Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume III, Appendix 8.1: Airborne Noise Technical Report

sse Renewables

PROJECT: Arklow Bank Wind Park 2 – Offshore Infrastructure.

Airborne Noise Impact– Technical Report.

Prepared by: AONA Environmental Consulting Ltd.

Date: May 2024

REPORT CONTROL

Project:	Arklow Bank Wind Park 2 – Offshore Infrastructure. Airborne Noise Impact Assessment – Technical Report.
Job Number:	ENV-9090

Document Checking:

Author:	Mervyn Keegan

Review By:	Olivia Maguire

Issue	Date	Status	Checked for Issue
1	02/05/2024	Final	Sure Partners Limited

AONA Environmental Consulting Ltd.
Unit 8A
Northwest Business Park
Sligo
F91 E285

www.aonaenvironmental.ie

Version	Date	Status	Author	Reviewed by	Approved by
1.0	02/05/2024	Final (External)	AONA	GoBe Consultants	Sure Partners Limited

Statement of Authority

Author	Experience
Mervyn Keegan, B.Sc., M.Sc., MIOA	M.Sc. Environmental Science, Queens University Belfast (1998) B.Sc. (Hons) Applied Biology, Coventry University (1996) Diploma in Pollution Assessment & Control, Institute of Technology, Sligo (1995) Diploma in Acoustics & Noise Control, Institute of Acoustics (University of Ulster, 2001) Mervyn Keegan is a Director of AONA Environmental Consulting Ltd. Mervyn is a Member of Institute of Acoustics, a Member of Institute of Air Quality Management and a Member of Institute of Environmental Sciences. Mervyn has over 25 years of experience in Environmental Consultancy and his main areas of expertise are in Noise, Air Quality & Odour impact assessment and mitigation design as well as Environmental Impact Assessment and IPPC Licensing. Mervyn has completed in excess of 100 Wind Energy Noise Impact Assessments throughout Ireland and Northern Ireland in accordance with the Wind Energy Development Guidelines (2006), the Draft Revised Wind Energy Development Guidelines (December 2019), ETSU-R-97, The Assessment and Rating of Noise from Wind Farms, Department of Trade and Industry (1996) and A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, Institute of Acoustics (2013).

Contents

1.1Introduction 1
1.2Relevant Guidance & Assessment Criteria 2
1.3Assessment Methodology 7
1.4Baseline Environment 17
1.5Predicted Noise Levels 27
1.6References 46

Tables

Table 8.1.1 Construction noise threshold levels based on the BS 5228 'ABC' method. 2

Table 8.1.2 List of representative NSR locations (NSR A – NSR J) along the Irish Sea coastline relative to the representative baseline noise survey measurement locations (LT1 – LT6) 8

Table 8.1.3 Details of baseline noise monitoring survey locations. 11

Table 8.1.4 A-weighted octave band sound power level (dB LwA) for the potential piling noise source (Note: Piling source height of 22.2 m above sea level assumed in prediction model.). 16

Table 8.1.5 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5 dB(A) from 3–12 m/s wind speeds based on baseline noise monitoring at LT 1. 25

Table 8.1.6 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 2. 25

Table 8.1.7 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 3. 25

Table 8.1.8 Measured Amenity Hours and Night-time background noise levels LA90 and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 4. 26

Table 8.1.9 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 5. 26

Table 8.1.10 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 6. 26

Table 8.1.11 Minimum WEDG 2006 Guideline Daytime & Night-time Noise Limits (dB(A)) measured at wind speeds from 3-12m/s across the six noise monitoring locations LT 1 – LT 6. 27

Table 8.1.12 Minimum ETSU-R-97 Guideline Daytime & Night-time Noise Limits (dB(A)) measured at wind speeds from 3-12m/s across the six noise monitoring locations LT 1 – LT 6 (Added for context, based on the ETSU-R-97 and IoA GPG methodologies). 27

Table 8.1.13 Expected Piling durations during the Construction Phase. 28

Table 8.1.14 Predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Daytime Noise Limits. 29

Table 8.1.15 Predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Evening Noise Limits. 31

Table 8.1.16 Predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Night-time Noise Limits. 33

Table 8.1.17 Predicted cumulative piling noise levels at each of the noise assessment locations, versus the BS5228 Daytime, Evening and Night-time Noise Limits. 37

Table 8.1.18 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 1 (Model 1A) from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit and ETSU-R-97 Simplified Limit. 39

Table 8.1.19 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 1 (Model 1B) from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit and ETSU-R-97 Simplified Limit. 41

Table 8.1.20 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 2 from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit and ETSU-R-97 Simplified Limit. 43

Graphs

Graph 8.1.1 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 1. 19

Graph 8.1.2 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 1.... 19

Graph 8.1.3 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 2. 20

Graph 8.1.4 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 2.... 20

Graph 8.1.5 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 3. 21

Graph 8.1.6 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 3.... 21

Graph 8.1.7 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 4. 22

Graph 8.1.8 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 4.... 22

Graph 8.1.9 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 5. 23

Graph 8.1.10 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 5.. 23

Graph 8.1.11 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 6..... 24

Graph 8.1.12 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 6.. 24

Graph 8.1.13 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 1 (Model 1A) from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit. 40

Graph 8.1.14 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 1 (Model 1B) from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit. 42

Graph 8.1.15 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 2 from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit. 44

Figures

Figure 8.1.1: Noise Sensitive Receivers A – J & Noise Monitoring Locations– 1 - 6 9

Figure 8.1.2: Windrose showing prevailing wind direction and frequency for the proposed ABWP2 Array location. 14

Project Description Glossary

Term	Meaning
Arklow Bank Wind Park 1	Arklow Bank Wind Park 1 consists of seven wind turbines, offshore export cable and inter-array cables. Arklow Bank Wind Park 1 has a capacity of 25.2 MW. Arklow Bank Wind Park 1 was constructed in 2003/04 and is operated by Arklow Energy Limited. It remains the first and only operational offshore wind farm in Ireland.
Arklow Bank Wind Park 2 – Offshore Infrastructure	"The Proposed Development", Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements under the existing Maritime Area Consent (MAC).
Arklow Bank Wind Park 2 (ABWP2) (The Project)	Arklow Bank Wind Park 2 (ABWP2) (the Project) is the onshore and offshore infrastructure. This EIAR is being prepared for the Offshore Infrastructure. Consent for the Onshore Grid Infrastructure and Operations Maintenance Facility has been granted in May and June 2022, respectively. • Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements to be consented in accordance with the Maritime Area Consent. This is the subject of this EIAR and will be referred to as 'the Proposed Development' in the EIAR. • Arklow Bank Wind Park 2 Onshore Grid Infrastructure(OGI): This relates to the onshore grid infrastructure for which planning permission has been granted. • Arklow Bank Wind Park 2 Operations and Maintenance Facility (OMF): This includes the onshore and nearshore infrastructure at the OMF, for which planning permission has been granted. • Arklow Bank Wind Park 2 EirGrid Upgrade Works: any non-contestable grid upgrade works, consent to be sought and works to be completed by EirGrid.
Array Area	The Array Area is the area within which the Wind Turbine Generators (WTGs), the Offshore Substation Platforms (OSPs), and associated cables (export, inter- array and interconnector cabling) and foundations will be installed.
EIA	An Environmental Impact Assessment (EIA) is a statutory process by which certain planned Projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Directive 2011/92/EU on the assessment of the effects of certain public and private Projects on the environment as amended by Directive 2014/52/EU of the European Parliament and of the Council (EIA Directive) and the regulations transposing the EIA Directive (EIA Regulations).
Foreshore	The bed and shore, below the line of high water of ordinary or medium tides, of the sea and of every tidal river and tidal estuary and of every channel, creek, and bay of the sea or of any such river or estuary including the subsoil below, and the water column above the bed and shore and extending to the 12 nautical mile limit

Term	Meaning
Landfall	The area in which the offshore export cables make landfall and is the transitional area between the offshore cabling and the onshore cabling.
Maritime Area Consent (MAC)	A consent to occupy a specific part of the maritime area on a non-exclusive basis for the purpose of carrying out a Permitted Maritime Usage strictly in accordance with the conditions attached to the MAC granted on 22nd December 2022 with reference number 2022-MAC-002.
Mitigation Measure	Measure which would avoid, reduce, or remediate an impact.
Permitted Maritime Usage	The construction and operation of an offshore windfarm and associated infrastructure (including decommissioning and other works required on foot of any permission for such offshore windfarm)
The Developer	Sure Partners Ltd.

Airborne Noise Impact Assessment Glossary

Term	Meaning
A-weighting	A filter that down-weights low frequency and high frequency sound to better represent the frequency response of the human ear when assessing the likely effects of noise on humans
Ambient noise	All-encompassing noise associated with a given environment, usually a composite of sounds from many sources both far and near, often with no particular sound being dominant
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 day time, evening or night time periods.
dB	Abbreviation for 'decibel'
dB(A)	Abbreviation for the decibel level of a sound that has been A-weighted
Decibel	The unit employed to measure the magnitude of sound
Directivity	The property of a sound source that causes more sound to be radiated in one direction than another
Equivalent continuous sound pressure level	The steady sound level which has the same energy as a time varying sound signal when averaged over the same time interval, T, denoted by $L_{Aeq,T}$
Frequency	The number of acoustic pressure fluctuations per second occurring about the atmospheric mean pressure (also known as the 'pitch' of a sound). Hertz is the unit normally employed to measure the frequency of a sound, equal to cycles per second of acoustic pressure fluctuations about the atmospheric mean pressure
Frequency analysis	The analysis of a sound into its frequency components
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
L_{Aeq}	The abbreviation of the A-weighted equivalent continuous sound pressure level
L_{A90}	The abbreviation of the 90 percentile noise indicator, often used for the measurement of background noise
Noise emission	The noise emitted by a source of sound

Noise immission	The noise to which a receiver is exposed
Octave band frequency analysis	A frequency analysis using a filter that is an octave wide (the upper limit of the filter's frequency band is exactly twice that of its lower frequency limit)
Receiver	Person or property exposed to the noise being considered
Residual noise	The ambient noise that remains in the absence of the specific noise whose effects are being assessed
Sound	A regular and ordered oscillation of air molecules that travels away from the source of vibration and creates fluctuating positive and negative acoustic pressure above and below atmospheric pressure.
Sound level meter	An instrument for measuring sound pressure level
Sound pressure level	A measure of the sound pressure at a point, in decibels
Sound power level	The total sound power radiated by a source, in decibels
Spectrum	A description of the amplitude of a sound as a function of frequency
Standardised wind speed	Values of wind speed at hub height corrected to a standardised height of ten metres using the same procedure as used in wind turbine emission testing

Acronyms

Term	Meaning
ABWP2	Arklow Bank Wind Park 2
DRWEDG19	The Draft Revised Wind Energy Development Guidelines
EIA	Environmental Impact Assessment
EIAR	EIA Report
EPA	Environmental Protection Agency
ETSU	Energy Technology Support Unit
GIS	Geographic Information System
GPG	Good Practice Guide
HWM	High Water Mark
IEC	International Electrotechnical Commission
IoA	Institute of Acoustics
LiDAR	Light Detection And Ranging
NSR	Noise Sensitive Receivers
O&M	Operational and Maintenance

OSP	Offshore Substation Platform
SLM	Sound Level Meters
UK	United Kingdom
UTM	Universal Transverse Mercator
WEDG2006	The 2006 Wind Energy Guidelines

Units

Unit	Description
dB	Decibel (unit used to measure the intensity of sound)
dB (A)	Decibel level of a sound that has been A-weighted
km/h	Kilometres per hour
m/s	Metres per second
$L_{Aeq}T$	The abbreviation of the A-weighted equivalent continuous sound pressure level over measurement time, T. Effectively represents an energetic average value.
$L_{A90,T}$	A-weighted fast weighted sound pressure level exceeded for 90% of the measurement period, T , often used for the measurement of background sound.

1 Airborne Noise Impact– Technical Report

1.1 Introduction

1.1.1.1 This Airborne Noise Impact Assessment Technical Report has been prepared by AONA Environmental Consulting Ltd. (AONA Environmental) to support the Environmental Impact Assessment Report (EIAR) for Arklow Bank Wind Park 2 (ABWP2) Offshore Infrastructure (the Proposed Development).

1.1.1.2 AONA Environmental Consulting Ltd. is an independent Environmental and Occupational Health and Safety consultancy that specialises in providing professional Air Quality and Odour Impact Assessments, Occupational Health and Safety at Work, Noise Impact and Acoustic Assessments. AONA Environmental Consulting Ltd. Consultants are members of the Institute of Acoustics, the Institute of Air Quality Management, the Institution of Environmental Sciences and the Occupational Health Society of Ireland. The consultancy services it provides are always in accordance with the relevant standards, guidelines and legal requirements. Its services range from the provision of monitoring surveys, dispersion & prediction modelling studies and advice of compliance with standards to detailed environmental impact assessment reports to accompany planning applications as well as the provision of legal opinion and expert witness.

1.1.1.3 Mervyn Keegan (B.Sc., M.Sc., MioA, MIES, MIAQM) is the author of this Technical Report. Mervyn Keegan has prepared in excess of 100 wind energy noise impact assessments over the last 20 years throughout Ireland and the UK in accordance with the relevant impact assessment standards, guidelines and EIAR legal requirements.

1.1.1.4 This Technical Report supports Chapter 8: Airborne Noise in Volume II of the EIAR for the Proposed Development. It presents the methodology used to predict noise levels within the Airborne Noise Study Area; the baseline noise data collected within the Airborne Noise Study Area; and the results of airborne noise modelling during construction (piling) and operational stages, which are used to predict the impacts of airborne noise on Noise Sensitive Receivers (NSRs).

1.1.1.5 This Airborne Noise Impact Assessment Technical Report considers the potential for the construction, operational and maintenance (O&M) and decommissioning phases of the Proposed Development to impact the nearest sensitive onshore NSRs to the project. This Technical Report describes the scope, relevant legislation and guidelines, the baseline conditions, the assessment methodology, and the predicted airborne noise levels.

1.1.1.6 During the Construction phase, noise levels from three alternative wind turbine type and layouts, Options 1 (Models 1A and 1B) and 2, have been predicted for the piling scenarios assessed, taking account of no piling noise mitigation and the use of piling noise mitigation options such as a screen, a dolly and a combination of both.

1.1.1.7 During the O&M phase, noise levels from the alternative wind turbine type and layouts for Options 1 (Models 1A and 1B) and 2 have been predicted.

1.1.1.8 Cumulative noise effects with other proposed developments that may also have an impact on the NSRs close to the Proposed Development are also considered.

1.2 Relevant Guidance & Assessment Criteria

1.2.1 Construction Noise Guidance & Assessment Criteria

1.2.1.6 There are no legislatively binding construction noise limits in Ireland. Hence, the construction noise assessment is based on the industry best practice outlined in BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise (BS 5228), which gives recommendations for methods of noise control relating to construction sites, including sites where demolition, remediation, ground treatment or related civil engineering works are being carried out, and open sites, where work activities/operations generate significant noise levels, including industry-specific guidance. The legislative background to noise control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. This part of BS5228 provides guidance concerning methods of predicting and measuring noise and assessing its impact on those exposed to it.

1.2.1.7 Annex E of BS 5228 provides guidance on assessing the potential significance of noise effects from construction activities. In relation to construction noise limits, BS 5228 details the 'ABC method', which recommends a construction noise limit based on the existing ambient noise level. General and short-term construction noise impacts that are deemed typical of any construction site noise sources, including activities such as ground preparation, site clearance, foundation earthworks, erection of new buildings, etc. are assessed in accordance with the 'ABC method' defined in BS 5228.

1.2.1.8 Ambient noise levels are determined through a baseline noise survey and then rounded to the nearest 5 dB to determine the appropriate category (A, B or C) and subsequent threshold value. A potential significant impact is indicated if the construction noise is greater than the threshold value in the appropriate category (A, B or C). If the site noise level exceeds the appropriate category value, and a potential significant effect is indicated, the assessor then needs to consider other project-specific factors, such as the number of NSRs affected and the duration and character of the impact, to determine if there is a significant effect Table 8.1.1, reproduced from BS5228, demonstrates the criteria for selection of a noise limit for a specific NSR location.

Table 8.1.1 Construction noise threshold levels based on the BS 5228 'ABC' method.

Assessment Category and Threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A (A)	Category B (B)	Category C I
Night time (23.00 to 07.00)	45	50	55
Evening and weekends (D)	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.–0 - 13.00)	65	70	75

Notes:

Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

1.2.2 Operational Noise Guidance and Assessment Criteria

The 2006 Wind Energy Guidelines (WEDG2006)

1.2.2.6 The noise impact assessment technical report has been prepared in accordance with guidance in relation to acceptable levels of noise from wind farms as contained in the document "Wind Energy Development Guidelines" published by the Department of the Environment, Heritage and Local Government in 2006 (WEDG2006). These guidelines are based on recommendations set out in the Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU-R-97) publication "The Assessment and Rating of Noise from Wind Farms" (1996). WEDG2006 relates specifically to onshore developments, but that in place of any specific offshore guidance, this is the most applicable guidance. The noise impact assessment technical guidance regarding noise limits is likely to be the same for onshore and offshore wind energy developments which means the guidance is relevant to offshore wind energy proposals.

1.2.2.7 Section 5.6 of the WEDG2006 Guidelines addresses noise and outlines the appropriate noise criteria in relation to wind farm developments and states that "An appropriate balance must be achieved between power generation and noise impact.". However, the Guidelines give no specific advice in relation to what constitutes an 'appropriate balance'.

1.2.2.8 In summary, the WEDG2006 Guidelines outlines the following guidance to identify appropriate wind turbine noise criteria curves at noise sensitive locations:

- An appropriate absolute limit level within the range of 35 – 40 dB $L_{A90,10min}$ for quiet daytime environments with background noise levels of less than 30 dB $L_{A90,10min}$;
- 45dB $L_{A90,10min}$ for daytime environments with background noise levels of greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- 43 dB $L_{A90,10min}$ for night-time periods.

1.2.2.9 An allowable increase of 5 dB(A) above background for night-time operation is not explicit within the WEDG2006 Guidelines. However, it is commonly applied in wind energy noise impact assessments and is detailed in numerous examples of planning conditions issued by local authorities and An Bord Pleanála. Therefore, a night-time allowance for 5 dB(A) above background has been adopted for this assessment.

The Draft Revised Wind Energy Development Guidelines (DRWEDG19)

1.2.2.10 In December 2019, the Draft Revised Wind Energy Development Guidelines (DRWEDG19) were published for consultation. However, the WEDG2006 Guidelines are the guidelines that should be considered, and not draft guidelines published since 2006.

1.2.2.11 In written answers to the Dáil Eireann dated 11th July 2023 Re: Wind Energy Guidelines, the Minister for the Department of Housing, Planning & Local Government, Mr. Darragh O'Brien, stated that "Action EL/23/4 of the Climate Action Plan 2023 Annex of Actions contains a commitment to having new draft Guidelines prepared by the end of Q4 2023, with revised Guidelines to be published in 2024. When finalised, the revised Guidelines will be issued under section 28 of the Planning and Development Act 2000, as amended, or subject to enactment of the Planning and Development Bill 2023, as a National Planning Statement, as appropriate. In the meantime, the current 2006 Wind Energy Development Guidelines remain in force.".

The Assessment and Rating of Noise from Wind Farms (ETSU-R-97 1996)

1.2.2.12 The ETSU-R-97 assessment procedure specifies that noise limits should be set relative to existing background noise levels at the nearest properties and that these limits should reflect the variation in both turbine source noise and background noise with wind speed. The wind speed range which should be considered is between the cut-in speed (the speed at which the turbines begin to operate) of the turbines and 12 m/s (43.2 km/h), where all wind speeds are referenced to a standardised 10 metre height using a standard correction.

1.2.2.13 Separate noise limits apply for the day-time and night-time. Day-time limits are chosen to protect a property's external amenity whilst outside their dwellings in garden areas and night-time limits are chosen to prevent sleep disturbance indoors. Absolute lower limits, different for day-time and night-time, are applied where the line of best-fit representation of the measured background noise levels equates to very low levels (< 30 dB(A) to 35 dB(A) for day-time, and < 38 dB(A) during the night).

1.2.2.14 The day-time noise limit is derived from background noise data measured during the 'quiet periods of the day' as defined in ETSU-R-97. Quiet day-time periods comprise weekday evenings (18:00 to 23:00), Saturday afternoons and evenings (13:00 to 23:00) and all day and evening on Sundays (07:00 to 23:00). Multiple samples of ten-minute background noise levels using the $L_{A90,10min}$ measurement index are measured contiguously over a wide range of wind speed conditions. The measured noise levels are then plotted against the simultaneously measured 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 day-time noise limit is then set to the greater of either a level 5 dB(A) above the best-fit curve to the background noise data over a 0-12 m/s wind speed range or a fixed level in the range 35 dB(A) to 40 dB(A). The precise choice of the fixed lower limit within the range 35 dB(A) to 40 dB(A) depends on a number of factors: the number of noise affected properties, the likely duration and level of exposure and the consequences of the choice on the potential power generating capability of the wind farm.

1.2.2.15 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 ten minute $L_{A90,10min}$ noise levels measured over these night-time periods are again plotted against the concurrent wind speed data and a 'best-fit' correlation is established. As with the day-time limit, the night-time noise limit is also set as the greater of: a level 5 dB(A) above the best-fit background curve or a fixed level of 43 dB(A). This fixed lower night-time limit of 43 dB(A) was set in ETSU-R-97 on the basis of World Health Organization (WHO) guidance (Environmental Health Criteria 12 – Noise. WHO, 1980) for the noise inside a bedroom and an assumed difference between outdoor and indoor noise levels with windows open. In the time since ETSU-R-97 was published, the WHO guidelines were revised to suggest a lower internal noise level, but conversely, a higher assumed difference between outdoor and indoor noise levels. Notwithstanding the WHO guideline revisions, the ETSU-R-97 limit remains best practice with respect to night-time noise levels. In addition, following revision of the night-time WHO criteria, ETSU-R-97 has been incorporated into planning guidance for Wales, England and Scotland and at no point during this process was it felt necessary to revise the guidance within ETSU-R-97 to reflect the change in the WHO guideline internal levels. The advice contained within ETSU-R-97 remains a valid reference on which to continue to base the fixed limit at night.

1.2.2.16 The exception to the setting of both the day-time and night-time lower fixed limits occurs in instances where a property occupier has a financial involvement in the wind farm development. Where this is the case then the lower fixed portion of the noise limit at that property may be increased to 45 dB(A) during both the day-time and the night-time periods alike.

1.2.2.17 ETSU-R-97 also offers an alternative simplified assessment methodology: '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. We are of the opinion that, if the noise is limited to an $L_{A90,10min}$ of 35 dB(A) up to wind speeds of 10 m/s at 10 m height, then this condition alone would offer sufficient protection of amenity, and background noise surveys would be unnecessary. We feel that, even in sheltered areas when the wind speed exceeds 10 m/s on the wind farm site, some additional background noise will be generated which will increase background levels at the property.' The noise limits defined in ETSU-R-97 relate to the total noise occurring at a dwelling due to the combined noise of all operational wind turbines. The assessment will therefore need to consider the combined operational noise of the ABWP2 Array with other wind farms in the area to be satisfied that the combined cumulative noise levels are within the relevant ETSU-R-97 criteria.

1.2.2.18 ETSU-R-97 also requires that the baseline levels on which the noise limits are based do not include a contribution from any existing turbine noise, to ensure cumulative increases are properly accounted for in the assessment.

1.2.2.19 As ETSU-R-97 does not specifically refer to onshore or offshore wind turbine noise assessment, it is an appropriate guidance for assessment of offshore wind turbine noise.

The Institute of Acoustics Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013) (IoA GPG)

1.2.2.20 The Institute of Acoustics Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013) (IoA GPG) does not replace the limits within ETSU-R-97, but it provides good practice guidance on the use of the ETSU-R-97 document in relation to background noise surveys and on the prediction of wind turbine noise. While the IoA GPG advises on the appropriate input parameters and correction factors to be used for the prediction of wind turbine noise, it is stated that the guidance does not cover long-distance propagation over sea as is relevant to offshore wind farms. Additionally, the IoA GPG Supplementary Guidance Note 6, Noise Propagation over Water for On-shore Wind Turbines (IoA GPG SGN6) does not cover noise propagation for offshore wind farms. The IoA GPG provides guidance on the modelling of onshore wind turbine noise, although the prescribed method is not applicable to offshore wind farms.

1.2.2.21 Predicting noise propagation over water in accordance with the ISO9613-2, the basis of the method in the IoA GPG, would underpredict offshore wind turbine noise in downwind conditions due there being no consideration of multiple reflections which occur over large distances and over reflective surfaces such as water. ISO9613-2 states that "inversion conditions over water surfaces are not covered and may result in higher sound pressure levels than predicted from this part of ISO 9613-2". As outlined in further detail below, the wind turbine noise prediction modelling has undertaken using the Danish BEK 135 prediction method in the WindPRO 4 software provided by EMD international. During crosswind and upwind conditions, due to these conditions resulting in upward refracting environments and the distances involved, there is very little chance of a significant effect, and therefore these conditions have not been assessed.

1.2.2.22 The guidance contained within the IoA GPG and the relevant Supplementary Guidance Notes–1 - Data Collection,–2 - Data Processing & Derivation of ETSU-R-97 background curves and–4 - Wind Shear are considered to represent best practice in relation to assessing the baseline noise monitoring data and has been adopted for this assessment. The IoA GPG states that at a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e. cut in speeds to wind speed of rated sound power of the proposed turbine). Background noise measurements (i.e. $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of the wind turbine development. Regression analysis is then conducted on the data sets to derive background noise

levels at various wind speeds to establish the appropriate day and night-time noise criterion curves.

1.2.2.23 This assessment has been carried out in accordance with the IoA GPG for guidance on the methodology for the assessment of the background noise survey data and the operational noise impact assessment of the offshore wind turbine noise. Therefore, in accordance with best practice, which includes ETSU-R-97 and IoA methodologies as described above, the assessment presented in the EIAR is based on the current guidance outlined in Section 5.6 of the Wind Energy Development Guidelines for Planning Authorities 2006.

1.2.3 Danish BEK No 135 af 07/02/2019 Bekendtgørelse om støj fra vindmøller (BEK 135)

1.2.3.6 Sound propagation from the proposed ABWP2 Wind Turbine Generators (WTGs), has been calculated using The Danish BEK No 135 af 07/02/2019 Bekendtgørelse om støj fra vindmøller (BEK 135) prediction method which has been utilised to inform the assessment of the construction piling phase and the operational noise assessment. During the construction phase of the Proposed Development, it is the piling which has the potential to result in a short-term noise impact.

1.2.3.7 The Danish BEK 135 prediction method is implemented within the WindPRO 4 software. This prediction method is currently used as a best practice methodology for the prediction of airborne noise from offshore wind energy. Other similar developments which have made use of the Danish BEK 135 prediction method include the Pentland Floating Offshore Wind Farm in Scotland and Awel Y Mor offshore wind farm in North Wales.

1.2.3.8 The sound propagation calculation method includes an estimation of the increase in noise due to multiple reflections during downwind conditions and a ground reflection correction that depends on proximity to shore.

1.2.3.9 From the offshore wind turbine and until landfall an offshore ground attenuation is used. At the shoreline a transition zone exists between 0m - 200m, where the model linearly changes to onshore ground attenuation. A multiple reflection correction is added to the portion of the transect which propagates over water. A frequency dependent multiple reflection correction occurs over a threshold distance, which is determined based on the source height and the wind speed. Longer distances and lower source heights result in a higher multiple reflection correction. The method assumes wind is travelling in the direction from the closest turbine to each NSR. Therefore, this is a precautionary approach on the basis that the wind direction will not always be travelling directly towards each NSR. For the remaining turbines, the magnitude of multiple reflections is determined by the component windspeed in that specified direction. From the shoreline, the multiple reflection component will not increase any further but remains a base value in the noise impact prediction.

1.2.3.10 As stated, BEK 135 is currently adopted as the most accurate calculation methodology available at present. The propagation calculation can be summarised as follows;

$$L_{pA} = L_{WA,ref} - 10\log_{10}(l^2 + h^2) - 11 + \Delta L_g - \Delta L_a + \Delta L_m$$

Where:

l is the distance from the base of the turbine to the calculation point.

h is the turbine hub height.

11 dB correction accounting for spherical spreading distance 10 * log 4п

ΔLg is correction for terrain (1.5 dB for onshore turbines and 3 dB for offshore turbines) and range where distance to coast <200m.

ΔLa is air absorption.

ΔLm is correction for multiple reflections.

1.2.3.11 The sound propagation calculation method has been used in other similar offshore wind farm applications such as the Pentland Floating Offshore Wind Farm off Scotland and Awel y Môr Offshore Wind Farm located approximately 10.5km off the Welsh coast in the Irish Sea.

1.2.3.12 There is a proposed 100m limit of deviation for each turbine location. The sound propagation calculations have assessed the WTGs at a specific set of coordinates for Project Design Options 1A, 1B and 2. A 100m location deviation may slightly change noise level predictions at NSRs by plus or minus 0.1 – 0.2 dB(A) at such significant offset distances. This is an insignificant noise level difference and does not affect the airborne noise impact assessment.

1.3 Assessment Methodology

1.3.1 Selected Noise Sensitive Receivers

1.3.1.6 The Airborne Noise Study Area was chosen to include locations representative of the closest NSRs to the Proposed Development. This includes the coastline adjacent to the Proposed Development and NSRs which are located in close proximity of this shoreline from Magherabeg, Co. Wicklow in the north to Ballymoney, Co. Wexford in the south (approximately 29 km stretch of the coastline) as shown in Figure 8.1.1**.**

1.3.1.7 Where one NSR is listed, this is chosen to be representative of groups of NSRs, for example clusters of houses, villages, towns or caravan parks. The noise impact at further NSRs is predicted to be the same or less than at the assessed locations.

1.3.1.8 The following ten NSRs (A – J) have been identified as representative NSRs along the coastline and are described in Table 8.1.2 and shown in Figure 8.1.1**:**

NSR–A - Blainroe Lodge Nursing Home (NSR1) – located approximately 350 m from the High Water Mark (HWM), and surrounded by residential areas and caravan holiday parks, along with leisure areas such as golf clubs and a beach;

NSR–B - Magherabeg (NSR2) – Isolated residential properties approximately 300 m from the HWM;

NSR–C - Ballincarrig (NSR3) – Caravan holiday park approximately 120 m from the HWM, with isolated residential properties further inland, and beaches;

NSR–D - Aisling House Nursing Home, Brittas Bay (NSR4) – Located approximately 500 m from the HWM and in a village location surrounded by residential and caravan holiday parks;

NSR–E - Ardinairy (NSR5) – Isolated residential dwelling located approximately 500 m from the HWM, surrounded by a golf club and beaches;

NSR–F - Johnstown and Ennereilly (NSR6) – Isolated residential dwellings located approximately 50-100 m from the HWM, and approximately 500 m north of the landfall. Surrounded by further isolated residential and village locations further inland, and a number of beaches;

NSR–G - Arklow Town, Ferrybank (NSR7) – Mixed residential, educational, leisure and commercial properties located north and south of the Avoca River;

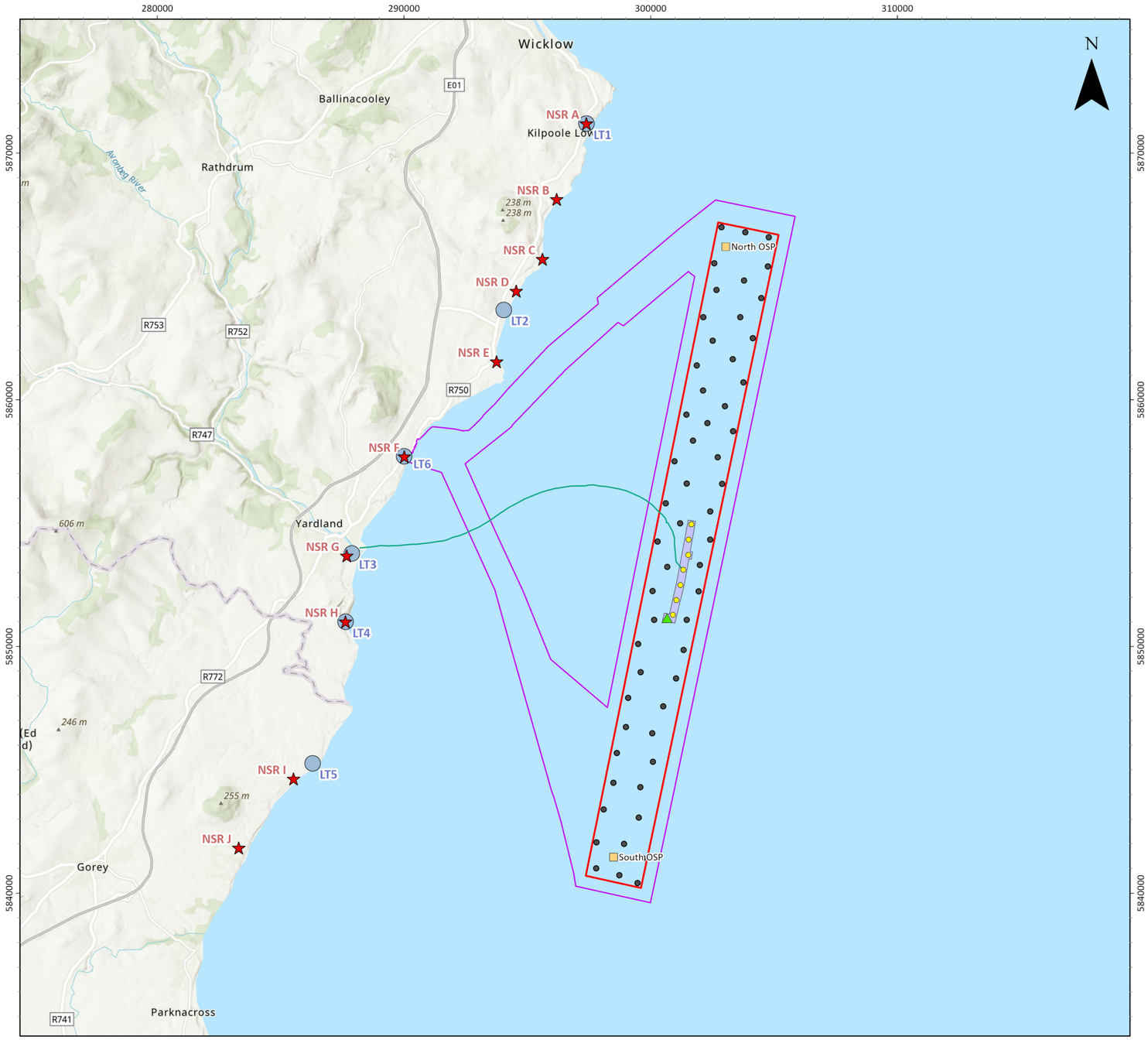
NSR–H - Askintinny (NSR8) – Isolated residential properties and caravan holiday park, located approximately 100 m from the HWM, surrounded by beaches;

NSR–I - Clones (NSR9) – Residential, caravan holiday park and beaches located approximately 75 m from the HWM at the closest point; and

NSR–J - Ballymoney (NSR10) – Townland, mixed residential dwellings, commercial and leisure located approximately 100 m from HWM at the closest point.

Table 8.1.2 List of representative NSR locations (NSR A – NSR J) along the Irish Sea coastline relative to the representative baseline noise survey measurement locations (LT1 – LT6)

Ref.	Location	Description	Grid Reference (UTM 29N)	Representative survey location
NSR A	Blainroe Lodge	Nursing Home	700455, 5871099	LT1
NSR B	Magherabeg	Residential	699509, 5867941	LT1
NSR C	Ballinacarrig	Caravan holiday park	699139, 5865475	LT1
NSR D	Brittas Bay and Aisling House	Residential and Nursing Home	698186, 5864099	LT2
NSR E	Ardinairy	Residential	697631, 5861180	LT2
NSR F	Johnstown and Ennereilly	Residential	694225, 5857032	LT6
NSR G	Arklow town and Ferrybank	Residential, commercial, schools, holiday, leisure	692233, 5852832	LT3
NSR H	Askintinny	Residential and caravan holiday park	692406, 5850166	LT4
NSR I	Clones	Residential and caravan holiday park	690838, 5843644	LT5
NSR J	Ballymoney	Residential	688857, 5840671	LT5



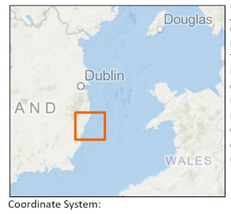
sse Renewables

Arklow Bank Wind Park 2

Noise Sensitive Receivers and Noise Modelling Locations

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP2 WTGs (56 Turbine Option)
- ABWP2 OSP Locations
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Array Area
- Noise Sensitive Receiver A-J
- Noise Monitoring Locations 1-6



Notes

OceanWise, Esri, GEBCO, Garmin, NaturalVue, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri UK, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS, Esri, Ordnance Survey, NASA, NGA, USGS. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 3 6 km

0 2 3 nm

Scale	Date	Drawn By	Checked By	Approved By
1:150,000 @ A3	11/04/2024	GB	EM	LK

Suites B2 & C2
Higher Mill
Higher Mill Lane
Buckfastleigh
Devon
TQ11 0EN
www.gobeconsultants.com
+44 (0)1626 323890

GoBe APEM Group

Figure Number 8.1.1

Figure Reference: Ark_001_NoiseMonitoringSurveyLocationsFig8.1.1

Figure 8.1.1: Noise Sensitive Receivers A – J & Noise Monitoring Locations–1 - 6

1.3.2 Baseline Monitoring Locations

1.3.2.6 Long term unattended noise monitoring was undertaken at six noise monitoring locations (LT1 – LT6) selected along the Irish Sea coastline between 27 August 2020 and 8 October 2020. The baseline noise levels have been used to inform the assessment of the potential impact of construction, operational and maintenance, and decommissioning noise. The baseline noise levels provide context and inform the assessment of the operational noise assessment.

1.3.2.7 The baseline noise environment across the study area was determined through unattended noise surveys at locations representative of the nearest NSRs to the ABWP2 Array Area. All monitors were in place for a minimum of two weeks.

1.3.2.8 The survey locations were selected in order to characterise the baseline conditions at the nearest NSRs. The areas were selected by desktop study, followed by site visits (carried out by consultants from RPS). The monitoring locations were as follows:

LT1 – In the vicinity of Silver Strand Caravan Park (coordinates UTM 29N 700455 5871099), and representative of surrounding residential NSRs including several caravan parks. This location is approximately 100 m from the HWM, and 7 km from the Array Area at the closest point.

LT2 –In the vicinity of the Brittas Bay Antique Shop (coordinates UTM 29N 697747 5863301), and representative of surrounding residential NSRs and the caravan parks at Ballincarrig. This location is approximately 230 m from the HWM, and 9 km from the Array Area at the closest point.

LT3 – Located inside Arklow South Dock, adjacent to the pier (coordinates UTM 29N 692431 5852951) and was selected to characterise the noise experienced by the nearby NSRs as a result of activity within the dock. This location is approximately 12 km from the Array Area at the closest point. There is a mix of residential, leisure and commercial properties located south of the River Avoca.

LT4 – Located at Askintinny, adjacent to Gleeson's Holiday Park (coordinates UTM 29N 692406 5850166), and representative of the surrounding residential and holiday NSRs. This location is approximately 100 m from the HWM, and 12 km from the Array Area at the closest point.

LT5 – Located at Clone Strand (coordinates UTM 29N 691555 5844341), and representative of surrounding residential NSRs, including Kilgorman Holiday Park and other static caravan parks. This location is approximately 100 m from the HWM, and 11 km from the Array Area at the closest point.

LT6 – Located on land north of Johnstown residence (coordinates UTM 29N 694211 5857054) and representative of surrounding residential NSRs. This location is approximately 150 m from the HWM and 10 km from the Array Area at the closest point.

1.3.2.9 All survey locations are shown in Figure 8.1.1. A summary of the locations and durations of the surveys is shown in Table 8.1.3.

Table 8.1.3 Details of baseline noise monitoring survey locations.

Ref.	Location	Grid Reference (UTM 29N)		Start Date	End Date	Survey Duration
LT1	Silver Strand	700455	5871099	27/08/2020	17/09/2020	21 days
LT2	Brittas Bay	697747	5863301	17/09/2020	08/10/2020	21 days
LT3	Arklow	692431	5852951	27/08/2020	17/09/2020	21 days
LT4	Askintinny	692406	5850166	27/08/2020	17/09/2020	21 days
LT5	Clone Strand	691555	5844341	02/09/2020	17/09/2020	15 days
LT6	Johnstown	694211	5857054	08/09/2020	22/09/2020	14 days

1.3.3 Baseline Monitoring Methodology

1.3.3.6 Sound level measurements at LT1-5 were taken using Brüel and Kjær 2250 Class 1 Sound Level Meters (SLM), positioned in free-field locations (more than 3 m from any reflecting surface other than the ground) with the microphones mounted on tripods 1.5 m above the ground. Measurements at LT6 were taken with a 01dB DUO Class 1 SLM, with the same positioning as above. Each SLM was checked for calibration prior to and immediately following the survey with no significant deviation found. Data were logged of the fast time weighted, A-weighted, broadband SPLs (Sound Pressure Levels) in ten minute periods. Long term surveys were undertaken following guidance contained in IoA GPG and in ISO-1996 (2016) 'Description and Measurement of Environmental Noise. Part 2: Guide to the Acquisition of Data Pertinent to Land Use' (British Standards Institution (BSI) 1991).

1.3.3.7 Meteorological conditions were monitored during the long-term surveys, with an unattended weather station installed at LT2 and LT6. Wind speeds were also measured offshore within the Array Area during the survey period with a LiDAR with a height above sea level of up to 172 m. The relevant meteorological data logged during the survey period included temperature, wind speed and direction, and precipitation rate.

1.3.3.8 It has been determined by AONA Environmental that the existing environment is unchanged at the monitoring locations since 2020, and the reported baseline noise levels are representative of the prevailing noise environment in 2023. The influence of the Covid pandemic during the baseline survey period will not have affected the quiet daytime and night time background noise levels, and may in fact have resulted in slightly lower background noise levels, which would result in a more conservative assessment.

1.3.3.9 A site visit to all selected noise monitoring locations was undertaken by AONA Environmental on 11 May 2023. This site visit concluded that no significant change that could have in any way significantly affected the previously measured background noise levels has occurred at any noise monitoring location since 2020.

1.3.4 Baseline Monitoring Data Analysis Methodology

1.3.4.6 The relevant noise limits have been derived based on the methodology contained within 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'. The measured noise data was accordingly divided into subsets:

- Amenity hours; 18.00 – 23.00 hours every day, 13.00 – 18.00 hours Saturday & 07.00 – 18.00 hours Sunday.
- Night-time hours; 23.00 – 07.00 hours every day

1.3.4.7 During the noise monitoring surveys between 27th August 2020 and 8th October 2020, wind speeds were recorded at various heights above sea level up to 172 m using a lidar mounted on an offshore platform. Analysis was carried out with reference to the highest hub height, i.e. 162 m with wind speed data extrapolated using the 148 m and 172 m measurements that have been provided using the method described in IoA GPG 2.6.3(b) and detailed in IoA GPG SGN 4 Section 2.4. Therefore, the hub height wind speeds have been standardised to 10 m height using the following equation:

$$U_1 = U_2 \frac{\ln\left(\frac{H_1}{z}\right)}{\ln\left(\frac{H_2}{z}\right)}$$

Where:

H_1 = The height of the wind speed to be calculated (10 m)

H_2 = The height of the measured or calculated hub height (HH) wind speed.

U_1 = The wind speed to be calculated.

U_2 = The measured or calculated HH wind speed.

z = A roughness length of 0.05 m is used to standardise hub height wind speeds to 10 m height in the International Electrotechnical Commission (IEC) 61400-11:2003 standard.

1.3.4.8 Sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have been screened from the noise monitoring surveys dataset. The assessment method outlined is in line with the guidance contained in the IoA GPG.

1.3.4.9 The recorded wind speed, corrected to a height of 10 m and the corresponding noise levels ($L_{A90,10min}$) during Amenity and Night-time hours were plotted on a scatter graph with a 2nd or 3rd order polynomial regression best fit trendline applied. From the polynomial regression best fit trendline, L_{A90} sound pressure levels were derived at integer values from 3-12 m/s during amenity and night-time hours. 5 dB is added to the derived amenity and night-time hours L_{A90} levels to obtain the relevant noise limit values.

1.3.4.10 The IoA GPG Supplementary Guidance Note (SGN) 2 supports Section 3 of the IoA GPG and provides examples of data processing which can be used to ensure that the influence of atypical noise sources on the measurement of background noise levels is minimised and to ensure that a typical representation of the existing noise environment is obtained. The subsequent derivation of ETSU-R-97 background noise curves is also discussed in SGN 2. SGN 2 advises that any data affected by noise which is not considered to be typical for a location should be identified and removed. The identification of unrepresentative data is not straight-forward but atypical noise sources not influenced by wind speed can be apparent in scatter graphs of background noise level against wind speed. Examples such as noise from vegetation,

road traffic, agricultural activities and from animals including birds (dawn chorus) and livestock can affect recorded noise levels.

1.3.4.11 In accordance with the 2006 Wind Energy Development Guidelines, the following wind turbine noise limits will apply at the NSR locations:

- An appropriate absolute limit level within the range of 35 – 40 dB $L_{A90,10min}$ for quiet daytime environments with background noise levels of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments with background noise levels of greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- 43 dB $L_{A90,10min}$ for night-time periods, or a maximum increase of 5 dB above background noise (whichever is higher) .

1.3.5 Noise Prediction Assessment Methodology

1.3.5.6 As stated, sound propagation from the proposed ABWP2 Array, has been calculated using the Danish BEK 135 prediction method.

1.3.5.7 The BEK 135 prediction method predicts noise levels at 6m/s and 8m/s wind speeds. Using the relevant sound power levels at increasing wind speeds for the wind turbines assessed, a corresponding predicted correlated noise level at all wind speeds at 4m/s, 5m/s, 7m/s and 9m/s-12m/s have been derived.

1.3.5.8 The BEK 135 model has been populated with a coastline shapefile based on the project Geographic Information Systems (GIS) team extract from the relevant portion of OSI county coastline for the project area, which, through comparison with satellite imagery, was deemed to more accurately represent a worst case scenario than the OSI High Water Mark data.

1.3.5.9 The assessment predicts noise levels for the worst case wind direction for each of the NSR locations. The reality of the proposed ABWP2 Array Area is that the prevailing wind direction does not represent these worst-case downwind conditions. As stated, during crosswind and upwind conditions, due to these conditions resulting in upward refracting environments and the distances involved, there is very little chance of a significant effect, and therefore these conditions have not been assessed.

1.3.5.10 This worst case prediction means that the model over predicts in the majority of cases. As outlined in Figure 8.1.2, the wind rose denotes the frequency of occurrence of various wind directions, as measured at 155 m height during the whole year of 2023 using the onsite LiDAR, standardised to 10m height in accordance with the Good Practice Guide. The downwind direction towards the coastline from the proposed ABWP2 Array constitutes only approximately 10% of the overall wind direction, with approximately 30% considered in an upwind direction and the remaining approximately 60% in a crosswind direction.

1.3.5.11 The onshore NSR locations will only be downwind of the proposed ABWP2 Array location for approximately 10% of the time. As a result, the predicted construction and operational noise levels at the NSR locations are worst-case predicted levels.

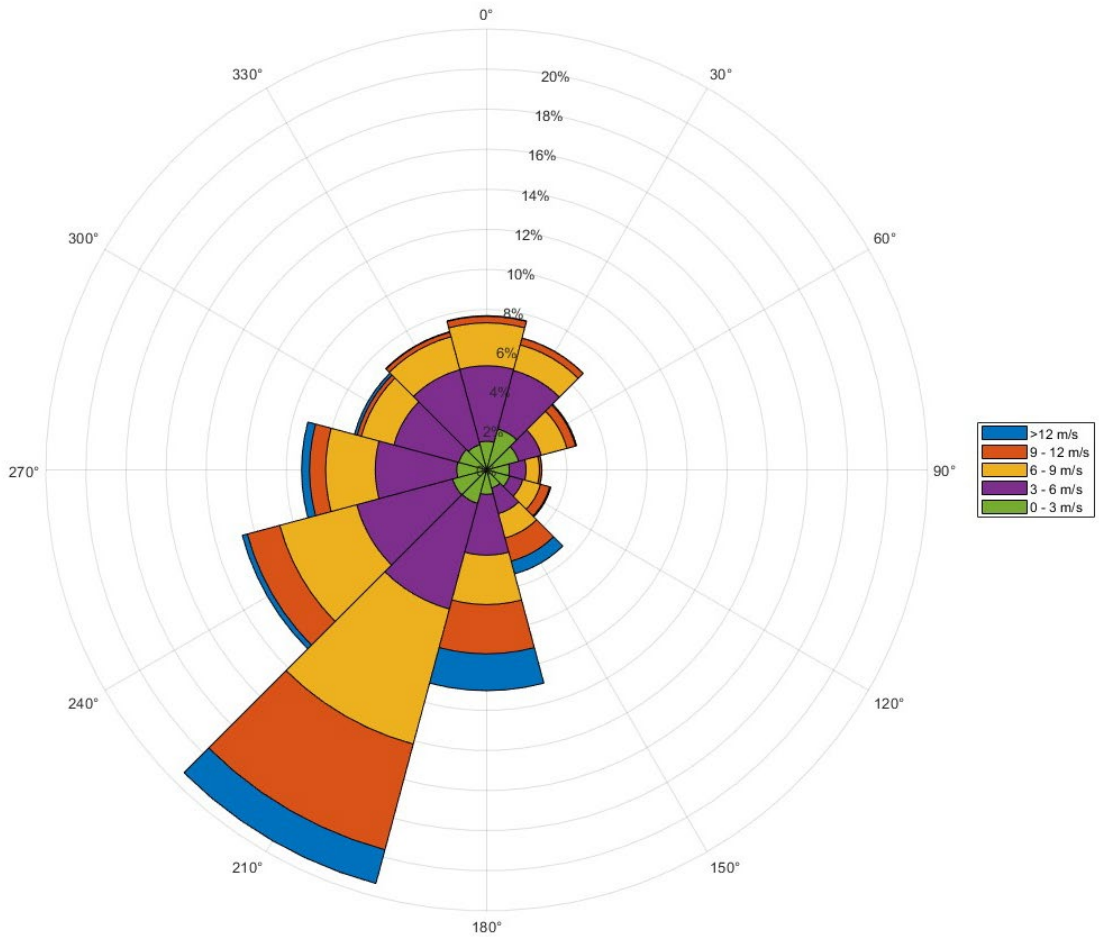


Figure 8.1.2: Windrose showing prevailing wind direction and frequency for the proposed ABWP2 Array location.

1.3.5.12 Sound propagation calculations using the BEK 135 prediction method within the WindPRO 4 software have been undertaken to assess the potential piling noise impact. While piling noise prediction is not specifically within the scope of BEK 135, it is expected that the conditions of noise propagation from the piling activities will be the same as that from noise propagation from wind turbines, i.e. subject to multiple reflections, etc. Hence, the BEK 135 prediction method has been utilised to inform the assessment of the construction piling and operational noise assessment.

1.3.6 Wind Turbine Assessment Details

1.3.6.6 Sound propagation calculations using the Danish BEK 135 prediction method within the WindPRO 4 software, have been undertaken for the Project Design Options 1 (Models 1A and 1B) and 2. Turbine location coordinates and sound power levels for the three different wind turbine options have been provided. Fifty-six Turbine location coordinates have been provided for Project Design Option 1 (Models 1A and 1B). Forty-seven turbine location coordinates have been provided for Project Design Option 2. This is outlined in detail in Volume II, Chapter 4: Description of Development.

1.3.6.7 Sound power level data has been provided by turbine manufacturers under non-disclosure agreements and cannot be reproduced in this report.

1.3.6.8 The IoA GPG states that it should be ensured that a margin of uncertainty is included within wind turbine source sound power level data when used in noise predictions, as there is uncertainty associated with the measurement of wind turbine noise. In accordance with the IoA GPG, an uncertainty factor of +2 dB has been added to the source sound power level data.

1.3.6.9 Operational wind turbines may emit two types of noise. Firstly, aerodynamic noise, which is a 'broad band' noise, 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.

1.3.6.10 Aerodynamic noise tends to be perceived when the wind speeds are low, although at very low wind speeds the blades do not rotate or rotate very slowly and so, at these wind speeds, negligible aerodynamic noise is generated. In higher winds, aerodynamic noise is generally masked by the normal sound of wind blowing through trees and around buildings. The level of this natural 'masking' noise relative to the level of wind turbine noise determines the subjective audibility of the wind farm. The relationship between wind turbine noise and the naturally occurring masking noise at residential dwellings situated onshore closest to the ABWP2 Array will, therefore, generally form the basis of the assessment of the levels of noise against accepted standards.

1.3.7 Piling Noise Assessment Details and Sound Power Level Data

1.3.7.6 Piling noise during construction is considered to be the main potential noise source . Sound propagation calculations using the BEK 135 prediction method within the WindPRO 4 software, have been undertaken to assess the potential piling noise impact when piling is undertaken at three representative locations in the north, centre and south of the proposed ABWP2 Array.

1.3.7.7 Noise from other activities associated with construction, such as cable installation, vessel movements, etc. will be significantly lower than that of piling on the basis of professional judgement, piling noise will be the most significant noise source during construction.

1.3.7.8 The sound power levels for the potential piling noise source have been provided by the Developer. The predicted noise level from various piling scenarios have been assessed taking account of the use of piling noise mitigation options comprising a screen, a dolly, a combination of both, as well as no piling noise mitigation at all.

1.3.7.9 Three representative piling locations have been assessed individually based on the proposed wind turbine coordinate locations in the Project Design Option 1 (Models 1A and 1B) ABWP2 Array Area, as follows;

- Piling Location 1 - 302,867, 5,866,991 (UTM 30N Grid Coordinates);
- Piling Location 2 - 300,962, 5,857,500 (UTM 30N Grid Coordinates) and
- Piling Location 3 - 298,101, 5,843,390 (UTM 30N Grid Coordinates)

1.3.7.10 These representative piling locations also represent piling noise from the north, centre and south of the proposed Project Design Option 2 (Model 2) 47 WTG Layout.

1.3.7.11 There is a proposed 100m limit of deviation for each turbine location. The piling sound propagation calculations have assessed the WTGs at specific coordinates for Project Design Options 1A, 1B and 2. A 100m location deviation may slightly change piling noise level predictions at NSRs by plus or minus 0.1 – 0.2 dB(A) at such significant offset distances. This is an insignificant noise level difference and does not affect the piling noise impact assessment.

1.3.7.12 These representative piling locations have been selected from the proposed Project Design Option 1 (Models 1A and 1B) of the ABWP2 Array Area, because piling will occur at only one location at a time and piling noise predictions are not necessary for

every proposed WTG monopile location. These piling noise predictions outline likely future piling noise levels from piling in the north, centre and south of the proposed ABWP2 Array Area. The piling noise predictions do not represent the highest piling noise level that will occur at every NSR, but the prediction of the maximum piling noise level in the north, centre and south of the proposed ABWP2 Array Area allows for the highest level of impact to be assessed in terms of significance versus construction noise limits. These representative piling locations also represent piling noise from the north, centre and south of the proposed Project Design Option 2 (Model 2) of the ABWP2 Array Area.

1.3.7.13 The piling noise levels outlined in Table 8.1.4 are different in the north and the south due to different hammer energies required to reach target depth and pile driving durations as a result of different seabed conditions. The energies associated with the WTG monopiles are equivalent to the energies associated with the Offshore Substation Platform (OSP), i.e. no need to assess separately.

Table 8.1.4 A-weighted octave band sound power level (dB LwA) for the potential piling noise source (Note: Piling source height of 22.2 m above sea level assumed in prediction model.).

Location	Mitigation	A-weighted octave band sound power level (dB L_{wA})								Sound Power Level (dB LwA)
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
North & Centre	None	124	133	140	144	145	140	132	118	149.1
North & Centre	Screen	123	128	132	134	132	123	113	99	138.3
North & Centre	Dolly	110	121	140	137	139	132	123	109	144
North & Centre	Screen & Dolly	109	116	132	127	126	115	104	90	134.1
South	None	125.6	134.6	141.6	145.6	146.6	141.6	133.6	119.6	150.7
South	Screen	124.6	129.6	133.6	135.6	133.6	124.6	114.6	100.6	139.9
South	Dolly	111.6	122.6	141.6	138.6	140.6	133.6	124.6	110.6	145.6
South	Screen & Dolly	110.6	117.6	133.6	128.6	127.6	116.6	105.6	91.6	135.7

1.3.7.14 It is important to note that the difference in power levels between the North & Centre and South of the Array Area is due to different hammer energies required to reach target depth as a result of differing seabed conditions. The hammer energies associated with the WTG monopiles are the same for the OSP monopiles and hence covered by the modelling in this assessment.

1.3.7.15 The piling source levels are conservative and have been used to devise the construction phase mitigation strategy.

1.3.7.16 The predicted noise levels for the piling scenarios have been evaluated assuming a single pile installed during the night-time period, with the predicted $L_{Aeq,8\ Hour}$ piling noise level compared to the night-time (23.00 to 07.00) construction noise threshold level of 45 dB $L_{Aeq,8\ Hour}$ based on the BS 5228 'ABC' method. Based on the BS 5228 'ABC' method, the corresponding daytime (07.00 – 19.00) and Saturdays (07.00 - 13.00) and evening and weekends construction noise threshold levels of 65 dB $L_{Aeq,12\ Hour}$ and of 55 dB $L_{Aeq,4\ Hour}$ respectively.

1.3.7.17 It is important to note that only one foundation will be piled at any one time. The 'North' and 'Centre' piles will take 210 minutes to drive while the 'Southern' piles will take 310 minutes to drive. When assessed over an 8 hour period (assuming piling is on-going during a night-time period), this will result in a -3.9 dB(A) and -1.9(A) dB correction respectively.

1.3.7.18 A cumulative piling noise impact scenario has also been investigated with Codling Wind Park, which is the closest proposed offshore wind farm to the ABWP2 Array Area. Due to offset distance, there is no potential for a cumulative piling noise impact from other similar proposed developments. Available project specific data for Codling Wind Park was used to determine the highest potential noise impact for the cumulative impact modelling'. This scenario has assumed that piling at the most northerly turbine location of the ABWP2 Array Area will occur concurrently with the most southerly turbine location on the Codling Wind Park offshore wind farm array. This is a most unlikely occurrence.

1.3.7.19 The nearest Codling Wind Park offshore wind farm piling location has been assessed to occur at 309,333, 5,876,162 (UTM 30 Grid Coordinates), assuming a 276 m rotor diameter. The Codling Wind Park piling location is located 11,220 m north-east of the proposed ABWP2 Array Area wind turbine Location 1 and 12,923 m east of NSR A, Blainroe Lodge.

1.4 Baseline Environment

1.4.1 Analysis of Background Noise Level Data

1.4.1.6 As stated, a baseline noise survey was undertaken to determine typical background noise levels at six representative NSR locations along the coastline in proximity the Proposed Development. Although the existing Arklow Bank Wind Park 1 (ABWP1) WTGs would have been operational during this survey, during the site visit in 2022 there was no audible noise from the existing WTGs. Based on professional judgement, the existing ABWP1 WTGs would not affect the background noise levels.

1.4.1.7 All measurement data was collected during the background noise surveys in accordance with the IoA GPG and accompanying, Supplementary Guidance Note 1: Data Collection (2014).

1.4.1.8 The results presented below refer to the noise data collated during 'amenity hours' of the daytime period and during the night-time period as defined in the IoA GPG. The measured noise data was accordingly divided into subsets:

- Amenity hours; 18.00 – 23.00 hours every day, 13.00 – 18.00 hours Saturday & 07.00 – 18.00 hours Sunday.
- Night-time hours; 23.00 – 07.00 hours every day

1.4.1.9 In accordance with the IoA GPG Supplementary Guidance Note (SGN) 2, the amenity hours and night-time scatter graphs for LT1 – LT6 have been reviewed and the scatter graphs for LT 1, LT 4 and LT 5 have been reviewed in detail with extraneous source noise levels at lower wind speeds of 1 – 3 m/s manually removed from the ETSU-R-97 scatter graphs. This approach reduces the derived background levels, therefore resulting in a more conservative (worst-case) assessment.

1.4.1.10 Graphs 1.1 – 1.12 present the recorded wind speed, corrected to a standardised height of 10 m and the corresponding noise levels ($L_{A90,10min}$) during Amenity and Night-time hours plotted on a scatter graph with a polynomial regression best fit trendline applied. From the polynomial regression best fit trendline, average L_{A90} sound pressure levels were derived from 3-12 m/s during amenity and night-time hours. 5 dB was added to the average amenity and night-time hours L_{A90} levels to determine relevant noise limits from 3-12m/s wind speeds based on baseline noise monitoring at each monitoring location as presented in Table 8.1.5– Table 8.1.10.

1.4.1.11 Table 8.1.11 outlines the minimum Daytime & Night-time Noise Limits (dB $L_{A90,10min}$) measured at wind speeds from 3-12m/s across the six noise monitoring locations based on the WEDG2006 Guidelines. In accordance with the WEDG2006 Guidelines, the following wind turbine noise limits will apply at the NSR locations:

- An appropriate absolute limit level within the range of 35 – 40 dB $L_{A90,10min}$ for quiet daytime environments with background noise levels of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments with background noise levels of greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- For night-time periods, the noise limits should be interpreted as 43 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher).

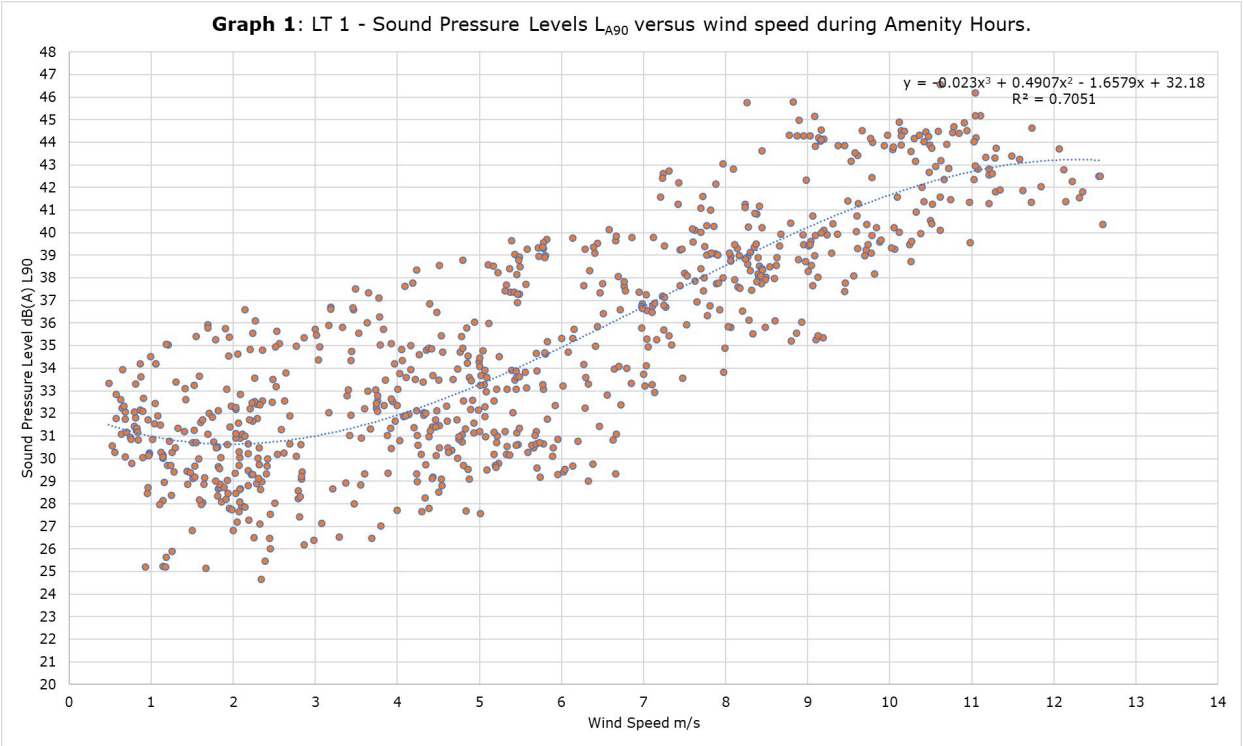
1.4.1.12 Following comparison of the previously presented guidance and recent noise conditions applied to wind energy developments by An Bord Pleanála, the proposed operational limits in $L_{A90,10min}$ for the Proposed Development are:-

- 40dB $L_{A90,10min}$ for quiet daytime environments of less than 30dB $L_{A90,10min}$;
- 45dB $L_{A90,10min}$ for daytime environments greater than 30dB $L_{A90,10min}$ or a maximum increase of 5dB above background noise (whichever is higher), and;
- 43dB $L_{A90,10min}$ or a maximum increase of 5dB above background noise (whichever is higher) for night-time periods.

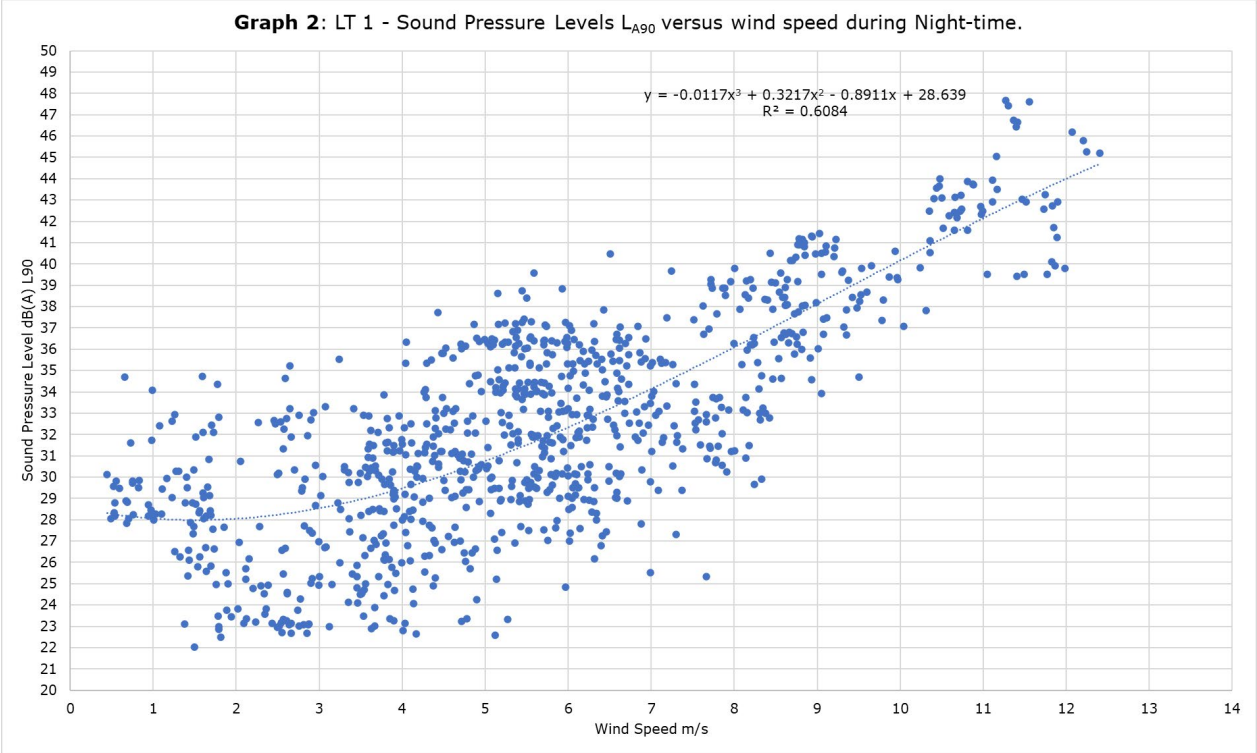
1.4.1.13 A '*quiet daytime environment of less than 30dB $L_{A90,10min}$*' was not recorded at wind speeds from 3-12m/s across the six noise monitoring locations LT 1 – LT 6 during the baseline noise survey.

1.4.1.14 These daytime and night-time noise limits are in accordance with the intent of the relevant Irish guidance WEDG2006, which requires '*an appropriate balance must be achieved between power generation and noise impact*'. These daytime and night-time noise limits also reference best practice including ETSU-R-97 and IoA GPG methodologies, and are comparable to recent noise planning conditions applied to wind energy developments by An Bord Pleanála.

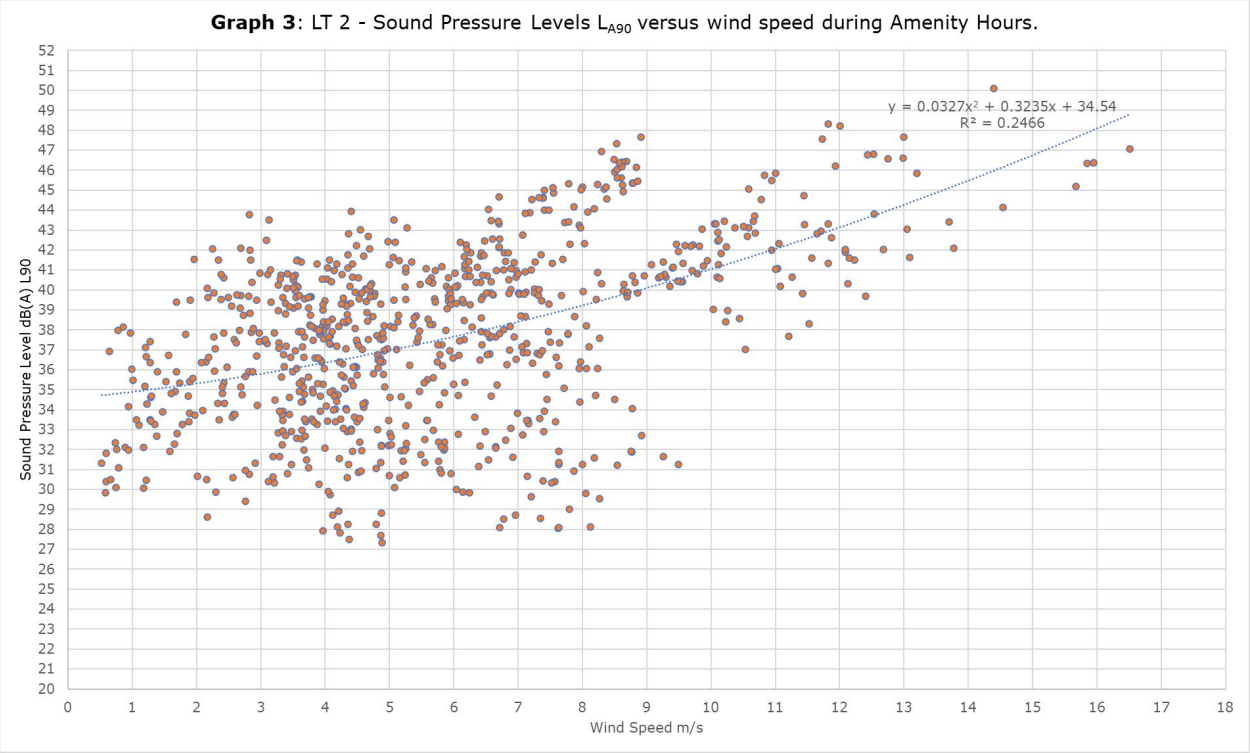
Graph 8.1.1 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 1.



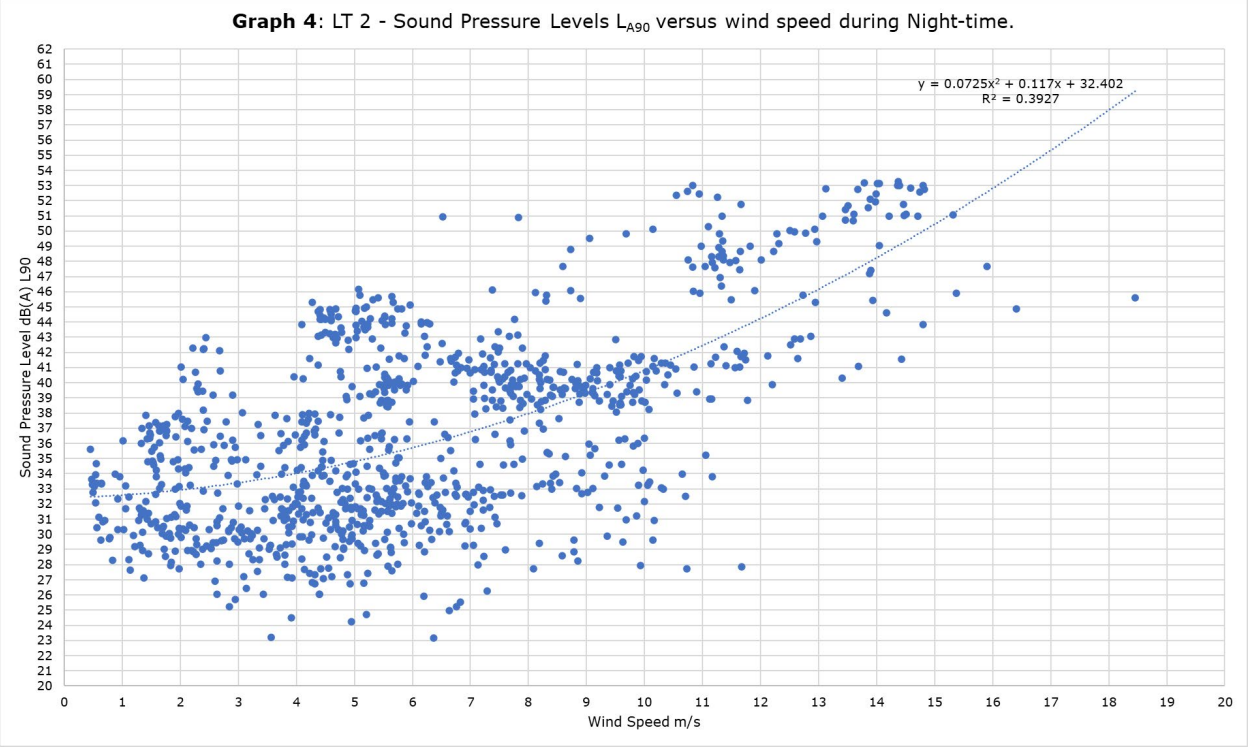
Graph 8.1.2 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 1.



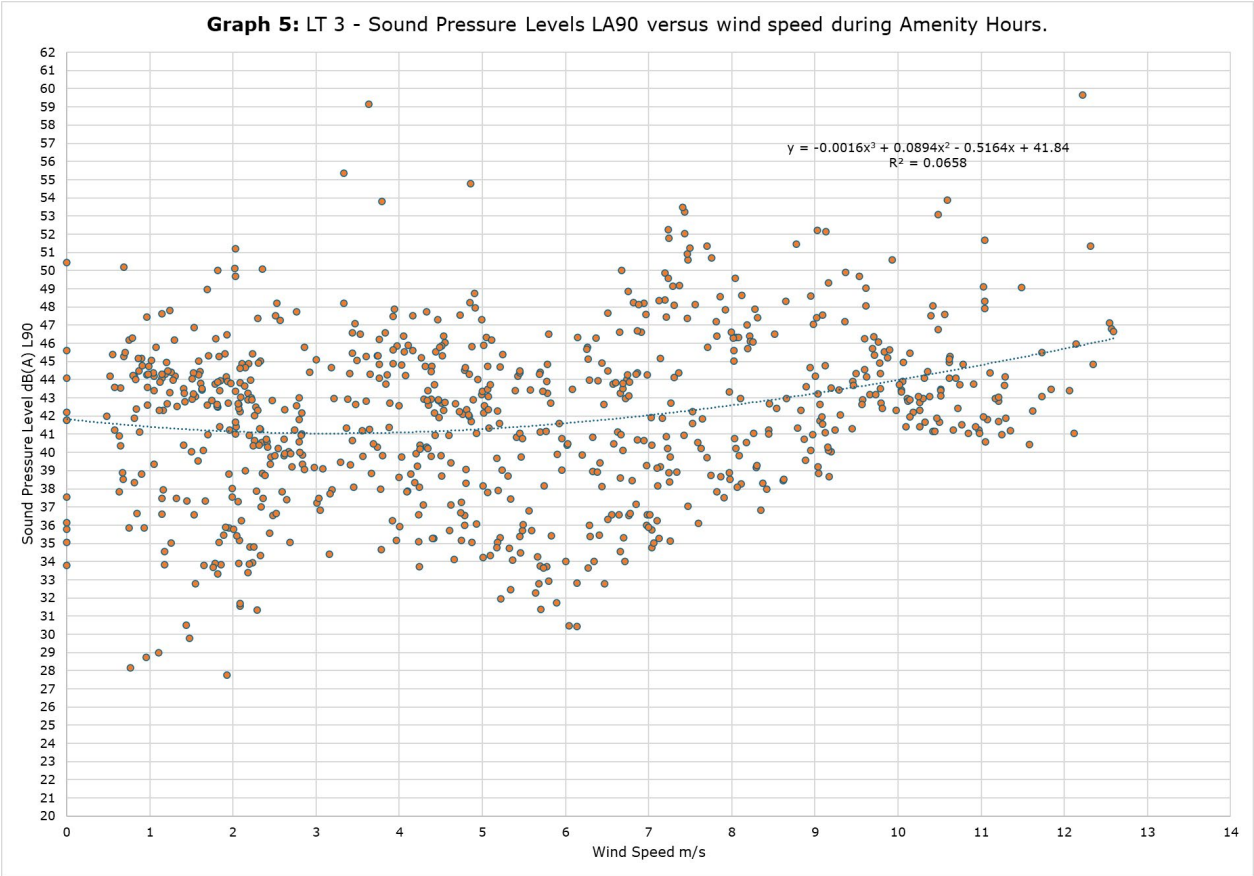
Graph 8.1.3 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 2.



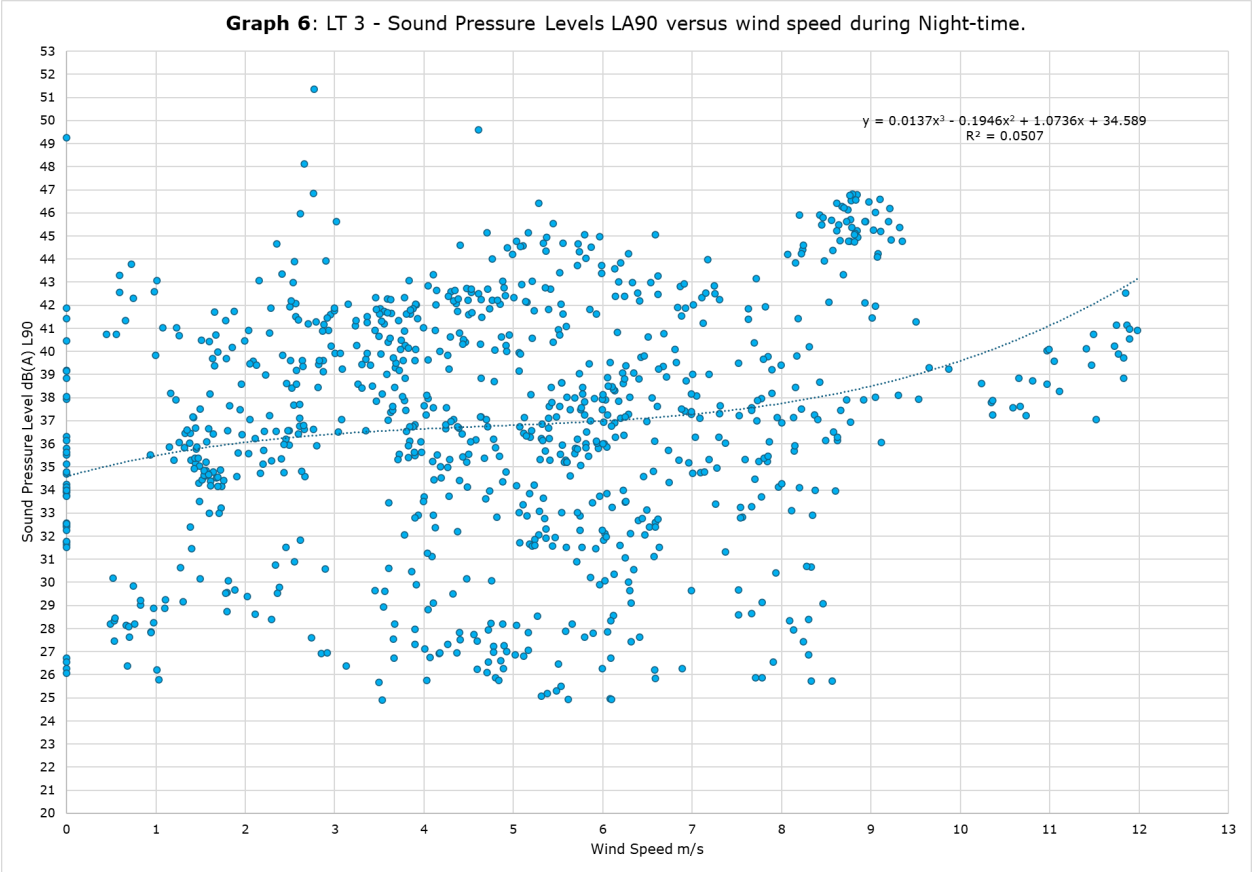
Graph 8.1.4 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 2.



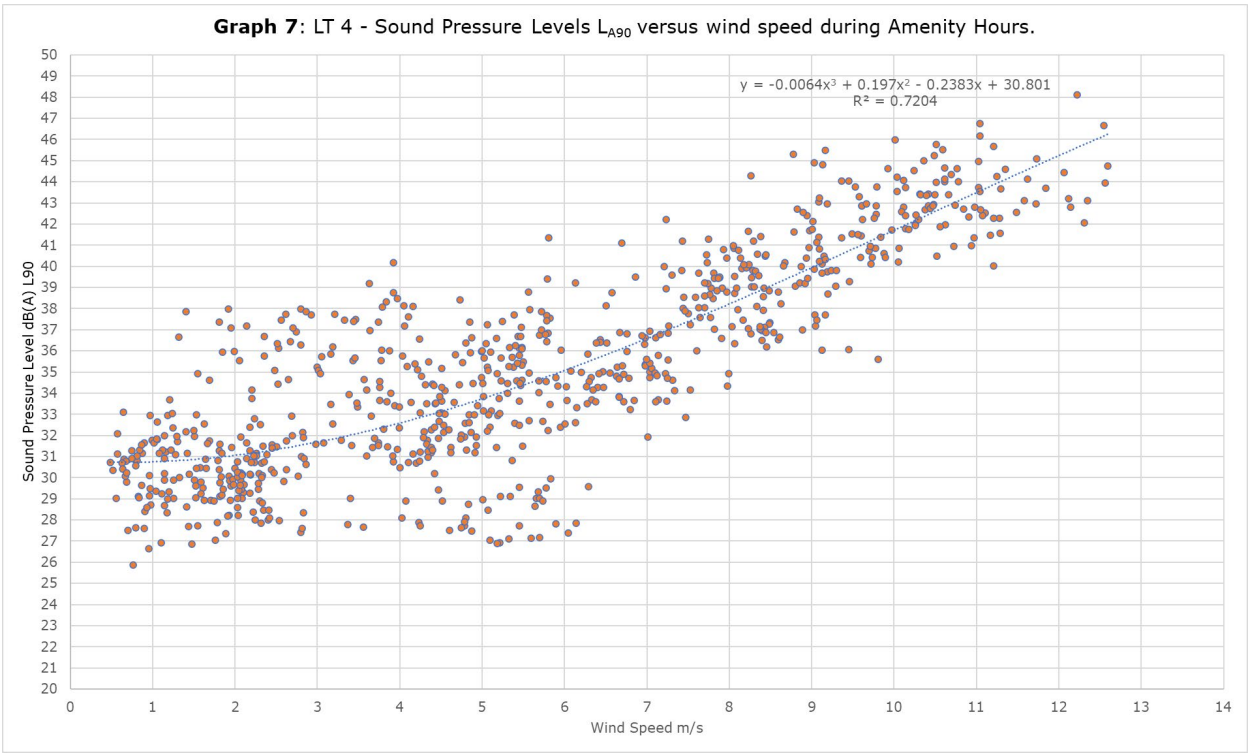
Graph 8.1.5 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 3.



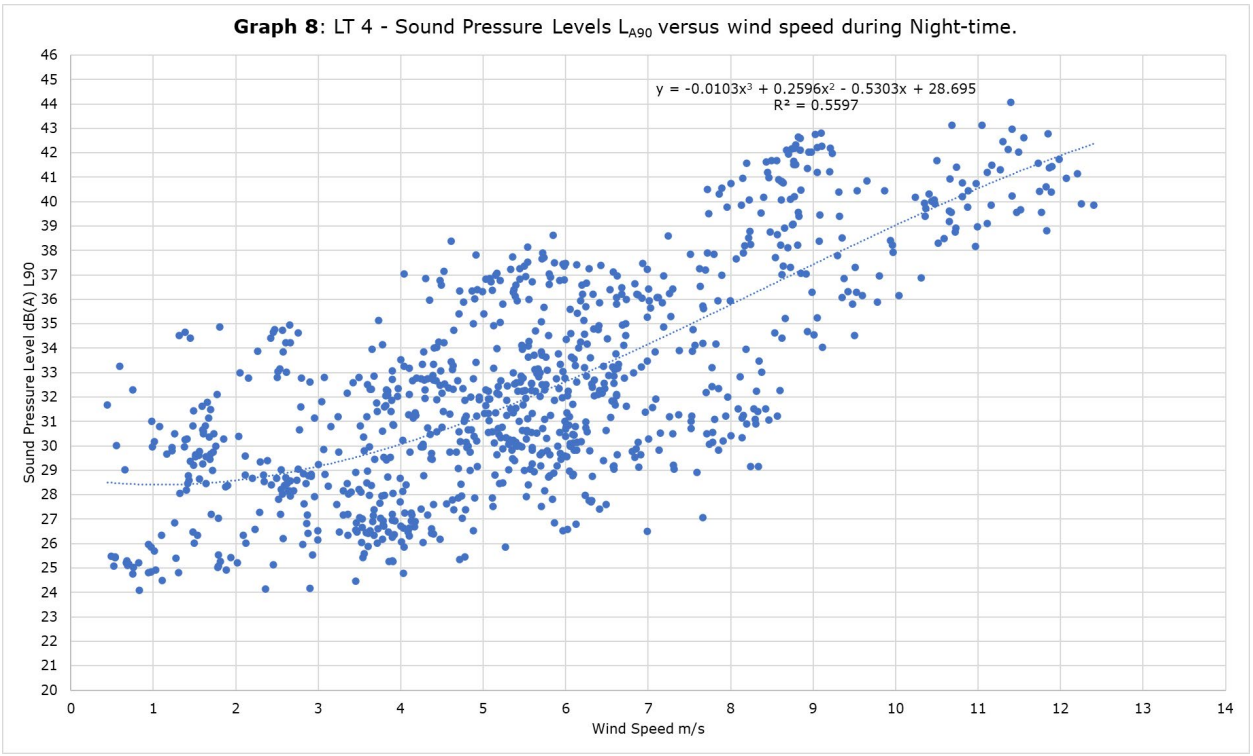
Graph 8.1.6 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 3.



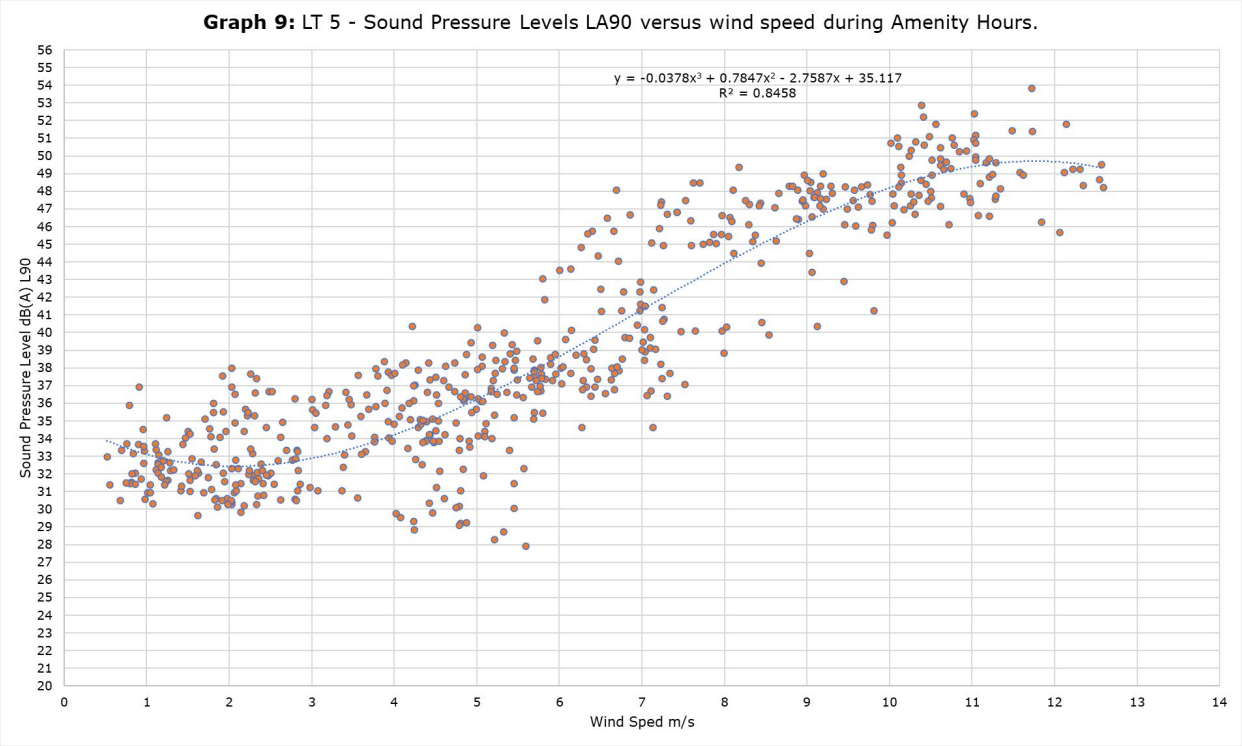
Graph 8.1.7 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 4.



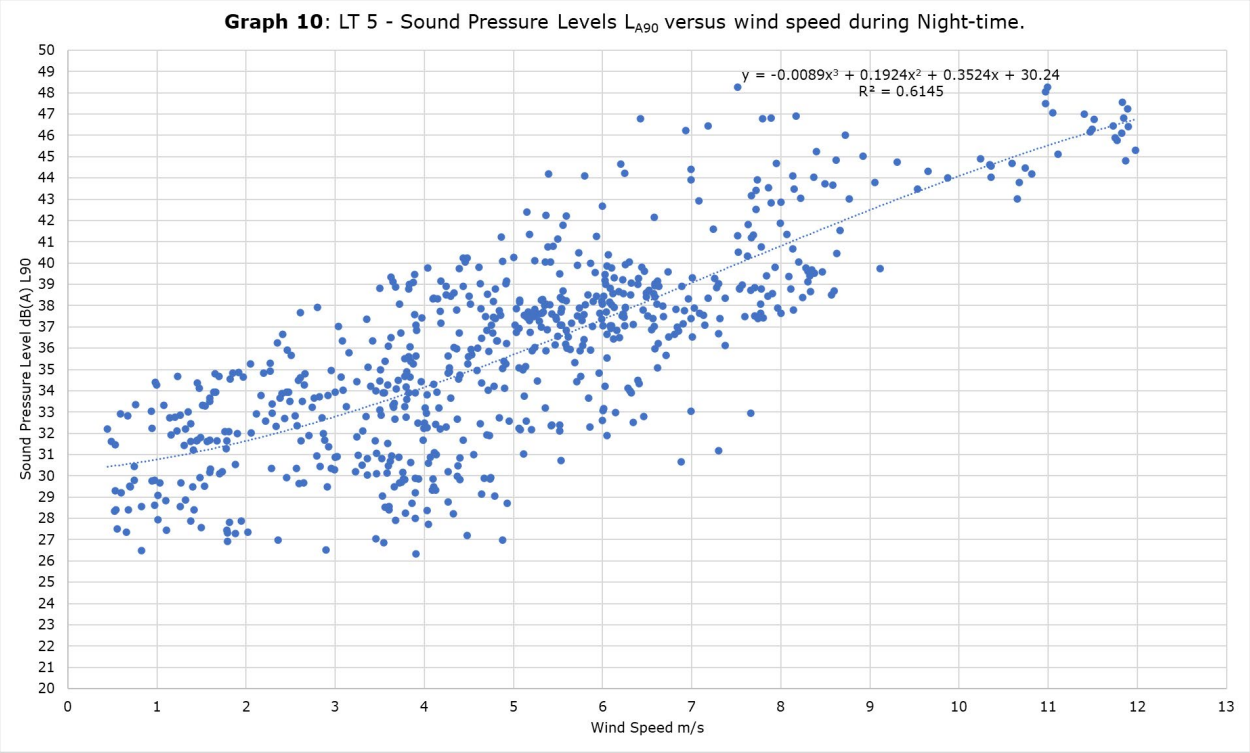
Graph 8.1.8 ETSU-R-97 Graphs of **Night-time Monitoring Results – LT 4.**



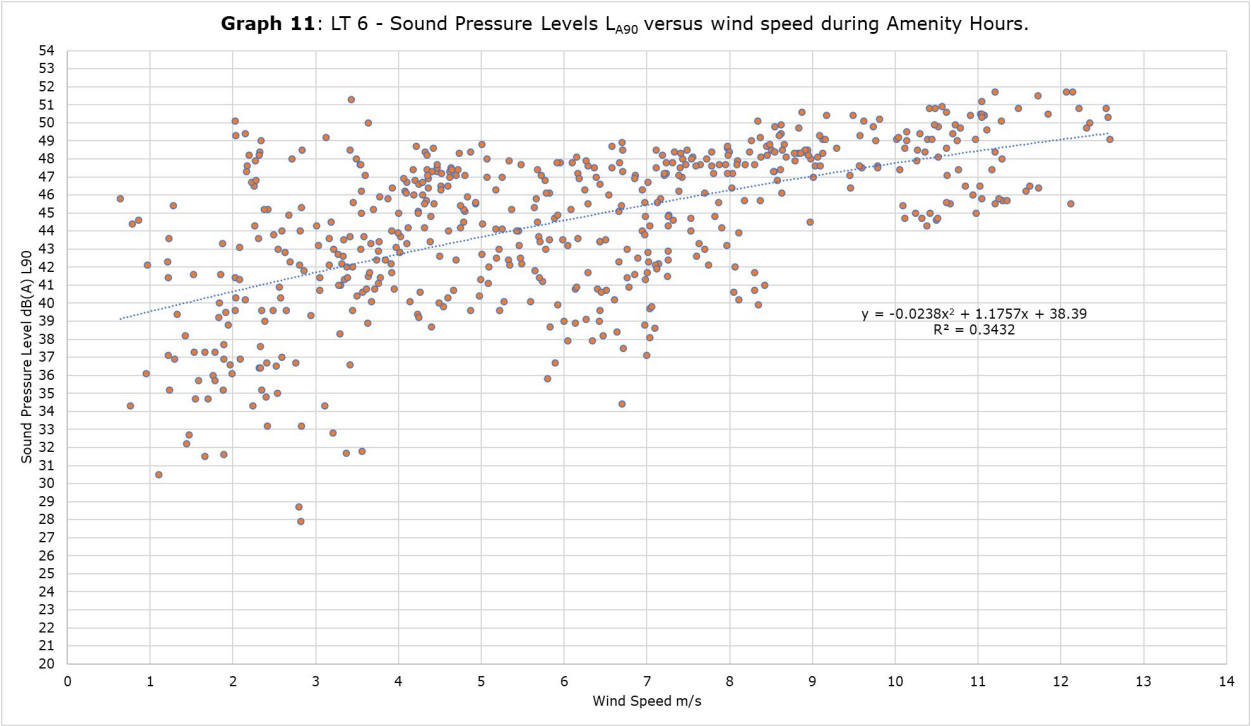
Graph 8.1.9 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 5.



Graph 8.1.10 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 5.



Graph 8.1.11 ETSU-R-97 Graphs of Amenity Hours Monitoring Results – LT 6.



Graph 8.1.12 ETSU-R-97 Graphs of Night-time Monitoring Results – LT 6.

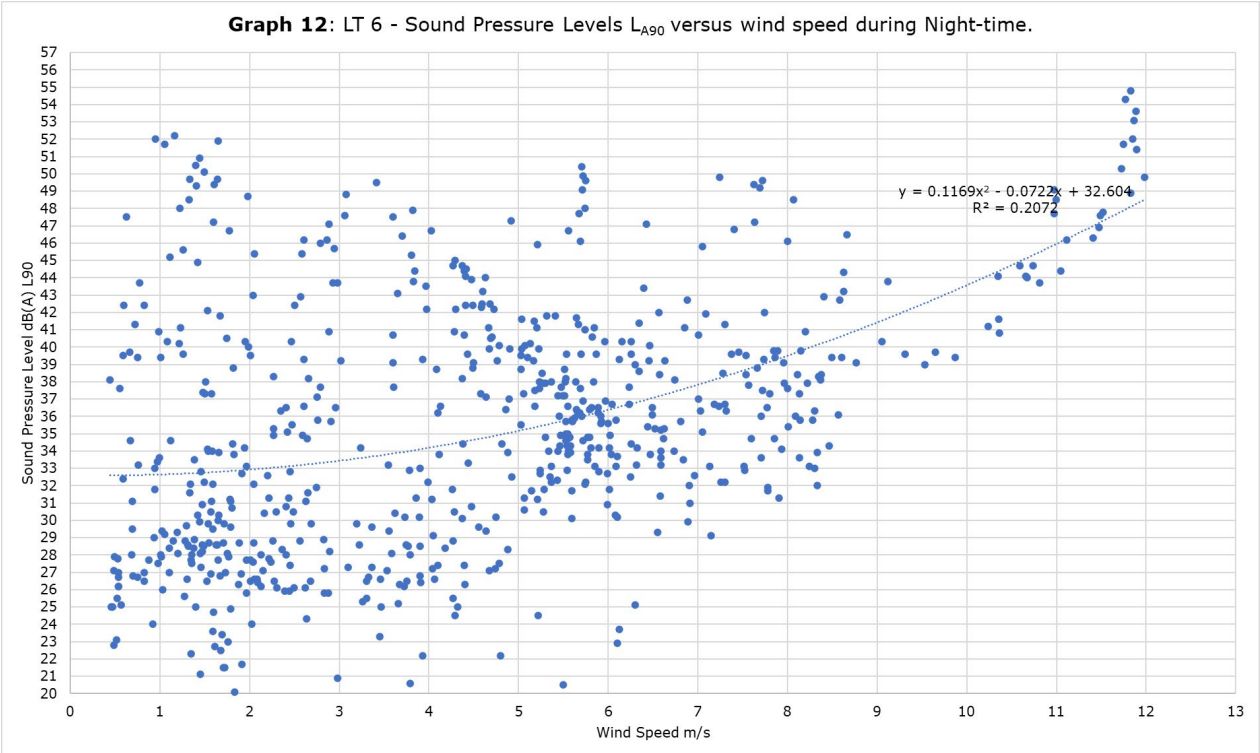


Table 8.1.5 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5 dB(A) from 3–12 m/s wind speeds based on baseline noise monitoring at LT 1.

Wind Speed	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
Amenity Hours Noise Level L_{A90} dB	31.0	31.9	33.3	34.9	36.7	38.5	40.2	41.7	42.7	43.2
Amenity Hours Noise Level +5dB	36.0	36.9	38.3	39.9	41.7	43.5	45.2	46.7	47.7	48.2
Night-time Noise Level L_{A90} dB	28.5	29.5	30.8	32.3	34.2	36.1	38.1	40.2	42.2	44.1
Night-time Noise Level +5dB	33.5	34.5	35.8	37.3	39.2	41.1	43.1	45.2	47.2	49.1

Table 8.1.6 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 2.

Wind Speed	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
Amenity Hours Noise Level L_{A90} dB	35.8	36.3	37.0	37.6	38.4	39.2	40.1	41.0	42.0	43.1
Amenity Hours Noise Level +5dB	40.8	41.3	42.0	42.6	43.4	44.2	45.1	46.0	47.0	48.1
Night-time Noise Level L_{A90} dB	33.4	34.0	34.8	35.7	36.8	38.0	39.3	40.8	42.5	44.2
Night-time Noise Level +5dB	38.4	39.0	39.8	40.7	41.8	43.0	44.3	45.8	47.5	49.2

Table 8.1.7 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 3.

Wind Speed	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
Amenity Hours Noise Level L_{A90} dB	41.1	41.1	41.3	41.6	42.1	42.6	43.3	44.0	44.8	45.8
Amenity Hours Noise Level +5dB	46.1	46.1	46.3	46.6	47.1	47.6	48.3	49.0	49.8	50.8
Night-time Noise Level L_{A90} dB	36.4	36.6	36.8	37.0	37.3	37.7	38.5	39.6	41.1	43.1
Night-time Noise Level +5dB	41.4	41.6	41.8	42.0	42.3	42.7	43.5	44.6	46.1	48.1

Table 8.1.8 Measured Amenity Hours and Night-time background noise levels LA90 and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 4.

Wind Speed	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
Amenity Hours Noise Level L_{A90} dB	31.7	32.6	33.7	35.1	36.6	38.2	39.9	41.7	43.5	45.3
Amenity Hours Noise Level +5dB	36.7	37.6	38.7	40.1	41.6	43.2	44.9	46.7	48.5	50.3
Night-time Noise Level L_{A90} dB	29.2	30.1	31.2	32.6	34.2	35.8	37.4	39.1	40.6	41.9
Night-time Noise Level +5dB	34.2	35.1	36.2	37.6	39.2	40.8	42.4	44.1	45.6	46.9

Table 8.1.9 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 5.

Wind Speed	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
Amenity Hours Noise Level L_{A90} dB	32.9	34.2	36.2	38.6	41.3	43.9	46.3	48.2	49.4	49.7
Amenity Hours Noise Level +5dB	37.9	39.2	41.2	43.6	46.3	48.9	51.3	53.2	54.4	54.7
Night-time Noise Level L_{A90} dB	32.8	34.2	35.7	37.4	39.1	40.8	42.5	44.1	45.6	46.8
Night-time Noise Level +5dB	37.8	39.2	40.7	42.4	44.1	45.8	47.5	49.1	50.6	51.8

Table 8.1.10 Measured Amenity Hours and Night-time background noise levels L_{A90} and Background level +5dB(A) from 3-12m/s wind speeds based on baseline noise monitoring at LT 6.

Wind Speed	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
Amenity Hours Noise Level L_{A90} dB	41.7	42.7	43.7	44.6	45.5	46.3	47.0	47.8	48.4	49.1
Amenity Hours Noise Level +5dB	46.7	47.7	48.7	49.6	50.5	51.3	52.0	52.8	53.4	54.1
Night-time Noise Level L_{A90} dB	33.4	34.2	35.2	36.4	37.8	39.5	41.4	43.6	46.0	48.6
Night-time Noise Level +5dB	38.4	39.2	40.2	41.4	42.8	44.5	46.4	48.6	51.0	53.6

1.4.1.15 Table 8.1.11 outlines a single set of wind turbine noise limits based on the lowest Amenity Hours and Night-time noise limits at increasing wind speeds from the six noise monitoring locations LT 1 – LT 6, for reference at all NSRs as opposed to referencing noise limits at increasing wind speeds at each individual NSR. This is a conservative approach and allows for a worst-case assessment at NSRs along the coastline in proximity the Proposed Development.

Table 8.1.11 Minimum WEDG 2006 Guideline Daytime & Night-time Noise Limits (dB(A)) measured at wind speeds from 3-12m/s across the six noise monitoring locations LT 1 – LT 6.

Wind Speed	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
Daytime Noise Limit dB(A)	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.0	47.0	48.1
Night-time Noise Limit dB(A)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.6	46.9

1.4.1.16 For context, based on the ETSU-R-97 and IoA GPG methodologies, Table 8.1.12 outlines the Daytime & Night-time Noise Limits (dB $L_{A90,10min}$) measured at wind speeds from 3-12m/s across the six noise monitoring locations. In accordance with the ETSU-R-97 Guidelines, the following wind turbine noise limits at the NSR locations have been derived from the polynomial regression best fit trendline, where average L_{A90} sound pressure levels were derived from 3 m/s - 12 m/s during amenity and night-time hours. 5 dB has added to the average amenity and night-time hours L_{A90} levels to obtain the relevant ETSU-R-97 limit values. The ETSU-R-97 night-time limit is 43 dB(A).

Table 8.1.12 Minimum ETSU-R-97 Guideline Daytime & Night-time Noise Limits (dB(A)) measured at wind speeds from 3-12m/s across the six noise monitoring locations LT 1 – LT 6 (Added for context, based on the ETSU-R-97 and IoA GPG methodologies).

Wind Speed	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
Daytime Noise Limit dB(A)	36.0	36.9	38.3	39.9	41.6	43.2	44.9	46.0	47.0	48.1
Night-time Noise Limit dB(A)	43	43	43	43	43	43	43	44	45.5	46.9

1.5 Predicted Noise Levels

1.5.1 Construction Phase - Predicted Airborne Noise Levels from Piling

1.5.1.6 Piling operations during construction of the Proposed Development will take place intermittently over an approximate six-month period as referenced in Volume II, Chapter 4, Description of the Development. Piling operations will be weather dependant, but could occur during daytime, evening and/or night-time.

1.5.1.7 Only one pile will be driven at any one time and in a 24 hour period. A representative piling location closest to the shoreline in the north, centre and south of the 56 turbine layout for Project Design Option 1 (Models 1A and 1B) and the 47 turbine layout for Project Design Option 2 have been selected to allow for a worst-case piling noise assessment. Therefore, the worst-case piling noise assessment is representative of Project Design Option 1 (Models 1A and 1B) and Project Design Option 2.

1.5.1.8 Table 8.1.13 outlines the expected piling duration during the Construction Phase.

Table 8.1.13 Expected Piling durations during the Construction Phase.

Parameter	56 WTG Options 1A & 1B	47 WTG Option 2	OSPs
Number of Structures requiring piling	56 No.	47 No.	2 No.
Maximum duration of piling (per pile)	5 hours 10 minutes	5 hours 10 minutes	5 hours 10 minutes
Number of piles impact hammered over 24 hours	1 No.	1 No.	1 No.
Total number of days when piling may occur over construction period	75 days	63 days	4 days

1.5.1.9 The predicted piling noise levels for the scenarios at Piling Locations 1-3 at the northern WTG location (Grid Ref. 302867, 5866991), at the central WTG location (Grid Ref. 300962, 5857500) and at the southern WTG location (Grid Ref. 298101, 5843390) of the Array Area, closest to the representative NSRs, versus BS5228 daytime, evening and night-time noise limits are presented in Tables 8.1.14, 8.1.15 and 8.1.16.

1.5.1.10 The piling scenarios have been assessed assuming no mitigation, the use of a screen, the use of a dolly and the use of both a screen and a dolly.

Table 8.1.14 Predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Daytime Noise Limits.

Piling Location 1 (North)		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Daytime Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance
A	65	56.2	-8.8	49.6	-15.4	53.5	-11.5	45.6	-19.4
B	65	55.2	-9.8	48.5	-16.5	52.4	-12.6	44.5	-20.5
C	65	55.7	-9.3	49.3	-15.7	53	-12	45.1	-19.9
D	65	53.3	-11.7	47.2	-17.8	50.4	-14.6	42.6	-22.4
E	65	51.6	-13.4	46.1	-18.9	48.3	-16.7	40.6	-24.4
F	65	44.8	-20.2	40.2	-24.8	40	-25	32.7	-32.3
G	65	43.5	-21.5	39.5	-25.5	37.3	-27.7	30.4	-34.6
H	65	41.3	-23.7	37.7	-27.3	33.5	-31.5	27.3	-37.7
I	65	38.5	-26.5	35.4	-29.6	28.8	-36.2	23.6	-41.4
J	65	35.4	-29.6	32.7	-32.3	24.1	-40.9	20	-45
Piling Location 2 (Centre)		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Daytime Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance
A	65	46.9	-18.1	42.1	-22.9	42.4	-22.6	35	-30
B	65	49.3	-15.7	44	-21	45.7	-19.3	38.1	-26.9
C	65	52.5	-12.5	46.7	-18.3	49.4	-15.6	41.6	-23.4
D	65	52.7	-12.3	46.8	-18.2	49.6	-15.4	41.9	-23.1
E	65	53.4	-11.6	47.3	-17.7	50.6	-14.4	42.7	-22.3
F	65	51.5	-13.5	45.9	-19.1	48.2	-16.8	40.5	-24.5
G	65	49.5	-15.5	44.4	-20.6	45.6	-19.4	38	-27
H	65	46.8	-18.2	42.2	-22.8	42.1	-22.9	34.8	-30.2
I	65	44.7	-20.3	40.6	-24.4	38.3	-26.7	31.5	-33.5
J	65	41	-24	37.6	-27.4	32.4	-32.6	26.6	-38.4

Piling Location 3 (South)		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Daytime Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance
A	65	41.8	-23.2	38.8	-26.2	31.7	-33.3	26.7	-38.3
B	65	43.4	-21.6	40.1	-24.9	34.4	-30.6	28.8	-36.2
C	65	45	-20	41.5	-23.5	37	-28	30.9	-34.1
D	65	45.6	-19.4	42	-23	38.1	-26.9	31.8	-33.2
E	65	46.8	-18.2	42.8	-22.2	40.5	-24.5	33.7	-31.3
F	65	49.2	-15.8	44.9	-20.1	43.6	-21.4	36.5	-28.5
G	65	50.8	-14.2	46.3	-18.7	46	-19	38.7	-26.3
H	65	52.3	-12.7	47.3	-17.7	48.2	-16.8	40.7	-24.3
I	65	54.2	-10.8	49	-16	50.6	-14.4	43	-22
J	65	50.6	-14.4	46	-19	45.9	-19.1	38.6	-26.4

Note 1: The 'North' and 'Centre' piles will take 210 minutes to drive while the 'Southern' piles will take 310 minutes to drive. When assessed over an 8 hour period (assuming piling is on-going during a night-time period), this will result in a -3.9 dB(A) and -1.9(A) dB correction respectively.

Table 8.1.15 Predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Evening Noise Limits.

Piling Location 1 (North)		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Evening Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance
A	55	56.2	1.2	49.6	-5.4	53.5	-1.5	45.6	-9.4
B	55	55.2	0.2	48.5	-6.5	52.4	-2.6	44.5	-10.5
C	55	55.7	0.7	49.3	-5.7	53	-2	45.1	-9.9
D	55	53.3	-1.7	47.2	-7.8	50.4	-4.6	42.6	-12.4
E	55	51.6	-3.4	46.1	-8.9	48.3	-6.7	40.6	-14.4
F	55	44.8	-10.2	40.2	-14.8	40	-15	32.7	-22.3
G	55	43.5	-11.5	39.5	-15.5	37.3	-17.7	30.4	-24.6
H	55	41.3	-13.7	37.7	-17.3	33.5	-21.5	27.3	-27.7
I	55	38.5	-16.5	35.4	-19.6	28.8	-26.2	23.6	-31.4
J	55	35.4	-19.6	32.7	-22.3	24.1	-30.9	20	-35
Piling Location 2 (Centre)		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Evening Noise Limit L L_{Aeq} dB	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance
A	55	46.9	-8.1	42.1	-12.9	42.4	-12.6	35	-20
B	55	49.3	-5.7	44	-11	45.7	-9.3	38.1	-16.9
C	55	52.5	-2.5	46.7	-8.3	49.4	-5.6	41.6	-13.4
D	55	52.7	-2.3	46.8	-8.2	49.6	-5.4	41.9	-13.1
E	55	53.4	-1.6	47.3	-7.7	50.6	-4.4	42.7	-12.3
F	55	51.5	-3.5	45.9	-9.1	48.2	-6.8	40.5	-14.5
G	55	49.5	-5.5	44.4	-10.6	45.6	-9.4	38	-17
H	55	46.8	-8.2	42.2	-12.8	42.1	-12.9	34.8	-20.2
I	55	44.7	-10.3	40.6	-14.4	38.3	-16.7	31.5	-23.5
J	55	41	-14	37.6	-17.4	32.4	-22.6	26.6	-28.4

Piling Location 3 (South)		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Evening Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4 Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance
A	55	41.8	-13.2	38.8	-16.2	31.7	-23.3	26.7	-28.3
B	55	43.4	-11.6	40.1	-14.9	34.4	-20.6	28.8	-26.2
C	55	45	-10	41.5	-13.5	37	-18	30.9	-24.1
D	55	45.6	-9.4	42	-13	38.1	-16.9	31.8	-23.2
E	55	46.8	-8.2	42.8	-12.2	40.5	-14.5	33.7	-21.3
F	55	49.2	-5.8	44.9	-10.1	43.6	-11.4	36.5	-18.5
G	55	50.8	-4.2	46.3	-8.7	46	-9	38.7	-16.3
H	55	52.3	-2.7	47.3	-7.7	48.2	-6.8	40.7	-14.3
I	55	54.2	-0.8	49	-6	50.6	-4.4	43	-12
J	55	50.6	-4.4	46	-9	45.9	-9.1	38.6	-16.4

Note 1: The 'North' and 'Centre' piles will take 210 minutes to drive while the 'Southern' piles will take 310 minutes to drive. When assessed over an 8 hour period (assuming piling is on-going during a night-time period), this will result in a -3.9 dB(A) and -1.9(A) dB correction respectively.

Table 8.1.16 Predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Night-time Noise Limits.

Piling Location 1 (North)		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Night Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq,\ 8\ Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq,\ 8\ Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq,\ 8\ Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq,\ 8\ Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance
A	45	56.2	11.2	49.6	4.6	53.5	8.5	45.6	0.6
B	45	55.2	10.2	48.5	3.5	52.4	7.4	44.5	-0.5
C	45	55.7	10.7	49.3	4.3	53	8	45.1	0.1
D	45	53.3	8.3	47.2	2.2	50.4	5.4	42.6	-2.4
E	45	51.6	6.6	46.1	1.1	48.3	3.3	40.6	-4.4
F	45	44.8	-0.2	40.2	-4.8	40	-5	32.7	-12.3
G	45	43.5	-1.5	39.5	-5.5	37.3	-7.7	30.4	-14.6
H	45	41.3	-3.7	37.7	-7.3	33.5	-11.5	27.3	-17.7
I	45	38.5	-6.5	35.4	-9.6	28.8	-16.2	23.6	-21.4
J	45	35.4	-9.6	32.7	-12.3	24.1	-20.9	20	-25
Piling Location 2 (Centre)		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Night Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq,\ 8\ Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq,\ 8\ Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq,\ 8\ Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq,\ 8\ Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance
A	45	46.9	1.9	42.1	-2.9	42.4	-2.6	35	-10
B	45	49.3	4.3	44	-1	45.7	0.7	38.1	-6.9
C	45	52.5	7.5	46.7	1.7	49.4	4.4	41.6	-3.4
D	45	52.7	7.7	46.8	1.8	49.6	4.6	41.9	-3.1
E	45	53.4	8.4	47.3	2.3	50.6	5.6	42.7	-2.3
F	45	51.5	6.5	45.9	0.9	48.2	3.2	40.5	-4.5
G	45	49.5	4.5	44.4	-0.6	45.6	0.6	38	-7
H	45	46.8	1.8	42.2	-2.8	42.1	-2.9	34.8	-10.2
I	45	44.7	-0.3	40.6	-4.4	38.3	-6.7	31.5	-13.5
J	45	41	-4	37.6	-7.4	32.4	-12.6	26.6	-18.4

Piling Location 3 (South)		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Night Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance
A	45	41.8	-3.2	38.8	-6.2	31.7	-13.3	26.7	-18.3
B	45	43.4	-1.6	40.1	-4.9	34.4	-10.6	28.8	-16.2
C	45	45	0	41.5	-3.5	37	-8	30.9	-14.1
D	45	45.6	0.6	42	-3	38.1	-6.9	31.8	-13.2
E	45	46.8	1.8	42.8	-2.2	40.5	-4.5	33.7	-11.3
F	45	49.2	4.2	44.9	-0.1	43.6	-1.4	36.5	-8.5
G	45	50.8	5.8	46.3	1.3	46	1	38.7	-6.3
H	45	52.3	7.3	47.3	2.3	48.2	3.2	40.7	-4.3
I	45	54.2	9.2	49	4	50.6	5.6	43	-2
J	45	50.6	5.6	46	1	45.9	0.9	38.6	-6.4

Note 1: The 'North' and 'Centre' piles will take 210 minutes to drive while the 'Southern' piles will take 310 minutes to drive. When assessed over an 8 hour period (assuming piling is on-going during a night-time period), this will result in a -3.9 dB(A) and -1.9(A) dB correction respectively.

1.5.1.11 The predicted piling noise levels for the various scenarios at Piling Locations 1-3 in the north, centre and south of the proposed ABWP2 Array Area closest to the representative NSRs, versus BS5228 daytime, evening and night-time noise limits are presented in Tables 8.1.14, 8.1.15 and 8.1.16. As stated, the piling operations have been assessed assuming no mitigation, the use of a screen, the use of a dolly and the use of both a screen and a dolly.

1.5.1.12 Table 8.1.14 outlines the predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Daytime Noise Limit of 65 dB $L_{Aeq, 12\ Hour}$. The predicted piling noise levels indicate that during daytime there will be no exceedance of the BS5228 Daytime Noise Limit of 65 dB $L_{Aeq, 12\ Hour}$ for all piling scenarios at all locations, whether or not there is noise mitigation employed on the piling rig. Therefore, there will be no significant daytime noise impact from piling operations.

1.5.1.13 Table 8.1.15 outlines the predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Evening Noise Limit of 55 dB $L_{Aeq, 4\ Hour}$. The predicted noise levels indicate that if piling is undertaken during the evening period at Piling Location 1 in the north of the ABWP2 Array Area, there will potentially be a very minor exceedance of the BS5228 Evening Noise Limit of 55 dB $L_{Aeq, 4\ Hour}$ by approximately 1 dB(A) at the NSRs A, B and C for the piling scenario with no mitigation measures employed. If any of the proposed mitigation measures are employed during piling at this location there will be no exceedance of the BS5228 Evening Noise Limit of 55 dB $L_{Aeq, 4\ Hour}$ at the NSRs A, B and C.

1.5.1.14 At all other locations, the predicted piling noise levels indicate that during the evening there will be no exceedance of the BS5228 Evening Noise Limit of 55 dB $L_{Aeq, 4\ Hour}$ for all piling scenarios, whether or not there is noise mitigation employed on the piling rig. Table 8.1.16 outlines the predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq, 8\ Hour}$.

1.5.1.15 The predicted noise levels indicate that if piling is undertaken during the night-time period at Piling Locations 1, 2 and 3 in the ABWP2 Array Area, there will be an exceedance of the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq, 8\ Hour}$ by approximately 1-11 dB(A) at the nearest NSRs for the piling scenario with no mitigation measures employed. If the proposed mitigation measures using both a screen and a dolly are employed during piling at Piling Locations 1, 2 and 3 during night-time there will be no exceedance of the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq, 8\ Hour}$ at all NSRs, with the exception of an exceedance of the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq, 8\ Hour}$ by 0.6 dB at NSR A.

1.5.1.16 The worst-case predicted piling noise levels at Piling Location 1, indicates a potential predicted exceedance of the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq, 8\ Hour}$ by 0.6 dB at NSR A. This is an insignificant exceedance of the Night-time Noise Limit of 45 dB $L_{Aeq, 8\ Hour}$ as a noise level difference of 0.6 dB is imperceptible. This is also extremely unlikely to occur as it assumes direct downwind propagation from Piling Location 1 towards NSR A. This is an unlikely meteorological event which assumes an easterly wind direction, which as shown in the windrose in Figure 8.1.2, will occur for approximately 10% of the year.

1.5.2 Construction Phase - Predicted Cumulative Airborne Noise Levels from Piling

1.5.2.6 The predicted noise levels for the worst-case cumulative piling noise impact scenario with piling occurring concurrently at Location 1 in the north of the proposed ABWP2 Array Area and at the most southerly turbine location on the Codling Wind Park offshore wind farm array, versus BS5228 daytime, evening and night-time noise limits are presented in Table 8.1.17**.**

1.5.2.7 The potential cumulative noise impacts from other offshore wind farm developments such as the Dublin array or other Phase 1 projects have been screened out due to the very significant distance between these project locations and the proposed ABWP2 Array Area. Due to the very significant offset distances, there is no opportunity for a cumulative noise impact to occur.

1.5.2.8 The predicted noise levels indicate that if piling is undertaken concurrently at Piling Location 1 in the ABWP2 Array and at the most southerly turbine location on the Codling Wind Park offshore wind farm array, there will be no exceedance of the BS5228 Daytime Noise Limit with no mitigation measures employed at both locations.

1.5.2.9 The predicted noise levels indicate that there will potentially be a very minor exceedance of the BS5228 Evening Noise Limit of 55 dB $L_{Aeq,\ 4\ Hour}$ by approximately 1 – 2 dB(A) at the NSRs A, B and C if no mitigation measures employed. If any of the proposed mitigation measures are employed during piling at these locations there will be no exceedance of the BS5228 Evening Noise Limit of 55 dB $L_{Aeq,\ 4\ Hour}$ at the NSRs A, B and C.

1.5.2.10 The predicted noise levels indicate that if piling is undertaken during night-time with a screen and dolly in operation, concurrently at Piling Location 1 in the ABWP2 Array and at the most southerly turbine location on the Codling Wind Park offshore wind farm array, there will potentially be a very slight exceedance of approximately 1 dB(A) of the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq,\ 8\ Hour}$ at NSRs A. However, the above worst-case cumulative piling scenario is most unlikely to occur as the scheduling of the piling activity for the Proposed Development and Codling Wind Park are highly unlikely to coincide at these locations.

Table 8.1.17 Predicted cumulative piling noise levels at each of the noise assessment locations, versus the BS5228 Daytime, Evening and Night-time Noise Limits.

Piling Location 1 (North) - Daytime		Scenario - 1 Piling No Mitigation		Scenario - 2 Piling With Screen		Scenario - 3 Piling With Dolly		Scenario - 4 Piling With Screen & Dolly	
NSR	BS5228 Daytime Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq, 8\ Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8\ Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8\ Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level $L_{Aeq, 8\ Hr}$ dB Note 1	BS5228 Daytime Noise Limit Exceedance
A	65	56.7	-8.3	50.2	-14.8	53.8	-11.2	45.9	-19.1
B	65	55.6	-9.4	49.1	-15.9	52.7	-12.3	44.8	-20.2
C	65	56	-9	49.8	-15.2	53.1	-11.9	45.3	-19.7
D	65	53.7	-11.3	47.9	-17.1	50.6	-14.4	42.8	-22.2
E	65	52.2	-12.8	46.9	-18.1	48.5	-16.5	40.9	-24.1
F	65	45.7	-19.3	41.4	-23.6	40.4	-24.6	33.3	-31.7
G	65	44.5	-20.5	40.7	-24.3	37.7	-27.3	31	-34
H	65	42.5	-22.5	39.1	-25.9	34	-31	28.1	-36.9
I	65	39.9	-25.1	37	-28	29.5	-35.5	24.7	-40.3
J	65	37	-28	34.5	-30.5	25.2	-39.8	21.5	-43.5
Piling Location 1 (North) - Evening		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Evening Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq, 4\ Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4\ Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4\ Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level $L_{Aeq, 4\ Hr}$ dB Note 1	BS5228 Evening Noise Limit Exceedance
A	55	56.7	1.7	50.2	-4.8	53.8	-1.2	45.9	-9.1
B	55	55.6	0.6	49.1	-5.9	52.7	-2.3	44.8	-10.2
C	55	56	1	49.8	-5.2	53.1	-1.9	45.3	-9.7
D	55	53.7	-1.3	47.9	-7.1	50.6	-4.4	42.8	-12.2
E	55	52.2	-2.8	46.9	-8.1	48.5	-6.5	40.9	-14.1
F	55	45.7	-9.3	41.4	-13.6	40.4	-14.6	33.3	-21.7
G	55	44.5	-10.5	40.7	-14.3	37.7	-17.3	31	-24
H	55	42.5	-12.5	39.1	-15.9	34	-21	28.1	-26.9
I	55	39.9	-15.1	37	-18	29.5	-25.5	24.7	-30.3
J	55	37	-18	34.5	-20.5	25.2	-29.8	21.5	-33.5

Piling Location 1 (North) - Night-time		**Scenario - 1 Piling No Mitigation**		**Scenario - 2 Piling With Screen**		**Scenario - 3 Piling With Dolly**		**Scenario - 4 Piling With Screen & Dolly**	
NSR	BS5228 Night Noise Limit L_{Aeq} dB	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level $L_{Aeq, 8 Hr}$ dB Note 1	BS5228 Night Noise Limit Exceedance
A	45	56.7	11.7	50.2	5.2	53.8	8.8	45.9	0.9
B	45	55.6	10.6	49.1	4.1	52.7	7.7	44.8	-0.2
C	45	56	11	49.8	4.8	53.1	8.1	45.3	0.3
D	45	53.7	8.7	47.9	2.9	50.6	5.6	42.8	-2.2
E	45	52.2	7.2	46.9	1.9	48.5	3.5	40.9	-4.1
F	45	45.7	0.7	41.4	-3.6	40.4	-4.6	33.3	-11.7
G	45	44.5	-0.5	40.7	-4.3	37.7	-7.3	31	-14
H	45	42.5	-2.5	39.1	-5.9	34	-11	28.1	-16.9
I	45	39.9	-5.1	37	-8	29.5	-15.5	24.7	-20.3
J	45	37	-8	34.5	-10.5	25.2	-19.8	21.5	-23.5

Note 1: The 'North' and 'Centre' piles will take 210 minutes to drive while the 'Southern' piles will take 310 minutes to drive. When assessed over an 8 hour period (assuming piling is on-going during a night-time period), this will result in a -3.9 dB(A) and -1.9(A) dB correction respectively.

1.5.3 Operational Phase - Predicted Airborne Noise Levels from ABWP2 Array Area

1.5.3.6 Based on the relevant broadband sound power level (dB L_{wA}) for the two different wind turbine Project Design Options 1 (Models 1A and 1B) and 2 at wind speeds from 3–12m/s, a corresponding predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the ABWP2 turbines has been presented.

1.5.3.7 Tables 8.1.18, 8.1.19 and 8.1.20 and Graphs 8.1.13, 8.1.14 and 8.1.15 outline the predicted noise levels for the different wind turbine options 1 (Models 1A and 1B) and 2 from the ABWP2 offshore turbines at each of the NSR locations for each wind speed over the range of wind speeds from 3 –12 m/s, on the basis of the assumptions discussed above.

Table 8.1.18 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 1 (Model 1A) from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit and ETSU-R-97 Simplified Limit.

NSR	Predicted noise levels at increasing wind speeds (dB(A))									
	3 m/s Note 1	4 m/s Note 1	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
NSR A	<20	<20	18.6	23.8	25.4	25.5	25.7	25.9	25.9	25.9
NSR B	<20	<20	19.4	24.6	25.9	26	26.2	26.4	26.4	26.4
NSR C	<20	<20	21.4	26.6	27.9	28	28.2	28.4	28.4	28.4
NSR D	<20	<20	20.1	25.3	26.8	26.9	27.1	27.3	27.3	27.3
NSR E	<20	<20	20	25.2	26.7	26.8	27	27.2	27.2	27.2
NSR F	<20	<20	17.8	23	24.9	25	25.2	25.4	25.4	25.4
NSR G	<20	<20	17.2	22.4	24.3	24.4	24.6	24.8	24.8	24.8
NSR H	<20	<20	16.3	21.5	23.4	23.5	23.7	23.9	23.9	23.9
NSR I	<20	<20	16.2	21.4	23.3	23.4	23.6	23.8	23.8	23.8
NSR J	<20	<20	13	18.2	20.3	20.4	20.6	20.8	20.8	20.8
Daytime Noise Limit dB(A)	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.0	47.0	48.1
Night-time Noise Limit dB(A)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.6	46.9
ETSU-R-97 Simplified Limit	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Compliance	√	√	√	√	√	√	√	√	√	√

Note 1: Sound Power Level Data for Option 1 A only available for 5–12 m/s wind speeds, hence values (<20) for 3 and 4 m/s are inferred from higher windspeeds.

Graph 8.1.13 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 1 (Model 1A) from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit.

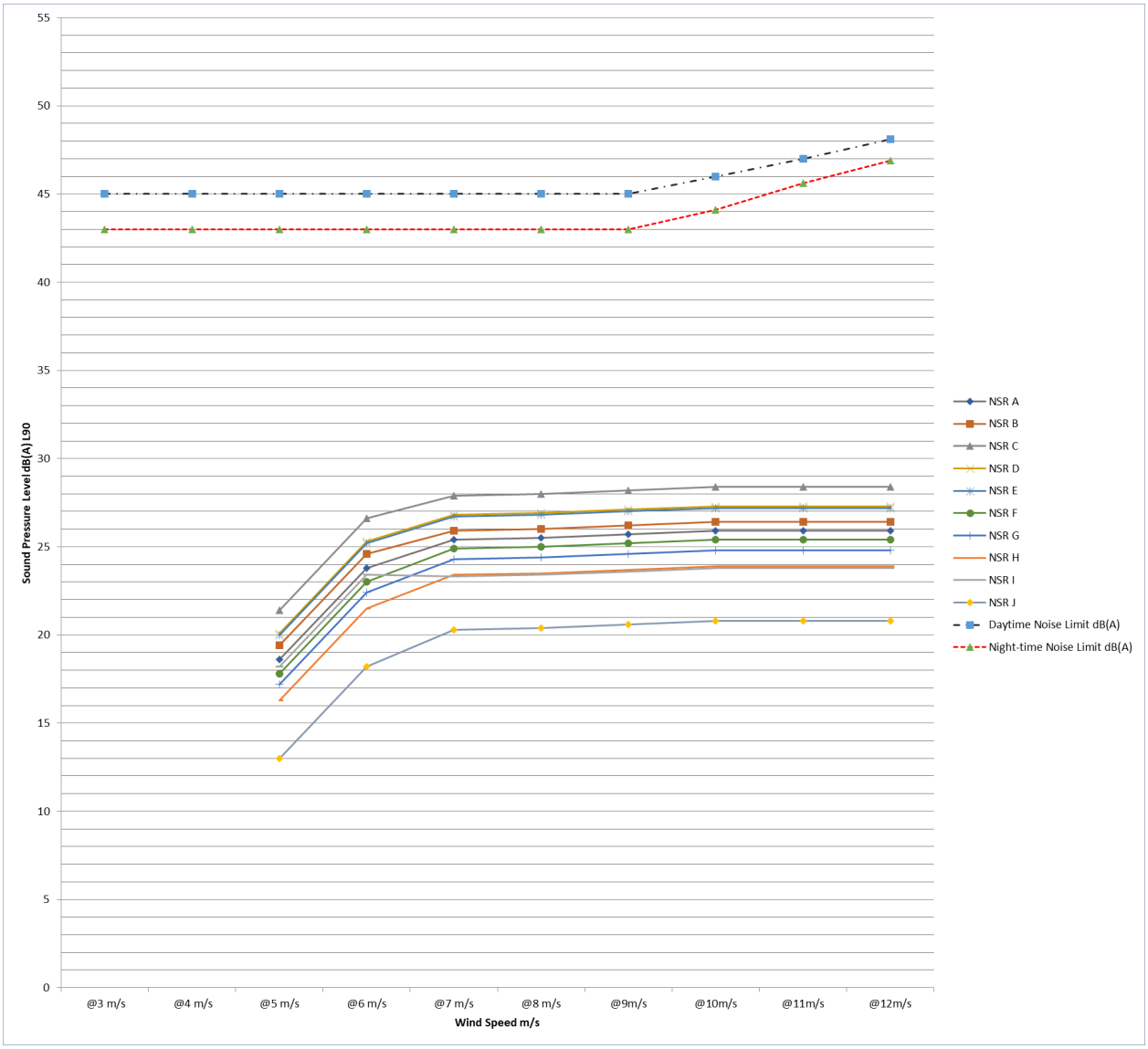


Table 8.1.19 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 1 (Model 1B) from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit and ETSU-R-97 Simplified Limit.

NSR	Predicted noise levels at increasing wind speeds (dB(A))									
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
NSR A	15.1	20.4	25.2	29.2	31.2	31.1	31.1	31.1	31.1	31.1
NSR B	15.7	21	25.8	29.8	31.5	31.4	31.4	31.4	31.4	31.4
NSR C	17.7	23	27.8	31.8	33.4	33.3	33.3	33.3	33.3	33.3
NSR D	16.6	21.9	26.7	30.7	32.5	32.4	32.4	32.4	32.4	32.4
NSR E	16.5	21.8	26.6	30.6	32.5	32.4	32.4	32.4	32.4	32.4
NSR F	14.7	20	24.8	28.8	31.2	31.1	31.1	31.1	31.1	31.1
NSR G	14.3	19.6	24.4	28.4	30.9	30.8	30.8	30.8	30.8	30.8
NSR H	13.4	18.7	23.5	27.5	30	29.9	29.9	29.9	29.9	29.9
NSR I	13.3	18.6	23.4	27.4	30	29.9	29.9	29.9	29.9	29.9
NSR J	10.5	15.8	20.6	24.6	27.4	27.3	27.3	27.3	27.3	27.3
Daytime Noise Limit dB(A)	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.0	47.0	48.1
Night-time Noise Limit dB(A)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.6	46.9
ETSU-R-97 Simplified Limit	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Compliance	√	√	√	√	√	√	√	√	√	√

Graph 8.1.14 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 1 (Model 1B) from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit.

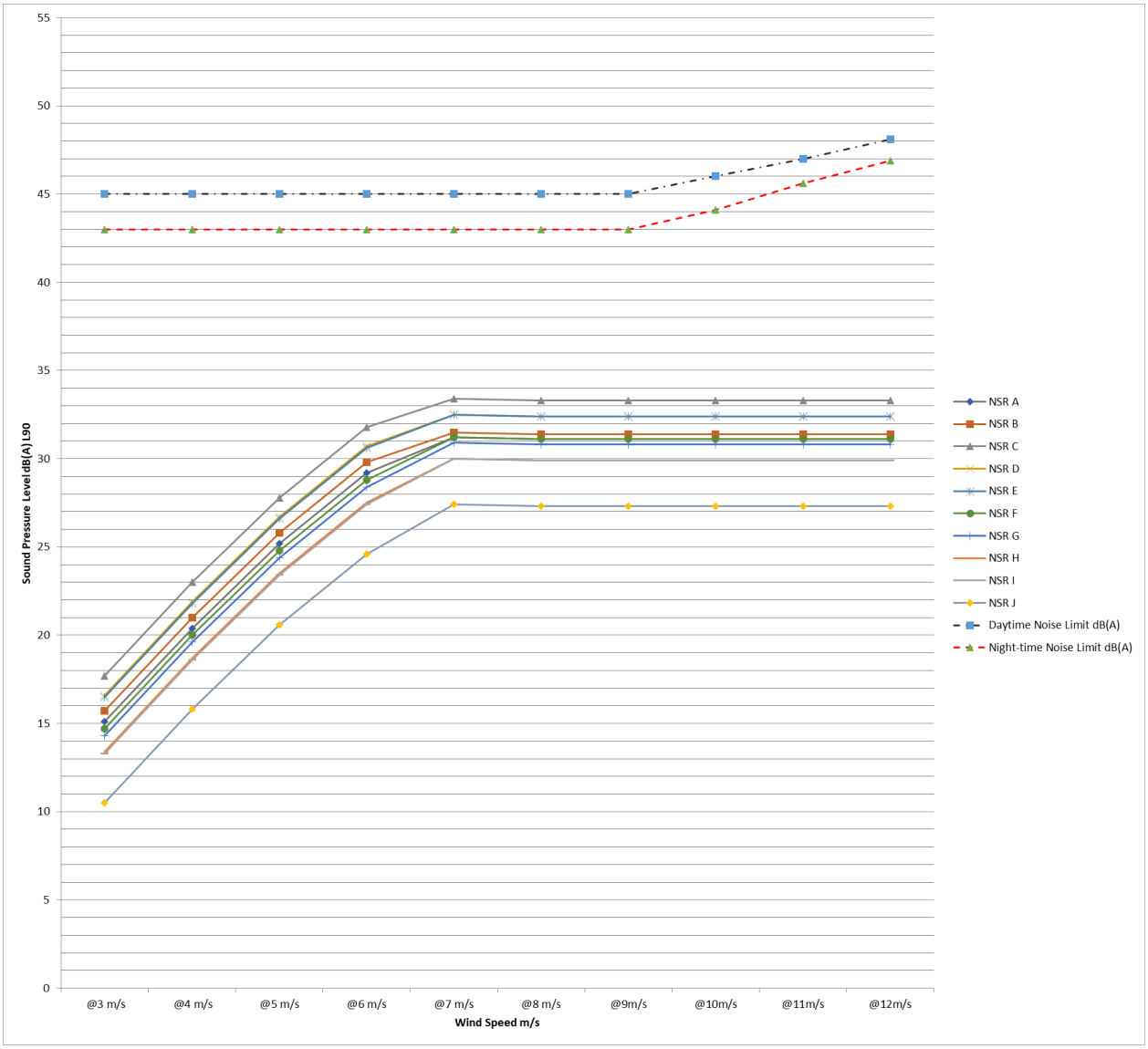
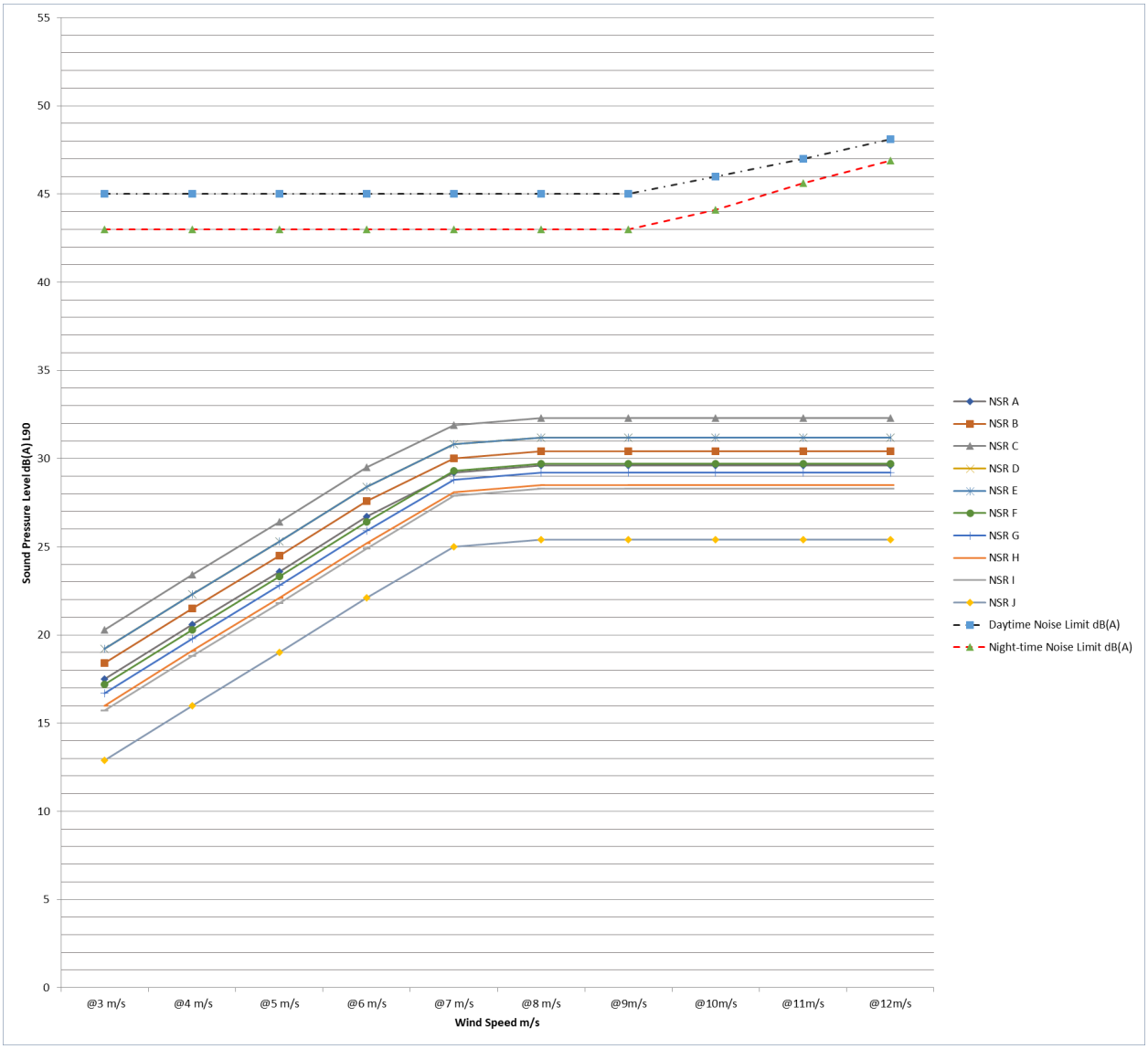


Table 8.1.20 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 2 from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit and ETSU-R-97 Simplified Limit.

NSR	Predicted noise levels at increasing wind speeds (dB(A))									
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
NSR A	17.5	20.6	23.6	26.7	29.2	29.6	29.6	29.6	29.6	29.6
NSR B	18.4	21.5	24.5	27.6	30	30.4	30.4	30.4	30.4	30.4
NSR C	20.3	23.4	26.4	29.5	31.9	32.3	32.3	32.3	32.3	32.3
NSR D	19.2	22.3	25.3	28.4	30.8	31.2	31.2	31.2	31.2	31.2
NSR E	19.2	22.3	25.3	28.4	30.8	31.2	31.2	31.2	31.2	31.2
NSR F	17.2	20.3	23.3	26.4	29.3	29.7	29.7	29.7	29.7	29.7
NSR G	16.7	19.8	22.8	25.9	28.8	29.2	29.2	29.2	29.2	29.2
NSR H	16	19.1	22.1	25.2	28.1	28.5	28.5	28.5	28.5	28.5
NSR I	15.7	18.8	21.8	24.9	27.9	28.3	28.3	28.3	28.3	28.3
NSR J	12.9	16	19	22.1	25	25.4	25.4	25.4	25.4	25.4
Daytime Noise Limit dB(A)	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.0	47.0	48.1
Night-time Noise Limit dB(A)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.6	46.9
ETSU-R-97 Simplified Limit	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Compliance	√	√	√	√	√	√	√	√	√	√

Graph 8.1.15 Predicted L_{A90} wind farm noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Option 2 from the ABWP2 Array Area, versus the WEDG2006 Guidelines noise limit.



1.5.4 Operational Phase - Discussion of Airborne Noise Levels from ABWP2 Array Area

1.5.4.6 While wind turbine noise levels will increase from lower to higher wind speeds due to the proposed ABWP2 Array Area, the predicted wind turbine noise levels will remain low, despite the proposed ABWP2 Array Area noise source being introduced into the acoustic environment.

1.5.4.7 As previously discussed, the WEDG2006 Guidelines are currently relevant for this assessment. It has been shown that the predicted ABWP2 Array Area L_{A90} noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Options 1 (Models 1A and 1B) and 2 from the ABWP2 Array Area will be well in accordance with the 2006 Guidelines daytime and night-time noise limits.

1.5.4.8 In accordance with best practice, which includes the ETSU-R-97 and IoA methodologies, it has been shown that the predicted ABWP2 Array Area L_{A90} noise levels at each of the noise assessment locations as a function of standardised wind speed for the wind turbine Project Design Options 1 (Models 1A and 1B) and 2 from the ABWP2 Array Area will be below the ETSU-R-97 simplified limit of 35 dB $L_{A90,10min}$ up to (and above) wind speeds of 10 m/s at a standardised 10 m height. As outlined in ETSU-R-97, this condition alone offers sufficient protection of amenity.

1.6 References

BS5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites –Part 1: Noise and Part 2 Vibration

ETSU-R-97, the Assessment and Rating of Noise from Wind Farms, Final ETSU-R-97 Report for the Department of Trade & Industry. The Working Group on Noise from Wind Turbines, 1997.

A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, M. Cand, R. Davis, C. Jordan, M. Hayes, R. Perkins, Institute of Acoustics, May 2013 and relevant Supplementary Guidance Notes, as follows;

Supplementary Guidance Note 1, Data Collection, September 2014.

Supplementary Guidance Note 2, Data Processing & Derivation of ETSU-R-97 background curves, September 2014.

Supplementary Guidance Note 3, Sound Power Level Data, July 2014.

Supplementary Guidance Note 4, Wind Shear, July 2014.

Supplementary Guidance Note 6, Noise Propagation Over Water for On-Shore Wind Turbines, July 2014.

EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (May 2022)

Wind Energy Development Guidelines, Department of the Environment, Heritage and Local Government (2006)

The Draft Revised Wind Energy Development Guidelines , Department of the Environment, Heritage and Local Government (2019)

ISO 1996-1:2016 'Acoustics. Description, measurement and assessment of environmental noise. Part 1: Basic quantities and assessment procedures' (2016).

ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation', International Standards Organisation, 1996.

BEK 135, 07/02/2019, Bekendtgørelse om Støj Fra Vindmøller (Executive Order on noise from wind turbines), Ministry of the Environment and Food, Denmark.

Pentland Floating Offshore Wind Farm EIAR. Volume 3: Appendix A.5.1 Operational Turbine Noise Assessment (2022).

Awel y Môr Offshore Wind Farm. Category 6: Environmental Statement. Volume 3, Chapter 10: Noise and Vibration (2022)