sources of noise during installation was wind induced noise. Weather condition at the time was cloudy at 8 oktas and wet underfoot. **Collection** - Dominant noise source as wind induced noise, and weather at the time of collection was cloudy and windy.

NOISE MONITORING EQUIPMENT DETAILS

	Number	Model	Serial Number	Last Calibrated/ Conformance Checked
Sound Level Meter	SLM 046	Rion NL-52	00386759	03/01/2024
Calibrator	CAL 002	Rion NC-74	34973250	14/11/2024

Weather Measurement	None
Equipment Notes	

NOISE MONITORING EQUIPMENT SETTINGS

	Frequency Weighting	Index	Interval	Time Weighting	Range	Audio Recording
Parameters Recorded	A	Leq, L90	10 Mins	Fast	20-110	No

MEASUREMENTS

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0301	26/02/2025 11:10	25/03/2025 10:39	94.0	94.3	-0.3	Wind, 8 oktas, ground damp under foot
0302	25/03/2025 10:47	30/04/2025 08:50	94.0	93.7	0.3	Wind induced noise, and weather is cloudy and windy

NML3 Photographs (Part 1)

North

East

NML3 Photographs (Part 2)

South

West

Field Data Sheet - NML4

Project Title	Neshion Energy Park	**Project Number**	16430
Client	Neshion Energy Park Limited	**Surveyor(s)**	MR & EH

MONITORING LOCATION

Location Number	NML4
Location Name	Laxobiggin
Location Description	The noise monitoring kit was placed in a fenced off small section of a field, located next to the property. The equipment located in a position that was at least 3.5m away from nearby facades or reflective surfaces.
Latitude	60.440669
Longitude	-1.248586
Noise sources noted during installation, kit maintenance and removal	**Installation** - The main sources of noise during installation was road noise from the south west. The stream to south was not audible at the time of installation, despite being in spate. Occasional noise from sheep in fields nearby. Weather conditions were sunny with a slight breeze. **Kit Maintenance** - It was very windy, and there was faint road traffic noise intermittently. Weather conditions were cloudy at 8 oktas and boggy under foot. **Collection** - Wind induced noise was the dominant noise source. Sheep and lambs in field nearby. Weather conditions were windy and overcast. No rain.

NOISE MONITORING EQUIPMENT DETAILS

	Number	Model	Serial Number	Last Calibrated/ Conformance Checked
Sound Level Meter	SLM 077	Rion NL-53	00541103	14/08/2024
Calibrator	CAL 002	Rion NC-74	34973250	14/11/2024

Weather Measurement	None
Equipment Notes	

NOISE MONITORING EQUIPMENT SETTINGS

	Frequency Weighting	Index	Interval	Time Weighting	Range	Audio Recording
Parameters Recorded	A	Leq, L90	10 Mins	Fast	20-110	No

MEASUREMENTS

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0401	26/02/2025 11:50	25/03/2025 11:12	94.0	93.6	0.4	Very windy, slight road traffic noise intermittently, 8 oktas, boggy under foot
0402	25/03/2025 11:20	30/04/2025 09:26	94.0	93.6	0.4	Wind induced noise was the dominant noise source. Sheep and lambs in field nearby. Weather conditions were windy and overcast. No rain.

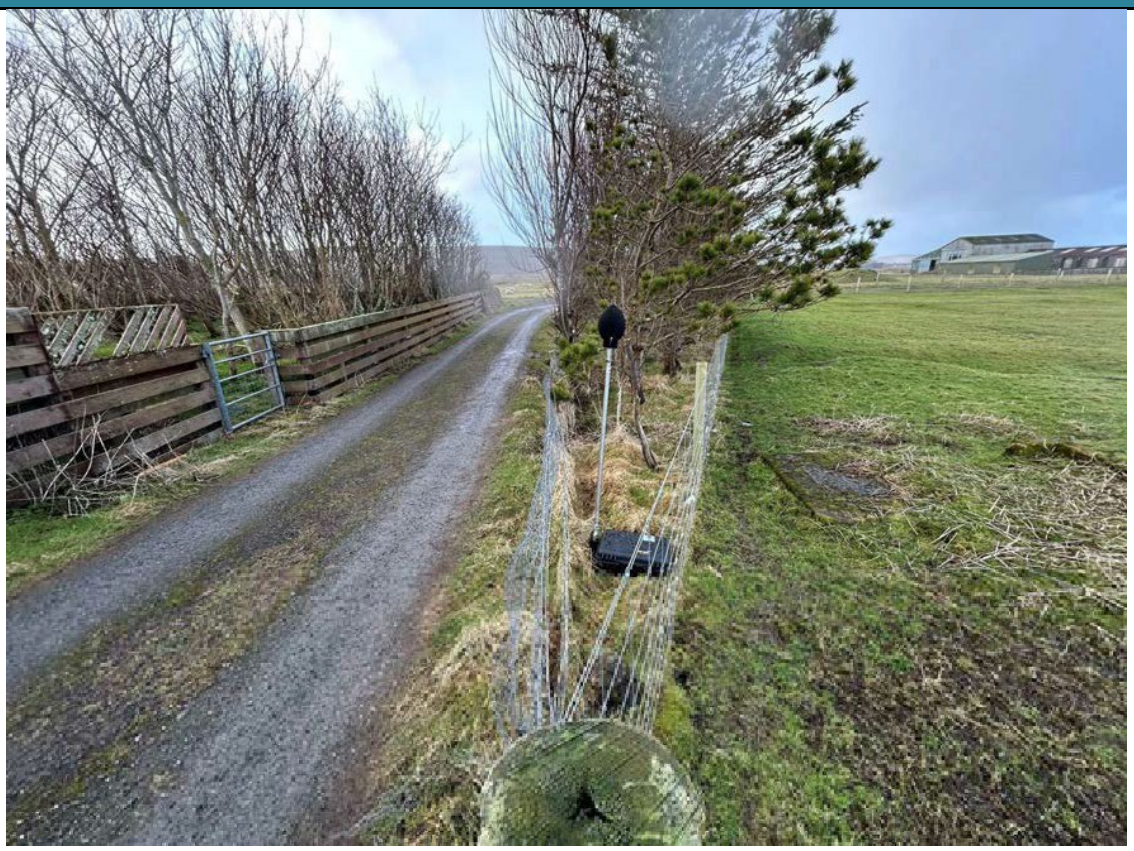
NML4 Photographs (Part 1)

North

East

NML4 Photographs (Part 2)

South



West

Field Data Sheet - NML5

Project Title	Neshion Energy Park	**Project Number**	16430
Client	Neshion Energy Park Limited	**Surveyor(s)**	MR & EH

MONITORING LOCATION

Location Number	NML5
Location Name	Garth Farmhouse
Location Description	The noise monitoring kit was placed in the back garden of the property, positioned away from road and facades. The equipment located in a position that was at least 3.5m away from nearby facades or reflective surfaces.
Latitude	60.451831
Longitude	-1.263741
Noise sources noted during installation, kit maintenance and removal	**Installation** - The main sources of noise during installation was road noise. Sullom Voe Oil Terminal was within sight but no noise from activities were audible. Similarly, the flare stack could be seen from the NML, but no noise could be heard. Weather conditions were sunny with a moderate breeze. **Kit Maintenance** - Noise sources include Intermittent road traffic, wind induced noise, dogs barking intermittently, birdsong, and industrial noise from Sullom Voe Oil Terminal Weather conditions were cloudy at 8 oktas, drizzle and boggy under foot, **Collection** - Dominant noise source was wind induced noise and noise from the direction of the Sullom Voe Terminal. The visible flare stacks did not look to be in operation and no noise could be heard from them. Weather conditions were windy and overcast. No rain.

NOISE MONITORING EQUIPMENT DETAILS

	Number	Model	Serial Number	Last Calibrated/ Conformance Checked
Sound Level Meter	SLM 055	Rion NL-52	00520923	05/08/2024
Calibrator	CAL 002	Rion NC-74	34973250	14/11/2024
Weather Measurement	Rain Gauge			
Equipment Notes	RG-2 installed at this location			

NOISE MONITORING EQUIPMENT SETTINGS

	Frequency Weighting	Index	Interval	Time Weighting	Range	Audio Recording
Parameters Recorded	A	Leq, L90	10 Mins	Fast	20-110	No

MEASUREMENTS

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0501	26/02/2025 12:20	25/03/2025 11:27	94.0	94.2	-0.2	Passing road traffic intermittently, very wind, noise from flare or machinery workings from oil/gas plant, 8 oktas, drizzle, boggy under foot, dogs barking intermittently, birdsong
0502	25/03/2025 11:40	30/04/2025 09:51	94.0	93.9	0.1	Dominant noise source was wind induced noise and noise from the direction of the Sullom Voe Terminal. The visible flare stacks did not look to be in operation and no noise could be heard from them. The rain gauge funnel was blocked with what looked like bird droppings. No rain data was collected. Weather conditions were windy and overcast. No rain.

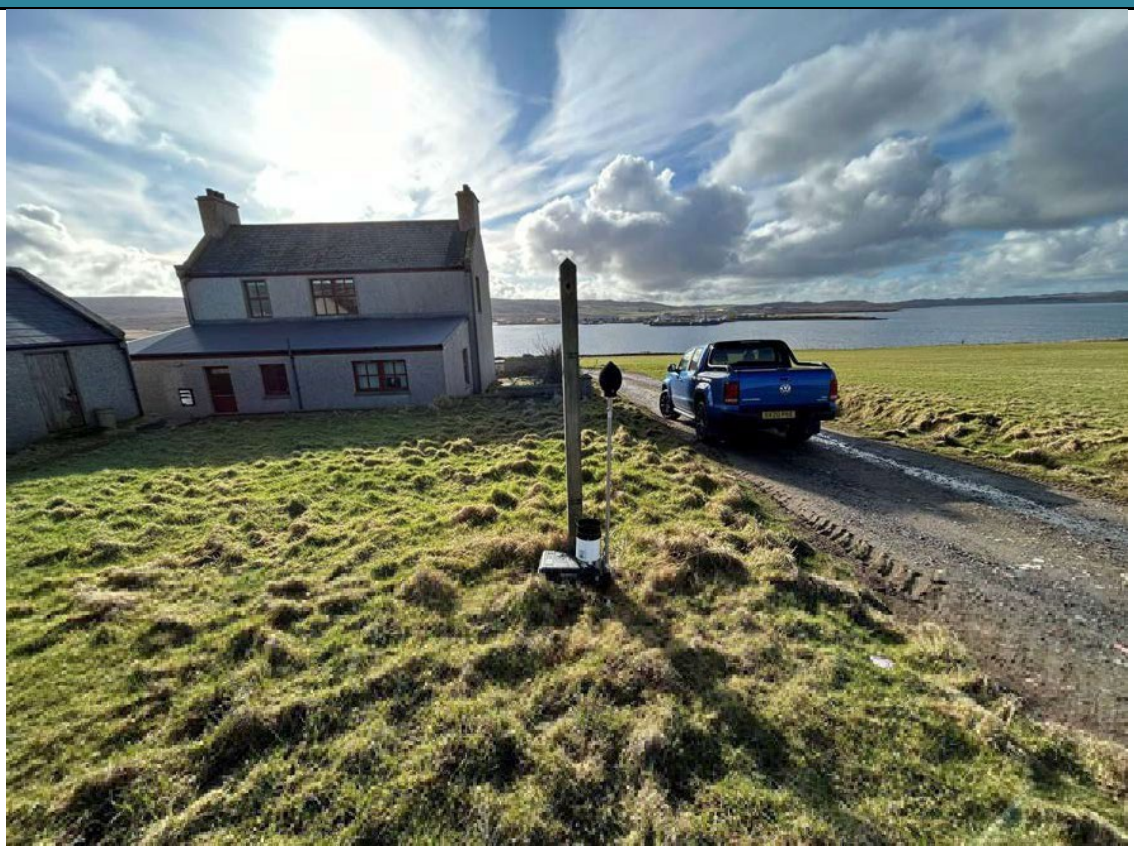
NML5 Photographs (Part 1)

North

East

NML5 Photographs (Part 2)

South



West

Annex 4 – Calibration/ Conformance Certificates for Sound Level Meters and Calibrator