Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume II, Chapter 8: Airborne Noise

sse Renewables

Versions	Date	Status	Author	Reviewed by	Approved by
1.0	02/05/2024	Final (External)	AONA Environmental Consulting Ltd.	GoBe Consultants	Sure Partners Limited

Statement of Authority

Name	Qualifications	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 and Odour impact assessment and mitigation design as well as Environmental Impact Assessment and Integrated Pollution Prevention and Control (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 Windfarms, 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).

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Glossary

Term	Meaning
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.
Arklow Bank Wind Park 1 (ABWP1)	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 owned and operated by Arklow Energy Limited. It remains the first and only operational offshore windfarm 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.
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. Consents for the Onshore Grid Infrastructure (Planning Reference 310090) and Operations Maintenance Facility (Planning Reference 211316) has been granted on 26th May 2022 and 20th July 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: 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.
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.
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.

Term	Meaning
Background noise	The noise level rarely fallen below in any given location over any given time period, often classed according to daytime, evening or night-time periods.
Cable Corridor and Working Area	The Cable Corridor and Working Area is the area within which export, inter-array and interconnector cabling will be installed This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area.
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.
EirGrid	State-owned electric power transmission system operator (TSO) in Ireland and Transmission Asset Owner (TAO) for the Project's transmission assets.
Environmental Impact Assessment (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).
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 (perceived 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.
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.

Term	Meaning
Mitigation Measure	Measure which would avoid, reduce, or remediate an impact.
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).
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).
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 power level	The total sound power radiated by a source, in decibels. Sound power levels used are referenced to 1pW.
Sound pressure level	A measure of the sound pressure at a point, in decibels. Sound pressure levels used are referenced to 20μPa.
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.
The Application	The full set of documents that will be submitted to An Bord Pleanála in support of the consent.
The Developer	Sure Partners Ltd.

Acronyms

Term	Meaning
ABWP1	Arklow Bank Wind Park 1
ABWP2	Arklow Bank Wind Park 2
AM	Amplitude Modulation
AMWG	Amplitude Modulation Working Group
BSI	British Standards Institution
CA	Competent Authority
CIA	Cumulative Impact Assessment
CNMP	Construction Noise Management Plan
DRWEDG19	The Draft Revised Wind Energy Development Guidelines
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
GIS	Geographical Information System
GPG	Good Practice Guide
HWM	High Water Mark
HSE	Health and Safety Executive
IEC	International Electrotechnical Commission
IOA	Institute of Acoustics
IS	Infrasound
ISO	International Organization for Standardization
LFN	Low Frequency Noise
LIDAR	Light Detection and Ranging

Term	Meaning
NSR	Noise Sensitive Receiver
OGI	Onshore Grid Infrastructure
OMF	Operations and Maintenance Facility
OSI	Ordnance Survey Ireland
OSP	Offshore Substation Platform
SGN	Supplementary Guidance Note
SLM	Sound Level Meters
SPL	Sound Pressure Level
UK	United Kingdom
WEDG2006	The 2006 Wind Energy Guidelines
WTG	Wind Turbine Generator

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	Kilometre
$L_{A90,T}$	A-weighted fast weighted sound pressure level exceeded for 90% of the measurement period, T , often used for the measurement of background sound.
$L_{Aeq,T}$	The abbreviation of the A-weighted equivalent continuous sound pressure level over measurement time, T. Effectively represents an energetic average value.
MW	Megawatt

8 Airborne Noise

8.1 Introduction

8.1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) presents the assessment of the potential impacts of the Arklow Bank Wind Park 2 (ABWP2) Offshore Infrastructure (hereafter referred to as 'the Proposed Development') on airborne noise. Specifically, this chapter considers the potential impact of the Proposed Development during the construction, operational and maintenance, and decommissioning phases. This chapter draws upon information contained within Volume III, Appendix 8.1: Airborne Noise Technical Report.

8.1.1.2 This Airborne Noise Impact Assessment has been prepared by Mervyn Keegan (M.Sc., B.Sc. MIOA) who is a Director of AONA Environmental Consulting Ltd. (AONA Environmental) to support the EIAR for the Proposed Development.

8.1.1.3 This Airborne Noise Impact Assessment considers the potential for the construction, operational and maintenance, and decommissioning phases of the Proposed Development to impact upon the noise environment at the nearest onshore noise sensitive receivers (NSRs).

8.1.1.4 This chapter describes the scope, relevant legislation, assessment methodology, and the baseline conditions existing at the site and its surroundings. It considers any potential significant environmental effects the proposed development would have on this baseline environment; the mitigation measures required to prevent, reduce or offset any significant adverse effects; and the likely residual effects after these measures have been employed. Cumulative noise effects with other proposed developments that may also have an impact on the NSRs are also considered.

8.2 Regulatory background

8.2.1.1 A summary of relevant legislation and policy is outlined in Table 8.1.

8.2.1.2 The relevant Irish planning policy and guidance has been outlined and the UK guidance for noise impact assessments has been chosen to supplement the existing Irish guidance on the basis of its geographical proximity to Ireland, as well as the recent increase in offshore renewable wind projects fully incorporating offshore noise impact assessment studies in the Environmental Impact Assessment (EIA) process.

Table 8.1: Summary of regulatory background

Publisher	Name of document incl. reference	Key provisions
Statutory		
Legislation		
Government of Ireland. Office of Attorney General.	S.I. No. 549/2018 – European Communities (Environmental Noise) Regulations 2018	These Regulations transpose EU Directive 2002/49/EC relating to the assessment and management of environmental noise as amended by Directive (EU) 2015/996
Government of Ireland. Office of Attorney General.	Section 28 of the Planning and Development Act, 2000 (as amended).	The Minister may, at any time, issue guidelines to planning authorities and An Bord Pleanála is required to have regard to any guidelines issued.
Planning Policy and Development Control		
Department of the Environment, Heritage and Local Government (2006)	The 2006 Wind Energy Guidelines (WEDG2006)	Gives guidance in relation to acceptable levels of noise from windfarms as contained in the document "Wind Energy Development Guidelines"
Department of Housing, Planning and Local Government (2019)	The Draft Revised Wind Energy Development Guidelines (DRWEDG19)	Gives draft guidance in relation to acceptable levels of noise from windfarms.
Non-Statutory		
Guidelines and technical standards		

Publisher	Name of document incl. reference	Key provisions
Environmental Protection Agency, 2022	Guidelines on the Information to be Contained in Environmental Impact Assessment Reports https://www.epa.ie/publications/monitoring–assessment/assessment/EIAR_Guidelines_2022_Web.pdf	These Guidelines apply to the preparation of all EIARs undertaken in the State (Ireland)
British Standards Institute	British Standard 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Noise	Gives recommendations for methods of noise control relating to construction sites, where activities generate significant noise levels, including industry-specific guidance
UK Department of Trade and Industry Noise Working Group (1996)	The Assessment and Rating of Noise from Windfarms (ETSU-R-97 1996)	Assessment procedure to specify noise limits that should be set relative to existing background noise levels at the nearest properties. These limits should reflect the variation in both Wind Turbine Generator (WTG) source noise and background noise with wind speed.
The Institute of Acoustics (IOA) (2013)	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)	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

8.3 Consultation

8.3.1.1 As outlined in Volume III, Appendix 3.1: Consultation Report, issues relevant to potential airborne noise impact have been sought from various stakeholders.

8.3.1.2 Noise from the construction of the Proposed Development was cited as a concern by a number of stakeholders living in the local area. Several stakeholders living in the area had commented that the construction of ABWP1 was audible and concerns were raised regarding the impact of construction noise from the Proposed Development. One stakeholder expressed a concern regarding night-time noise stating that it had caused personal disruption during the construction of ABWP1. Hence, the potential airborne noise impact from the Proposed Development on all noise sensitive locations has been clearly identified and assessed in this Chapter of the EIAR.

Table 8.2: Summary of consultation relating to Airborne Noise.

Date	Consultation type	Consultation and key issue raised	Section where provision is addressed
2023	Health and Safety Executive (HSE) Response	Consider the Environmental Noise Regulations 2006, including recommendations Re: barriers, baseline survey, Mitigation and Wind Energy Guidelines.	All Sections.

8.4 Study area

8.4.1 Selected Noise Sensitive Receivers

8.4.1.1 The Airborne Noise Study Area was chosen to include locations representative of the closest Noise Sensitive Receivers (NSR) 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. 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 should be the same or less than at the assessed locations.

8.4.1.2 The following ten noise sensitive receivers (NSRs A-J) have been identified as key receivers and are described in Table 8.3 and shown in Figure 8.1:

- 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 - Ardinary (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, located approximately 480 m from the HWM;
- 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 8.3: List of representative noise sensitive 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	Ballincarrig	Caravan holiday park	699139, 5865475	LT1
NSR D	Brittas Bay and Aisling House	Residential and Nursing Home	698186, 5864099	LT2
NSR E	Ardinary	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

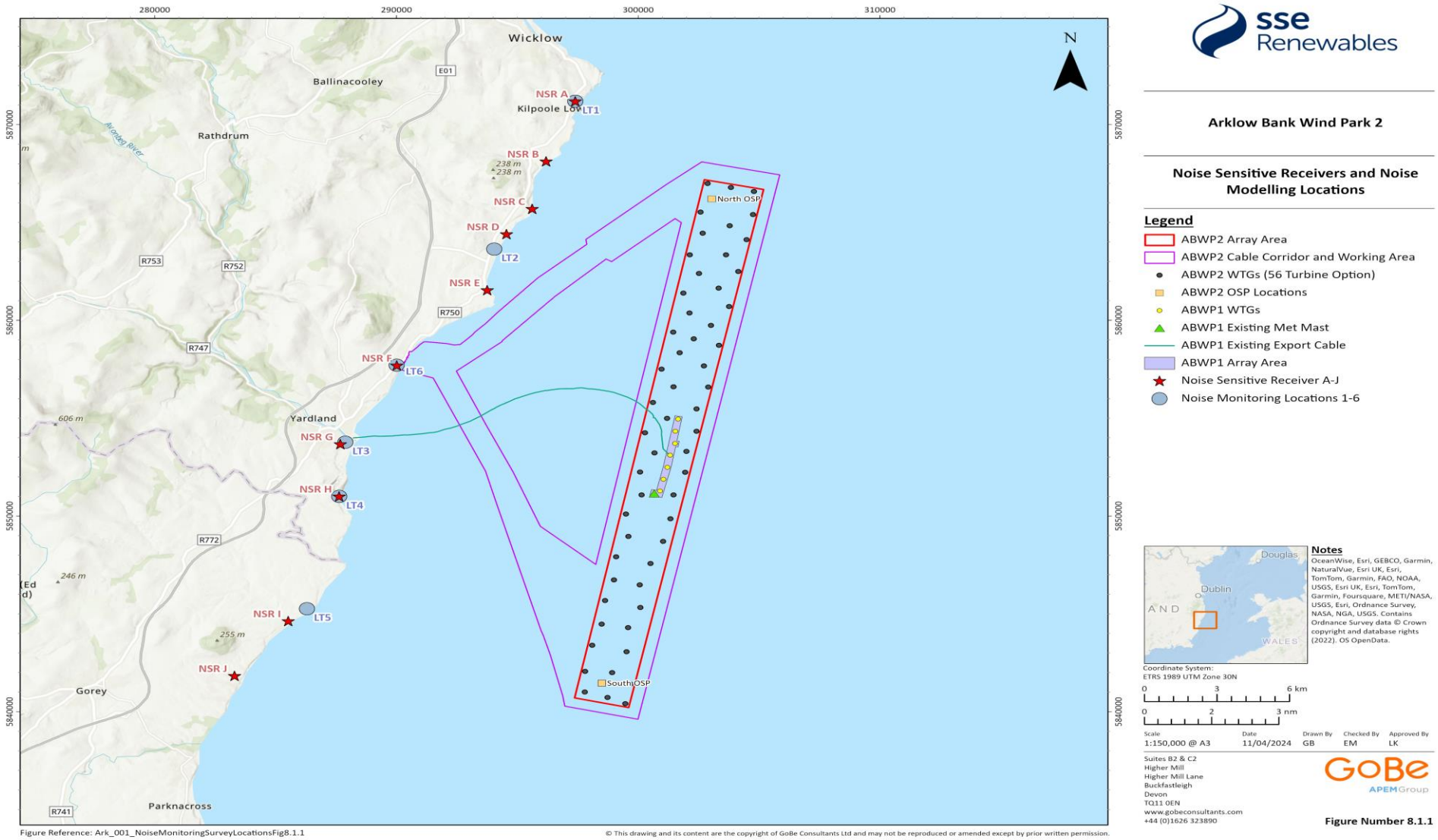

Figure 8.1: Noise Sensitive Receivers A – J and Noise Monitoring Locations 1 - 6

8.5 Methodology

8.5.1 Methodology to inform the baseline

Desktop studies

8.5.1.1 Information on the existing environment and the NSRs within the airborne noise study area was collected through a detailed desktop review of previous studies and baseline noise survey datasets.

8.5.1.2 The previously completed baseline noise surveys and collated background noise data (as undertaken by RPS in 2021) has been reviewed and reproduced in this noise impact assessment.

Site specific surveys

8.5.1.3 In order to inform the EIAR, reference to previously undertaken site-specific baseline noise surveys were undertaken.

8.5.1.4 Sound level measurements at LT1-5 were undertaken by RPS in 2020 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 (Sound Pressure Levels) SPLs in ten-minute periods. Long term surveys were undertaken following guidance contained in IOA Good Practice Guide (GPG) and in BS 7445 2:1991 “Description and Measurement of Environmental Noise. Part 2: Guide to the Acquisition of Data Pertinent to Land Use” (British Standards Institution (BSI) 1991).

8.5.1.5 Meteorological conditions were monitored during the long-term surveys, with an unattended weather station installed at LT2 and LT6. Wind speeds were also measured on site during the survey period with a Light Detection and Ranging (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.

8.5.1.6 Long term unattended noise monitoring was undertaken at six noise monitoring locations 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 noise and to provide context and inform the assessment of the operational noise assessment.

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

8.5.1.8 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 micro-siting via site visits. 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 receivers 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 receivers 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 receivers 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 receivers. 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 receivers, 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; and
- LT6 - Located on land north of Johnstown residence (coordinates UTM 29N 694211 5857054) and representative of surrounding residential receivers. This location is approximately 150 m from the HWM and 10 km from the Array Area at the closest point.

8.5.1.9 All survey locations are shown in Figure 8.1. A summary of the locations and durations of the surveys is shown in Section 8.4.

Table 8.4: 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

8.5.1.10 During the noise monitoring surveys between 27 August 2020 and 8 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 Supplementary Guidance Note (SGN) 4 Section 2.4. Therefore, the hub height wind speeds have been standardised to 10 m height. 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.

8.5.1.11 A site visit to all selected noise monitoring locations was undertaken by AONA Environmental Consulting Ltd. 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. 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.

8.5.2 Derived Construction Noise Limits

8.5.2.1 The baseline noise levels which inform the operational assessment noise limits are based on background noise levels L_{A90} versus increasing windspeeds in order to determine the background noise levels at wind speeds from 3-12m/s. For the derivation of construction noise limits, the measured baseline $L_{Aeq,T}$ noise levels are used to compare against the BS5228 'ABC criteria' (Table 8.5). Based on the measured background noise levels L_{A90} versus increasing windspeeds (as reported in detail in Section 8.5.3 below), it is conservatively assumed that all NSRs are in Category A. Based on Table 8.6, Construction noise threshold levels based on the BS 5228 'ABC' method, this results in a daytime construction noise threshold level of 65 dB L_{Aeq}, an evening construction noise threshold levels of 55 dB L_{Aeq} and a night-time construction noise threshold level of 45 dB L_{Aeq}. These daytime, evening and night-time construction noise threshold levels are the most conservative limits outlined in BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise.

8.5.3 Derived Operational Noise Limits

8.5.3.1 As stated, the baseline noise survey was undertaken to determine background noise levels at six representative NSR locations along the coastline in proximity to the Proposed Development.

8.5.3.2 All measurement data was collected during the background noise surveys in accordance with the Institute of Acoustic's Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IOA GPG, 2013) and accompanying, Supplementary Guidance Note 1: Data Collection (2014).

8.5.3.3 The noise data was 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 and 07.00 - 18.00 hours Sunday; and
- Night-time hours; 23.00 - 07.00 hours every day.

8.5.3.4 In accordance with the IOA GPG and Supplementary Guidance Note (SGN) 2, ETSU-R-97 scatter graphs have been prepared for the recorded wind speed, corrected to a standardised height of 10 m and the corresponding noise levels (LA90,10min) during Amenity and Night-time hours. The data has been plotted on a scatter graph with a polynomial regression best fit trendline applied. From the polynomial regression best fit trendline, average LA90 sound pressure levels were derived from 3-12 m/s during amenity and night-time hours. Noise limits were determined between 3-12 m/s wind speeds by adding 5 dB to the average amenity and night-time hours, subject to the appropriate lower cutoff values. These plots are presented in Volume III, Appendix 8.1: Airborne Noise Technical Report.

8.5.3.5 Table 8.5 outlines the minimum Daytime and 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 and in accordance with best practice, which includes ETSU-R-97 and IOA GPG methodologies. 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 has been interpreted as 43 dB $L_{A90,10min}$; or a maximum increase of 5 dB above background noise (whichever is higher).

Table 8.5: Minimum WEDG2006 Guideline Daytime and 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

8.5.3.6 For context, based on the ETSU-R-97 and IOA GPG methodologies, Table 8.6 outlines the Daytime and Night-time Noise Limits (dB $L_{A90,10min}$) measured at wind speeds from 3 m/s-12 m/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 was 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 8.6: Minimum ETSU-R-97 Guideline Daytime and 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

8.5.3.7 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.

8.5.3.8 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.

8.5.3.9 A quiet daytime environment of less than 30 dB $L_{A90,10min}$ 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. Therefore, the daytime and night-time noise limits at wind speeds from 3-12 m/s as outlined in Table 8.5 are the relevant noise limits for the Proposed Development.

8.5.4 'Do nothing' scenario

8.5.4.1 Annex IV of the EIA Directive sets out the information required to be included in an EIAR. This includes "a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge". In the event that the Proposed Development does not proceed, an assessment of the future baseline conditions has been carried out and is described within this section.

8.5.4.2 Should the Proposed Development not proceed, the future expected noise levels have been quantified by the background noise levels at six representative NSR locations along the coastline in proximity the Proposed Development as have been previously undertaken. The operational noise limits derived from the baseline noise surveys are outlined in Section 8.5.2. The baseline noise conditions are not expected to evolve significantly without implementation of the Proposed Development. It is also considered that the other proposed developments in the area, considered within the cumulative assessment, would not have a significant impact on the evolution of the baseline sound levels due to distance from the study area. The background noise levels in the study area are dominated by other sounds, i.e. wind, waves, traffic, agricultural practices etc, which are unlikely to change.

8.5.5 Data limitations

8.5.5.1 No significant data limitations or assumptions have been applied for the purpose of the noise impact assessment, other than the following:

- Sound propagation to inform the assessment of the construction piling and operational noise assessment from the Array Area, has been calculated using the BEK 135 prediction method which assumes NSRs worst-case wind directions for each assessment location. This provides for precautionary predicted noise levels but is not reflective of the long-term average; and
- The piling scenarios have been assessed assuming no mitigation measure in place, and with piling noise mitigation options in operation including the use of a screen, the use of a dolly and the use of both a screen and a dolly. Best available piling noise data has been used for this purpose.

8.6 Impact assessment methodology

8.6.1 Key parameters for assessment

8.6.1.1 The assessment of significance of effects has been carried out on both of the two discrete Project Design Options detailed in Volume II, Chapter 4: Description of Development. This approach has allowed for a robust and full assessment of the Proposed Development.

8.6.1.2 The two Project Design Options (Project Option 1 and Project Option 2) and parameters relevant to the potential noise impact of each are detailed in Table 8.7 and Table 8.8.

Table 8.7: Project design parameters and impacts assessed – Project Design Option 1 (Models 1A and 1B)

Potential impact	Phase			Project Design Option 1 (Models 1A and 1B)
	C	O	D	
Increased noise levels at NSRs (NSR) along the coastline from piling during construction	✓	×	×	**Construction phase** 56 WTGs installed on monopile foundations.
Airborne noise impact at NSRs along the coast during operation	×	✓	×	**Operational and maintenance phase** Noise from operational WTGs; 56 WTG location coordinates have been provided for Project Design Option 1 (Models 1A and 1B).

Table 8.8: Project design parameters and impacts assessed – Project Design Option 2

Potential impact	Phase			Project design Project Design Option 2
	C	O	D	
Increased noise levels at NSRs along the coastline from piling during construction	✓	×	×	**Construction phase** 47 WTGs installed on monopile foundations.
Airborne noise impact at NSRs along the coast during operation	×	✓	×	**Operational and maintenance phase** Noise from operational WTGs; 47 WTG location coordinates have been provided for Project Design Option 2.

8.6.2 Impacts scoped out of the assessment

8.6.2.1 On the basis of the baseline environment and the description of the Proposed Development outlined in Volume II, Chapter 4: Description of Development, no potentially significant construction and/or operational noise impacts have been scoped out of the assessment for airborne noise. This Airborne Noise Impact Assessment considers the construction, operation and decommissioning of the Proposed Development WTGs in detail, but not construction and operational noise from the Onshore Development components. The Airborne Noise impacts associated with the onshore works have been assessed separately as part of the EIAR for the Arklow Bank Wind Park 2 Onshore Grid Infrastructure (OGI) and Operations and Maintenance Facility (OMF). An Bord Pleanála granted planning approval for the OGI (Case Reference: 310090). Planning permission was granted by Wicklow County Council for the OMF (Planning Register Reference: 21/1316).

8.6.2.2 The wind turbine noise prediction modelling was undertaken using the Danish BEK 135 prediction method in the WindPRO 4 software. 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.

8.6.2.3 During the Decommissioning Phase, all structures above the seabed will be removed, while scour protection, cables and cable protection will be left in situ. Decommissioning will have a significantly lesser degree of noise impact to that produced by piling processes, which is the main noise source during the construction stage. During decommissioning piling operations will not be required. Decommissioning activities at a distance of six kilometres or greater offshore will not be audible onshore.

8.6.2.4 The potential impacts due to Low Frequency Noise (LFN), Amplitude Modulation (AM) and tonality have been scoped out of the assessment of operational noise due to distance of the Proposed Development from the shoreline NSRs.

8.6.2.5 LFN refers to the low frequency end of the audible sound spectrum. LFN refers to sound waves above 20 Hz and below 200 Hz. Sound at frequencies below 20 Hz is referred to as infrasound (IS). Sound levels decrease as the distance from the source increases, a phenomenon called ‘geometric spreading’ which applies similarly to all frequencies. Sound waves dissipate when travelling through the air due to air absorption and this dissipation is more efficient at higher frequencies. Therefore, LFN propagates from the source more easily compared to high frequency noise. Because LFN can travel further away than high frequency sound waves, some studies have reported that LFN from wind turbines could be measured in specific weather conditions at quite large distances well in excess of 1 km from the source. Nevertheless, it has also been found that, at normal distances from wind turbine(s)/farms to residential properties, measured LFN rarely exceeds the natural ambient background noise or other LFN sources, even in a naturally quiet environment such as the rural countryside. While very low frequencies can travel further, and LFN can be measured at slightly higher levels than ambient levels, at significant distances beyond 1 km, the LFN levels are typically far below the hearing threshold. With increasing distance from the source, LFN levels will eventually be masked by, and eventually become negligible compared to other natural and/or anthropogenic noise sources which include wind-induced noise in the vegetation, traffic noise, etc. In the case of ABWP2, it is naturally occurring noise sources such as wind noise and coastal wave noise that will mask these LFN levels at the shoreline NSRs at a distance of greater than 6 km from the ABWP2 turbines.

8.6.2.6 AM is a characteristic feature of windfarm noise and has the potential to contribute to annoyance and sleep disturbance. AM is defined as periodic fluctuations in the level of audible noise from a wind turbine(s), the frequency of the fluctuations being related to the blade passing frequency of the turbine rotor(s). AM is a periodic variation in SPL at the blade-pass frequency, typically between 0.4 and 2 Hz, and is typically most prominent during the evening and night-time when

environmental conditions tend to be more favourable for AM. AM is a highly variable phenomenon, depending on meteorological conditions, distance from the windfarm and windfarm operating conditions. AM can be challenging to detect. In the unlikely event that a complaint is received which indicates potential AM associated with turbine operation, an independent acoustic consultant shall be employed to assess the level of AM in accordance with the methods outlined in the IOA Wind Turbine Noise Amplitude Modulation Working Group (AMWG) document A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016) or subsequent revisions.

8.6.2.7 A tonal noise impact from wind turbine noise can generally be attributed to gearbox related noise. However, improvements in turbine design in recent years have greatly reduced potential for tonal noise attributed to gearbox related noise. When a noise source emits noise that is concentrated in a narrow part of the spectrum or contains a high proportion of energy at a single frequency (a pure tone) this is referred to as tonal noise. As with LFN levels, with increasing distance from the source any potential for a tonal noise impact will eventually be masked by naturally occurring noise sources such as wind noise and coastal wave noise that will mask low level tonal noise levels at the shoreline NSRs at a distance of greater than 6 km from the ABWP2 turbines. In the unlikely event that a complaint is received in relation to a potential tonal impact, International Organization for Standardization (ISO) 1996-2:2017 – Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels – Annex J – Objective method for assessing the audibility of tones in noise is the method used to assess the audibility of a tone as perceived by the listener.

8.6.3 Construction Noise Guidance and Assessment Criteria

8.6.3.1 BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise 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. There is no specific guidance in relation to construction noise limits in Ireland. The 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.

8.6.3.2 Annex E of BS5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Part 1: Noise, provides guidance on assessing the potential significance of noise effects from construction activities. In relation to construction noise limits, BS 5228-1:2009+A1: 2014 Noise and Vibration Control on Construction and Open Sites Part 1: Noise details the 'ABC method', which recommends a construction noise limit based on the existing ambient noise level. General 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.

8.6.3.3 Table 8.9 reproduced from BS5228, demonstrates the criteria for selection of a noise limit for a specific receiver location.

Table 8.9: Construction noise threshold levels based on the BS 5228 'ABC' method

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

Notes:

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

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

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

(D) 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

8.6.4 Operational Noise Guidance and Assessment Criteria

The 2006 Wind Energy Guidelines (WEDG2006)

8.6.4.1 The noise impact assessment has been based on guidance in relation to acceptable levels of noise from windfarms 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 and 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.

8.6.4.2 The WEDG2006 Guidelines were issued by the Minister pursuant to section 28 of the Planning and Development Act, 2000 which provides that: "(1) The Minister may, at any time, issue guidelines to planning authorities regarding any of their functions under this Act and planning authorities shall have regard to those guidelines in the performance of their functions ... (2) Where applicable, the Board shall have regard to any guidelines issued to planning authorities under section (1) in the performance of its functions".

8.6.4.3 Section 143 of the 2000 Act provides that: "(1) The Board shall, in performing its functions, have regard to - (a) the policies and objectives for the time being of the Government, a State authority, the Minister, planning authorities and any other body which is a public authority whose functions have, or may have, a bearing on the proper planning sustainable development of cities, towns or other areas, whether urban or rural".

8.6.4.4 Section 5.6 of the WEDG2006 Guidelines addresses noise and outlines the appropriate noise criteria in relation to windfarm 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'.

8.6.4.5 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 $L_{A90,10min}$;

- 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.

8.6.4.6 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)

8.6.4.7 In December 2019, the Draft Revised Wind Energy Development Guidelines (DRWEDG19) were published for consultation. However, the WEDG2006 Guidelines are the guidelines that have been issued under section 28 of the Planning and Development Act 2000 in written answers to the Dáil Eireann dated 11 July 2023 Re: Wind Energy Guidelines, the Minister for the Department of Housing, Planning and 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 Windfarms (ETSU-R-97 1996)

8.6.4.8 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 ten-metre measurement height using a standard correction.

8.6.4.9 Separate noise limits apply for the daytime 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. 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 windfarm.

8.6.4.10 The night-time noise limit is derived from background noise data measured during the night-time periods (23:00 to 07:00) with no differentiation being made between weekdays and weekends. The 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).

8.6.4.11 ETSU-R-97 requires that the baseline levels on which the noise limits are based do not include a contribution from any existing turbine noise, to prevent unreasonable cumulative increases.

8.6.4.12 The exception to the setting of both the daytime and night-time lower fixed limits occurs in instances where a property occupier has a financial involvement in the windfarm 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 daytime and the night-time periods alike.

8.6.4.13 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*".

8.6.4.14 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 from the ABWP2 Array Area with other windfarms in the area to be satisfied that the combined cumulative noise levels are within the relevant ETSU-R-97 criteria.

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)

8.6.4.15 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 IOA GPG advises on the appropriate input parameters and correction factors and amendments to ISO 9613-2:1996 to be used for the prediction of wind turbine noise, the IOA GPG states the guidance does not cover long-distance propagation over sea as is relevant to offshore windfarms. 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 windfarms.

8.6.4.16 The guidance contained within the IOA GPG and the relevant Supplementary Guidance Notes 1 - Data Collection, 2 - Data Processing and 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.

8.6.4.17 Reference has been made to 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.

8.6.5 Noise Prediction Assessment Methodology

8.6.5.1 Offshore windfarm noise predictions undertaken in accordance with the ISO 9613-2 tend to underpredict offshore wind turbine noise due to there being no consideration of multiple reflections which occur over large distances and over reflective surfaces such as water. ISO 9613-2 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". Therefore, the ISO9613-2 methodology has not been used to predict the offshore wind turbine noise levels in this noise impact assessment. As outlined, the wind turbine noise prediction modelling has undertaken using the Danish BEK 135 prediction method in the WindPRO 4 software provided by EMD International.

8.6.5.2 Sound propagation from the Array Area, 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 and operational noise assessment. The Danish BEK 135 prediction method is implemented within the WindPRO 4 software. This prediction method is currently used as a standard methodology for the offshore wind energy industry. Other similar developments which have made use of the Danish BEK 135 prediction method include the Pentland Floating Offshore Windfarm in Scotland and Awel Y Mor offshore windfarm in North Wales.

8.6.5.3 The BEK 135 sound propagation calculation method includes an estimation of the increase in noise due to multiple reflections and a ground reflection correction that depends on proximity to shore.

8.6.5.4 From the offshore wind turbine and until landfall an offshore ground attenuation is used. At the shoreline a transition zone exists between 0 m - 200 m, 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.

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

8.6.5.6 The BEK 135 model has been populated with a coastline shapefile based on the project Geographical Information System (GIS) team extract from the relevant portion of Ordnance Survey Ireland (OSI) county coastline for the area.

8.6.5.7 BEK135 considers the worst wind direction for each NSR. The reality of the Array Area location is that the prevailing wind direction does not represent these prevailing downwind conditions. As such, the model predicts the received noise level at the receiver, under downwind conditions at all times, which causes the model to over predict during conditions not represented by BEK135. As outlined in Figure 8.2, the wind rose denotes the direction the wind is blowing from. The downwind direction towards the coastline from the Array Area 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. As a result, the predicted construction and operational noise levels at the NSR locations are precautionary predicted levels.

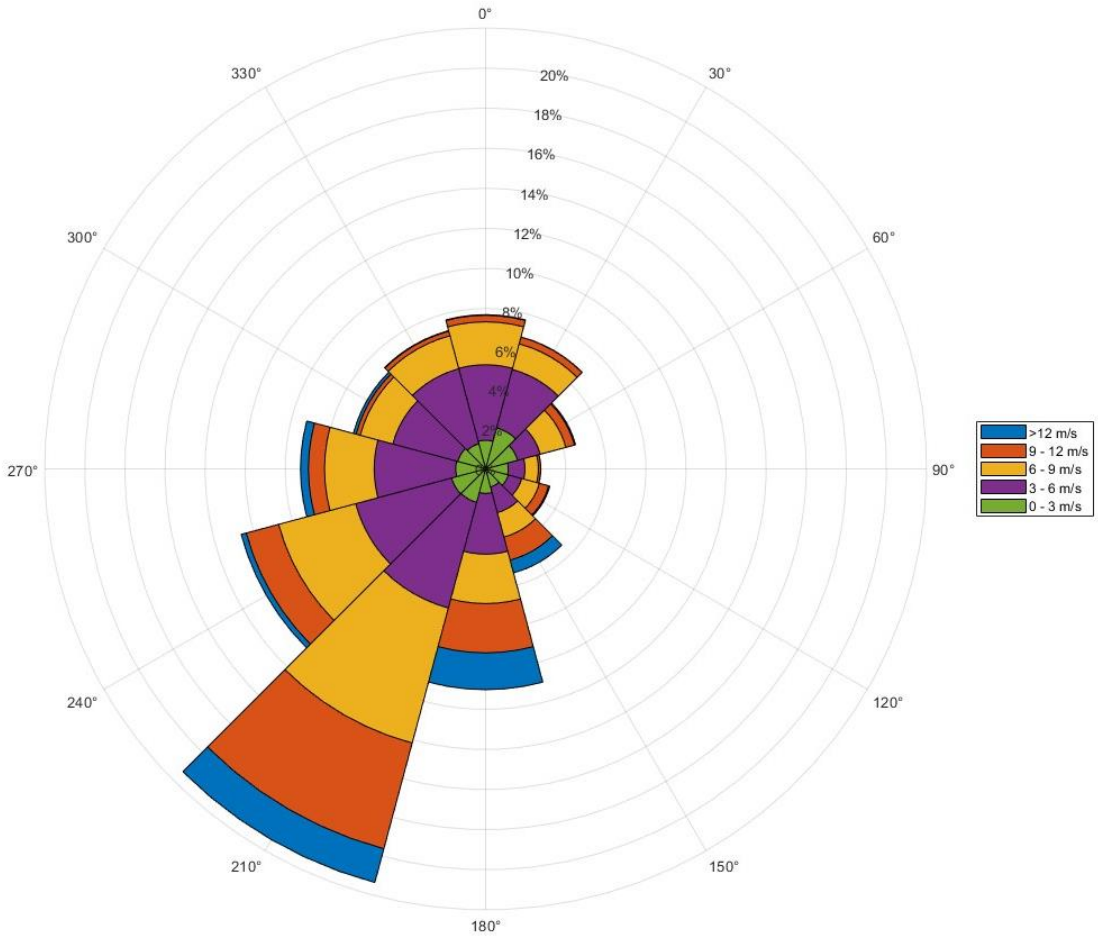

Figure 8.2: Windrose showing prevailing wind direction and frequency for the Array Area

8.6.5.8 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 within the scope of BEK 135, the conditions of noise propagation from piling will be the same as that from noise propagation from WTGs, i.e. subject to multiple reflections.

8.6.6 Piling Assessment Details and Sound Power Level Data

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

8.6.6.2 Three representative piling locations have been assessed individually based on the proposed WTG coordinate locations from the Project Design Option 1 (Models 1A and 1B) 56 WTG Layout;

- 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).

8.6.6.3 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.

8.6.6.4 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.

8.6.6.5 These representative piling locations have been selected from the Project Design Option 1 (Models 1A and 1B) 56 WTG layout, 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 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 Array Area allows for the highest level of impact to be assessed in terms of significance versus construction noise limits.

8.6.6.6 The piling noise levels are outlined in Table 8.10. It is important to note that the difference in power levels between the North and 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 Offshore Substation Platform (OSP) monopiles and hence covered by the modelling in this assessment.

Table 8.10: 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})								Broadband Sound Power Level (dB LwA)
		63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	
North and Centre	None	124	133	140	144	145	140	132	118	149.1
North and Centre	Screen	123	128	132	134	132	123	113	99	138.3
North and Centre	Dolly	110	121	140	137	139	132	123	109	144
North and Centre	Screen and 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 and Dolly	110.6	117.6	133.6	128.6	127.6	116.6	105.6	91.6	135.7

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

8.6.6.8 The predicted noise levels for the piling scenarios have been evaluated assuming a single pile installed during the night-time period, versus the construction noise limits based on the BS 5228 'ABC' method, as outlined in Section 8.5.2 Derived Construction Noise Limits. Therefore, the predicted $L_{Aeq,8\ Hour}$ piling noise level has been compared to the night-time (23.00 to 07.00) construction noise threshold level of 45 dB $L_{Aeq,8\ Hour}$.

8.6.6.9 The predicted piling noise level has also been compared to 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.

8.6.6.10 It is important to note that only one foundation will be piled at any one time. The 'North' and 'Centre' piles will take up to 210 minutes to drive while the 'Southern' piles will take up to 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.

8.6.6.11 A cumulative piling noise impact scenario has also been investigated. 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 WTG location within the Array Area will occur concurrently with the most southerly WTG location on the Codling Wind Park offshore windfarm array area. This is a most unlikely occurrence.

8.6.6.12 The nearest Codling Wind Park piling location has been assessed to occur at 309,333, 5,876,162 (UTM 30 Grid Coordinates), assuming a conservative 276 m rotor diameter. The Codling Wind Park piling location is located 11,220 m north-east of the Proposed Development WTG Location 1 and 12,923 m east of NSR A, Blainroe Lodge, which is considered to be the NSR most sensitive to cumulative construction noise impacts.

8.6.7 WTG Assessment Details

8.6.7.1 Sound propagation calculations using the Danish BEK 135 prediction method within the WindPRO 4 software, have been undertaken for three different WTG options. WTG location coordinates and sound power levels for the three different WTG options have been provided.

8.6.7.2 Fifty-six WTG location coordinates have been provided for Project Design Option 1 (Models 1A and 1B). Forty-seven WTG location coordinates have been provided for Project Design Option 2.

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

8.6.7.4 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.

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

8.7 Methodology for assessing the significance of effects

8.7.1 Overview

8.7.1.1 The airborne noise impact assessment has followed the methodology set out in Volume II, Chapter 5: EIA Methodology. Specific to the airborne noise impact assessment, the following guidance documents have also been considered:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022);
- BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Noise;
- The 2006 Wind Energy Guidelines (WEDG2006);
- The Assessment and Rating of Noise from Windfarms (ETSU-R-97 1996); and
- The Institute of Acoustics Good Practise Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013) (IOA GPG).

8.7.2 Impact assessment criteria

8.7.2.1 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of receivers and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of the receivers and the magnitude of

potential impacts. The terms used to define sensitivity and magnitude are based on those which are described in further detail in Volume II, Chapter 5: EIA Methodology.

8.7.2.2 WEDG2006 and ETSU-R-97 do not define significance criteria but describe a framework for the measurement of windfarm noise and give indicative noise levels considered to offer a reasonable degree of protection to windfarm neighbours, without placing unreasonable restrictions on windfarm development. Achievement of the WEDG2006 derived noise limits ensures that wind turbine noise will comply with current Government guidance.

8.7.2.3 In terms of the EIA Regulations in this assessment, the use of the term "significance" refers to compliance or non-compliance with the WEDG2006 derived noise limits.

8.7.2.4 Where the predicted wind turbine noise levels achieves, or is less than, the WEDG2006 derived noise limits, then the noise effects are deemed not significant. Any breach of the derived WEDG2006 Noise Limits due to the Proposed Development has the potential to result in a significant effect.

8.7.2.5 In terms of assessing the significance of effects, the predicted L_{A90} noise levels at each of the noise assessment location as a function of standardised wind speed have been compared to the WEDG2006 derived daytime and night-time noise limits. The predicted L_{A90} noise levels have also been compared against the measured background noise level at increasing wind speeds and 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.

SENSITIVITY

8.7.2.6 Land use that is considered sensitive to potential noise impacts are referred to as NSRs. NSRs consist of, but are not limited to, residential properties, schools, libraries, hotels and caravan parks, hospitals, and other care facilities for example. As outlined in Section 8.4.1, NSRs have been selected based on a representative location (in the case of residential areas). In the case of a group of receivers, the closest receiver has been chosen as representative for the purposes of the noise impact assessment.

8.7.2.7 The level of sensitivity of a NSR to a change in construction or operational airborne noise level is dependent on factors such as the duration of exposure, frequency of exposure and probability of noise effects. For example, the sensitivity of a NSR to a change in construction airborne noise level may be over a relatively short duration, a potentially infrequent occurrence and with a potentially high probability of short-term effect, depending on magnitude of impact. However, the sensitivity of a NSR to a change in operational airborne noise level may be over a long and continuous duration, with a potentially frequent occurrence and with a potentially low probability of long-term effect, depending on magnitude of impact.

8.7.2.8 The sensitivity of the selected NSRs has been assessed in terms of construction phase piling (short-term duration and infrequent) and operational WTG noise (long-term duration and continuous).

MAGNITUDE

8.7.2.9 In assigning magnitude of impact, the spatial extent, duration, frequency and reversibility of the impact from the construction, operational and maintenance, or decommissioning phases of the Proposed Development have been considered.

8.7.2.10 The criteria used to define magnitude of impact in this chapter are outlined in Table 8.11 and based on Environmental Protection Agency (EPA) (2022) guidance.

Table 8.11: Definition of terms relating to the magnitude of an impact

Magnitude	Definition
High	Duration: The impact is anticipated to result in a permanent change to the receiver. Frequency: The impact will occur constantly throughout the relevant project phase. Probability: The impact is reasonably expected to occur. Consequences (adverse): The impact would have a permanent change on a sufficient number of individuals to affect the long-term viability of the population. Consequences (positive): Long term increase in the population size.
Medium	Duration: The impact is anticipated to result in a change to the receiver that will last for up to one year. Frequency: The impact will occur constantly throughout a relevant project phase. Probability: The effect is reasonably expected to occur. Consequences (adverse): The impact would have a temporary change on most individuals and a permanent impact on a small proportion of the population, although would not affect the long-term viability of the population. Consequences (positive): Increase in population health and/or size as a result of benefits to the supporting habitat.
Low	Duration: The impact is anticipated to result in a change to the receiver that will last days at most. Frequency: The impact will occur frequently throughout a relevant project phase. Probability: The effect is unlikely to occur. Consequences (adverse): The impact would result in a short-term and/or intermittent change to a small proportion of the population but is unlikely to alter the population trajectory. Consequences (positive): Short term benefit to the supporting habitat resulting in increased reproductive potential but unlikely to increase population health and/or size.
Negligible	Duration: The impact is anticipated to result in a change to the receiver that will last a day at most. Frequency: The impact will occur once or infrequently throughout a relevant project phase. Probability: The effect is unlikely to occur. Consequences (adverse): The impact would result in a very short term, recoverable change to a very small proportion of the population and would not alter the population size or trajectory. Consequences (positive): Very minor benefit to the supporting habitat influencing foraging efficiency of a limited number of individuals, but not increasing population health and/or size.

SIGNIFICANCE OF EFFECT

8.7.2.11 The EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (May 2022) define how the significance attributed to effects can be determined by a combination of scientific (objective) and subjective (social) concerns and the professional judgement of competent experts can play an important role in the determination of significance.

8.7.2.12 The relevant terms listed in Table 8.12 can be used to consistently describe specific effects and all categories of terms do not need to be used for every effect.

8.7.2.13 The EPA Guidelines outline that there are seven generalised degrees of effect significance that are commonly used in EIA. These are Imperceptible, Not Significant, Slight, Moderate,

Significant, Very Significant and Profound. Generalised definitions of each of these are provided in Table 8.12.

Table 8.12: EPA Guidelines Descriptions of Effects

Quality of Effects; It is important to inform the non-specialist reader whether an effect is positive, negative or neutral.	Positive Effects A change which improves the quality of the environment (for example, by increasing species diversity, or improving the reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
	Neutral Effects No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative/Adverse Effects A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem, or damaging health or property or by causing nuisance).
Describing the Significance of Effects; 'Significance' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful (also see *Determining Significance*)	Imperceptible An effect capable of measurement but without significant consequences.
	Not Significant An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight Effects An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate Effects An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects An effect which, by its character, magnitude, duration or intensity, alters a sensitive aspect of the environment.
	Very Significant An effect which, by its character, magnitude, duration or intensity, significantly alters most of a sensitive aspect of the environment.
	Profound Effects An effect which obliterates sensitive characteristics.
Describing the Extent and Context of Effects; Context can affect the perception of significance. It is important to establish if the effect is unique or, perhaps, commonly or increasingly experienced.	Extent Describe the size of the area, the number of sites and the proportion of a population affected by an effect.
	Context Describe whether the extent, duration or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
	Likely Effects

Describing the Probability of Effects; Descriptions of effects should establish how likely it is that the predicted effects will occur so that the Competent Authority(CA) can take a view of the balance of risk over advantage when making a decision.	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely Effects The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Duration and Frequency of Effects; 'Duration' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful.	Momentary Effects Effects lasting from seconds to minutes.
	Brief Effects Effects lasting less than a day.
	Temporary Effects Effects lasting less than a year.
	Short-term Effects Effects lasting one to seven years.
	Medium-term Effects Effects lasting seven to fifteen years.
	Long-term Effects Effects lasting fifteen to sixty years.
	Permanent Effects Effects lasting over sixty years.
	Reversible Effects Effects that can be undone, for example through remediation or restoration.
	Frequency of Effects Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).

8.7.2.14 The significance of the effect upon the NSR has been determined by correlating the magnitude of the impact and the sensitivity of the NSR. The particular method employed for this assessment is presented in Table 8.13. Where a range of significance of effect is presented in Table 8.13, the final assessment for each effect is based upon expert judgement.

Table 8.13: Significance of effect matrix

			Baseline Environment - Sensitivity			
			High	Medium	Low	Negligible
Description of Impact - Magnitude	Adverse Impact	High	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible
		Medium	Significant	Moderate*	Slight	Imperceptible
		Low	Moderate*	Slight	Slight	Imperceptible
	Neutral Impact	Negligible	Not Significant	Not Significant	Not Significant	Imperceptible
	Positive Impact	Low	Moderate*	Slight	Slight	Imperceptible
		Medium	Significant	Moderate*	Slight	Imperceptible
		High	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible

*Moderate levels of effect have the potential, subject to the assessor's professional judgement to be significant or not significant. Moderate will be considered as significant or not significant in EIA terms, depending on the sensitivity and magnitude of change factors evaluated. These evaluations are explained as part of the assessment, where they occur.

8.7.3 Factored in measures

8.7.3.1 The Project Design Options set out in Volume II, Chapter 4: Description of Development includes a number of designed-in measures and management measures (or controls) which have been factored into the Proposed Development and are committed to be delivered by the Developer as part of the Proposed Development.

8.7.3.2 These factored-in measures are standard measures applied to offshore wind development, including a Construction Noise Management Plan for the Proposed Development. Factored-in measures relevant to the assessment of airborne noise are presented in Table 8.14. These measures are integrated into the Description of Development and have therefore been considered in the impact assessment (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development. This approach is in line with EPA guidance which states that 'in an EIAR it may be useful to describe avoidance measures that have been integrated into the proposed proposal' (EPA, 2022).

Table 8.14: Factored in measures

Factored in measures	Justification
Implementation and adherence to the Construction Noise Management Plan (CNMP) (Volume III, Appendix 25.8).	Development of and adherence to a Construction Noise Management Plan.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339).	The Developer was granted a Foreshore Licence (FS007339) for Site Investigations (associated with the Proposed Development) from the Minister for Housing, Local Government and Heritage in May 2022. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339) being carried out. As such there is no temporal overlap between the activities consented in this Foreshore Licence and the Proposed Development and there will be no potential for cumulative effects.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out.	The Developer submitted a Foreshore Licence Application for Site Surveys to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out. As such there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development.

8.8 Assessment of the significance of effects

8.8.1.1 The impacts of the construction, operational and maintenance and decommissioning phases of both Project Design Options proposed for the Proposed Development have been assessed on representative NSRs along the coastline. The potential impacts arising from the construction, operational and maintenance and decommissioning phases of the Proposed Development are listed in Table 8.7 to Table 8.8, along with the project parameters against which each impact has been assessed.

8.8.1.2 A description of the potential effect on representative NSRs along the coastline caused by each identified impact is provided in Section 8.9 and Section 8.10.

8.9 Assessment of Project Design Option 1

8.9.1 Impact 1 – Increased noise levels at NSRs along the coastline from piling during construction.

8.9.1.1 This impact assessment focusses on potential airborne noise impact as a result of piling during construction, as this activity has the greatest potential for impact on NSRs along the coastline.

8.9.1.2 The potential impacts of noise arising during non-percussive noise-generating activities such as dredging and trenching during the construction and decommissioning phases have been scoped out of this assessment. Such activities at a distance of 6–13 km offshore will not result in an audible onshore noise impact.

8.9.1.3 A piling source height of 22.2 m above sea level has been assumed in the BEK 135 prediction model, which represents the average height of the hammer during the installation. This allows for a robust assessment as an average noise source height during piling.

8.9.1.4 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 Development. Piling operations will be weather dependant, but could occur during daytime, evening and/or night-time.

8.9.1.5 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 Options 1A and 1B (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 Options 1A, 1B (Models 1A and 1B) and Project Design Option 2.

8.9.1.6 Table 8.15 outlines the expected piling duration during the Construction Phase.

Table 8.15: Expected Piling durations during the Construction Phase.

Parameter	56 WTG Options 1A and 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 mins	5 hours 10 mins	5 hours 10mins
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

SENSITIVITY OF THE RECEIVER

8.9.1.7 Land use that is considered sensitive to potential noise impacts are referred to as NSRs. NSRs consist of, but are not limited to, residential properties, schools, libraries, hotels and caravan parks, hospitals, and other care facilities for example. As outlined in Section 8.4.1, NSRs have been selected based on a representative location (in the case of residential areas). In the case

of a group of receivers, the closest receiver has been chosen as representative for the purposes of the noise impact assessment.

8.9.1.8 Ten NSRs (NSRs A - J) have been identified as key receivers and are described in Section 8.4.1.

8.9.1.9 The maximum sensitivity of all the onshore NSRs is 'Medium' based on the likely duration, frequency and probability of airborne noise impact during the construction phase as outlined in Table 8.11, from the EPA Guidelines 2022.

Assessment of construction Phase Impacts

8.9.1.10 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 Table 8.16, Table 8.17 and Table 8.18.

8.9.1.11 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.

MAGNITUDE OF THE IMPACT

8.9.1.12 Table 8.16 outlines the predicted piling noise levels at each of the noise assessment locations, versus the BS 5228 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, with no mitigation measures employed.

8.9.1.13 Table 8.17 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 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. 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.

8.9.1.14 Table 8.18 outlines the predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq, 8\ Hour}$. The predicted noise levels indicate that if piling is undertaken during the night-time period at Piling Locations 1, 2 and 3 in the 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.

8.9.1.15 In summary, the following can be concluded in terms of piling noise impact:

- The predicted piling noise levels will be in accordance with the BS5228 Daytime Noise Limit of 65 dB $L_{Aeq, 12\ Hour}$ for all piling scenarios, whether or not there is noise mitigation employed on the piling rig;
- If piling is undertaken during the evening period at Piling Location 1 in the north of the 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 if no mitigation measures are employed;
- If piling is undertaken during the night-time period at Piling Locations 1, 2 and 3 in the north, centre and south of the Array Area, mitigation measures will need to be employed during piling to ensure that there will be no exceedance of the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq, 8\ Hour}$ at all NSRs;

- The magnitude of piling noise impact has been derived from factors comprising; the noise impact's extent, duration, frequency, probability, and consequence;
- BS5228 Method 2, '5 dB(A) Change' states that "Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq, T}$ from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect". Table 8.15 indicates that the actual piling noise in proximity to each NSR will occur for less than one month during the overall construction phase; and
- It is also worthy of note that the predicted piling noise levels represent downwind conditions, which have been shown to occur for approximately 10% of the time. Therefore, the piling noise will not be audible throughout the whole of the installation campaign.

8.9.1.16 The magnitude of the impact due to the short duration and infrequent occurrence of piling activity has been assessed as follows:

- 'Low' magnitude during daytime;
- 'Low' magnitude during evening; and
- 'Medium' magnitude during night-time.

Table 8.16: 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 and Dolly	
NSR	BS5228 Daytime Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ 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 **and** Dolly	
NSR	BS5228 Daytime Noise	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance

	Limit dB L_{Aeq}								
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 **and** Dolly	
NSR	BS5228 Daytime Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ 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 8.17: 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 and Dolly	
NSR	BS5228 Evening Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 4 Hr}$ 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 **and** Dolly	
NSR	BS5228 Evening Noise	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance

	Limit dB L_{Aeq}								
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 **and** Dolly	
NSR	BS5228 Evening Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 4 Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 4 Hr}$ 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 8.18: 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 and Dolly	
NSR	BS5228 Night Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ 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 **and** Dolly	
NSR	BS5228 Night Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ 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 and Dolly	
NSR	BS5228 Night Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ 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.

SIGNIFICANCE OF THE EFFECT

8.9.1.17 The magnitude of the impact has been assessed as '**Low**' during daytime, '**Low**' during evening and '**Medium**' during night-time, with the maximum sensitivity of the NSRs being '**Medium**'. Therefore, the significance of effect from piling noise activities is as follows:

- '**Slight'** significance during daytime;
- '**Slight'** significance during evening; and
- '**Moderate'** significance during night-time.

8.9.1.18 Based on the EPA 2022 Guidelines, a significance level of '**Moderate'** significance or less is concluded to be **not significant** in terms of construction airborne noise, based on the sensitivity of the receiver and the magnitude of predicted airborne noise levels.

8.9.1.19 It is evident that noise limits of 65 dB, 55 dB and 45 dB $L_{Aeq,\ T}$ from site noise alone, for the daytime, evening and night-time periods, respectively, can be achieved by programming piling works to avoid sensitive periods such as evening and / or night-time.

8.9.1.20 Nevertheless, the piling activity has been assessed using piling industry standard mitigation measures to assess if noise limits can be achieved through the application of physical mitigation measures such as a screen, a dolly or a combination of both screen and dolly during evening and / or night-time periods.

PROPOSED MITIGATION

8.9.1.21 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.

8.9.1.22 The predicted piling noise levels with mitigation measures assuming the use of a screen, the use of a dolly and the use of both a screen and a dolly, for the scenarios at Piling Locations 1-3 in the north, centre and south of the Array Area closest to the representative NSRs, versus BS5228 daytime, evening and night-time noise limits are presented in Table 8.16**,** Table 8.17 and Table 8.18**.**

8.9.1.23 Table 8.17 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 Array Area, there will no exceedance of the BS5228 Evening Noise Limit of 55 dB $L_{Aeq,\ 4\ Hour}$ at the NSRs A, B and C if any of the proposed mitigation measures are employed during piling at this location.

8.9.1.24 Table 8.18 outlines the predicted piling noise levels at each of the noise assessment locations, versus the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq,\ 4\ Hour}$. 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. This piling noise level is unlikely to occur as it assumes direct downwind propagation from the piling location, which is most unlikely to occur due to the prevailing south-westerly wind direction. Also, a noise level difference of 0.6 dB is imperceptible and a negligible exceedance.

8.9.1.25 The Developer commits to meeting the BS5228-1 construction noise limits during piling activities during day, evening and night and the industry standard methods of mitigation using both a screen and a dolly are to be employed during any piling operations that take place during evening in the north of the site and night-time periods at any location during downwind propagation conditions.

RESIDUAL EFFECT ASSESSMENT

8.9.1.26 The predicted piling noise levels for the scenarios at Piling Locations 1-3 in the north, centre and south of the Array Area closest to the representative NSRs, versus BS5228 daytime, evening and night-time noise limits with the industry standard methods of mitigation using both a screen and a dolly are presented in Table 8.16, Table 8.17 and Table 8.18.

8.9.1.27 With mitigation, the magnitude of the impact due to the short duration and infrequent occurrence of piling activity over the approximate six-month period has been assessed as follows:

- '**Low**' magnitude during daytime;
- '**Low**' magnitude during evening; and
- '**Low**' magnitude during night-time.

8.9.1.28 With mitigation, the significance of effect from piling noise activities is as follows:

- '**Slight**' significance during daytime;
- '**Slight**' significance during evening; and
- '**Slight**' significance during night-time.

8.9.1.29 Therefore, based on EPA 2022 Guidelines, a significance level of '**Slight'** significance is concluded to be **not significant** in terms of construction airborne noise, based on the sensitivity of the receiver and the magnitude of predicted airborne noise levels.

8.9.1.30 The significance of effect from piling noise is **not significant** in EIA terms. Therefore, no additional mitigation to that already identified, i.e. the industry standard methods of mitigation using both a screen and a dolly, are considered necessary. Therefore**,** no significant adverse residual effects have been predicted in respect of piling noise.

8.9.1.31 To mitigate potential significant effects during piling the Construction Noise Management Plan (CNMP), specifies measures to reduce or avoid significant effects. The CNMP includes measures such as piling under certain wind conditions to ensure no significant effects at NSRs (see Volume III, Appendix 25.8: Construction Noise Management Plan).

8.9.2 Impact 2 – Airborne noise impact at NSRs along the coastline from piling during operation.

Operational and maintenance phase

SENSITIVITY OF THE RECEIVER

8.9.2.1 Land use that is considered sensitive to potential noise impacts are referred to as NSRs. NSRs consist of, but are not limited to, residential properties, schools, libraries, hotels and caravan parks, hospitals, and other care facilities for example. As outlined in Section 8.4.1, NSRs have been selected based on a representative location (in the case of residential areas). In the case of a group of receivers, the closest receiver has been chosen as representative for the purposes of the noise impact assessment.

8.9.2.2 Ten NSRs (NSRs A - J) have been identified as key receivers and are described in Section 8.4.1.

8.9.2.3 The maximum sensitivity of all the onshore NSRs is 'High' based on the likely duration, frequency and probability of airborne noise impact during the operation phase.

MAGNITUDE OF IMPACT

8.9.2.4 Based on the relevant broadband sound power level (dB LwA) for the two different WTG Project Design Option 1 (Models 1A and 1B) at wind speeds from 3-12m/s, corresponding predicted L_{A90} windfarm noise levels at each of the noise assessment locations as a function of standardised wind speed for the WTGs at the Proposed Development has been presented.

8.9.2.5 Table 8.19 and Table 8.20, and Figure 8.3 and Figure 8.4 outline the predicted noise levels for the two different WTG Project Design Option 1 (Models 1A and 1B) from the WTGs at the Proposed Development 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 8.19: Predicted L_{A90} windfarm noise levels at each of the noise assessment locations as a function of standardised wind speed for the WTG Project Design Option 1 (Model 1A) from the Array Area, versus the 2006 Guidelines noise limit and ETSU-R-97 Simplified Limit.

Receiver	Predicted noise levels at increasing wind speeds (dB $L_{A90,T}$)									
	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	<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 Project Design Option 1 (Model 1A) only available for 5–12 m/s wind speeds. No sound power level data is available for wind speeds of 3m/s and 4m/s for the WTG Project Design Option 1 (Model 1A). The resultant sound pressure level at wind speeds of 3m/s and 4m/s will be less than predicted sound pressure levels at 5m/s.

Table 8.20: Predicted L_{A90} windfarm noise levels at each of the noise assessment locations as a function of standardised wind speed for the WTG Project Design Option 1 (Model 1B) from the Array Area, versus the 2006 Guidelines noise limit and ETSU-R-97 Simplified Limit.

Receiver	Predicted noise levels at increasing wind speeds (dB $L_{A90,T}$)									
	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	√	√	√	√	√	√	√	√	√	√

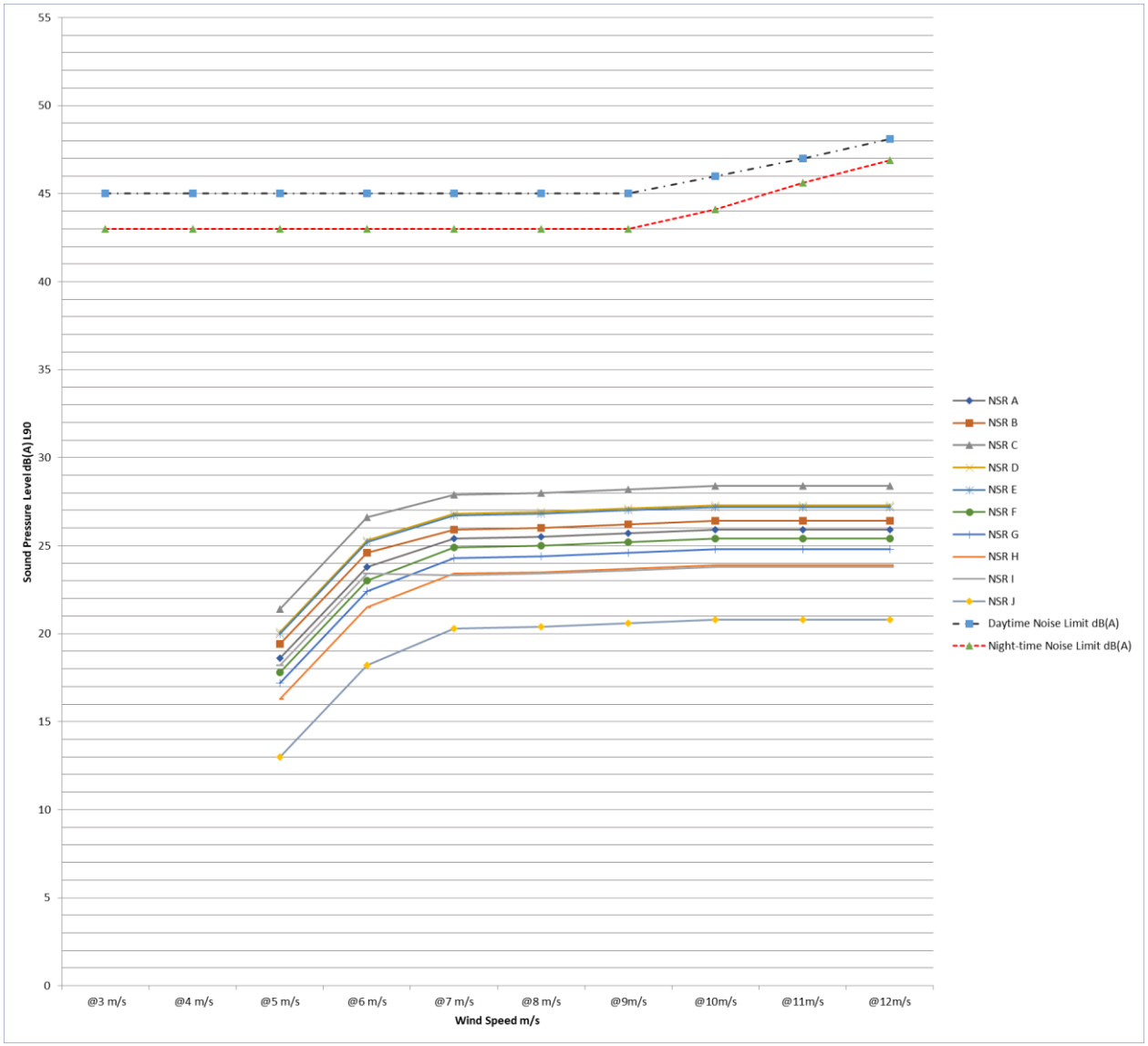

Figure 8.3: Predicted L_{A90} windfarm noise levels at each of the noise assessment locations as a function of standardised wind speed for the WTG Project Design Option 1 (Model 1A) from the Array Area, versus the 2006 Guidelines noise limit

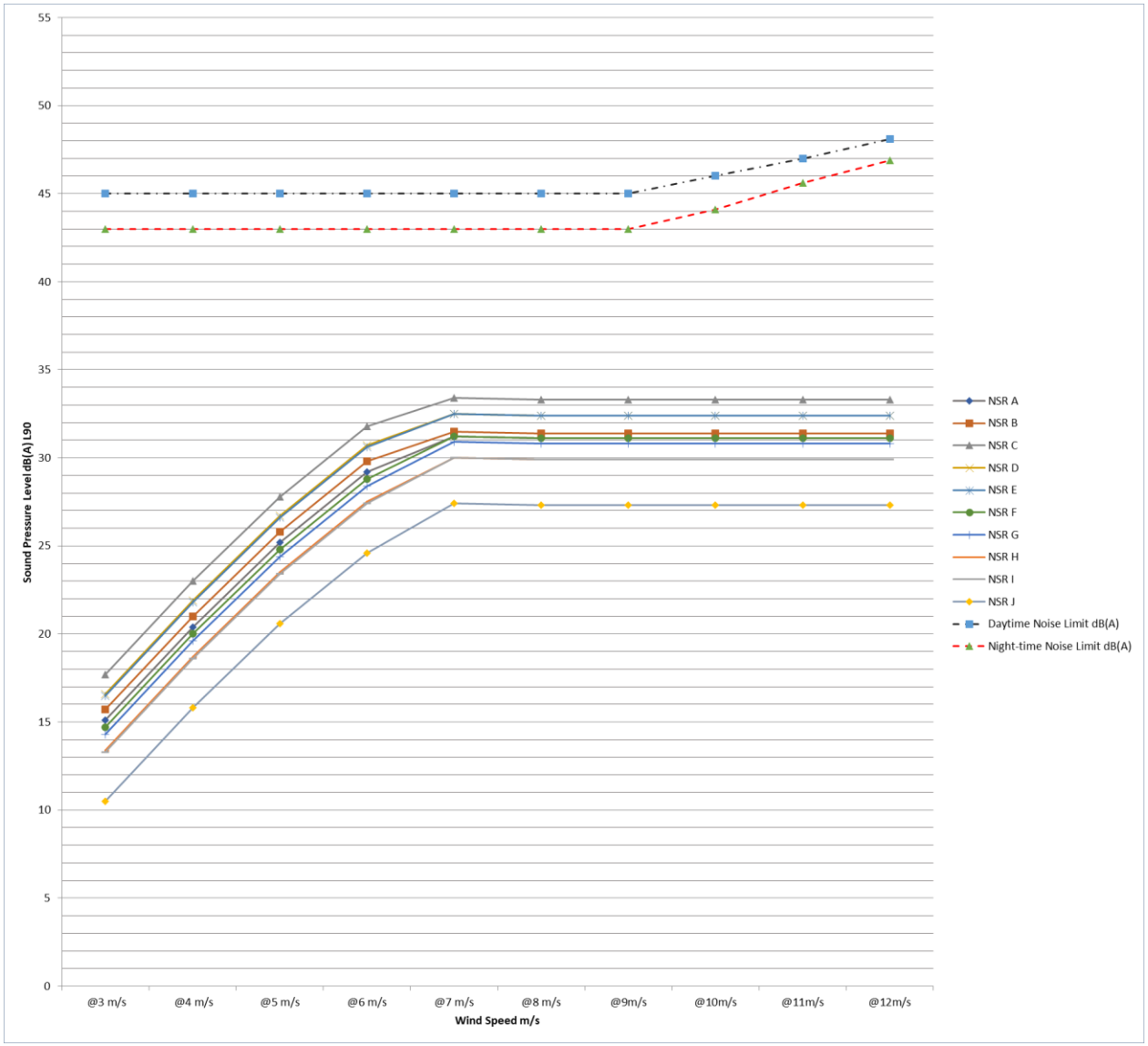

Figure 8.4: Predicted L_{A90} windfarm noise levels at each of the noise assessment locations as a function of standardised wind speed for the WTG Project Design Option 1 (Model 1B) from the Array Area, versus the 2006 Guidelines noise limit

8.9.2.6 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) from the ABWP2 Array Area will be well in accordance with the 2006 Guidelines daytime and night-time noise limits.

8.9.2.7 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) from the ABWP2 Array Area will be below the ETSU-R-97 simplified limit of 35 dB LA90,10min 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.

8.9.2.8 The predicted noise levels associated with the Array Area will be well within the relevant noise limit criteria for windfarm developments in Ireland.

8.9.2.9 The magnitude of operational airborne noise impact has been derived from factors comprising: the noise impact's extent, duration, frequency, probability, and consequence.

8.9.2.10 The magnitude of the impact due to the extent, duration, frequency, probability, and consequence of operational airborne noise has been assessed as follows:

- 'Low' magnitude during daytime;
- 'Low' magnitude during evening; and
- 'Low' magnitude during night-time.

SIGNIFICANCE OF EFFECT

8.9.2.11 The magnitude of the operational noise impact has been assessed as '**Low**' during daytime, '**Low**' during evening and '**Low**' during night-time, with the maximum sensitivity of the NSRs being '**High**'. Therefore, the significance of effect from operational noise is as follows:

- '**Moderate**' significance during daytime;
- '**Moderate'** significance during evening; and
- '**Moderate'** significance during night-time.

8.9.2.12 Based on EPA 2022 Guidelines, a significance level of '**Moderate**' significance is concluded to be not significant in terms of operational airborne noise, based on the sensitivity of the receiver and the magnitude of predicted airborne noise levels. The predicted airborne noise levels for Project Design Option 1 (Model 1A and 1B) are below the ETSU-R-97 simplified limit of 35 dB $L_{A90,10min}$ across a range of wind speeds from 3-12 m/s at all NSRs and this indicates that operational noise levels will be unmeasurable at all onshore NSRs and these predicted noise levels indicate a sufficient protection of amenity.

PROPOSED MITIGATION

8.9.2.13 No additional (non-embedded) mitigation measures are required to reduce the magnitude of the operational airborne impact and the significance of the effect for Project Design Option 1 (Models 1A and 1B).

RESIDUAL EFFECT ASSESSMENT

8.9.2.14 No significant adverse residual effects have been predicted in respect of operational airborne noise.

8.9.2.15 In terms of residual effect, the predicted L_{A90} noise levels at each of the noise assessment locations as a function of standardised wind speed for the Project Design Option 1 (Models 1A

and 1B) from the Array Area are well below the WEDG2006 daytime and night-time noise limits and the ETSU-R-97 simplified limit of 35 dB $L_{A90,10min}$. Therefore, Project Design Option 1 (Model 1A and 1B) will result in an insignificant airborne noise impact.

8.10 Assessment of Project Design Project Design Option 2

8.10.1 Impact 1 – Increased noise levels at NSRs along the coastline from piling during construction.

8.10.1.1 This impact assessment focusses on potential airborne noise impact as a result of piling during construction, as this activity has the greatest potential for impact on NSRs along the coastline.

8.10.1.2 The potential impacts of noise arising during non-percussive noise-generating activities such as dredging and trenching during the construction and decommissioning phases have been scoped out of this assessment. Such activities at a distance of 6–15 kilometres offshore will not result in an audible onshore noise impact.

8.10.1.3 As stated in Section 8.9.1, a representative piling location closest to the shoreline in the north, centre and south of the 56 WTG layout for Option 1 (Models 1A and 1B) and the 47 WTG layout for Project Design Option 2 have been selected to allow for a precautionary piling noise assessment. Therefore, the piling noise assessment is representative of Project Deign Option 1 (Models 1A and 1B) and Project Design Option 2.

8.10.1.4 The predicted piling noise levels for the scenarios at Piling Locations 1-3 in the north, centre and south of the Array Area closest to the representative NSRs, versus BS5228 daytime, evening and night-time noise limits are presented in Table 8.16, Table 8.17 and Table 8.18.

8.10.1.5 As stated, a representative piling location closest to the shoreline in the north, centre and south of the 56-turbine layout for Project Design Options 1A and 1B (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.

8.10.1.6 Therefore, the same Magnitude, Significance of Effect, Proposed Mitigation and Residual Effect applies to the piling scenarios assessed assuming no mitigation, the use of a screen, the use of a dolly and the use of both a screen and a dolly for Project Design Option 2, as for Project Design Option 1 (Models 1A and 1B).

8.10.2 Impact 2 – Airborne noise impact at NSRs along the coast during operation

Operational and maintenance phase

SENSITIVITY OF THE RECEIVER

8.10.2.1 Land use that is considered sensitive to potential noise impacts are referred to as NSRs. NSRs consist of, but are not limited to, residential properties, schools, libraries, hotels and caravan parks, hospitals, and other care facilities for example. As outlined in Section 8.4.1, NSRs have been selected based on a representative location (in the case of residential areas). In the case of a group of receivers, the closest receiver has been chosen as representative for the purposes of the noise impact assessment.

8.10.2.2 Ten NSRs (NSRs A-J) have been identified as key receivers and are described in Section 8.4.1.

8.10.2.3 The maximum sensitivity of all the onshore NSRs is ‘High’ based on the likely duration, frequency and probability of airborne noise impact during the operation phase.

MAGNITUDE OF IMPACT

8.10.2.4 Based on the relevant broadband sound power level (dB LwA) for Project Design Option 2 at wind speeds from 3-12m/s, a corresponding predicted L_{A90} windfarm noise levels at each of the noise assessment locations as a function of standardised wind speed for the WTGs of the Proposed Development has been presented. Table 8.21 and Figure 8.5 outlines the predicted noise levels for Project Design Option 2 from the WTGs for the Proposed Development at each of the NSR locations for each wind speed over the range of wind speeds from 3 -12 m/s.

Table 8.21: Predicted L_{A90} windfarm noise levels at each of the noise assessment locations as a function of standardised wind speed for WTG Project Design Option 2 from the Array Area, versus the 2006 Guidelines noise limit and ETSU-R-97 Simplified Limit

Receiver	Predicted noise levels at increasing wind speeds (dB $L_{A90,T}$)									
	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	√	√	√	√	√	√	√	√	√	√

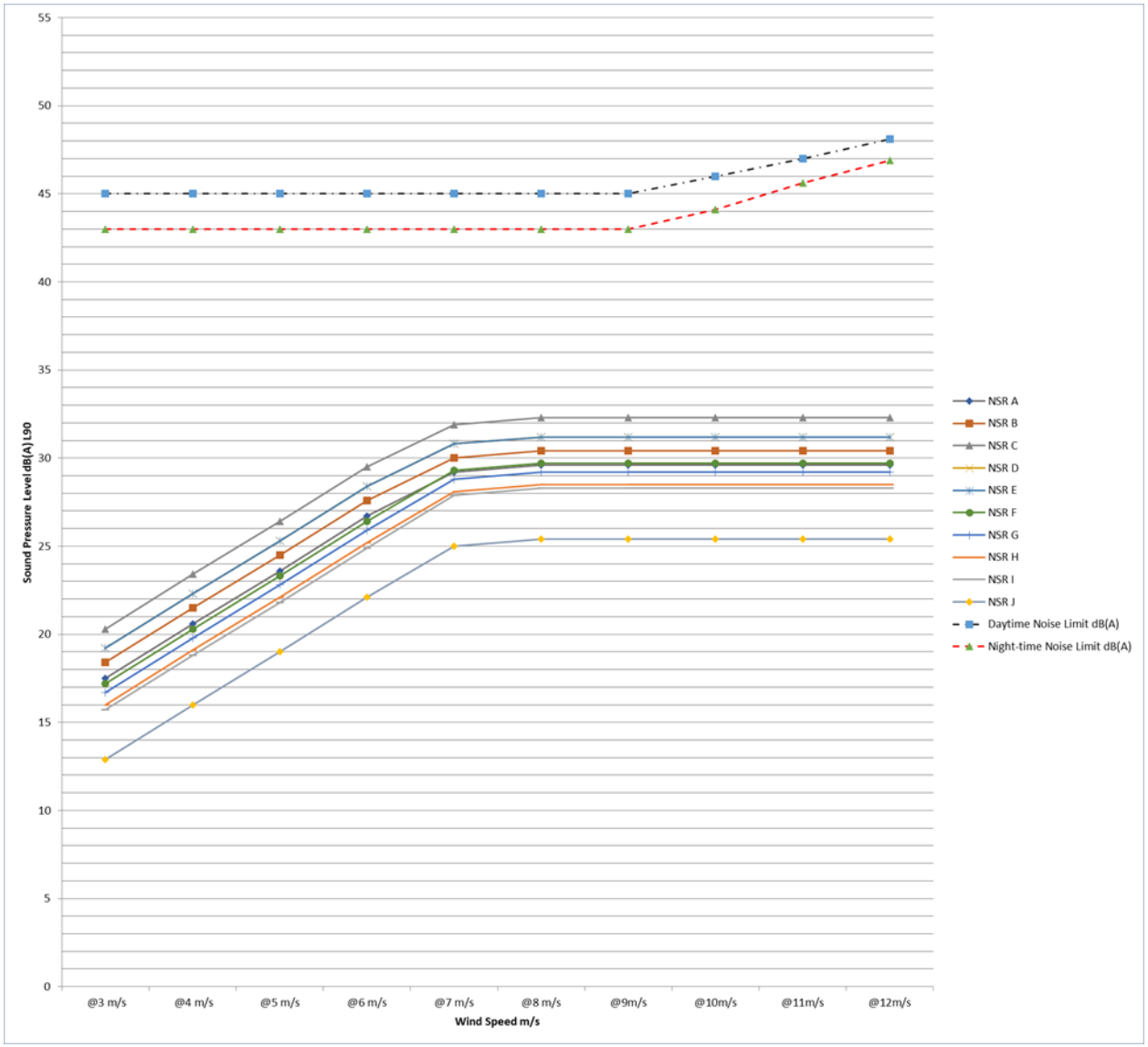

Figure 8.5: Predicted L_{A90} windfarm noise levels at each of the noise assessment locations as a function of standardised wind speed for WTG Project Design Option 2 from the Array Area, versus the 2006 Guidelines noise limit

8.10.2.5 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 Option 2 from the ABWP2 Array Area will be well in accordance with the 2006 Guidelines daytime and night-time noise limits.

8.10.2.6 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 Option 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.

8.10.2.7 The predicted noise levels associated with Project Design Option 2 will be well within the relevant noise limit criteria for windfarm developments in Ireland.

8.10.2.8 The magnitude of operational airborne noise impact has been derived from factors comprising: the noise impact's extent, duration, frequency, probability, and consequence.

8.10.2.9 The magnitude of the impact due to the extent, duration, frequency, probability, and consequence of operational airborne noise has been assessed as follows:

- 'Low' magnitude during daytime;
- 'Low' magnitude during evening; and
- 'Low' magnitude during night-time.

SIGNIFICANCE OF EFFECT

8.10.2.10 The magnitude of the operational noise impact has been assessed as '**Low**' during daytime, '**Low**' during evening and '**Low**' during night-time, with the maximum sensitivity of the NSRs being 'High'. Therefore, the significance of effect from operational noise is as follows:

- '**Moderate'** significance during daytime;
- '**Moderate'** significance during evening; and
- '**Moderate'** significance during night-time.

8.10.2.11 Based on EPA 2022 Guidelines, a significance level of '**Moderate'** significance is concluded to be **not significant** in terms of operational airborne noise, based on the sensitivity of the receiver and the magnitude of predicted airborne noise levels. The predicted airborne noise levels for Project Design Option 2 are below the ETSU-R-97 simplified limit of 35 dB $L_{A90,10min}$ across a range of wind speeds from 3-12 m/s at all NSRs and this indicates that operational noise levels will be unmeasurable at all onshore NSRs and these predicted noise levels indicate a sufficient protection of amenity.

PROPOSED MITIGATION

8.10.2.12 No additional (non-embedded) mitigation measures are required to reduce the magnitude of the operational airborne impact and the significance of the effect for Project Design Option 2.

RESIDUAL EFFECT ASSESSMENT

8.10.2.13 No significant adverse residual effects have been predicted in respect of operational airborne noise.

8.10.2.14 In terms of residual effect, the predicted L_{A90} noise levels at each of the noise assessment locations as a function of standardised wind speed for the Project Design Option 2 from the Array Area are well below the WEDG2006 daytime and night-time noise limits and the ETSU-R-97

simplified limit of 35 dB $L_{A90,10min}$. Therefore, Project Design Option 2 will result in an insignificant airborne noise impact.

8.11 Cumulative impacts assessment methodology

8.11.1 Methodology

8.11.1.1 The Cumulative Impact Assessment (CIA) takes into account the impacts associated with the Proposed Development together with other proposed and reasonably foreseeable projects, plans and existing and permitted projects. The projects and plans selected as relevant to the CIA presented within this chapter are based upon the results of a screening exercise (see Volume III, Appendix 3.2: Cumulative Impact Assessment Screening). Each project and plan have been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon, effect-receiver pathways and the spatial/temporal scales involved.

8.11.1.2 A tiered approach is adopted to provide an assessment of the Proposed Development as a whole. The tiering methodology is provided in Volume III, Appendix 3.2: CIA Screening.

8.11.1.3 The Cumulative Impact Assessment (CIA) also takes into account the impacts associated with the Proposed Development together with the existing ABWP1 which consists of seven WTGs, offshore export cable and inter-array cables. ABWP1 has a capacity of 25.2 MW and was constructed in 2003/04 and is operated by Arklow Energy Limited. It remains the first and only operational offshore windfarm in Ireland.

8.11.1.4 The specific projects scoped into this cumulative impact assessment, and the tiers into which they have been allocated are presented in Table 8.22. The operational projects included within the table are included due to their completion/commission subsequent to the data collection process for the Proposed Development and as such not included within the baseline characterisation.

8.11.1.5 Due to the commitments made by the Developer in respect of the Foreshore Licence FS007339 and Foreshore Licence Application FS007555 (Table 8.14), FS007339 and FS007555 have been screened out of the cumulative impact assessment.

Table 8.22: List of other projects and plans considered within the cumulative impact assessment

Project/Plan	Status	Distance from Array Area (km)	Distance from Cable Corridor and Working Area (km)	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
Tier 1							
Arklow Bank Wind Park 1	Operational	0	0	Existing Offshore in central area of the Proposed Development. ABWP1 consists of seven WTG s	2003/2004	2004 – to date	Potential cumulative airborne noise impact with the Proposed Development operational and maintenance phases.
Phase 1 Projects							
Codling Wind Park (formerly known as Codling I and Codling II)	Proposed	10.3	9.4	'Relevant Project'. Updated application expected to be made under the Maritime Area Planning Act 2021.	2027 – 2028 (Piling To occur in 2027	2029 -	Potential for temporal overlap with Proposed Development construction and operational and maintenance phases. Potential cumulative airborne noise impact with the Proposed Development operational and maintenance phases.

8.11.1.7 Table 8.23 presents the potential impacts, development phase, and the list of projects / plans with which the two Project Design Options have been cumulatively assessed.

Table 8.23: Cumulative assessment impacts, phases, scenarios, and projects to be considered cumulatively

Potential cumulative impact	Phase			Projects considered cumulatively	Justification for projects considered cumulatively
	C	O	D		
Temporary cumulative airborne noise from piling	✓	×	×	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** • Arklow Bank Wind Park 1 **Phase 1 Projects** • Codling Wind Park	Outcome of the CIA will be highest when the greatest number of schemes are under construction, operation, maintenance or decommissioning concurrently.
Cumulative operational airborne noise	×	✓	×	Project parameters associated with Project Design Option 1 or 2 plus the following projects: **Tier 1** • Arklow Bank Wind Park 1 **Phase 1 Projects** • Codling Wind Park	Outcome of the CIA will be highest when the greatest number of schemes are under construction, operation, maintenance or decommissioning concurrently.

Cumulative impact assessment

8.11.2 Project Design Option 1 and 2 - Impact 1 - Temporary cumulative airborne noise from piling

Construction phase

8.11.2.1 A cumulative piling noise impact scenario has been assessed. Publicly available project specific data for Codling Wind Park was used to determine the highest potential noise impact for the cumulative piling noise impact modelling. This scenario has assumed that piling at the most northerly WTG location of the Array Area will occur concurrently with the most southerly WTG location on the Codling Wind Park offshore windfarm array area. This is a most unlikely occurrence.

8.11.2.2 The nearest Codling Wind Park offshore windfarm piling location has been assessed to occur at 309,333, 5,876,162 (UTM 30 Grid Coordinates), assuming a conservative 276 m rotor diameter. The Codling Wind Park piling location is located 11,220 m north-east of the Proposed Development's WTG Location 1 and 12,923 m east of NSR A, Blainroe Lodge.

8.11.2.3 A description of the significance of cumulative piling effects upon the ten representative NSRs located along the coastline arising from each identified impact is given below.

SENSITIVITY OF THE RECEIVER

8.11.2.4 As stated in Section 8.9.1, ten NSRs (NSRs A-J) have been identified as key receivers and are described in in Section 8.4.1.

8.11.2.5 The maximum sensitivity of all the onshore NSRs is 'Medium' based on the likely duration, frequency and probability of airborne noise impact due to the piling operations during the construction phase.

TIER 1

8.11.2.6 There is no potential for a significant cumulative noise impact due to the operation of ABWP1, which consists of seven WTGs, and intermittent piling noise occurring concurrently in the Array Area. The operation of the existing ABWP1 results in an insignificant noise level compared to the short-term intermittent piling noise.

PHASE 1 PROJECTS

MAGNITUDE OF IMPACT

8.11.2.7 Due to the absence of project-specific data for Codling Wind Park, professional judgement was used to determine the highest potential noise impact for the cumulative piling noise impact scenario with piling occurring concurrently at Location 1 in the north of the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm array area. The results of the cumulative piling noise impact scenario were compared versus BS5228 daytime, evening and night-time noise limits as presented in Table 8.24.

8.11.2.8 Potential cumulative noise impacts from other offshore windfarm 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 Development. Due to the very significant offset distances, there is no opportunity for a cumulative noise impact to occur.

Table 8.24: 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 and Dolly	
NSR	BS5228 Daytime Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Daytime Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ 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 and Dolly	
NSR	BS5228 Evening Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Evening Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ 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 and Dolly	
NSR	BS5228 Night Noise Limit dB L_{Aeq}	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ Note 1	BS5228 Night Noise Limit Exceedance	Predicted Level dB $L_{Aeq, 8\ Hr}$ 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.

8.11.2.9 The predicted noise levels for the cumulative piling noise impact scenario with piling occurring concurrently at Location 1 in the north of the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm array area, versus BS5228 daytime, evening and night-time noise limits are presented in Table 8.24.

8.11.2.10 In summary, the following can be concluded for the cumulative piling noise impact:

- The predicted noise levels indicate that if piling is undertaken concurrently at Piling Location 1 in the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm array area, there will be no exceedance of BS5228 Daytime Noise Limit of 65 dB $L_{Aeq, 12\ Hour}$ for all piling scenarios, whether or not there is noise mitigation employed on the piling rig;
- If piling is undertaken during the evening period at Piling Location 1 in the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm 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 1-2 dB(A) at the NSRs A, B and C if no mitigation measures are employed; and
- If piling is undertaken during the night-time period at Piling Location 1 in the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm array area, mitigation measures as outlined in the CNMP will need to be employed during piling to achieve compliance with the BS5228 Night-time Noise Limit of 45 dB $L_{Aeq, 8\ Hour}$ at all NSRs.

8.11.2.11 The magnitude of cumulative piling noise impact has been derived from factors comprising; the noise impact's extent, duration, frequency, probability, and consequence. BS5228 states that "Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq, T}$ from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect".

8.11.2.12 The magnitude of the impact due to the short duration and infrequent occurrence of concurrent piling activity at Piling Location 1 in the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm array over the approximate six-month period has been assessed as follows:

- **'Low'** magnitude during daytime;
- '**Low**' magnitude during evening; and
- '**Medium**' magnitude during night-time.

SIGNIFICANCE OF THE EFFECT

8.11.2.13 The magnitude of the impact has been assessed as '**Low'** during daytime, '**Low'** during evening and '**Medium'** during night-time, with the maximum sensitivity of the NSRs being '**Medium'.** Therefore, the significance of effect from concurrent piling activity at Piling Location 1 in the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm array is as follows:

- '**Slight'** significance during daytime;
- '**Slight'** significance during evening; and
- '**Moderate'** significance during night-time.

8.11.2.14 Based on the EPA 2022 Guidelines, a significance level of '**Moderate'** significance or less is concluded to be **not significant** in terms of construction airborne noise, based on the sensitivity of the receiver and the magnitude of predicted airborne noise levels.

8.11.2.15 However, given that there is a very low potential for concurrent piling activity at Piling Location 1 in the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm array, it can be concluded that cumulative piling noise will not result in a significant noise impact.

8.11.2.16 As such, it is evident that noise limits can be achieved by programming piling works to avoid sensitive periods such as evening and/or night-time.

8.11.2.17 Nevertheless, the piling activity has been assessed using piling industry standard mitigation measures to assess if noise limits can be achieved through the application of physical mitigation measures such as a screen, a dolly or a combination of both screen and dolly during evening and/or night-time periods.

PROPOSED MITIGATION

8.11.2.18 The cumulative 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.

8.11.2.19 The predicted cumulative piling noise levels with mitigation measures assuming the use of a screen, the use of a dolly and the use of both a screen and a dolly, for the scenarios at Piling Location 1 in the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm array closest to the representative NSRs, versus BS5228 daytime, evening and night-time noise limits are presented in Table 8.24.

8.11.2.20 Table 8.24 outlines that 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.

8.11.2.21 Table 8.24 outlines that if piling is undertaken during night-time with a screen and dolly in operation, concurrently at Piling Location 1 in the Array Area and at the most southerly WTG location on the Codling Wind Park array area, 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 NSR A. However, the above worst-case cumulative piling scenario is most unlikely to occur as the scheduling of the piling activity for ABWP2 and Codling Wind Park are highly unlikely to coincide at these locations. Overall, it can be concluded that there will be no significant cumulative piling noise impact.

RESIDUAL EFFECT ASSESSMENT

8.11.2.22 There is a very low potential for concurrent piling activity at Piling Location 1 in the Array Area and at the most southerly WTG location on the Codling Wind Park offshore windfarm array. With mitigation, the magnitude of the noise impact due to the concurrent piling activity over a short duration of piling activity over the approximate six-month period has been assessed as follows:

- '**Low'** magnitude during daytime;
- '**Low'** magnitude during evening; and
- '**Low'** magnitude during night-time.

8.11.2.23 With mitigation, the significance of effect from piling noise activities is as follows:

- '**Slight'** significance during daytime;
- '**Slight'** significance during evening; and
- '**Slight'** significance during night-time.

8.11.2.24 Therefore, based on EPA 2022 Guidelines, a significance level of '**Slight'** significance is concluded to be **not significant** in terms of construction airborne noise, based on the sensitivity of the receiver and the magnitude of predicted airborne noise levels.

8.11.2.25 The significance of effect from cumulative piling noise is not significant in EIA terms. Therefore, no additional mitigation to that already identified, i.e. the industry standard methods of mitigation using both a screen and a dolly are considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of cumulative piling noise.

8.11.2.26 To mitigate potential significant effects during piling a Construction Noise Management Plan (CNMP) has been submitted with the Application (Volume III, Appendix 25.8), which specifies measures to reduce or avoid significant effects. The CNMP includes measures such as piling under certain wind conditions to ensure no significant effects at NSRs.

8.11.2.27 During the decommissioning of ABWP1, all structures above the seabed will be removed, while scour protection, cables and cable protection will be left in situ. Decommissioning will have a significantly lesser degree of noise impact to that produced by piling processes. During decommissioning of ABWP1 piling operations will not be required. The potential impacts of noise arising during non-percussive noise-generating activities during the decommissioning of ABWP 1 have been scoped out of this assessment. The ABWP1 decommissioning activities at a distance of 10 km or greater offshore, will not be audible onshore and will not result in an onshore noise impact.

8.11.3 Project Design Option 1 and 2 - Impact 2 – Cumulative operational airborne noise

Tier 1

OPERATIONAL AND MAINTENANCE PHASE

MAGNITUDE OF IMPACT

8.11.3.1 The cumulative operational impact assessment takes into account the potential cumulative airborne noise impacts associated with the Proposed Development together with the existing ABWP1. ABWP1 consists of seven GE 3.6 MW WTGs, with a total capacity of 25.2 MW.

8.11.3.2 Based on publicly available information, the existing GE 3.6 WTGs have a sound power level of ~106-108 dB, which is >10dB below the sound power level of any of the candidate WTGs for Options 1 (Models 1A and 1B) and 2.

8.11.3.3 As a precautionary cumulative assessment, if the 7 No. GE 3.6 WTGs had the same sound power level as any of the WTGs for Project Design Options 1 (Models 1A and 1B) and 2, the addition of seven WTGs to a 56 turbine array would result in an imperceptible 0.4 dB increase [10xLog(63/56)], while the addition of seven WTGs to the 47 WTG array would result in an imperceptible 0.6 dB increase [10xLog(54/47)]. Therefore, the cumulative noise levels from ABWP1 and ABWP2 as a function of standardised wind speed will be below the ETSU-R-97 simplified limit of 35 dB $L_{A90,10min}$ across a range of wind speeds from 3-12 m/s at all NSRs and this indicates that operational noise levels will be unmeasurable at all onshore NSRs. As outlined in ETSU-R-97, this condition alone offers sufficient protection of amenity.

8.11.3.4 The residual noise impact of the cumulative operational impact from ABWP1 and ABWP2 will result in an insignificant airborne noise impact.

8.11.3.5 Based on the information during public consultation (provided in Volume III, Appendix 3.1: Consultation Report), there is no evidence of operational noise complaints due to the operation of ABWP1. During site visits, it was the subjective finding that the existing ABWP1 is inaudible on the coastline.

OPERATIONAL AND MAINTENANCE PHASE

MAGNITUDE OF IMPACT

8.11.3.6 The potential cumulative effects of other proposed offshore windfarms have been considered in terms of noise impact. The Codling Wind Park offshore windfarm array area is to be located to the north of the Array Area.

8.11.3.7 The nearest Codling Wind Park offshore WTG location is located 11,220m north-east of the Proposed Development Array Area WTG Location 1 for Option 1 (Models 1A and 1B), and 12,923m east of NSR A, Blainroe Lodge. The Array Area WTG Location 1 for Option 1 (Models 1A and 1B) is located 6,895m east of NSR A, which is the nearest NSR along the coastline. Codling Wind Park are predicting a noise level of 31 dB L_{A90} due to Codling Wind Park only at NSR A. The operational noise level predictions for Project Design Options 1 and 2, indicate that the predicted noise levels at NSRs A-J are well below the operational noise limits outlined in the WEDG2006 guidelines, with a maximum predicted noise level of 33 dB LA90 at NSR C for Project Design Option 1B at all wind speeds. Therefore, the cumulative noise levels from ABWP1, ABWP2 and Codling Wind Park as a function of standardised wind speed will meet the ETSU-R-97 simplified limit of 35 dB $L_{A90,10min}$ across a range of wind speeds from 3-12 m/s at all NSRs and this indicates that operational noise levels will be unmeasurable at all onshore NSRs. As outlined in ETSU-R-97, this condition alone offers sufficient protection of amenity.

8.11.3.8 There are no existing or proposed onshore wind turbines or windfarms that need to be considered in terms of cumulative noise impact, due to being located well in excess of any distance at which a significant cumulative airborne noise impact could occur. The nearest onshore windfarm is approximately 10 km from the coastline NSRs.

8.11.3.9 The magnitude of the cumulative operational impact of ABWP1 and the Proposed Development due to the extent, duration, frequency, probability, and consequence of the operational airborne noise has been assessed as follows:

- 'Low' magnitude during daytime;
- 'Low' magnitude during evening; and
- 'Low' magnitude during night-time.

SIGNIFICANCE OF EFFECT

8.11.3.10 The magnitude of the cumulative operational impact of ABWP1, ABWP2 and Codling Wind Park has been assessed as '**Low**' during daytime, '**Low**' during evening and '**Low**' during night-time, with the maximum sensitivity of the NSRs being 'High'. Therefore, the significance of effect from cumulative operational impact of ABWP1 and Codling Wind Park with the Proposed Development is as follows:

- '**Moderate'** significance during daytime;
- '**Moderate'** significance during evening; and
- '**Moderate'** significance during night-time.

8.11.3.11 Based on EPA 2022 Guidelines, a significance level of '**Moderate**' significance is concluded to be not significant in terms of operational airborne noise, based on the sensitivity of the receiver and the magnitude of predicted airborne noise levels. The predicted airborne noise levels are below the WEDG2006 daytime and night-time noise limits and the ETSU-R-97 simplified limit of 35 dB $L_{A90,10min}$ across a range of wind speeds from 3-12 m/s at all NSRs and this indicates that operational noise levels will be unmeasurable at all onshore NSRs.

PROPOSED MITIGATION

8.11.3.12 No additional (non-embedded) mitigation measures are required to reduce the magnitude of the operational airborne impact and the significance of the effect of the cumulative operational impact of ABWP1 and Codling Wind Park with the Proposed Development.

RESIDUAL EFFECT ASSESSMENT

8.11.3.13 No significant adverse residual effects have been predicted in respect of operational airborne noise due to the cumulative operational impact of ABWP1, ABWP2 and Codling Wind Park.

8.11.3.14 In terms of residual effect, the predicted L_{A90} noise levels as a function of standardised wind speed at each of the noise assessment locations for ABWP1, ABWP2 and Codling Wind Park are below the WEDG2006 daytime and night-time noise limits and the ETSU-R-97 simplified limit of 35 dB $L_{A90,10min}$. Therefore, the cumulative operational residual noise impact of ABWP1, ABWP2 and Codling Wind Park will result in an insignificant airborne noise impact.

8.12 Transboundary effects

8.12.1.1 No transboundary airborne noise effects will arise.

8.12.1.2 A screening of transboundary impacts has been carried out and has identified that due to distance offset, there was no potential for significant transboundary effects with regard to airborne noise from the Proposed Development upon the interests of other states.

8.13 Summary of effects

8.13.1.1 During the construction phase of the Proposed Development, a short-term noise impact may occur during piling during downwind conditions (i.e. while wind is blowing from the proposed Array Area towards the NSRs on the shore). However, the predicted piling noise levels will be in accordance with the BS5228 Daytime Noise Limits for all piling scenarios (Project Design Options 1 and 2), whether or not there is noise mitigation employed on the piling rig.

8.13.1.2 If piling is undertaken during the evening period at Piling Location 1 in the north of the ABWP2 Array Area during downwind conditions, 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 if no mitigation measures are employed (Project Design Options 1 and 2).

8.13.1.3 If piling is undertaken during the night-time period at Piling Locations 1, 2 and 3 in the north, centre and south of the Array Area without mitigation during downwind conditions, there may be an exceedance of the BS 5228 night-time Noise Limit of 45 dB $L_{Aeq,\ 8\ Hour}$.

8.13.1.4 Mitigation measures are available which would result in sufficient attenuation to ensure no exceedance of the BS5228 night-time Noise Limit at all NSRs (Project Design Options 1 and 2). Therefore, the above indicates that construction noise limits can be achieved either by programming piling works to avoid sensitive periods such as evening and/or night-time, during periods not favourable to noise propagation (e.g. when NSRs are upwind of piling activities), or through the application of physical mitigation measures such as a screen, a dolly or a combination of both screen and dolly.

8.13.1.5 The residual noise impact of the construction of the Proposed Development will result in a 'Slight' impact. Committed mitigation measures, are presented in full in Volume III, Appendix 25.8: Construction Noise Management Plan.

8.13.1.6 The Developer commits to meeting the BS5228 construction noise limits due to piling activities during day, evening and night through the use of programming, piling during periods not favourable to noise propagation or the use of industry standard methods of mitigation (screen and

/ or dolly) during evening and night-time piling operations, as outlined in Volume III, Appendix 25.8 Construction Noise Management Plan.

8.13.1.7 A cumulative piling noise impact scenario has also been investigated with Codling Wind Park (Codling Wind Park), which is the closest proposed offshore windfarm to the ABWP2 Array area. The potential cumulative noise impacts from other offshore windfarm 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.

8.13.1.8 The predicted cumulative noise levels indicate that if piling is undertaken concurrently at Piling Location 1 in the ABWP2 Array Area and at the most southerly turbine location on the Codling Wind Park offshore windfarm array, there will be no exceedance of the BS5228 Daytime Noise Limit with no mitigation measures employed at both locations. 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 $L_{Aeq,\ 4\ Hour}$ during downwind conditions at the NSRs A, B and C. If the proposed mitigation measures are employed 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 NSR A during downwind conditions. However, the above worst-case cumulative piling scenario is most unlikely to occur. Therefore, the above indicates that construction noise limits can be achieved either through the measures outlined above for the project alone or through the avoidance of cumulative piling through managing of schedules. Committed mitigation measures are presented in full in Volume III, Appendix 25.8: Construction Noise Management Plan.

8.13.1.9 The predicted operational noise levels have been compared to noise limits derived in accordance with the "Wind Energy Development Guidelines" published by the Department of the Environment, Heritage and Local Government in 2006, with reference to the Department of Trade and Industry (UK) Energy Technology Support Unit (ETSU-R-97) publication "The Assessment and Rating of Noise from Wind Farms" (1996) as well as The Institute of Acoustics Good Practise Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013) (IOA GPG).

8.13.1.10 The predicted noise levels associated with the operation of the Proposed Development will be well within the relevant noise limit criteria for windfarm developments in Ireland, and it has been determined that no significant effect will be associated with the operation of the Proposed Development.

8.13.1.11 A cumulative operational impact assessment has been undertaken to assess the potential cumulative airborne noise impacts associated with the Proposed Development together with the existing ABWP1. ABWP1 consists of seven GE 3.6 MW wind WTGs, with a total capacity of 25.2 MW. The cumulative airborne noise effect of the Proposed Development together with ABWP1 WTGs will result in an insignificant airborne noise impact.

8.13.1.12 The cumulative noise levels from Codling Wind Park and ABWP2 as a function of standardised wind speed will meet the ETSU-R-97 simplified limit of 35 dB $L_{A90,10min}$ across a range of wind speeds from 3-12 m/s at all NSRs and this indicates that operational noise levels will be unmeasurable at all onshore NSRs. As outlined in ETSU-R-97, this condition alone offers sufficient protection of amenity. Therefore, there will be an insignificant cumulative operational airborne noise impact.

8.13.1.13 There are no other existing or proposed onshore wind turbines or windfarms that need to be considered in terms of cumulative noise impact, due to being located well in excess of any distance at which a significant cumulative airborne noise impact could occur.

8.13.1.14 The residual noise effects associated with the Proposed Development has been assessed in accordance with the guidance provided in EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (May 2022). The residual noise impact of the operation of the Proposed Development will result in an insignificant airborne noise impact.

Table 8.25: Summary of potential environmental impacts, mitigation and monitoring for Project Design Project Design Option 1

Description of impact	Phase C	Phase O	Phase D	Factored-in measures	Magnitude of impact	Sensitivity of Receivers	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Increased noise levels at NSRs along the coastline from piling during construction.	✓	×	×	Development of and adherence to a Construction Noise Management Plan. Full details of factored-in measures can be found in Section 8.9.1	Low	Medium	**Slight adverse** (not significant in EIA terms)	Industry standard methods of mitigating using a screen and / or a dolly, or the use of programming of piling during periods not favourable to noise propagation will be implemented during piling events in evening and night-time periods	**Slight adverse** (not significant in EIA terms)	In the event of noise complaint, onshore noise monitoring will be undertaken at NSR to determine noise levels from piling.
Airborne noise impact at NSRs along the coast during operation	×	✓	×	None	Low	High	**Moderate** (not significant in EIA terms)	None	Imperceptible / Not significant in EIA terms	None

Description of impact	Phase C O D	Factored-in measures	Magnitude of impact	Sensitivity of Receivers	Significance of effect	Additional measures	Residual effect	Proposed monitoring

Table 8.26: Summary of potential environmental impacts, mitigation and monitoring for Project Design Project Design Option 2

Description of impact	Phase C	O	D	Factored-in measures	Magnitude of impact	Sensitivity of Receivers	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Increased noise levels at NSRs along the coastline from piling during construction.	✓	×	×	Development of and adherence to a Construction Noise Management Plan. Full details of factored-in measures can be found in Section 8.7.3.	Low	Medium	**Slight adverse** (not significant in EIA terms)	Industry standard methods of mitigation using a screen and/or a dolly will be implemented during piling events in evening and night-time periods.	**Slight adverse** (not significant in EIA terms)	In the event of noise complaint, onshore noise monitoring will be undertaken at NSR to determine noise levels from piling.
Airborne noise impact at NSRs along the coast during operation	×	✓	×	N/A	Low	High	**Moderate** (not significant	None	Imperceptible / Not	N/A

Description of impact	Phase C O D	Factored-in measures	Magnitude of impact	Sensitivity of Receivers	Significance of effect	Additional measures	Residual effect	Proposed monitoring
					in EIA terms)		significant in EIA terms	

8.14 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)