



Sporad na Mara Offshore Wind Farm

Offshore Project

Environmental Impact Assessment Report

Chapter 19: Offshore Airborne Noise, Volume 2a

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19 OFFSHORE AIRBORNE NOISE

19.1 INTRODUCTION

19.1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) presents the results of the assessment of the likely significant effects of the proposed Spiorad na Mara Offshore Wind Farm (hereafter referred to as the 'Offshore Project') with respect to Offshore Airborne Noise, including potential construction and operational effects.

19.1.1.2 This chapter and associated figures and appendices should be read in conjunction with the project description provided in **Chapter 3: Project Description, Volume 1a**. Noise and vibration impacts from the Onshore Project are considered in the Onshore Transmission Works (OTW) Project, as outlined in **Chapter 1: Introduction, Volume 1a**. This chapter should be read in conjunction with the relevant parts of the following chapters:

- **Chapter 6: Socio-economics, Volume 2a:** which considers the economic impacts of the Offshore Project in relation to tourism;
- **Chapter 20: Other Sea Users and Recreations, Volume 2a:** which considers offshore noise effects on other sea users' receptors;
- **Chapter 22: Offshore Human Health, Volume 2a:** which considers offshore noise effects on human health receptors.

19.1.1.3 This technical chapter describes the following:

- Legislation, planning policy and other documentation that has informed the assessment (Section 19.2 and **Appendix 19.1: Policy, Guidance and Legislative Context, Volume 2c**);
- Outcomes of consultation and engagement that has been undertaken to date, including how matters relating to offshore airborne noise have been addressed (Section 19.3);
- The scope of the assessment for offshore airborne noise (Section 19.4);
- The methods used for baseline data gathering and impact assessment (Section 19.5);
- The determined baseline noise environment (Section 19.6);
- The relevant maximum design scenario and the embedded environmental measures relevant to offshore airborne noise (Section 19.7);
- Assessment of potential offshore airborne noise significant effects and further mitigation (Section 19.8 and Section 19.9);
- Assessment of Combined effects (Section 19.10);
- Assessment of Whole Project effects (Section 19.11);
- Assessment of Cumulative effects (Section 19.12);
- Assessment of transboundary effects (Section 19.13);
- Summary of residual effects (Section 19.14);
- Glossary and abbreviations used in the airborne noise assessment (Section 19.15);

- Information sources and documentation referred to in this chapter (Section 19.16).

19.1.1.4 The chapter is supported by the following appendices and figures:

- **Figure 19.1: Baseline Noise Measurement Locations, Volume 2b;**
- **Figure 19.2: Cumulative Developments, Volume 2b;**
- **Figure 19.3: Noise Sensitive Receptors, Volume 2b;**
- **Appendix 19.1, Volume 2c;**
- **Appendix 19.2: Noise Modelling and Prediction, Volume 2c;**
- **Appendix 19.3: Baseline Noise Survey, Volume 2c;**
- **Appendix 19.4: Wind Shear Correction, Volume 2c;**
- **Appendix 19.5: Baseline Noise Conditions – All Wind Directions, Volume 2c;**
- **Appendix 19.6: Baseline Noise Analysis Comparison – Design Option 1 vs Design Option 2, Volume 2c;**
- **Appendix 19.7: Baseline Noise Conditions - Directional Split, Volume 2c;**
- **Appendix 19.8: Existing Wind Turbine Contribution Check, Volume 2c;**
- **Appendix 19.9: Modelled Receptor Noise Levels, Volume 2c;**
- **Appendix 19.10: Noise Limits, Volume 2c;**
- **Appendix 19.11: Cumulative Wind Turbine Noise Assessment, Volume 2c.**

19.2 SUMMARY OF POLICY, GUIDANCE AND LEGISLATIVE CONTEXT

19.2.1.1 This section outlines the policy and guidance that is relevant to the assessment of likely significant effects from offshore airborne noise associated with the construction and operation of the Offshore Project. There is no legislation specifically applicable to Offshore Airborne Noise, and currently no national or local policy or guidance addressing offshore wind with respect to noise. In the absence of offshore noise policy and guidance, relevant onshore documents have been used. In addition, other national, regional, and local policies are considered within this assessment where they are judged to be relevant. Further information on policies relevant to the Environmental Impact Assessment (EIA) is provided in **Chapter 2: Policy and Legislative Context, Volume 1a** and **Appendix 19.1, Volume 2c**.

19.2.1.2 A summary of the policy and guidance relevant to offshore airborne noise is provided in **Table 19-1**.

Table 19-1 Summary of policy, guidance and legislative context in relation to Offshore Airborne Noise

Legislative/Policy	Summary
National Policy	
National Planning Framework 4 (NPF4), 2024	NPF4 sets out Scotland/ <i>Alba</i> long-term spatial strategy and national planning policies. Noise is referenced several times at a high level. Policy 11 requires that noise impacts on communities and individual dwellings are addressed with respect to renewable energy. Policy 23 advises that development proposals that are likely to raise unacceptable noise issues will not be supported.
Onshore Wind Policy Statement (OnWPS) 2022	Whilst this Scottish Government document is concerned with onshore wind development, it sets out a principle of understanding with respect to the application of the noise assessment methodology presented in The Energy Technology Support Units': R-97 document: <i>Assessment and rating of noise from wind farms</i> (ETSU-R-97). Namely, that "all applicants are required to follow the framework and use it to assess and rate noise from wind energy developments". It goes on to state that ETSU-R-97 should continue to be applied until new guidance is produced. The document also recognises that The Institute of Acoustics' guidance document: <i>A Good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise</i> (IOA GPG) is a useful tool which can be used in conjunction with ETSU-R-97.
Offshore Wind Energy – Draft updated Sectoral Marine Plan (OWESMP) 2025	The draft Sectoral Marine Plan provides the spatial planning framework for the ScotWind and Innovation and Targeted Oil & Gas (INTOG) leasing rounds. The document identifies key environmental risks for the North region, these include "Noise, vibration, light and shadow flicker effects on the west coast of the Isle of Lewis".
Planning Advice Note 1/2011, Planning and Noise (PAN 1/2011), 2011	PAN 1/2011 provides advice on the role of the planning system in helping to prevent and limit adverse effects of noise. The PAN promotes the principles of good acoustic design and a sensitive approach to the location of new development. It promotes the appropriate location of noisy development within the vicinity of existing noise generating uses, to ensure that quality of life is not unreasonably affected and that new development continues to support sustainable economic growth.
Outer Hebrides Local Development Plan – Adopted Plan, 2018 (OHLDP)	The Plan sets out the Comhairle's land-use planning policies to facilitate sustainable economic growth. Policy EI 8 highlights that all onshore wind energy developments will be assessed against the Council's 'Supplementary Guidance for Wind Energy Development' (see below).
Onshore wind turbines: planning advice, 2014	Scottish Government's planning advice relating to onshore wind turbines. This online resource advises that Energy Technology Support Units R-97 (ETSU-R-97) and the Institute of Acoustics: A Good Practice Guide (IOA GPG) should be used to assess and rate noise from wind energy developments. It highlights that the Scottish Government accepts that the IOA GPG represents current industry good practice.
Outer Hebrides Local Development Plan –	This document provides advice to assist in planning for wind energy development in the Outer Hebrides/ <i>Na h-Eileanan Sià</i> . With reference to

Legislative/Policy	Summary
Supplementary Guidance for Wind Energy Development, 2021	noise, the document sets out information requirements and guidance on assessment methods and criteria to be adopted. For construction, proposals should take account of British Standard (BS) 5228-1 and BS 5228-2. For operation, ETSU-R-97 is referenced.
Technical Guidance	
Energy Technology Support Units R-97 document 'The Assessment and Rating of noise from Windfarms, 1996 (ETSU-R-97)	ETSU-R-97 sets out the United Kingdom's (UK's) methodology for assessing operational noise from wind turbines. The document provides a method for determining appropriate daytime and night-time noise limits. Those limits are derived based on acceptable fixed lower limits, and an allowable exceedance over prevailing background noise levels, including consideration to a range of prevailing wind speed conditions.
The Institute of Acoustics: A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, 2013 (IOA GPG)	The IOA GPG represents current good practice in applying the ETSU-R-97 method in the assessment of noise impacts from wind turbine developments. The document provides clarification and guidance on ETSU-R-97 noise assessments, including consultation, background noise survey methodology, noise survey data analysis, derivation of noise limits, noise prediction model input data, algorithms and parameters, cumulative impact assessment procedures, assessment reporting and planning conditions. A set of Supplementary Guidance Notes (SGNs) also form part of the publication and include further specific detail for different technical areas.
British Standard (BS) 5228-1:2009+A1:2014 Code of practice for noise vibration control on construction and open sites – Part 1: Noise	The standard sets out methods for calculating and assessing construction noise. The standard provides the latest recommendations for methods of noise control where there is a need for the protection of persons living and working in the vicinity of, and those working on, construction and open sites. The standard provides a database of information, including previously measured sound pressure level data for a variety of different construction plant undertaking various common activities.

19.3 SCOPING AND CONSULTATION

19.3.1 OVERVIEW

19.3.1.1 This section describes the stakeholder engagement undertaken for the Offshore Project. This consists of the outcome of, and response to, the Scoping Opinion in relation to the Offshore Airborne Noise assessment (hereafter referred to as the 'formal consultation'). An overview of engagement undertaken for the Project as a whole can be found in **Chapter 5: Approach to EIA, Volume 1a** and **Appendix 5.4: Stakeholder Consultation and Engagement, Volume 1c**.

19.3.1.2 Consultation is a key feature of the EIA process and continues throughout the lifecycle of the Offshore Project, from the initial stages through to consent and post consent.

19.3.1.3 This section captures all consultation and engagement and has been ongoing with a number of prescribed and non-prescribed consultation bodies and local authorities in relation to Offshore Airborne Noise. All consultation to date has been undertaken in line with the process described in **Chapter 5, Volume 1a** and **Appendix 5.4, Volume 1c**. Feedback received during this process has been incorporated into the EIA wherever possible as appropriate.

19.3.2 SCOPING OPINION

19.3.2.1 Sporad na Mara Limited (hereafter referred to as 'the Applicant') submitted a Scoping Report (Sporad na Mara, 2023) and request for a Scoping Opinion to the Marine Directorate Licensing Operations Team (MD-LOT) in September 2023. A Scoping Opinion was received in May 2024. The Scoping Report set out the proposed assessment methodologies, an outline of the baseline data, and presented the proposed scope of the assessment for the EIA. The responding comments received on the Scoping Opinion and how these have been addressed in this EIA is provided in **Appendix 5.2: Response to Scoping Opinion, Volume 1c**.

19.3.2.2 A summary of the responses relevant to Offshore Airborne Noise is shown in **Table 19-2**. Regard has also been given to other stakeholder comments that were received in relation to the Scoping Report.

19.3.2.3 The Scoping Report considered Airborne Noise and Vibration as an assessment to include within the EIAR, however Offshore Airborne Noise was not included as a standalone aspect. Following stakeholder feedback a standalone Offshore Airborne Noise assessment has been included within this EIAR.

Table 19-2 Summary of consultation for Offshore Airborne Noise

Consultee	Date/Document	Comment	Response/where this is addressed in the EIAR
<p>Scottish Ministers</p>	<p>Scoping Opinion (MD-LOT, 2023)</p>	<p>Scoping Opinion, paragraph: 5.3.8.2 Advises the inclusion of human health impacts due to airborne noise and vibration from the Offshore Project.</p> <p>Scoping Opinion, paragraph: 5.3.8.2 Further advises the consideration of the wind turbine study on adverse health effects referenced in representations made by Barvas Estate Trust, Carloway Estate Trust, Galson Estate Trust and Anderson MacArthur (on behalf of Lewis Island Crofters).</p> <p>Scoping Opinion, paragraph: 5.3.8.3 Advises the inclusion of a noise impact assessment in the EIA Report, with a focus on low frequency noise as a risk to human health, as requested by representations made by Sandwick Community Council, Shawbost Community Council, Bernera Community Council and South Bragar Grazings Committee.</p>	<p>The comments raised by Scottish Ministers in the Scoping Opinion represent a consolidation of the airborne noise related comments raised by consultee representations, see following rows in this table.</p> <p>The scope of the completed assessment has included an assessment of offshore airborne noise impacts on humans. The construction assessment is based on the UK industry standard guidance BS 5228-1. The operational assessment is based on the UK industry standard guidance ETSU-R-97, and the guidance contained in IOA GPG which is accepted by the Scottish Government as current industry good practice.</p> <p>Human health impacts are not explicitly referenced by ETSU-R-97 or IOA GPG. ETSU-R-97 noise limits have been derived with reference to several factors, including existing standard and guidance relating to noise emissions, the need of society for renewable energy sources to emission of pollutants in pursuance of Government energy policy.</p> <p>Infrasound and low frequency noise impacts fall outside the scope of the UK industry standard guidance, ETSU-R-97, and are not included in the IOA GPG which is accepted by the Scottish Government as current industry good practice.</p>

Consultee	Date/Document	Comment	Response/where this is addressed in the EIAR
			<p>WSP published (September 2023) their report 'A review of noise guidance for onshore wind turbines' for the then Department for Business, Energy and Industrial Strategy (The BEIS report). That report confirms that: <i>"...the weight of evidence appears to indicate that wind turbine infrasound has no adverse effects on human health at typical exposure levels..."</i> and that; <i>"...due to the inherent characteristics of wind turbine sound, suitable controls on A-weighted sound levels are expected to also provide sufficient control for the potential impact of low frequency noise"</i>.</p> <p>Assessment of operational airborne noise is included in this chapter (Section 19.9).</p>
Barvas Estate Trust	Consultation representations	<p>Barvas Estate Trust representation requests that the EIA should include a Noise Impact Assessment evaluating risks from low-frequency noise and infrasound to humans and wildlife. It should include a comprehensive review of peer-reviewed research on infrasound effects.</p> <p>The representation states that the Scoping Report omits human health impacts. Reference is made to Dumbrille, A, McMurtry, R. Y. Krogh, C. M. <i>Wind turbines and adverse health effects: Applying Bradford Hill's criteria for causation</i>. Environmental Disease 2021; 6:65-87 (Dumbrille <i>et al.</i>, 2021).</p>	See response to Scottish Ministers.

Consultee	Date/Document	Comment	Response/where this is addressed in the EIAR
Carloway Estate Trust	Consultation representations	Carloway Estate Trust representation states that the Scoping Report omits human health impacts. Reference is made to Dumbrille <i>et al.</i> , 2021.	See response to Scottish Ministers.
Comhairle nan Eilean Siar (CnES)	Consultation representations	CnES Environmental Health agrees with the scope outlined in the Scoping Report regarding what has been included and excluded.	Activities scoped into the assessment of Offshore Airborne Noise are detailed in Table 19-4 . Activities scoped out of the assessment of Offshore Airborne Noise are detailed in Table 19-5 .
Galson Estate Trust	Consultation representations	Galson Estate Trust representation states that the Scoping Report omits human health impacts. Reference is made to Dumbrille et al 2021.	See response to Scottish Ministers.
Lewis Island Crofters	Consultation representations	Anderson MacArthur (on behalf of Lewis Island Crofters) representation states that the Scoping Report omits human health impacts. Reference is made to Dumbrille <i>et al.</i> , 2021.	See response to Scottish Ministers.
Sandwick Community Council	Consultation representations	Sandwick Community Council representation requests that the EIA should include a Noise Impact Assessment evaluating risks from low-frequency noise and infrasound to humans and nonhuman life. It should include a comprehensive review of peer-reviewed research on infrasound effects.	See response to Scottish Ministers.
Shawbost Community Council	Consultation representations	Shawbost Community Council representation requests that the EIA should include a Noise Impact Assessment evaluating risks from low-frequency noise and infrasound to humans and nonhuman life.	See response to Scottish Ministers.

Consultee	Date/Document	Comment	Response/where this is addressed in the EIAR
		It should include a comprehensive review of peer-reviewed research on infrasound effects.	
South Bragar Grazings Committee	Consultation representations	South Bragar Grazings Committee representation requests that the EIA should include a Noise Impact Assessment evaluating risks from low-frequency noise and infrasound to humans and nonhuman life. It should include a comprehensive review of peer-reviewed research on infrasound effects.	See response to Scottish Ministers.

19.4 SCOPE OF THE ASSESSMENT

19.4.1 OVERVIEW

19.4.1.1 This section sets out the scope of the EIA for Offshore Airborne Noise. This scope has been developed as the Offshore Project design has evolved and responds to feedback received to date as set out in Section 19.3.

19.4.2 SPATIAL SCOPE AND STUDY AREA

19.4.2.1 The Offshore Airborne Noise assessment is completed at the nearest noise sensitive receptors (NSRs) to the Offshore Project. The assessment is completed on the basis that if noise impacts are acceptable at these locations, then they will also be acceptable at more distant NSRs. The selected NSRs are located along, but inside the northwest coastline of the Isle of Lewis/*Eilean Leòdhais*.

19.4.3 TEMPORAL SCOPE

19.4.3.1 The temporal scope of the assessment of Offshore Airborne Noise is the entire lifetime of the Offshore Project, which therefore covers the construction, operation and maintenance (O&M), and decommissioning phases. The construction phase is anticipated to commence in 2028/2029 and last for a period of approximately 5 years. The O&M phase is expected to last for a minimum of 35 years. It is anticipated that the decommissioning phase will consist of the reverse of the construction phase, including a similar duration.

19.4.4 POTENTIAL RECEPTORS

19.4.4.1 The spatial scope of the assessment enables the identification of NSRs which may experience a change/potential impact as a result of the Offshore Project. Residential properties along the northwest coast of the Isle of Lewis/*Eilean Leòdhais* have the potential to experience the greatest effect from airborne noise. A sample of receptor groups have been identified; the receptor groups have been selected based on proximity to the Array Area and to provide a geographical spread. The identified receptors groups with the potential to experience the greatest significant effects for airborne noise are outlined in **Table 19-3**.

Table 19-3 Receptors groups requiring assessment for Offshore Airborne Noise

Receptor Group	Receptors included within group
Garenin/ <i>Na Gearrannan</i>	Receptor group comprises residential dwellings (including NSR 1) as well as the Blackhouse Village buildings within the crofting township of Garenin/ <i>Na Gearrannan</i> on the west of the Isle of Lewis/ <i>Eilean Leòdhais</i> .
Dalmore/ <i>Dail Mhor</i>	Receptor group comprises residential dwellings (including NSR 2) in the hamlet of Dalmore/ <i>Dail Mhor</i> on the west of the Isle of Lewis/ <i>Eilean Leòdhais</i> .
South Shawbost/ <i>Siabost bho Dheas</i>	Receptor group comprises residential dwellings (including NSR 3) in the village of Shawbost/ <i>Siabost</i> on the west of the Isle of Lewis/ <i>Eilean Leòdhais</i> .
Labost	Receptor group comprises residential dwellings (including NSR 4) in the crofting township Labost on the west of the Isle of Lewis/ <i>Eilean Leòdhais</i> .
Brue/ <i>Brù</i>	Receptor group comprises residential dwellings (including NSR 5) in the crofting township of Brue/ <i>Brù</i> on the west of the Isle of Lewis/ <i>Eilean Leòdhais</i> .
Ballantrushal/ <i>Baile an Truiseil</i>	Receptor group comprises residential dwellings (including NSR 6) in the village of Ballantrushal/ <i>Baile an Truiseil</i> on the west of the Isle of Lewis/ <i>Eilean Leòdhais</i> .

19.4.4.2 For each receptor group, a representative NSR location is selected for assessment. The selected NSR is representative of all the receptors in the group. The selected NSR locations are detailed in **Table 19-20** and **Figure 19.3, Volume 2b**.

19.4.5 ACTIVITIES OR IMPACTS SCOPING INTO ASSESSMENT

19.4.5.1 Potential impacts from Offshore Airborne Noise that have been scoped-in for assessment are summarised in **Table 19-4**.

Table 19-4 Activities or impacts scoped into the assessment for Offshore Airborne Noise

Receptor	Activity or Impact	Potential effects
Construction		
All receptor groups identified in Table 19-3 .	Offshore construction percussive piling noise.	Offshore percussive piling activities have the potential to generate noise levels exceeding established thresholds, resulting in a potentially significant adverse noise impact during the construction phase.
Operation and maintenance		
All receptor groups identified in Table 19-3 .	Offshore Wind Turbine Generator (WTG) noise.	WTGs have the potential to generate noise levels exceeding established noise limits, resulting in a potentially significant adverse noise impact during the operational phase.

19.4.6 ACTIVITIES OR IMPACTS SCOPED OUT OF ASSESSMENT

19.4.6.1 Several potential impacts have been scoped out of further assessment, resulting from a conclusion of no likely significant effect. These conclusions have been made based on the knowledge of the baseline environment, the nature of planned works and the wealth of evidence on the potential for impact from such projects more widely. The conclusions follow (in a site-based context) existing best practice. Each scoped-out activity or impact is considered in turn in **Table 19-5**.

Table 19-5 Activities or impacts scoped-out of assessment for Offshore Airborne Noise

Activity or impact	Rationale for scoping out
Construction vessel noise	<p>Noise generated by vessel movements supporting the construction phase of the Offshore Project are not considered to result in a likely significant effect.</p> <p>Most construction vessel traffic will occur far from the shoreline and noise from these vessels would not be heard on land closest to the site.</p> <p>The noise produced during WTG installation works would be minimal, due to the slow and precise nature of the work.</p> <p>Vessels supporting the landfall construction, namely Horizontal Directional Drilling (HDD) works, is not expected to contribute to construction noise levels at NSRs. Noise levels will be dominated by the onshore HDD equipment, which is both louder and closer to NSRs, compared to the support vessels. The assessment of onshore HDD works will be presented in the OTW Project.</p>
Operational wind turbine infrasound and	These noise impacts fall outside the scope of an ETSU-R-97 compliant assessment; and are not included in the IOA GPG which is accepted by the Scottish Government as current industry good practice.

Activity or impact	Rationale for scoping out
low frequency noise	In December 2022, WSP published their report 'A review of noise guidance for onshore wind turbines' for the then Department for Business, Energy and Industrial Strategy (The BEIS report). That report confirms that: <i>"...the weight of evidence appears to indicate that wind turbine infrasound has no adverse effects on human health at typical exposure levels..."</i> and that; <i>"...due to the inherent characteristics of wind turbine sound, suitable controls on A-weighted sound levels are expected to also provide sufficient control for the potential impact of low frequency noise"</i> .
Operational wind turbine amplitude modulation	<p>This noise impact fall outside the scope of an ETSU-R-97 compliant assessment; and is not included in the IOA GPG which is accepted by the Scottish Government as current industry good practice.</p> <p>Regarding amplitude modulation (the variation in noise level associated with the wind turbine operation at the rate at which turbine blades pass a fixed point), the ETSU-R-97 assessment method accounts for this, up to a stated degree, it being a component part of typical wind turbine noise. The remaining potential issue is therefore only that associated with possible 'excess' amplitude modulation, i.e. at a level above that already accounted for in the ETSU-R-97 assessment method. However, there is currently no reliable or recognised means to predict the likely occurrence of amplitude modulation. There are reported recommendations for its measurement and quantification, but at the time of writing there has been no endorsement of those approaches from any Scottish Minister or Departments.</p>
Operational wind turbine vibration impact on humans	The separation distances between turbines and NSRs is more than 6 km. At these distances there will not be a vibration impact.
Operational fog signal noise	The Offshore Project will require fog signals, which are essential safety infrastructure which only operate during specific low visibility conditions. The model has not yet been selected, a representative example is the Sabik FS02 unit, which has a quoted signal output of 134 dB at 1 m (equivalent to approximately 145 dB sound power). The output frequency is 850 Hz (lower frequencies are not used, so that the signal is audible above the low frequency ship generated noise). The sound power level, 145 dB, is set such that the device is audible at ships within a 2 nautical mile range (3.7 km). By comparison, the closest receptors are at 6.8 km, affording addition attenuation due to distance. Taking this into account, their intermittent use during specific low visibility conditions, and that receptors can be considered less sensitive to a noise source designed in the interest of safety, a significant effect is not expected. Assessment of fog signals is therefore scoped out.
Decommissioning phase	<p>No potential likely significant effects have been identified for the decommissioning phase, as this stage does not involve percussive piling activities.</p> <p>A decommissioning plan and programme will be developed prior to construction and updated during the operational phase of the project to account for any changes to industry best practice, relevant legislation and policy, or developments in technology.</p>

19.5 METHODOLOGY FOR BASELINE DATA GATHERING AND IMPACT ASSESSMENT

19.5.1 METHODOLOGY FOR BASELINE DATA GATHERING

Overview

19.5.1.1 Baseline data has been collected at locations along the northwest coast of the Isle of Lewis/*Eilean Leòdhais*. The baseline data and source are identified, as well as the data limitations and assumptions. A summary of the baseline noise survey is presented.

19.5.1.2 The methodology for environmental impact assessment is set out, including the criteria used to determine significance.

Desk study

19.5.1.3 A desk study has been undertaken to assist in determining the baseline conditions, this has included:

- Identification of potential cumulative wind turbine/wind farm developments and their associated details (both operational and projects in planning);
- Identification of NSRs, including those with the greatest potential to be subject to a significant adverse impact from the Offshore Project operating in isolation, and under the cumulative scenario;
- Identification of possible local noise sources in the vicinity of the identified NSRs;
- Identification of a sample of representative locations at which to undertake baseline noise monitoring;
- Identification of information to inform the operational noise level predictions.

19.5.1.4 The data sources that have been collected and used to inform this Offshore Airborne Noise assessment are summarised in **Table 19-6**.

Table 19-6 Data sources used to inform the Offshore Airborne Noise EIA

Source	Date	Summary	Coverage of study area
CnES website	Date accessed: October 2025	Local authority information including: <ul style="list-style-type: none"> • OHLDP Supplementary Guidance for Wind Energy Development - Map 3; • Online planning portal. 	Full coverage of study area
Enercon	Date accessed: May 2025	Manufacturer's sound power data for wind Enercon E-44 turbines installed at the Baile an Truseil Wind Energy Project (BaT Wind Farm) and Horshader Wind Farm:	Non spatial data

Source	Date	Summary	Coverage of study area
		<ul style="list-style-type: none"> SIAS-04 SPL E44 OM I Rev2_1-eng-eng.doc, Rev 2.1, dated 19 June 2012, entitled: Sound Power Level of the ENERCON E-44 Operational Mode I. 	
Galston Estate Trust website	Date accessed: May 2025	Details of the cumulative wind farm developments: <ul style="list-style-type: none"> BaT Wind Farm existing development; West Coast Community Energy (WCCE Wind Farm) pre-planning development. 	Site specific information relating to the wind farm developments.
Google	Date accessed: August 2024	Publicly available satellite mapping	Full coverage of study area
Google	Date accessed: August 2024	Publicly available street photography	Full coverage of study area
Horshader Community Development website	Date accessed: June 2025	Details of the cumulative wind farm development: Horshader Wind Farm existing development.	Site specific information relating to the wind farm development.
Muaitheabhal Wind Farm Repower – Figure 5.6: Operational, Consented and Proposed Wind farms	Date accessed: June 2025	Details of the cumulative wind farm developments: <ul style="list-style-type: none"> BaT Wind Farm existing development; Horshader Wind Farm existing development. 	Site specific information relating to the wind farm developments.
NatureScot	Date accessed: March 2025	Onshore Wind farm Proposals mapping	Full coverage of study area
Ordnance Survey (OS)	Date accessed: August 2024	AddressBase Core®	60% coverage
OS	Date accessed: August 2024	1:25000 OS Explorer mapping	Full coverage of study area
OS	Date accessed: October 2025	1:50000 OS Land Ranger mapping	Full coverage of study area
Saare Wind Energy Meretuulepargi Keskkonnamõju hindamine	Date accessed: October 2025	Vestas V236 sound power levels (L_{WA}) in 1/3 octave bands Vestas technical report reference: <i>DMS 0105-2594_01 V236-15 MW</i>	Non-spatial data
Vestas V236-15.0 MW	Date accessed: October 2025	Vestas V236 maximum broadband sound power level (L_{WA})	Non-spatial data
The Wind Power	Date accessed: October 2025	Horshader wind turbine development installed turbine	Non-spatial data

Site Surveys

19.5.1.5 The baseline noise survey that has been used to inform this Offshore Airborne Noise assessment is summarised in **Table 19-7**.

Table 19-7 Site surveys undertaken

Survey type	Scope of survey	Coverage of study area
Baseline noise survey 2024/2025 (see Section 19.6, Appendix 19.3, Volume 2c, Appendix 19.5, Volume 2c, Appendix 19.6, Volume 2c, and Appendix 19.7, Volume 2c.	<p>A detailed baseline noise survey has been undertaken to determine the prevailing background noise levels at a sample of 6 NSRs along the west side of the Isle of Lewis/<i>Eilean Leòdhais</i>. The noise monitoring locations were selected to be representative of the surrounding NSRs at each location and along the stretch of the western side of the island closest to the Offshore Project.</p> <p>Prevailing weather conditions during the survey were measured using a Floating Light Detection and Ranging (FLiDAR) system. The FLiDAR was located centrally in the Array Area and provides a reliable representation of the typical offshore wind conditions.</p>	Full coverage of study area.

19.5.2 DATA LIMITATIONS AND ASSUMPTIONS

19.5.2.1 The WTG type to be installed at the Offshore Project is not yet known and would depend both on the design option taken forward and the results of a tender process (see **Chapter 3, Volume 1a**). The tender process would not be progressed until after the application for the Offshore Project has been determined.

19.5.2.2 Predictions and assessments have therefore been undertaken, for each of the 2 options under consideration within the Project Design Envelope, based on a candidate WTG type.

19.5.2.3 For Option 1 (up to 60 WTGs; smaller turbine), manufacturer noise emission data for a 15 MW, 236 m rotor candidate WTG type has been used. The selected Option 1 candidate WTG fits within the design envelope for this option. The Option 1 candidate WTG has a maximum sound power level of 115.3 dB(A).

19.5.2.4 For Option 2 (up to 44 WTGs; larger turbine), manufacturer noise emission data for a 22 MW WTG with an approximate 280m rotor diameter is not currently available. For the purposes of this assessment, a maximum broadband noise level of 122 dB(A) has been adopted. The Option 1 noise emission dataset has been applied, with an increase of +6.7 dB to produce an overall level of 122 dB(A).

- 19.5.2.5 All Predictions include a +2 dB correction for uncertainty.
- 19.5.2.6 Regardless, it should be noted that it is standard practice for a wind farm development to be subject to a noise related consent condition stipulating appropriate noise level limits to which it must comply once operational. Such noise level limits have been derived as part of this assessment, see Section 19.9 and can be used to ensure an appropriate control over future noise emissions.
- 19.5.2.7 The existing BaT Wind Farm (also known as Loch Sminig Wind Farm) is an existing cumulative development, see Section 19.6.4. It has been identified that the daytime noise level limits that this development is subject to are incorrectly conditioned to apply only to 'quiet daytime hours', not *all* daytime hours. To address this, noise levels have not been 'capped' to its conditioned daytime noise limit, instead being taken in full, with an additional +2 dB allowance included for potential future increases.
- 19.5.2.8 The Horshader Wind Farm is an existing cumulative development, see Section 19.6.1. The applicable noise conditions were requested but not provided. To address this, noise levels for this development were not 'capped', with an additional +2 dB allowance included for potential future increases.
- 19.5.2.9 At this stage, the construction piling source levels are not yet known and would depend on variables including the option taken forward, hammer energy, pile diameter and ground conditions. For the assessment of percussive piling noise, conservative parameters have been adopted for source level, the Maximum Design Scenario parameters and assessment assumptions are outlined in **Table 19-21**.
- 19.5.2.10 The propagation of sound over large water bodies can result in reduced attenuation when compared to propagation over land. For sound propagation over water, the methodology assumes a flat sea surface acting as a reflective plane and downward sound refraction. This refraction typically occurs under downwind conditions and temperature inversions. When both a flat sea and downward refraction are present, multiple sound reflections can occur, leading to elevated sound levels due to increased sound energy transmission. In assessing percussive piling noise, conservative propagation parameters are applied, including incorporating the multiple reflection phenomenon.

19.5.3 METHODOLOGY FOR ENVIRONMENTAL IMPACT ASSESSMENT

Introduction

- 19.5.3.1 The project-wide generic approach to assessment is set out in **Chapter 5, Volume 1a**. The following sections provide the assessment methodology used to assess the potential impacts of Offshore Airborne Noise only.
- 19.5.3.2 A matrix approach as described in **Chapter 5, Volume 1a** has been used to determine the significance of effects, by comparing impact magnitude against receptor value and sensitivity.

19.5.3.3 This methodology has been used to assess the construction and O&M phases of the Offshore Project.

19.5.3.4 The significance of effects for construction and O&M phase impacts is determined by consideration to the NSR sensitivity and the impact magnitude, by application of the matrix presented in **Table 19-8**.

Table 19-8: Airborne noise significance matrix

Magnitude of impact	NSR Sensitivity		
	High	Medium	Low
High	Major	Moderate	Minor
Medium	Moderate	Minor	Negligible
Low	Minor	Negligible	Negligible
Slight	Negligible	Negligible	Negligible

19.5.3.5 Guidance from the Technical Advice Note (TAN) to PAN 1/2011 has been used to determine NSR sensitivity, as shown in **Table 19-8**. The sensitivity of NSRs is the same across impact types and applies to both construction and O&M phases.

Table 19-9: NSR sensitivity

NSR sensitivity	Description	Examples
High	Receptors where people or operations are particularly susceptible to noise and/or vibration.	Residential, quiet outdoor recreational areas, schools, hospitals, places of worship.
Medium	Receptors moderately sensitive to noise and/or vibration, where it may cause some distraction or disturbance.	Offices, restaurants and sports grounds (where quiet conditions are necessary).
Low	Receptors where distraction or disturbance from noise and/or vibration is minimal.	Unoccupied buildings or factories and working environments with existing levels of noise. Sports ground where noise is a normal part of the event.

Assessment methodology: Construction phase percussive piling noise

19.5.3.6 The offshore Turbine Area is located approximately 6 km from the nearest shoreline.

19.5.3.7 The assessment of construction noise is based on comparing predicted percussive piling noise levels during the construction phase, to threshold level criteria selected accounting for the ambient noise levels at NSRs.

19.5.3.8 The assessment of construction percussive piling noise has included the following steps:

- Identify the nearest NSRs to the Offshore Project;

- Select a representative sample of the identified NSRs for assessment, ensuring a good geographic spread across the local area;
- Set noise threshold level criteria based on the most stringent guidance contained in BS 5228-1, namely, the Category A thresholds detailed in the ABC method;
- Identify the proposed piling techniques and assess the highest noise generating method, namely, percussive piling;
- Undertake noise level predictions for a range of distances that cover the percussive pile technique area. Refer to **Appendix 19.2, Volume 2c** for additional details of the noise modelling process and applied prediction method;
- Include 4 noise prediction scenarios based on the variable hammer energy to be used across the Turbine Area (see **Chapter 3, Volume 1a** and **Appendix 3.1, Volume 1c**):
 - Apply 100% hammer energy (5,000 kJ) with multiple reflections correction (worst-case),
 - Apply 100% hammer energy (5,000 kJ) with spherical spreading,
 - Apply 50% hammer energy (2,500 kJ) with multiple reflections correction,
 - Apply 50% hammer energy (2,500 kJ) with spherical spreading;
- Assess predicted percussive piling noise levels against the construction noise threshold level criteria;
- Determine the resulting significance of effect;
- Consider available noise mitigation measures where any exceedance of the noise threshold level criteria is identified.

Magnitude - Construction phase percussive piling noise

- 19.5.3.9 The impact magnitude for construction percussive piling noise is based on the BS 5228-1 ABC method, see **Appendix 19.1, Volume 2c**.
- 19.5.3.10 Construction noise thresholds are set in relation to ambient noise levels. At the NSRs, these levels are largely determined by weather conditions. Periods of higher wind increase the ambient noise, which would allow for higher permissible construction noise thresholds. For this assessment, the most conservative approach has been applied, adopting Category A threshold levels.
- 19.5.3.11 The Category A construction noise thresholds are 65 dB $L_{Aeq,T}$ daytime, 55 dB $L_{Aeq,T}$ evening and 45 dB $L_{Aeq,T}$ night-time. If noise levels exceed these values, a potential significant effect is indicated, but the significance could be tempered, for example if the exceedance is for a short duration.
- 19.5.3.12 It is standard practice in environmental assessments to adopt a tiered magnitude of impact scale. An appropriate magnitude of impact scale has been derived based on the BS 5228-1 ABC method. The ABC method has a 5 dB step between each category (i.e. between Categories A and B, and between Categories B and C), a 5 dB step has been applied to the impact magnitude scale, as shown in **Table 19-10**.

Table 19-10: Impact magnitude scale - construction noise (L_{Aeq,T} dB)

Magnitude of impact	Day*	Evening**	Night [†]
High	≥70	≥60	≥50
Medium	≥65- <70	≥55- <60	≥45- <50
Low	≥60- <65	≥50- <55	≥40- <45
Slight	<60	<50	<40
* Weekdays 07:00-19:00 and Saturdays 07:00-13:00)			
** Weekdays 19:00-23:00, Saturdays 13:00-23:00, Sundays 07:00-23:00)			
† Weekdays, Saturdays, Sundays 23:00-07:00)			

Sensitivity - Construction phase percussive piling noise

19.5.3.13 All identified NSRs are residential properties and are therefore classified as high sensitivity receptors.

Significance - Construction phase percussive piling noise

19.5.3.14 The significance of effects for construction phase impacts is determined by consideration to the NSR sensitivity and the impact magnitude, by application of the matrix presented in **Table 19-8**.

19.5.3.15 Effects identified to be Negligible or Minor are regarded as 'not significant', whereas those identified as 'Moderate' or 'Major' are considered 'significant'.

Assessment methodology: O&M phase WTG noise

19.5.3.16 The assessment of operational wind turbine noise (WTN) from the Offshore Project has been undertaken following the methodology detailed within ETSU-R-97 and the IOA GPG, including the following steps:

- Identify potential cumulative wind turbine/wind farm developments;
- Identify the nearest NSRs to the Offshore Project, including those with the greatest potential to be affected by the Offshore Project operating alone and in combination with cumulative developments;
- Select a representative sample of the identified NSRs for assessment, ensuring good geographic coverage across the local area;
- Undertake a detailed baseline noise survey, including measurements at 6 different locations;
- Correlate baseline noise data with concurrent wind speed data measured on the Offshore Project site;
- Analyse the baseline noise survey data in accordance with ETSU-R-97 and the IOA GPG, giving separate consideration to 'quiet daytime' and night-time periods, and determine the relationships between background noise level and standardised wind speed;
- Undertake separate analysis for the highest hub height associated with the Turbine Layout Options within the design envelope (Option 1: 175.8 m hub height; Option 2: 198.4 m hub height);

- Compare the results of the baseline data analysis for each WTG type and retain the most conservative results for use in the assessment (see **Appendix 19.6, Volume 2c**);
- Identify the influence of wind direction on noise and separate the retained data into 2 subsets: winds from onshore and winds from offshore;
- Identify the total ETSU-R-97 daytime and night-time WTN level limits for each measurement location (see **Appendix 19.10, Volume 2c**);
- Set the fixed elements of the total noise limits in accordance with ETSU-R-97;
- Set the variable elements of the total noise level limits at background level +5 dB(A), as required by ETSU-R-97;
- Prepare a noise model for each Turbine Layout Option under appraisal, including the representative NSRs and the identified cumulative developments. Refer to **Appendix 19.2, Volume 2c** for details of the noise modelling process and applied prediction methodology;
- Undertake noise level predictions for the Offshore Project (both Turbine Layout Options) and the cumulative developments, operating alone and in combination;
- Undertake noise level predictions for each Option for 3 wind directions (see **Appendix 19.9, Volume 2c**):
 - Downwind: wind from offshore;
 - Upwind: wind from onshore;
 - Crosswind: wind between onshore and offshore;
- Undertake cumulative development noise level predictions for downwind propagation using installed turbine types, see **Appendix 19.9, Volume 2c**;
- Undertake noise level predictions for each NSR for 10 m height integer wind speeds between turbine cut-in wind speed and 12 m/s;
- Undertake noise level predictions for each Option using a candidate WTG type that fits within the design envelope;
- Apply appropriate corrections for uncertainty within all predictions;
- Determine residual noise level limits for NSRs where cumulative developments may make an acoustically relevant contribution. Calculate these limits including a +2 dB allowance for potential future noise level increases from cumulative developments;
- Compare the predicted noise levels for the Offshore Project operating in isolation against the derived noise level limits;
- Demonstrate that compliance with the noise level limits ensures no cumulative impact from the Offshore Project, as the limits already account for cumulative noise;
- Consider available noise mitigation measures where any exceedance of applicable noise level limits is identified.

19.5.3.17 The noise limits used to assess the Offshore Project represent acceptable noise levels. These limits take into account the noise generated from the identified cumulative developments. Therefore, when the Offshore Project's scoped-in activities remain within these limits, no significant effects are

expected. However, if the Offshore Project’s scoped-in activities exceed the established noise limits, a significant effect will occur, and the need for additional mitigation measures will be evaluated.

Magnitude - O&M phase WTG noise

19.5.3.18 For operational WTN, a tiered magnitude of impact scale has been derived based on ETSU-R-97, see **Appendix 19.1, Volume 2c**, and adopting a 5 dB step, as shown in **Table 19-11**.

Table 19-11: Impact magnitude scale - O&M phase WTG noise

Magnitude of impact	WTG noise level compared to the applicable limit (dB)
High	Greater than or equal to +5
Medium	Greater than or equal to 0 and less than +5
Low	Less than 0 and greater than -5
Slight	Less than 5

Sensitivity - O&M phase WTG noise

19.5.3.19 All identified NSRs are residential properties and are therefore classified as high sensitivity receptors.

Significance - O&M phase WTG noise

19.5.3.20 The significance of effects for O&M phase impacts is determined by consideration to the NSR sensitivity and the impact magnitude, by application of the matrix presented in **Table 19-8**.

19.5.3.21 Effects identified to be Negligible or Minor are regarded as ‘not significant’, whereas those identified as ‘Moderate’ or ‘Major’ are considered ‘significant’.

19.6 BASELINE CONDITIONS

19.6.1 BASELINE NOISE SURVEY

19.6.1.1 A detailed baseline noise survey has been carried out at a sample of NSRs located along, but inside the northwest coastline. The dominant noise sources are natural in nature (wind induced noise and noise from the coastline/sea). The observed dominant noise sources recorded at each survey location are detailed in **Appendix 19.3, Volume 2c**. The monitoring locations were selected to avoid contribution from existing WTG.

19.6.1.2 Continuous long-term (LT) monitoring was undertaken at the locations listed in **Table 19-12**. These locations were selected to be representative of the NSRs detailed in **Table 19-3** whilst also providing a good geographic spread across the local area.

Table 19-12: Summary of baseline noise monitoring locations

ID	Location	Easting	Northing	Start	End	Duration	NSR ¹
LT1	Garenin/ <i>Na Gearrannan</i>	119452	944201	17 December 2024 12:10	28 January 2025 04:10	41 days 16 hrs	NSR1
LT2	Dalmore/ <i>Dail Mhor</i>	121964	944601	17 December 2024 11:10	28 January 2025 03:10	41 days 16 hrs	NSR2
LT3	South Shawbost/ <i>Siabost bho Dheas</i>	124564	947611	16 December 2024 16:20	27 January 2025 08:20	41 days 16 hrs	NSR3, NSR9
LT4	Labost	127978	949398	17 December 2024 10:30	28 January 2025 02:30	41 days 16 hrs	NSR4
LT5	Brue/ <i>Brù</i>	133293	950361	16 December 2024 15:40	27 January 2025 07:40	41 days 16 hrs	NSR5
LT6	Ballantrushal/ <i>Baile an Truiseil</i>	137650	953908	16 December 2024 14:50	27 January 2025 06:50	41 days 16 hrs	NSR6, NSR7, NSR8

¹ The baseline noise monitoring locations are representative of the identified NSRs.

19.6.1.3 The measurement locations are shown on **Figure 19.3, Volume 2b**.

19.6.1.4 The IOA GPG advises that a survey duration of less than 2 weeks is unlikely to be sufficient to obtain a dataset covering the required range of wind speeds and directions (the latter if relevant). It can be seen from **Table 19-12** that all measurement locations were subject to significantly longer measurement durations than the minimum 14-day period, to ensure that a representatively wide range of wind conditions have been captured.

19.6.1.5 Further survey details are provided in **Appendix 19.3, Volume 2c**.

Meteorological Data

19.6.1.6 For the duration of this baseline noise survey, simultaneous 10-minute meteorological measurements were undertaken on the site of the Offshore Project. A meteorological FLiDAR measurement system was installed in October 2023 at Easting 120778 and Northing 956755, and was measuring over the noise survey period.

19.6.1.7 The FLiDAR system recorded data included rainfall, average wind speed and wind direction. Wind speed and direction measurements were obtained over a range of different heights above mean sea level. The data used for this assessment was that obtained at 150 m, 160 m, 170 m, and 180 m.

19.6.1.8 The FLiDAR measurements were accurate to within the IOA GPG requirements of +/- 0.2 m/s for windspeed and +/- 6° for wind direction.

Baseline Noise Survey Results

- 19.6.1.9 To determine how the measured background noise levels change with wind speed at each measurement location, it is necessary to correlate the noise measurement data with wind speed data standardised to 10 m height (U_{10}) for the proposed hub height.
- 19.6.1.10 The 2 Options being appraised for the Offshore Project have the following hub height ranges above mean sea level:
- Option 1 (smaller turbine) hub height range: 148.0 m-175.8 m;
 - Option 2 (larger turbine) hub height range: 168.0 m-198.4 m.
- 19.6.1.11 For each Option, the highest hub height has been selected, to ensure a worst-case analysis of the baseline data.
- 19.6.1.12 The measured average wind speeds obtained at heights of 150 m and 170 m have been used to determine the corresponding wind speeds at the selected Option 1 hub height of 175.8 m. The measured average wind speeds obtained at heights of 160 m and 180 m have been used to determine the corresponding wind speeds at the selected Option 2 hub height of 198.4 m.
- 19.6.1.13 The hub height wind speeds have then been adjusted to 10 m (standardised) height using the standard wind shear profile corresponding with standard ground roughness. The method used is detailed in **Appendix 19.4, Volume 2c**, and is in accordance with the IOA GPG.
- 19.6.1.14 This standardisation process is necessary to allow a fair comparison of results against predicted WTN levels, which are undertaken based on WTN emission data also referenced to the same 10 m standardised height.
- 19.6.1.15 The standardised 10 m height average wind speed data and the measured $L_{A90,10\text{min}}$ noise level data for each measurement location were time-synchronised with Greenwich Mean Time (GMT)/Coordinated Universal Time (UTC). Adopting GMT/UTC within the analysis ensured that it was based on the timeclock to which the UK population were operating at the time of the baseline noise survey. Account was also given to whether the time stamp associated with each data set (i.e., the noise measurement data set and meteorological data set) represented the start or end of each measurement period.
- 19.6.1.16 The synchronised datasets were then filtered to remove any periods of significant rain (which was defined as 1 mm or more within the preceding 1-hour period), as well as any identified anomalous noise events not considered representative of the underlying background noise levels. Examples of anomalous noise events might include, for example, the operation of a fixed or mobile plant item, or lawn mowing operation which falsely increased the measured background levels for a limited period. Such events were identified from a manual inspection of the noise measurement data traces.

19.6.1.17 After filtering, the data was split into the following sets as defined in ETSU-R-97:

- Quiet daytime hours: 18:00-23:00 on all days, as well as 13:00-18:00 on Saturdays and Sundays, and 07:00-13:00 on Sundays;
- Night-time hours: 23:00 and 07:00 on all days.

19.6.1.18 Separate graphs for the quiet daytime and night-time periods for each measurement location are presented in **Appendix 19.5, Volume 2c** using Option 2 (198.4 m hub height) data. To determine the prevailing background noise levels, each graph includes a third order polynomial line of best fit.

19.6.1.19 A comparison of the graphs for Option 1 (175.8 m hub height) and Option 2 shows minimal difference in baseline noise results, see **Appendix 19.6, Volume 2c**. Therefore, the baseline data analysis for Option 2 has been used, as its higher hub height represents the worst-case scenario.

19.6.2 DIRECTIONAL FILTERING

19.6.2.1 The Offshore Project is proposed to the northwest of the shoreline, and the shoreline was observed to be one of the key sources contributing to the background noise conditions. The shoreline is always to the west of the measurement locations, so the background noise levels will change depending upon wind direction. The operational sound levels arising from the Offshore Project at the NSRs will also depend upon wind direction.

19.6.2.2 Additional analysis has therefore been undertaken with the measured baseline split into downwind and upwind by applying directional filtering.

19.6.2.3 Downwind conditions refer to wind directions ranging from 238°-58°, originating from the sea. Upwind conditions refer to wind directions ranging from 58°-238°, originating from the land.

19.6.2.4 The data analysis for the downwind and upwind directional splits is presented in **Appendix 19.7, Volume 2c**. For each directional split, and each measurement location, separate analysis graphs are presented for quiet daytime and night-time periods. Each graph depicts the data that has been retained in the analysis and that which has been removed either due to rain or manually for anomalous events.

19.6.2.5 With directional filtering applied, the background noise data points are more tightly grouped, indicating greater correlation. As a result, it is considered appropriate to apply directional filtering to background noise level data based on wind direction.

19.6.2.6 To define the relationship between wind speed and background noise level, each graph includes a 3rd-order polynomial line of best fit for the retained dataset.

19.6.3 BACKGROUND NOISE LEVELS

19.6.3.1 The identified background noise levels, determined from the polynomial trend lines presented in Plates 1-1 to 1-24 of **Appendix 19.7, Volume 2c**, are presented in **Table 19-13** (Downwind conditions) and **Table 19-14** (Upwind conditions).

Table 19-13: Baseline noise survey - Background noise levels - Downwind conditions

Period	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
Measurement Location LT1											
Quiet Daytime	32.5	34.0	35.5	36.9	38.3	39.7	41.1	42.5	43.9	45.4	46.9
Night-time	36.5	37.0	37.6	38.3	39.1	40.0	41.1	42.3	43.7	45.2	46.9
Measurement Location LT2											
Quiet Daytime	41.4	42.5	43.5	44.5	45.4	46.4	47.4	48.5	49.6	51.0	52.5
Night-time	40.6	42.4	43.8	45.0	45.9	46.8	47.6	48.5	49.5	50.7	52.2
Measurement Location LT3											
Quiet Daytime	40.2	41.0	41.9	42.9	44.0	45.2	46.6	48.1	49.7	51.4	53.2
Night-time	40.5	41.3	42.1	43.1	44.2	45.3	46.6	48.0	49.6	51.2	53.1
Measurement Location LT4											
Quiet Daytime	36.5	37.9	39.2	40.5	41.8	43.1	44.3	45.5	46.8	48.0	49.3
Night-time	37.0	38.3	39.6	40.8	42.0	43.2	44.4	45.7	47.0	48.3	49.6
Measurement Location LT5											
Quiet Daytime	41.2	42.8	44.2	45.4	46.5	47.5	48.5	49.6	50.6	51.8	53.2
Night-time	42.1	43.7	45.0	46.1	47.1	47.9	48.8	49.7	50.6	51.7	52.9
Measurement Location LT6											
Quiet Daytime	38.4	38.8	39.4	40.2	41.1	42.2	43.3	44.6	46.0	47.4	48.8
Night-time	39.4	39.8	40.4	41.0	41.7	42.5	43.4	44.3	45.4	46.5	47.7

Table 19-14: Baseline noise survey - Background noise levels - Upwind conditions

Period	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
Measurement Location LT1											
Quiet Daytime	37.3	36.5	36.1	36.3	36.8	37.7	38.9	40.4	42.1	43.9	45.8
Night-time	35.9	35.2	35.0	35.3	36.0	37.0	38.3	39.9	41.6	43.5	45.5
Measurement Location LT2											
Quiet Daytime	39.7	38.2	37.5	37.6	38.3	39.6	41.4	43.5	45.8	48.3	50.8
Night-time	36.4	35.6	35.4	35.8	36.7	38.1	39.9	42.0	44.3	46.8	49.5

Period	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
Measurement Location LT3											
Quiet Daytime	42.1	41.1	40.6	40.5	40.7	41.2	42.0	43.0	44.1	45.4	46.7
Night-time	43.6	41.7	40.6	40.1	40.2	40.7	41.6	42.9	44.3	45.9	47.6
Measurement Location LT4											
Quiet Daytime	39.6	38.8	38.4	38.3	38.5	39.0	39.8	40.7	41.8	43.1	44.4
Night-time	41.0	39.6	38.6	38.1	38.0	38.2	38.7	39.5	40.5	41.6	42.9
Measurement Location LT5											
Quiet Daytime	40.3	38.8	37.8	37.3	37.1	37.2	37.7	38.4	39.4	40.5	41.8
Night-time	45.3	41.7	39.1	37.3	36.4	36.2	36.5	37.4	38.7	40.2	41.9
Measurement Location LT6											
Quiet Daytime	36.1	35.7	35.6	35.6	35.9	36.3	36.9	37.6	38.5	39.4	40.4
Night-time	41.6	38.3	36.0	34.7	34.1	34.2	34.9	36.0	37.4	39.0	40.6

19.6.4 FUTURE BASELINE

19.6.4.1 Over the lifetime of the Offshore Project, up to circa 2070, it is reasonable to assume that, over time, background noise levels at the closest NSRs to the Offshore Project will generally remain unchanged due to dominant noise sources being natural in nature (wind induced noise and noise from the coastline/sea). Minor increases in road traffic noise may occur, consistent with typical growth trends and potential rises in local vehicle usage. However, marked change in land use or population density are not anticipated.

19.6.5 CUMULATIVE DEVELOPMENTS

19.6.5.1 The following onshore wind farm developments have been identified on the northwest side of the island:

- BaT Wind Farm – Operational;
- Horshader Wind Farm – Operational;
- WCCE Wind Farm – Pre Planning Stage.

19.6.5.2 **Figure 19.3, Volume 2b** presents the locations of the cumulative wind turbine developments.

19.6.5.3 The BaT Wind Farm is operational and comprises 3 x 900 kW Enercon E44 WTGs, each with a hub-height of 55 m and rotor diameter of 44 m (corresponding to a tip height of circa 77 m). This wind farm is located approximately 650 m from the nearest NSR and approximately 1.3 km inland from the northwest coastline. These separation distances are such that there is the potential for a cumulative impact to arise with the Offshore Project. This development has therefore been scoped-in to the assessment. Further details on this development are presented in the Section 19.6.5.9.

19.6.5.4 The Horshader wind farm is operational and comprises 1 x 900 kW Enercon E44 WTGs, the turbine has an assumed hub-height of 55 m and rotor diameter of 44 m (corresponding to a tip height of circa 77 m). This wind farm is located approximately 670 m from the nearest NSR and approximately 1.5 km inland from the northwest coastline. These separation distances are such that there is the potential for a cumulative impact to arise with the Offshore Project. This development has therefore been scoped-in to the assessment. Further details on this development are presented in paragraphs 19.6.5.11 to 19.6.5.14.

19.6.5.5 The WCCE is a proposed community-owned wind farm in the northwest of the island. This proposal currently comprises 9 x 5 MW WTGs, each with hub height up to 110 m/tip height up to 180 m. However, this proposed development is only at pre-planning stage with no live planning application. The site of this proposed development is at Barvas/*Barabhas* Moor, east of the A857 which links Lower Bravas in the northwest with Stornoway/*Steòrnabhagh* in the southeast. The site is located approximately 2.6 km from the nearest NSR that is in the direction of the Offshore Project (Sgoil an Taobh Siar School to the northwest) and approximately 4.2 km from the NSRs closest to the shoreline in that direction. These separation distances are sufficient that a cumulative impact with the Offshore Project is not expected to arise. This development has therefore been scoped-out of the assessment.

19.6.5.6 The following offshore wind farm developments have been identified off the north/northwest coastline of the island:

- The Talisk Floating Offshore Wind Farm – Proposed;
- The Havbredey Floating Wind Farm – Proposed.

19.6.5.7 The Talisk array area is approximately 25 km off the northern coast of the island. The Havbredey array area is approximately 35 km off the northern coast of the island. These separation distances are sufficient that a cumulative impact with the Offshore Project is not expected to arise. These developments have therefore been scoped-out of the assessment.

19.6.5.8 The location of the above wind farm developments is shown in **Figure 19.2, Volume 2b**.

Baile an Truseil Wind Energy Project (operational)

19.6.5.9 The BaT Wind Farm is an operational onshore wind farm comprising 3 x 900 kW Enercon E44 WTGs, located as shown in **Table 19-15**. These positions were identified using satellite imagery.

Table 19-15: Baile an Truseil Wind Energy Project – WTG locations

WTG Reference	Easting (m)	Northing (m)	Hub Height (m)	Distance to Project WTGs
T1	137350	952499	55	Approximately 9.3 km
T2	137381	952778	55	Approximately 9.1 km
T3	136801	952850	55	Approximately 8.7 km

19.6.5.10 The nearest NSRs in different directions from the BaT Wind Farm, with the potential to be subject to a cumulative impact with the Offshore Project, are listed in **Table 19-16**.

Table 19-16: Baile an Truseil Wind Energy Project – Nearest NSRs

NSR	Easting	Northing	Distance to closest BaT WTG	Distance to Project WTGs
17A Ballantrushal/Baile an Truseil	137817	953284	650 m	Approximately 9 km
Morven/A' Mhorbhairne	136309	951437	1.5 km	Approximately 9 km

Horshader Wind Farm (operational)

19.6.5.11 This onshore wind farm is operational. It's 1 x 900 kW Enercon E44 WTGs is located as detailed in **Table 19-17**. The location has been determined from satellite imagery.

Table 19-17: Horshader Wind Farm – WTG location

WTG Reference	Easting (m)	Northing (m)	Hub Height (m)	Distance to Project WTGs
T1	124446	945834	55	Approximately 7.9 km

19.6.5.12 The nearest NSR to the Horshader Wind Farm, with the potential to be subject to a cumulative impact with the Offshore Project, is listed in **Table 19-18**.

Table 19-18: Horshader Wind Farm – Nearest NSRs

NSR	Easting	Northing	Distance to closest Horshader WTG	Distance to Project WTGs
4 Cnoc A Charnain	124992	946218	670 m	Approximately 7.9 km

19.6.5.13 The existing WTGs and nearest NSRs are shown on **Figure 19.3, Volume 2b**.

19.6.5.14 The planning application reference for this development is: 08/00407/PPD. Planning Condition 29 of the consent stipulates the noise level limits to which this development must comply, whilst Condition 30 details compliance noise monitoring requirements and Condition 31 requires that noise levels are reduced the specified noise limits in the case of exceedances being identified. These conditions are as follows:

"29: At wind speeds not exceeding 12m/s, as measured or calculated at a height of 10m above ground level at the nearest wind monitoring mast; the wind turbine noise level at any dwelling or other noise sensitive premises shall not exceed:

a) during night hours, 38 dB $L_{A90, 10min}$, or the Night Hours $L_{A90, 10min}$ Background Noise Level plus 5 dB(A), whichever is greater;

b) during Quiet Waking Hours, 35 dB $L_{A90, 10min}$ or the Quiet Waking Hours $L_{A90, 10min}$ Background Noise Level plus 5 dB(A), whichever is the greater.

In this condition:

'wind turbine noise level' means the rated noise level due to the combined effect of all the wind turbines, excluding existing background noise level but including any tonal penalty incurred under the methodology described in ETSU-R-97, pages 99 - 109;

'Background Noise Level' means the ambient noise level already present within the environment (in the absence of noise generated by the development) as measured and correlated with Wind Speeds;

'wind speeds' means wind speeds measured or calculated at a height of 10 metres above ground level on the wind farm site at the wind monitoring mast;

'Night Hours' means 2300 - 0700 hours on all days;

'Quiet Waking Hours' means 1800 - 2300 hours on all days, plus 0700 - 1800 hours and Sundays and 1300 - 1800 hours on Saturdays;

'Noise Sensitive Premises' means premises, the occupants of which could be exposed to noise from wind farm and includes hospitals, residential homes, nursing homes etc.

Condition 30: At the request of the Planning Authority, following a valid complaint to the Planning Authority relating to noise emissions from the wind turbine, the company shall measure, at its own expense the level of noise emissions from the wind turbine. The measurement and calculation of noise levels shall be undertaken in accordance with 'The Assessment and Rating of Noise from Wind Farms', September 1996, ETSU report number ETSU-R-97 having regard to paragraphs 1-3 and 5-11 inclusive, of the Schedule, pages 95 to 97; and Supplementary Guidance Notes to the Planning Obligation, pages 99 - 109.

Condition 31: Should the noise levels in the foregoing condition be exceeded, the company shall take steps to ensure that noise emissions from the wind turbine are reduced to the aforementioned noise levels or less".

19.6.5.15 Sound power level data for the installed Enercon E44 WTG type has been provided by the manufacturer in the form of an Enercon technical data sheet and a turbine noise emission test report. The technical data sheet contains broadband sound power level data (L_{WA}) for integer wind speeds at standardised 10 m height for the WTG installed with 55 m hub. The test report contains both broadband and 1/3 and 1/1 octave band sound power level data (L_{WA}) for integer wind speeds at standardised 10 m height for the WTG installed with 50 m hub. To allow direct comparison between the 2 sets of information, the equivalent hub height wind speeds were calculated for the test data, based on the standard ground roughness length value of $z_0 = 0.05$ and the equation presented in Page 33 of the IOA GPG. The data were then re-standardised to 10 m height for a 55 m hub height. The conversion was completed following the approach detailed in the IOA GPG

and **Appendix 19.4, Volume 2c**. The level data from the technical data sheet was then compared with the re-standardised test data. It was found that the technical data sheet did not contain a sufficient allowance for uncertainty to be compliant with the requirements of the IOA GPG. As such, to ensure IOA GPG compliance, the re-standardised test data has been used with the addition of an expanded uncertainty correction of $1.645 \sigma^1$ the uncertainty stated in the test report.

19.6.5.16 The resulting sound power level data that have been applied for the Enercon E44 WTGs are presented in **Table 19-19**.

19.6.5.17 Note that the test report and the manufacturers technical data sheet only included sound power level data for integer wind speeds between 7 and 10 m/s inclusive. The presented values for 4-6 m/s have been calculated based on the polynomial trend lines presented in the test report for 7-10 m/s, extended to cover these lower wind speeds. The octave band spectra for 7 m/s have been applied to wind speeds between 4 and 6 m/s inclusive.

Table 19-19: Sound power levels (L_{WA}) for the Enercon 900 kW E44, 55 m hub height, A-weighted, dB

Wind Speed Referenced to 10 m Height (Standardised U10), m/s	Octave Band Centre Frequency (Hz)									dB(A)
	32	63	125	250	500	1k	2k	4k	8k	
4	-	68.5	75.2	80.2	81.2	82.6	79.7	73	68.3	87.6
5	-	75.1	81.7	86.7	87.8	89.1	86.3	79.6	74.9	94.2
6	-	79.3	86	91	92	93.4	90.5	83.8	79.1	98.4
7	-	82.1	88.7	93.7	94.8	96.1	93.3	86.6	81.9	101.2
8	-	85.1	90.6	94.1	96.3	98.3	95.5	88.3	82.2	102.9
9	-	85.8	92.2	94.5	97.4	98.8	95.4	88.1	81.7	103.5
10	-	85.6	91.2	94.7	97.7	98.8	95.5	88.2	81.3	103.5

Data includes and uncertainty allowance of $1.645 G$ the stated test report uncertainty values.

19.6.6 EXISTING WIND TURBINE CONTRIBUTION CHECKS

19.6.6.1 ETSU-R-97 requires that the background sound levels are determined in absence of noise from existing WTGs.

Measurement Location LT2

19.6.6.2 On the other side of the glen to Measurement Location LT2, there are 2 existing small-scale WTGs. Their planning application references are 13/00557/PPD and 12/00600/PPD. The first confirms a single WTG with 20.6 m mast and 5.55 m blade whilst the second confirms a single WTG with 15 m

¹ Greek letter σ (sigma) represents measurement uncertainty as per IOA GPG.

mast and 2.25 m blade. Both are therefore small / farm scale WTGs. The first is of circa 20 kW power rating and the second is smaller.

19.6.6.3 **Appendix 19.3, Volume 2c** confirms that Measurement Location LT2 was located at a position acoustically screened from these 2 existing WTGs, and that noise from them was not audible above sea noise. This was the case during both windy periods and calmer periods. The baseline data collected at Measurement Location LT2 is therefore considered to have been obtained in absence of any acoustically relevant contribution from these 2 existing WTGs.

Measurement Location LT3

19.6.6.4 Measurement Location LT3 was installed approximately 1.8 km from the existing 900 kW Enercon E44 Horshader Wind Farm WTG. **Appendix 19.3, Volume 2c** confirms that noise from the Horshader Wind Farm was not audible at Measurement location LT3 during either windy periods or calmer periods.

19.6.6.5 Notwithstanding this, ordinarily, whilst there is a reasonable setback distance between this measurement location and the Horshader Wind Farm WTG, it would be normal to undertake a directional analysis of the measured background data, with the results used to check whether there had been an acoustically relevant contribution from these existing WTGs to the measured background noise levels. However, in this case, it has been established that the background noise levels can change with direction due to the coastline being a key noise source. Such a directional analysis would therefore be an unreliable means of checking whether the measured baseline data includes any acoustically relevant contribution from these WTGs.

19.6.6.6 An alternative approach has therefore been adopted. Comparison has been drawn between predicted noise levels for the Horshader Wind Farm, and the measured background noise levels.

19.6.6.7 Noise level predictions have been undertaken for the Horshader Wind Farm applying the WTG location and sound power level data presented in **Table 19-19**. The noise level predictions have been undertaken in accordance with the IOA GPG for worst-case downwind propagation conditions, following the method detailed in **Appendix 19.2, Volume 2c** for onshore wind WTGs.

19.6.6.8 The prediction results for Measurement Location LT3 are presented in Plate 2-1 (quiet daytime) and Plate 2-2 (night-time) of **Appendix 19.8, Volume 2c**. The predicted results are plotted against the background sound level data and the associated polynomial trend lines for Measurement Location LT3 under upwind conditions, as this represents the lowest (worst-case) background sound levels measured.

19.6.6.9 The predicted noise levels from the Horshader Wind Farm are substantially below the measured background sound levels.

19.6.6.10 The polynomial trend lines through the background sound level data have no inflection (point on a curve where the direction of curvature changes) reflective of how the WTG noise levels change with

increasing wind speed. In addition, during the night-time period, the predicted levels are always more than 10 dB below the fixed limit element of 43 dB(A) which apply during this period.

19.6.6.11 The baseline data collected at Measurement Location LT3 is therefore considered to have been obtained in absence of any acoustically relevant contribution from the existing BaT Wind Farm.

Measurement Location LT6

19.6.6.12 Measurement Location LT6 was installed approximately 1.15 km from the closest of the 3 existing 900 kW Enercon E44 WTGs which form the BaT Wind Farm. **Appendix 19.3, Volume 2c** confirms that noise from the BaT Wind Farm was not audible above sea noise at Measurement location LT6 during either windy periods or calmer periods.

19.6.6.13 At LT6, the background noise levels vary with direction due to coastal noise, making standard directional analysis unreliable (see paragraph 19.6.6.5). Instead, a contribution check was carried out by comparing predicted BaT Wind Farm noise levels with the measured background noise levels.

19.6.6.14 Noise level predictions have been undertaken for the BaT Wind Farm applying the WTG location and sound power level data presented in **Table 19-19**. Calculations follow the IOA GPG for worst-case downwind propagation conditions, as detailed in **Appendix 19.2, Volume 2c** for onshore wind WTGs.

19.6.6.15 Measurement Location LT6 results are presented in Plate 2-3 (quiet daytime) and Plate 2-4 (night-time) of **Appendix 19.8, Volume 2c**. These are plotted against the background sound level data under upwind conditions, when the lowest (worst-case) background sound levels were measured.

19.6.6.16 The predicted noise levels from the BaT Wind Farm are substantially below the measured background sound levels, with the biggest difference being during the daytime (for which the lowest noise limits apply). During the night-time period, the predicted levels are always more than 10 dB below the fixed limit element of 43 dB(A) which apply during this period.

19.6.6.17 The baseline data collected at Measurement Location LT6 is therefore considered to have been obtained in absence of any acoustically relevant contribution from the existing BaT Wind Farm.

19.6.7 NOISE SENSITIVE RECEPTORS SELECTED FOR ASSESSMENT

19.6.7.1 The selected NSR locations are detailed in **Table 19-20** and shown in **Figure 19.3, Volume 2b**. No NSRs have a financial involvement in the Offshore Project.

Table 19-20: NSRs selected for assessment

Ref.	NSR name	Description	Easting	Northing	Closest WTG ¹	Distance to nearest WTG ¹	Comment
NSR1	Garenin/ Na Geàrrannan	Residential	119462	944207	Offshore Project	7.3 km	Representative of closest NSRs to the southwest extent of the Offshore Project.
NSR2	Dalmore/ <i>Dail Mhor</i>	Residential	121950	944596	Offshore Project	7.9 km	Representative of closest NSRs to the southwest extent of the Offshore Project.
NSR3	South Shawbost/ <i>Siabost bho Dheas</i>	Residential	124574	947621	Offshore Project	6.5 km	Representative of closest NSRs to the centre of the Offshore Project.
NSR4	Labost	Residential	127991	949414	Offshore Project	6.8 km	Representative of closest NSRs to the centre of the Offshore Project.
NSR5	Brue/ <i>Brù</i>	Residential	133293	950377	Offshore Project	9.0 km	Representative of closest NSRs to the northeast of the Offshore Project.
NSR6	Ballantrushal <i>/Baile an Truiseil</i>	Residential	137654	953927	Offshore Project	8.4 km	Representative of closest NSRs to the northeast of the Offshore Project.
					BaT	1.1 km	
NSR7	17A Ballantrushal <i>/ Baile an Truiseil</i>	Residential	137819	953286	Offshore Project	9.0 km	Closest NSR north of BaT Wind Farm.
					BaT	650 m	
NSR8	Morven/1A' <i>Mhorbhairne</i>	Residential	136314	951425	Offshore Project	9.7 km	Closest NSR north of BaT Wind Farm.
					BaT	1.5 km	
NSR9	4 Cnoc A Charnain	Residential	124992	946218	Offshore Project	7.9 km	Closest NSR northeast of Horshader Wind Farm.
					Horshader	670 m	

¹ Distances are approximate and apply equally to both layout Options.

19.7 BASIS FOR ENVIRONMENTAL IMPACT ASSESSMENT

19.7.1 MAXIMUM DESIGN SCENARIO

- 19.7.1.1 Assessing using a parameter-based design envelope approach means that the assessment considers a maximum design scenario whilst allowing the flexibility to make improvements in the future in ways that cannot be predicted at the time of submission of the consent applications. The assessment of the maximum adverse scenario for each NSR establishes the maximum potential adverse impact and as a result impacts of greater adverse significance would not arise should any other development scenario (as described in **Chapter 3, Volume 1a**) to that assessed within this chapter be taken forward in the final scheme design.
- 19.7.1.2 The maximum parameters and assessment assumptions that have been identified to be relevant to Offshore Airborne Noise are outlined in **Table 19-21** and are in line with **Chapter 3, Volume 1a**.
- 19.7.1.3 Although pre-construction surveys may involve some limited and temporary interactions with the marine environment, the potential impacts of any such activities fall well within the MDS parameters assessed for this chapter. The MDS includes activities such as WTG foundation drilling and grouting, and Offshore Cable installation which represent a conservative upper bound on seabed disturbance, and vessel presence. These MDS activities therefore encompass the environmental footprint of pre-construction survey methods, which are significantly lower in magnitude, duration, and spatial extent.
- 19.7.1.4 For this reason, the potential environmental interactions of pre-construction surveys are not separately assessed, as they are already inherently accommodated within the worst-case assumptions underpinning the MDS for this topic.
- 19.7.1.5 The difference in timing between pre-construction surveys and construction activities does not affect the assessment because the MDS represents the maximum magnitude of change, independent of phasing or scheduling. The pre-construction surveys occur over a much shorter duration and at materially lower intensities than the MDS bounding activities, and therefore do not introduce any temporal additive effects beyond those already assessed.

Table 19-21: Maximum Design Scenario considered for impacts on Offshore Airborne Noise

Project phase and activity/impact	Maximum Design Scenario	Maximum assessment assumptions	Justification
Construction			
Offshore percussive piling noise	<p>Foundation Installation for Scenario 1 (WTGs and OSP): the installation of multi-leg jacket foundations with pin piles via percussive piling within the Turbine Area.</p> <p>Percussive Piling Area: percussive piling will only be undertaken within the northeast portion of the Turbine Area in the Percussive Piling Area. A maximum of 35 WTG foundations and 1 OSP foundation will be installed via percussive piling in the northeast portion of the Turbine Area.</p> <ul style="list-style-type: none"> Maximum number of foundations (WTG and OSP) requiring installation via percussive piling: 156 pin piles <p>WTG specifications:</p> <ul style="list-style-type: none"> Maximum of WTGs: up to 60 (Option 1, smaller turbine) Each multi-leg jacket pile foundation will have up to 4 legs, each with 1 pin pile. Pin pile diameter: up to 5 m; Piling installation depth: up to 120 m. <p>Maximum number of WTG foundations requiring installation via percussive piling: a maximum of 35 multi-leg jacket foundations, with up to 4 pin piles (1 per leg) each equates to a total of 140 pin piles.</p> <p>OSP specifications:</p> <ul style="list-style-type: none"> Maximum of OSPs: up to 1 Each multi-leg jacket pile foundation will have up to 8 legs, each up to 2 pin piles. Pin pile diameter: up to 6 m; Piling installation depth: up to 120 m. <p>Maximum number of OSP foundations requiring installation via percussive piling: 1 OSP foundation with up to 16 pin piles (up to 2 per leg) equates a total of 16 pin piles.</p> <p>Duration: limited the length of percussive piling installation of pin piles to 5.5 hours and casings to 4.5 hours per 24-hour period. This is inclusive of soft start and ramp up procedures.</p> <p>Concurrent piling: No concurrent percussive piling events are permitted.</p> <p>Maximum hammer energy per 24 hour period: Variable maximum hammer energy across the Percussive Piling Area. This area is split into 3 zones to limit the maximum hammer energy. Maximum hammer energy of 2,500kJ and 5,000kJ have been assessed.</p> <p>Construction programme: Installation of WTG foundations (drilling or piling): will be undertaken between April-October over a 2 year period, totalling 14 months of active work (see Appendix 3.1, Volume 1c).</p>	<p>Sound power level 145 dB LWA assessed.</p> <p>Multiple reflection sound propagation adopted.</p>	<p>Represents the maximum number of piles, the maximum possible duration of piling and the greatest hammer energy (leading to the greatest propagation of noise).</p> <p>Construction piling noise levels have been determined through application of the ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors. Part 2: General method of calculation' (ISO 9613-2) methodology, with an adaption applied for propagation over water to account for reduced distance attenuation (compared to propagation over land).</p> <p>The maximum assessment assumptions represent the maximum noise levels that could potentially affect NSRs.</p>

Project phase and activity/impact	Maximum Design Scenario	Maximum assessment assumptions	Justification
Operation and maintenance			
Operational WTG noise	<p>Operational WTG noise: Number of WTGs: both minimum and maximum number of WTGs Options have been assessed:</p> <ul style="list-style-type: none"> Option 1: up to 60 smaller WTGs (15 MW) Option 2: up to 44 larger WTGs (22 MW) <p>Operational and maintenance programme - Duration is up to 35 years.</p> <p>Maximum sound power: both minimum and maximum WTGs Options have been assessed:</p> <ul style="list-style-type: none"> Option 1: up to 60 smaller WTGs (15 MW) - up to 115.3 dB Option 2: up to 44 larger WTGs (22 MW) - up to 122.0 dB <p>WTG hub height (above msl):</p> <ul style="list-style-type: none"> Option 2: up to 44 larger WTGs (22 MW) - up to 198.4 m 	Multiple reflection sound propagation adopted.	<p>The maximum assessment scenario represents the maximum noise levels that could potentially affect NSRs.</p> <p>Assessment of the potential airborne operational phase impact of an offshore wind farm are not generally considered within planning applications.</p> <p>Operational WTG noise levels have been determined through application of the ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors. Part 2: General method of calculation' (ISO 9613-2) methodology, with an adaption applied for propagation over water to account for reduced distance attenuation (compared to propagation over land).</p> <p>The assessment has considered the maximum number of WTGs for the WTG sizes considered within the design envelope. To consider that:</p> <ul style="list-style-type: none"> Although Option 2 includes fewer WTGs, they generate higher noise levels due to the turbine size. Although Option 1 WTGs are quieter, they are greater in number. <p>Adopting the highest hub height in the baseline data analysis ensures the most conservative analysis results for use in the assessment.</p>

19.7.2 EMBEDDED MITIGATION MEASURES

19.7.2.1 As part of the Offshore Project design process, several embedded mitigation measures have been adopted to reduce the potential for impacts from Offshore Airborne Noise and these have evolved over the development process as the EIA has progressed and in response to consultation.

19.7.2.2 The embedded mitigation measures also include those that have been identified as good or standard practice and include actions that would be undertaken to meet existing legislation requirements. As there is a commitment to implementing the embedded mitigation, and also to various standard sectoral practices and procedures, they are considered inherently part of the design of the Project and are set out in this EIAR.

19.7.2.3 **Table 19-22** sets out the relevant embedded mitigation measures within the design and how these affect the Offshore Airborne Noise assessment.

Table 19-22: Relevant Offshore Airborne Noise embedded mitigation measures

ID	Environmental measure proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to Airborne Noise assessment
M019	A final Offshore Environmental Management Plan (OEMP) will be developed prior to commencement of construction (building on Outline Offshore EMP, Volume 3) in compliance with legislative requirements and/or best practice standards and guidance and adhered to.	Pre-Construction and Construction	Secured in the Section 36 Consent and/or Marine Licence conditions. Details will be provided within the OEMP.	Mitigate and minimise noise from offshore construction activities.

19.8 ASSESSMENT OF EFFECTS: CONSTRUCTION PHASE

19.8.1 OFFSHORE CONSTRUCTION PERCUSSIVE PILING NOISE

19.8.1.1 Calculations of the noise emissions from the offshore percussive piling noise have been undertaken based on the piling methodology discussed in **Appendix 19.2, Volume 2c**. Noise levels at NSRs from offshore percussive piling are expected to vary significantly due to meteorological factors such as wind speed, wind direction, wind shear, temperature gradient and sea surface scattering. These meteorological conditions affect how far sound travels from the source.

19.8.1.2 The maximum design scenario relating to airborne percussive piling noise during the construction phase are presented in **Table 19-21**.

19.8.1.3 The magnitude of impact is based on the criteria detailed in Section 19.5.3 and **Chapter 5, Volume 1a**. A description of the likely magnitude of impact on NSRs caused by each identified impact is given in the following paragraphs.

Magnitude

19.8.1.4 The construction magnitude of impact semantic scale is defined in **Table 19-10**.

19.8.1.5 **Table 19-23** presents the percussive piling assessment for 100% hammer energy (5,000 kJ), including multiple reflections (cylindrical spreading). Slight magnitude impacts are predicted for all turbine locations during the day. Medium magnitude impacts are predicted for turbine locations less than 8 km from NSRs during the evening. Medium and high magnitude impacts are predicted at all turbine locations during the night.

Table 19-23 Offshore percussive piling noise levels, hammer energy 100%, multiple reflections, free-field $L_{Aeq,T}$, dB(A)

Magnitude of impact	Distance		
	Day	Evening	Night
High	-	< 5 km	< 12 km
Medium	< 3 km	< 8 km	< 19 km
Low	< 5 km	< 12 km	≥ 19 km
Slight	≥ 5 km	≥ 12 km	-

19.8.1.6 **Table 19-24** presents the percussive piling assessment for 100% hammer energy (5,000 kJ), excluding cylindrical spreading. Slight magnitude impacts are predicted for all turbine locations during the day and evening. Medium magnitude impacts are predicted for turbine locations less than 9 km from NSRs during the night.

Table 19-24 Offshore percussive piling noise levels, hammer energy 100%, spherical spreading, free-field $L_{Aeq,T}$, dB(A)

Magnitude of impact	Distance		
	Day	Evening	Night
High	-	< 3 km	< 6 km
Medium	-	< 5 km	< 9 km
Low	< 3 km	< 6 km	> 11 km
Slight	≥ 3 km	≥ 6 km	≥ 11 km

19.8.1.7 **Table 19-25** presents the percussive piling noise assessment for reducing hammer energy from 5,000-2,500 kJ, this is a drop to 50%. The reduction in sound power is estimated to be 3.0 dB ($10\log_{10}(0.5)$). The calculations include the multiple reflection correction (cylindrical spreading). Slight and low magnitude impacts are predicted for all turbine locations during the day and evening. Medium and high magnitude impacts are predicted for turbine locations less than 14 km from NSRs during the night.

Table 19-25 Offshore percussive piling noise levels, hammer energy 50%, multiple reflections, free-field $L_{Aeq,T}$, dB(A)

Magnitude of impact	Distance		
	Day	Evening	Night
High	-	<4 km	<10 km
Medium	<3 km	<6 km	<14 km
Low	<4 km	<10 km	≥14 km
Slight	≥4 km	≥10 km	-

19.8.1.8 **Table 19-26** presents the percussive piling noise assessment for reducing hammer energy from 5,000-2,500 kJ, this is a drop to 50%. The calculations exclude cylindrical spreading. Slight magnitude impacts are predicted for all turbine locations during the day and evening. Medium magnitude impacts are predicted for turbine locations less than 7 km from NSRs during the night.

Table 19-26 Offshore percussive piling noise levels, hammer energy 50%, spherical spreading, free-field $L_{Aeq,T}$, dB(A)

Magnitude of impact	Distance		
	Day	Evening	Night
High	-	<3 km	<5 km
Medium	-	<4 km	<7 km
Low	<3 km	<5 km	<10 km
Slight	≥3 km	≥5 km	≥10 km

Sensitivity or value of receptor

19.8.1.9 The selected NSRs are all categorised as having a high sensitivity. NSR sensitivity criteria is defined in **Table 19-9**.

Significance of effect

19.8.1.10 Percussive piling works are anticipated to take place during the construction phase of the Offshore Project. Considering the embedded mitigation described in **Table 19-22**, the effects of percussive piling on NSRs are summarised in **Table 19-27**.

19.8.1.11 For all receptors, significance is determined based on the worst-case propagation (i.e. multiple reflection correction) and the shortest distance between the NSR and the closest percussive piling location.

Table 19-27: Significance of effect of Offshore Airborne Noise during the construction phase

NSR	Time-period	Magnitude	Sensitivity	Embedded mitigation measures	Significance of effect	Significance
NSR1 Garenin/ <i>Na Gearrannan</i>	Day	Slight	High	M019	Negligible	Not Significant
	Evening	Low	High		Minor	Not Significant
	Night	High	High		Major	Significant
NSR2 Dalmore/ <i>Dail Mhor</i>	Day	Slight	High	M019	Negligible	Not Significant
	Evening	Low	High		Minor	Not Significant
	Night	High	High		Major	Significant
NSR3 South Shawbost/ <i>Siabost bho Dheas</i>	Day	Slight	High	M019	Minor	Not Significant
	Evening	Medium	High		Moderate	Significant
	Night	High	High		Major	Significant
NSR4 Labost	Day	Slight	High	M019	Minor	Not Significant
	Evening	Medium	High		Moderate	Significant
	Night	High	High		Major	Significant
NSR5 Brue/ <i>Brù</i>	Day	Slight	High	M019	Negligible	Not Significant
	Evening	Low	High		Minor	Not Significant
	Night	High	High		Major	Significant
NSR6 Ballantrushal/ <i>Baile an Truiseil</i>	Day	Slight	High	M019	Negligible	Not Significant
	Evening	Low	High		Minor	Not Significant
	Night	High	High		Major	Significant

Further environmental mitigation

19.8.1.12 As significant effects in EIA terms were predicted for offshore airborne percussive piling noise, the following further environmental mitigation relevant to Offshore Airborne Noise has been identified.

Table 19-28: Relevant Offshore Airborne Noise further mitigation measures

ID	Environmental measure proposed	Project phase measure introduced	How the environmental measures will be secured
A007	The Airborne Noise Piling Strategy will be developed to incorporate further measures, such as those identified in Chapter 19: Offshore Airborne Noise, Volume 2c , to mitigate the potential impacts of the percussive piling activity to an acceptable level.	Construction	Secured in the Section 36 Consent and/or Marine Licence via the condition for an Airborne Noise Piling Strategy to be submitted to MD-LOT for approval.

19.8.1.13 Following the identification of the potential significant evening and night-time airborne noise impact due to the percussive piling works, the Applicant will commit to producing and following an Airborne Noise Piling Strategy to mitigate and minimise the adverse impacts (A007). The Airborne Noise Piling Strategy will be further refined through detailed design and availability of equipment following the contractor tendering process and equipment readiness. Following this, further mitigation to minimise potential noise impact will be explored and detailed in the Airborne Noise Piling Strategy for consultation with MD-LOT. This plan will be produced post-consent.

19.8.1.14 To mitigate the potential impacts of the percussive piling activity to an acceptable outcome, the Applicant will explore the use of further measures or a combination of the measures listed below:

- Restrict percussive piling works during time-periods predicted to exceed BS 5228-1 thresholds;
- Phase works so that percussive piling activities closest to shore avoid more sensitive times (i.e. evening and night);
- Reduction in hammer blow energy at piling locations where exceedances are predicted;
- Use of non-percussive, lower noise generating piling techniques;
- Undertake a noise monitoring regime during the offshore percussive piling activities;
- Restriction of percussive piling under certain conditions, e.g. flat sea surface state, low downwind speed.

19.8.1.15 To comply with BS 5228-1 construction noise thresholds, the Applicant will implement a noise monitoring program for offshore percussive piling activities, to be outlined in the Piling Strategy.

19.8.1.16 Following detailed design and availability of construction contractors and equipment, if further mitigation is identified this will be explored. Post-consent, the Applicant will engage with MD-LOT and consider additional factors that could benefit NSRs. For example, minimising the overall

duration of works is generally advantageous, if higher noise levels can significantly shorten the overall works duration this would be considered. It can also be beneficial to schedule quieter working periods to provide respite.

Significance of residual effect

- 19.8.1.17 A combination of further mitigation measures will be implemented until compliance with applicable BS 5228-1 construction noise threshold is achieved. Compliance will be verified through a noise monitoring programme undertaken during offshore percussive piling activities. A range of mitigation measures may be used, with the most appropriate option varying according to factors such as time of day, pile location, geological conditions, atmospheric conditions, and sea state.
- 19.8.1.18 The significance of residual effect is presented in **Table 19-29** following further environmental mitigation (A007) relevant to Offshore Airborne Noise has been identified. The worst-case residual effects are Minor, these are **Not Significant**.
- 19.8.1.19 To provide additional context, the assessment adopts a precautionary approach by applying enhanced sound propagation that occurs under specific meteorological conditions. These conditions are expected to arise for up to 14% of the time. Technical details of the propagation method used is provided in **Appendix 19.2, Volume 2c**. Outside these specific conditions, sound propagation will tend towards spherical spreading, with further reductions anticipated under upwind conditions.

Table 19-29: Significance of residual effect - offshore percussive piling construction noise

NSR	Significance of residual effect (significance)		
	Daytime significance	Evening significance	Night-time significance
NSR 1 Garenin/ <i>Na Gearrannan</i>	Adverse temporary local direct Negligible effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)
NSR2 Dalmore/ <i>Dail Mhor</i>	Adverse temporary local direct Negligible effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)
NSR3 South Shawbost/ <i>Siabost bho Dheas</i>	Adverse temporary local direct Negligible effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)
NSR4 Labost	Adverse temporary local direct Negligible effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)
NSR5 Brue/ <i>Brù</i>	Adverse temporary local direct Negligible effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)

NSR	Significance of residual effect (significance)		
	Daytime significance	Evening significance	Night-time significance
NSR6 Ballantrushal/ <i>Baile an Truiseil</i>	Adverse temporary local direct Negligible effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)	Adverse temporary local direct Minor effect. (Not Significant)

19.9 ASSESSMENT OF EFFECTS: OPERATION AND MAINTENANCE

19.9.1 OPERATIONAL WTG NOISE

Baseline Noise Survey

19.9.1.1 The baseline noise survey results (see Section 19-22) have been analysed to establish the prevailing noise climate. The noise level limits have been determined drawing upon the results of the baseline noise survey as presented in Plate 1-1 to Plate 1-24 of **Appendix 19.7, Volume 2c**. Each graph includes a polynomial trend line that represents the determined background noise level and how it changes with wind speed.

Setting Noise Limits

19.9.1.2 ETSU-R-97 states that during the daytime, the fixed element of the limit should be selected between 35 and 40 dB(A), with further relaxation up to 45 dB(A) allowable where the NSR has a financial involvement in the development. For the Offshore Project, no NSRs have a financial involvement. The guidance also states that the selection of the lower limit should consider “*the number of dwellings in the neighbourhood of the windfarm*”, “*the effect of noise limits on the number of kWh generated*” and the “*duration and level of exposure*”. Regarding exposure, both the proportion of time when background noise levels are low and the extent to which they drop are important considerations in setting an appropriate lower limit.

19.9.1.3 Clearly therefore, where a proposed development would generate a small amount of energy and has the potential to affect many NSRs, the fixed element of the daytime noise level limit should be set at the lower bound of the 35-40 dB(A) range. Conversely, where a proposed development would generate a large amount of energy but with the potential to affect a small number of NSRs, the fixed element of the daytime noise level limit should be set at the upper bound of the 35-40 dB(A) range.

19.9.1.4 The Offshore Project has the potential to generate a very large amount of energy and the potential energy loss in the case of applying a noise level limit that is too low is also therefore very large.

19.9.1.5 In addition, due to the presence of the coastline as a constant natural environmental noise source and the naturally higher wind speeds found at this exposed coastal location, the prevailing background noise levels are not as low as typically found at in-land/hillside/moorland sites. The NSRs will generally spend more time at the higher wind speed range with higher associated

background noise levels. The higher prevailing background noise levels will therefore serve to reduce the level and duration of any potential exposure to the future operational noise levels from the Offshore Project.

19.9.1.6 Accordingly, the fixed elements of the cumulative daytime and night-time noise level limits have been set at 40 dB(A) and 43 dB(A) respectively.

19.9.1.7 The resulting cumulative noise level limits are therefore as follows:

Properties without a financial involvement (Non-FI)

- Daytime (07:00-23:00): The quiet daytime hours background noise level (L_{A90}) +5 dB or 40 dB(A), whichever is the higher;
- Night-time (23:00-07:00): The night-time hours background noise level (L_{A90}) +5 dB or 43 dB(A), whichever is the higher.

Properties with a financial involvement (FI):

- None/not applicable.

19.9.1.8 Application of the above limits is in accordance with ETSU-R-97.

Noise Limits

19.9.1.9 The resulting total cumulative noise level limits can be seen in Plate 3-1 to Plate 3-12 of **Appendix 19.10, Volume 2c**, and are presented in tabular form in **Table 19-30** (Downwind conditions) and **Table 19-31** (Upwind conditions). These limits apply to the total cumulative WTN levels.

Table 19-30: Total cumulative noise limits, $L_{A90,T}$ dB(A) - Downwind conditions

Noise Limit	Wind Speed Referenced to 10 m Height (Standardised U_{10}), m/s										
	2	3	4	5	6	7	8	9	10	11	12
Measurement Location LT1											
Daytime (Non FI)	40.0	40.0	40.5	41.9	43.3	44.7	46.1	47.5	48.9	50.4	51.9
Night-time (Non FI)	43.0	43.0	43.0	43.3	44.1	45.0	46.1	47.3	48.7	50.2	51.9
Measurement Location LT2											
Daytime (Non FI)	47.5	47.5	48.5	49.5	50.4	51.4	52.4	53.5	54.6	56.0	57.5
Night-time (Non FI)	47.4	47.4	48.8	50.0	50.9	51.8	52.6	53.5	54.5	55.7	57.2
Measurement Location LT3											
Daytime (Non FI)	46.0	46.0	46.9	47.9	49.0	50.2	51.6	53.1	54.7	56.4	58.2
Night-time (Non FI)	46.3	46.3	47.1	48.1	49.2	50.3	51.6	53.0	54.6	56.2	58.1
Measurement Location LT4											
Daytime (Non FI)	42.9	42.9	44.2	45.5	46.8	48.1	49.3	50.5	51.8	53.0	54.3
Night-time (Non FI)	43.3	43.3	44.6	45.8	47.0	48.2	49.4	50.7	52.0	53.3	54.6

Noise Limit	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
Measurement Location LT5											
Daytime (Non FI)	47.8	47.8	49.2	50.4	51.5	52.5	53.5	54.6	55.6	56.8	58.2
Night-time (Non FI)	48.7	48.7	50.0	51.1	52.1	52.9	53.8	54.7	55.6	56.7	57.9
Measurement Location LT6											
Daytime (Non FI)	43.8	43.8	44.4	45.2	46.1	47.2	48.3	49.6	51.0	52.4	53.8
Night-time (Non FI)	44.8	44.8	45.4	46.0	46.7	47.5	48.4	49.3	50.4	51.5	52.7

Table 19-31: Total cumulative noise limits, L_{A90,T} dB(A) – Upwind conditions

Noise Limit	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
Measurement Location LT1											
Daytime (Non FI)	41.1	41.1	41.1	41.3	41.8	42.7	43.9	45.4	47.1	48.9	50.8
Night-time (Non FI)	43.0	43.0	43.0	43.0	43.0	43.0	43.3	44.9	46.6	48.5	50.5
Measurement Location LT2											
Daytime (Non FI)	42.5	42.5	42.5	42.6	43.3	44.6	46.4	48.5	50.8	53.3	55.8
Night-time (Non FI)	43.0	43.0	43.0	43.0	43.0	43.1	44.9	47.0	49.3	51.8	54.5
Measurement Location LT3											
Daytime (Non FI)	45.5	45.5	45.5	45.5	45.7	46.2	47.0	48.0	49.1	50.4	51.7
Night-time (Non FI)	45.1	45.1	45.1	45.1	45.2	45.7	46.6	47.9	49.3	50.9	52.6
Measurement Location LT4											
Daytime (Non FI)	43.3	43.3	43.3	43.3	43.5	44.0	44.8	45.7	46.8	48.1	49.4
Night-time (Non FI)	43.0	43.0	43.0	43.0	43.0	43.2	43.7	44.5	45.5	46.6	47.9
Measurement Location LT5											
Daytime (Non FI)	42.1	42.1	42.1	42.1	42.1	42.2	42.7	43.4	44.4	45.5	46.8
Night-time (Non FI)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7	45.2	46.9
Measurement Location LT6											
Daytime (Non FI)	40.6	40.6	40.6	40.6	40.9	41.3	41.9	42.6	43.5	44.4	45.4
Night-time (Non FI)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	45.6

Noise Level Predictions

19.9.1.10 To facilitate the assessment of operational noise from the Offshore Project and the identified cumulative development (the BaT and Horshader Wind Farms), detailed noise level predictions have been undertaken. The approach to the completed operational noise modelling work is detailed within Section 1.3 of **Appendix 19.2, Volume 2c**.

19.9.1.11 The noise modelling results have been used to determine NSR noise levels for the following scenarios:

- The Offshore Project operating in isolation (Option 1 and Option 2);
- The cumulative development (BaT and Horshader Wind Farm) operating in isolation.

19.9.1.12 Predictions for the BaT and Horshader Wind Farms operating in isolation have been used to allow determination of the 'residual' noise level limits that remain available for use by the Offshore Project when considered in isolation.

19.9.1.13 Noise level predictions for the BaT and Horshader Wind Farms have been undertaken on basis of the installed WTG type but including an additional +2 dB increase to account for potential increases in noise levels in the future whilst still operating within the terms of their planning permissions.

WTG Sound Power Level Data

Turbine Layout Option 1

19.9.1.14 The Option 1 candidate WTG type (15 MW, 236 m rotor diameter, 115.3 dB(A) maximum sound power), installed with a worst-case (highest) hub height of 175.8 m.

19.9.1.15 Broadband noise emission data for this WTG has been supplied by the Applicant. The original data is referenced to hub height wind speed and has been converted to standardised 10 m height wind speed, in accordance with ETSU-R-97 requirements. This conversion had been completed following the approach detailed in the IOA GPG and **Appendix 19.4, Volume 2c** for a hub height of 175.8 m. This represents the worst-case scenario for Option 1.

19.9.1.16 The resulting sound power level data is presented in **Table 19-32** including an additional +2 dB correction for uncertainty.

19.9.1.17 Octave band spectral data for the WTG is presented in **Table 19-33**. The spectral data has been normalised to the broadband level data in **Table 19-32** as part of the modelling process.

Table 19-32: Broadband sound power level for Option 1 candidate WTG with 175.8 m hub, L_{WA} , (dB(A))

WTG Model	Wind Speed Referenced to 10 m (U_{10}) m/s							
	3	4	5	6	7	8	9	10+
Option 1: 15 MW, 236 m rotor diameter, 175.8 m hub	102.3	105.3	110.8	114.7	117.1	117.3	117.3	117.3
Data includes a +2 dB uncertainty correction								

Table 19-33: 1/1 Octave band sound power level spectra (L_{WA}) for Option 1 candidate WTG, dB(A)

Wind Speed Referenced to 10 m Height (Standardised U_{10}), m/s	Octave Band Centre Frequency (Hz)									dB(A)
	32	63	125	250	500	1k	2k	4k	8k	
At rated power	85.0	96.4	104.7	109.7	111.0	107.9	103.1	95.5	84.7	115.3

Turbine Layout Option 2

19.9.1.18 The Option 2 candidate WTG type (22 MW, 280 m rotor diameter, 122 dB(A) maximum sound power), installed with a worst-case (highest) hub height of 198.4 m.

19.9.1.19 Manufacturers noise emission data for this WTG is not currently available. For this assessment, the Option 1 one-third octave band noise emission data have been adopted, but with an uplift of +6.7 dB(A), such that the maximum sound power level is 122.1 dB(A). Including the uplift is an appropriate step, given the increase in WTG size and power rating.

19.9.1.20 The data was standardised to 10 m height wind speed following the approach detailed in the IOA GPG and **Appendix 19.4, Volume 2c**. The conversion was completed for a hub height of 198.4 m, which represents a worst-case for Option 2.

19.9.1.21 The resulting broadband noise emission data applied for this WTG is detailed in **Table 19-34** including +2 dB correction for uncertainty.

Table 19-34: Assumed broadband sound power level for Option 2 candidate WTG with 198.4 m hub, L_{WA} , (dB(A))

WTG Model	Wind Speed Referenced to 10 m (U_{10}) m/s							
	3	4	5	6	7	8	9	10+
Option 2: 22 MW, 280 m rotor diameter, 198.4 m hub	109.1	112.5	117.6	121.7	124.0	124.0	124.0	124.0
Data includes a +2 dB uncertainty correction								

BaT Wind Farm

19.9.1.22 The sound power level data applied for this development, is that detailed within **Table 19-19**.

Horshader Wind Farm

19.9.1.23 The sound power level data applied for this development, is also that detailed within **Table 19-19**.

Propagation Directivity

19.9.1.24 Operational noise level predictions have been undertaken for both Option 1 and Option 2. In each case, predictions have been undertaken to determine the NSR noise levels for 3 different scenarios:

- Downwind Propagation;
- Crosswind Propagation;
- Upwind Propagation.

19.9.1.25 Downwind propagation occurs when the wind is blowing from WTGs towards the NSR. Based on 'Figure 6a' from the IOA GPG, no directivity correction is applied for flat landscapes.

19.9.1.26 Crosswind propagation occurs when the wind direction is perpendicular to the line between the WTGs and the NSR. Based on 'Figure 6a' from the IOA GPG, a -2 dB directivity correction is applied for flat landscapes.

19.9.1.27 Upwind propagation occurs where the wind is blowing from the NSR towards the WTGs. Based on 'Figure 6A' from the IOA GPG, a directivity correction of up to -13 dB can apply. However, recognising that it would not be possible for a NSR to be directly upwind of all WTGs at the same time, a conservative -6 dB directivity correction is applied.

19.9.1.28 For the cumulative development (BaT and Horshader Wind Farms), noise level predictions have been undertaken assuming worst-case downwind propagation only.

19.9.1.29 The full suite of calculated NSR noise levels is presented in **Appendix 19.9, Volume 2c**.

Application of Baseline Data and Cumulative Limits

19.9.1.30 **Table 19-35** details which background noise data/cumulative noise limits have been applied at each NSR.

Table 19-35: Applied background noise monitoring locations/Noise limits

Ref.	Property Name	Applied Limits/Background Noise Data	Notes
NSR1	Garenin/Na Gearrannan	Measurement Location LT1	No cumulative developments
NSR2	Dalmore/Dail Mhor	Measurement Location LT2	No cumulative developments
NSR3	South Shawbost/Siabost bho Dheas	Measurement Location LT3	No cumulative developments
NSR4	Labost	Measurement Location LT4	No cumulative developments
NSR5	Brue/Brù	Measurement Location LT5	No cumulative developments
NSR6	Ballantrushal/Baile an Truiseil	Measurement Location LT6	No cumulative developments
NSR7	17A Ballantrushal/Baile an Truiseil	Measurement Location LT6	Potential for cumulative effect with BaT Wind Farm
NSR8	Morven/A' Mhorbhairne	Measurement Location LT6	Potential for cumulative effect with BaT Wind Farm
NSR9	Cnoc A Charnain	Measurement Location LT3	Potential for cumulative effect with Horshader Wind Farm

Residual Noise Limits

- 19.9.1.31 At NSR1 to NSR6, there are no cumulative wind farm developments, so the total cumulative noise level limits detailed in **Table 19-30** (Downwind conditions) and **Table 19-31** (Upwind conditions) can be applied to the Offshore Project in isolation.
- 19.9.1.32 At NSR7, NSR8 and NSR9 there is the potential for a cumulative noise impact to occur, due to the proximity of existing operational WTGs. It is therefore necessary to determine the residual noise level limits that remain available for use by the Offshore Project when considered in isolation.
- 19.9.1.33 For NSR7 and NSR8, the residual noise level limits have been calculated by subtracting BaT Wind Farm noise levels from the total cumulative noise level limits for Measurement Location LT6, taken from **Table 19-30** (downwind conditions) and **Table 19-31** (upwind conditions). This is presented in Plates 4-1 to Plate 4-4, and Plates 4-7 to Plate 4-10 in **Appendix 19.10, Volume 2c**.
- 19.9.1.34 The predicted noise levels from the BaT Wind Farm have been taken from Table 4-2 of **Appendix 19.9, Volume 2c**, and an additional +2 dB uplift has been applied to account for possible future noise level increases from that development, whilst still operating within the terms of its planning permission.
- 19.9.1.35 For NSR9, the residual noise level limits have been calculated by subtracting Horshader Wind Farm noise levels from the total cumulative noise level limits for Measurement Location LT3, taken from **Table 19-30** (Downwind conditions) and **Table 19-31** (Upwind conditions).
- 19.9.1.36 The predicted noise levels from the Horshader Wind Farm have been taken from Table 3-2 of **Appendix 19.9, Volume 2c**, and an additional +2 dB uplift has been applied to account for possible future noise level increases from that development, whilst operating within its consent.
- 19.9.1.37 The residual noise level limits calculated for NSR7, NSR8 and NSR9 are presented in **Table 19-36** (Downwind conditions) and **Table 19-37** (Upwind conditions). Corresponding graphs are presented in **Appendix 19.10, Volume 2c**.

Table 19-36: Residual noise limits, $L_{A90,T}$ dB(A) - Downwind conditions

Noise Limit	Wind Speed Referenced to 10 m Height (Standardised U_{10}), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 7 – 17A Ballantrushal/Baile an Truiseil– Downwind conditions											
Daytime (Non FI)	-	44.0	44.4	45.1	45.9	46.9	48.0	49.3	50.8	52.2	53.7
Night-time (Non FI)	-	45.0	45.4	45.9	46.5	47.2	48.0	49.0	50.1	51.3	52.5
NSR 8 – Morven/A' Mhorbhairne – Downwind conditions											
Daytime (Non FI)	-	43.8	44.4	45.2	46.1	47.2	48.3	49.6	51.0	52.4	53.8
Night-time (Non FI)	-	44.8	45.4	46.0	46.7	47.5	48.4	49.3	50.3	51.5	52.7
NSR 9 – 4 Cnoc A Charnain – Downwind conditions											

Noise Limit	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
Daytime (Non FI)	-	46.0	46.9	47.8	48.9	50.1	51.5	53.0	54.6	56.4	58.2
Night-time (Non FI)	-	46.3	47.1	48.1	49.1	50.3	51.5	53.0	54.5	56.2	58.0

Table 19-37: Residual noise limits, L_{A90,T} dB(A) – Upwind conditions

Noise Limit	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 7 – 17A Ballantrushal/Baile an Truiseil– Upwind conditions											
Daytime (Non FI)	-	40.7	40.5	40.4	40.2	40.1	40.3	41.0	42.2	43.4	44.6
Night-time (Non FI)	-	43.0	43.0	42.9	42.6	42.2	41.8	41.6	41.5	42.8	44.9
NSR 8 – Morven/A' Mhorbhairne – Upwind conditions											
Daytime (Non FI)	-	40.6	40.6	40.6	40.9	41.3	41.9	42.6	43.5	44.4	45.4
Night-time (Non FI)	-	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	45.6
NSR 7 – 17A Ballantrushal/Baile an Truiseil– Upwind conditions											
Daytime (Non FI)	-	45.5	45.5	45.4	45.6	46.0	46.8	47.8	48.9	50.3	51.6
Night-time (Non FI)	-	45.1	45.1	45.1	45.1	45.5	46.4	47.6	49.2	50.8	52.5

Compliance Assessment

- 19.9.1.38 The predicted operational noise levels for the Offshore Project (taken from Tables 2-2 to 2-7 of **Appendix 19.9, Volume 2c**), have been assessed by comparison against the applicable noise limits.
- 19.9.1.39 For NSR1 to NSR6, the total cumulative noise level limits have been applied, taken from **Table 19-30** (Downwind conditions) and **Table 19-31** (upwind conditions). For NSR7 and NSR8 the residual noise limits from **Table 19-36** (downwind conditions) and **Table 19-37** (upwind conditions) have been applied.
- 19.9.1.40 For NSR7 and NSR8, the residual noise limits from **Table 19-36** (downwind conditions) and **Table 19-37** (Upwind conditions) have been applied.
- 19.9.1.41 For NSR9, the residual noise limits from **Table 19-36** (downwind conditions) and **Table 19-37** (upwind conditions) have been applied.
- 19.9.1.42 The maximum design parameters assessed meet the operational noise limits.
- 19.9.1.43 The Option 1 assessments are presented in **Table 19-38** (downwind conditions) and **Table 19-39** (upwind conditions). The Option 2 assessment are presented in **Table 19-40** (downwind conditions) and **Table 19-41** (upwind conditions).

19.9.1.44 A graphed form of these assessments is presented in Plates 1-1 to 1-18 in **Appendix 19.11, Volume 2c**. For additional context, those graphs also present the predicted NSR noise levels for crosswind propagation conditions.

19.9.1.45 The predicted operational WTN levels at the closest NSRs are presented in **Table 19-38** to **Table 19-41**. For both Option 1 and Option 2 operational WTN levels are below daytime and night-time limits at all NSRs during both downwind and upwind conditions.

Table 19-38: Noise limit assessment, $L_{A90,T}$ dB(A) - Option 1 - Downwind conditions

	Wind Speed Referenced to 10 m Height (Standardised U_{10}), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 1 – Garenin/Na Gearrannan – Daytime											
Daytime Limit [A]	40.0	40.0	40.5	41.9	43.3	44.7	46.1	47.5	48.9	50.4	51.9
WTN Level [B]	-	22.5	25.5	31.0	34.9	37.3	37.5	37.5	37.5	37.5	37.5
Compliance [B-A]	-	-17.5	-15.0	-10.9	-8.4	-7.4	-8.6	-10.0	-11.4	-12.9	-14.4
NSR 1 – Garenin/Na Gearrannan – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.3	44.1	45.0	46.1	47.3	48.7	50.2	51.9
WTN Level [B]	-	22.5	25.5	31.0	34.9	37.3	37.5	37.5	37.5	37.5	37.5
Compliance [B-A]	-	-20.5	-17.5	-12.3	-9.2	-7.7	-8.6	-9.8	-11.2	-12.7	-14.4
NSR 2 – Dalmore/Dail Mhor – Daytime											
Daytime Limit [A]	47.5	47.5	48.5	49.5	50.4	51.4	52.4	53.5	54.6	56.0	57.5
WTN Level [B]	-	22.5	25.5	31.0	34.9	37.3	37.5	37.5	37.5	37.5	37.5
Compliance [B-A]	-	-25.0	-23.0	-18.5	-15.5	-14.1	-14.9	-16.0	-17.1	-18.5	-20.0
NSR 2 – Dalmore/Dail Mhor – Night-time											
Night-time Limit [A]	47.4	47.4	48.8	50.0	50.9	51.8	52.6	53.5	54.5	55.7	57.2
WTN Level [B]	-	22.5	25.5	31.0	34.9	37.3	37.5	37.5	37.5	37.5	37.5
Compliance [B-A]	-	-24.9	-23.3	-19.0	-16.0	-14.5	-15.1	-16.0	-17.0	-18.2	-19.7
NSR 3 – South Shawbost/Siabost bho Dheas – Daytime											
Daytime Limit [A]	46.0	46.0	46.9	47.9	49.0	50.2	51.6	53.1	54.7	56.4	58.2
WTN Level [B]	-	24.2	27.2	32.7	36.6	39.0	39.2	39.2	39.2	39.2	39.2
Compliance [B-A]	-	-21.8	-19.7	-15.2	-12.4	-11.2	-12.4	-13.9	-15.5	-17.2	-19
NSR 3 – South Shawbost/Siabost bho Dheas – Night-time											
Night-time Limit [A]	46.3	46.3	47.1	48.1	49.2	50.3	51.6	53.0	54.6	56.2	58.1
WTN Level [B]	-	24.2	27.2	32.7	36.6	39.0	39.2	39.2	39.2	39.2	39.2
Compliance [B-A]	-	-22.1	-19.9	-15.4	-12.6	-11.3	-12.4	-13.8	-15.4	-17.0	-18.9
NSR 4 – Labost – Daytime											
Daytime Limit [A]	42.9	42.9	44.2	45.5	46.8	48.1	49.3	50.5	51.8	53.0	54.3
WTN Level [B]	-	24.1	27.1	32.6	36.5	38.9	39.1	39.1	39.1	39.1	39.1
Compliance [B-A]	-	-18.8	-17.1	-12.9	-10.3	-9.2	-10.2	-11.4	-12.7	-13.9	-15.2
NSR 4 – Labost – Night-time											
Night-time Limit [A]	43.3	43.3	44.6	45.8	47.0	48.2	49.4	50.7	52.0	53.3	54.6
WTN Level [B]	-	24.1	27.1	32.6	36.5	38.9	39.1	39.1	39.1	39.1	39.1
Compliance [B-A]	-	-19.2	-17.5	-13.2	-10.5	-9.3	-10.3	-11.6	-12.9	-14.2	-15.5
NSR 5 – Brue/Brù – Daytime											
Daytime Limit [A]	47.8	47.8	49.2	50.4	51.5	52.5	53.5	54.6	55.6	56.8	58.2
WTN Level [B]	-	22.0	25.0	30.5	34.4	36.8	37.0	37.0	37.0	37.0	37.0
Compliance [B-A]	-	-25.8	-24.2	-19.9	-17.1	-15.7	-16.5	-17.6	-18.6	-19.8	-21.2

	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 5 – Brue/Brù – Night-time											
Night-time Limit [A]	47.8	47.8	49.2	50.4	51.5	52.5	53.5	54.6	55.6	56.8	58.2
WTN Level [B]	-	22.0	25.0	30.5	34.4	36.8	37.0	37.0	37.0	37.0	37.0
Compliance [B-A]	-	-25.8	-24.2	-19.9	-17.1	-15.7	-16.5	-17.6	-18.6	-19.8	-21.2
NSR 6 – Ballantrushal/Baile an Truiseil– Daytime											
Daytime Limit [A]	43.8	43.8	44.4	45.2	46.1	47.2	48.3	49.6	51.0	52.4	53.8
WTN Level [B]	-	20.9	23.9	29.4	33.3	35.7	35.9	35.9	35.9	35.9	35.9
Compliance [B-A]	-	-22.9	-20.5	-15.8	-12.8	-11.5	-12.4	-13.7	-15.1	-16.5	-17.9
NSR 6 – Ballantrushal/Baile an Truiseil– Night-time											
Night-time Limit [A]	44.8	44.8	45.4	46.0	46.7	47.5	48.4	49.3	50.4	51.5	52.7
WTN Level [B]	-	20.9	23.9	29.4	33.3	35.7	35.9	35.9	35.9	35.9	35.9
Compliance [B-A]	-	-23.9	-21.5	-16.6	-13.4	-11.8	-12.5	-13.4	-14.5	-15.6	-16.8
NSR 7 – 17A Ballantrushal/Baile an Truiseil– Daytime											
Daytime Limit [A]	-	44.0	44.4	45.1	45.9	46.9	48.0	49.3	50.8	52.2	53.7
WTN Level [B]	-	20.6	23.6	29.1	33.0	35.4	35.6	35.6	35.6	35.6	35.6
Compliance [B-A]	-	-23.4	-20.8	-16.0	-12.9	-11.5	-12.4	-13.7	-15.2	-16.6	-18.1
NSR 7 – 17A Ballantrushal/Baile an Truiseil– Night-time											
Night-time Limit [A]	-	45.0	45.4	45.9	46.5	47.2	48.0	49.0	50.1	51.3	52.5
WTN Level [B]	-	20.6	23.6	29.1	33.0	35.4	35.6	35.6	35.6	35.6	35.6
Compliance [B-A]	-	-24.4	-21.8	-16.8	-13.5	-11.8	-12.4	-13.4	-14.5	-15.7	-16.9
NSR 8 – Morven/A' Mhorbhairne – Daytime											
Daytime Limit [A]	-	43.8	44.4	45.2	46.1	47.2	48.3	49.6	51.0	52.4	53.8
WTN Level [B]	-	20.8	23.8	29.3	33.2	35.6	35.8	35.8	35.8	35.8	35.8
Compliance [B-A]	-	-23.0	-20.6	-15.9	-12.9	-11.6	-12.5	-13.8	-15.2	-16.6	-18.0
NSR 8 – Morven/A' Mhorbhairne – Night-time											
Night-time Limit [A]	-	44.8	45.4	46.0	46.7	47.5	48.4	49.3	50.3	51.5	52.7
WTN Level [B]	-	20.8	23.8	29.3	33.2	35.6	35.8	35.8	35.8	35.8	35.8
Compliance [B-A]	-	-24.0	-21.6	-16.7	-13.5	-11.9	-12.6	-13.5	-14.5	-15.7	-16.9
NSR 9 – 4 Cnoc A Charnain – Daytime											
Daytime Limit [A]	-	46.0	46.9	47.8	48.9	50.1	51.5	53.0	54.6	56.4	58.2
WTN Level [B]	-	22.9	25.9	31.4	35.3	37.7	37.9	37.9	37.9	37.9	37.9
Compliance [B-A]	-	-23.1	-20.9	-16.4	-13.6	-12.4	-13.6	-15.1	-16.7	-18.4	-20.3
NSR 9 – 4 Cnoc A Charnain – Night-time											
Night-time Limit [A]	-	46.3	47.1	48.1	49.1	50.3	51.5	53.0	54.5	56.2	58.0
WTN Level [B]	-	22.9	25.9	31.4	35.3	37.7	37.9	37.9	37.9	37.9	37.9
Compliance [B-A]	-	-23.4	-21.2	-16.6	-13.8	-12.5	-13.6	-15.0	-16.6	-18.3	-20.1

Table 19-39: Noise limit assessment, $L_{A90,T}$ dB(A) - Option 1 – Upwind conditions

	Wind Speed Referenced to 10 m Height (Standardised U_{10}), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 1 – Garenin/Na Gearrannan – Daytime											
Daytime Limit [A]	41.1	41.1	41.1	41.3	41.8	42.7	43.9	45.4	47.1	48.9	50.8
WTN Level [B]	-	16.5	19.5	25.0	28.9	31.3	31.5	31.5	31.5	31.5	31.5
Compliance [B-A]	-	-24.6	-21.6	-16.3	-12.9	-11.4	-12.4	-13.9	-15.6	-17.4	-19.3
NSR 1 – Garenin/Na Gearrannan – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.0	43.3	44.9	46.6	48.5	50.5
WTN Level [B]	-	16.5	19.5	25.0	28.9	31.3	31.5	31.5	31.5	31.5	31.5
Compliance [B-A]	-	-26.5	-23.5	-18.0	-14.1	-11.7	-11.8	-13.4	-15.1	-17.0	-19.0
NSR 2 – Dalmore/Dail Mhor – Daytime											
Daytime Limit [A]	42.5	42.5	42.5	42.6	43.3	44.6	46.4	48.5	50.8	53.3	55.8
WTN Level [B]	-	16.5	19.5	25.0	28.9	31.3	31.5	31.5	31.5	31.5	31.5
Compliance [B-A]	-	-26	-23.0	-17.6	-14.4	-13.3	-14.9	-17.0	-19.3	-21.8	-24.3
NSR 2 – Dalmore/Dail Mhor – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.1	44.9	47.0	49.3	51.8	54.5
WTN Level [B]	-	16.5	19.5	25.0	28.9	31.3	31.5	31.5	31.5	31.5	31.5
Compliance [B-A]	-	-26.5	-23.5	-18.0	-14.1	-11.8	-13.4	-15.5	-17.8	-20.3	-23.0
NSR 3 – South Shawbost/Siabost bho Dheas – Daytime											
Daytime Limit [A]	45.5	45.5	45.5	45.5	45.7	46.2	47.0	48.0	49.1	50.4	51.7
WTN Level [B]	-	18.2	21.2	26.7	30.6	33.0	33.2	33.2	33.2	33.2	33.2
Compliance [B-A]	-	-27.3	-24.3	-18.8	-15.1	-13.2	-13.8	-14.8	-15.9	-17.2	-18.5
NSR 3 – South Shawbost/Siabost bho Dheas – Night-time											
Night-time Limit [A]	45.1	45.1	45.1	45.1	45.2	45.7	46.6	47.9	49.3	50.9	52.6
WTN Level [B]	-	18.2	21.2	26.7	30.6	33.0	33.2	33.2	33.2	33.2	33.2
Compliance [B-A]	-	-26.9	-23.9	-18.4	-14.6	-12.7	-13.4	-14.7	-16.1	-17.7	-19.4
NSR 4 – Labost – Daytime											
Daytime Limit [A]	43.3	43.3	43.3	43.3	43.5	44.0	44.8	45.7	46.8	48.1	49.4
WTN Level [B]	-	18.1	21.1	26.6	30.5	32.9	33.1	33.1	33.1	33.1	33.1
Compliance [B-A]	-	-25.2	-22.2	-16.7	-13.0	-11.1	-11.7	-12.6	-13.7	-15.0	-16.3
NSR 4 – Labost – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.2	43.7	44.5	45.5	46.6	47.9
WTN Level [B]	-	18.1	21.1	26.6	30.5	32.9	33.1	33.1	33.1	33.1	33.1
Compliance [B-A]	-	-24.9	-21.9	-16.4	-12.5	-10.3	-10.6	-11.4	-12.4	-13.5	-14.8
NSR 5 – Brue/Brù – Daytime											
Daytime Limit [A]	42.1	42.1	42.1	42.1	42.1	42.2	42.7	43.4	44.4	45.5	46.8
WTN Level [B]	-	16.0	19.0	24.5	28.4	30.8	31.0	31.0	31.0	31.0	31.0
Compliance [B-A]	-	-26.1	-23.1	-17.6	-13.7	-11.4	-11.7	-12.4	-13.4	-14.5	-15.8

	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 5 – Brue/Brù – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7	45.2	46.9
WTN Level [B]	-	16.0	19.0	24.5	28.4	30.8	31.0	31.0	31.0	31.0	31.0
Compliance [B-A]	-	-27.0	-24.0	-18.5	-14.6	-12.2	-12.0	-12.0	-12.7	-14.2	-15.9
NSR 6 – Ballantrushal/Baile an Truiseil– Daytime											
Daytime Limit [A]	40.6	40.6	40.6	40.6	40.9	41.3	41.9	42.6	43.5	44.4	45.4
WTN Level [B]	-	14.9	17.9	23.4	27.3	29.7	29.9	29.9	29.9	29.9	29.9
Compliance [B-A]	-	-25.7	-22.7	-17.2	-13.6	-11.6	-12.0	-12.7	-13.6	-14.5	-15.5
NSR 6 – Ballantrushal/Baile an Truiseil– Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	45.6
WTN Level [B]	-	14.9	17.9	23.4	27.3	29.7	29.9	29.9	29.9	29.9	29.9
Compliance [B-A]	-	-28.1	-25.1	-19.6	-15.7	-13.3	-13.1	-13.1	-13.1	-14.1	-15.7
NSR 7 – 17A Ballantrushal/Baile an Truiseil– Daytime											
Daytime Limit [A]	-	40.7	40.5	40.4	40.2	40.1	40.3	41.0	42.2	43.4	44.6
WTN Level [B]	-	14.6	17.6	23.1	27.0	29.4	29.6	29.6	29.6	29.6	29.6
Compliance [B-A]	-	-26.1	-22.9	-17.3	-13.2	-10.7	-10.7	-11.4	-12.6	-13.8	-15.0
NSR 7 – 17A Ballantrushal/Baile an Truiseil– Night-time											
Night-time Limit [A]	-	43.0	43.0	42.9	42.6	42.2	41.8	41.6	41.5	42.8	44.9
WTN Level [B]	-	14.6	17.6	23.1	27.0	29.4	29.6	29.6	29.6	29.6	29.6
Compliance [B-A]	-	-28.4	-25.4	-19.8	-15.6	-12.8	-12.2	-12.0	-11.9	-13.2	-15.3
NSR 8 – Morven/A' Mhorbhairne – Daytime											
Daytime Limit [A]	-	40.6	40.6	40.6	40.9	41.3	41.9	42.6	43.5	44.4	45.4
WTN Level [B]	-	14.8	17.8	23.3	27.2	29.6	29.8	29.8	29.8	29.8	29.8
Compliance [B-A]	-	-25.8	-22.8	-17.3	-13.7	-11.7	-12.1	-12.8	-13.7	-14.6	-15.6
NSR 8 – Morven/A' Mhorbhairne – Night-time											
Night-time Limit [A]	-	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	45.6
WTN Level [B]	-	14.8	17.8	23.3	27.2	29.6	29.8	29.8	29.8	29.8	29.8
Compliance [B-A]	-	-28.2	-25.2	-19.7	-15.8	-13.4	-13.2	-13.2	-13.2	-14.2	-15.8
NSR 9 – 4 Cnoc A Charnain – Daytime											
Daytime Limit [A]	-	45.5	45.5	45.4	45.6	46.0	46.8	47.8	48.9	50.3	51.6
WTN Level [B]	-	16.9	19.9	25.4	29.3	31.7	31.9	31.9	31.9	31.9	31.9
Compliance [B-A]	-	-28.6	-25.5	-20.0	-16.3	-14.3	-14.8	-15.8	-17.0	-18.3	-19.7
NSR 9 – 4 Cnoc A Charnain – Night-time											
Night-time Limit [A]	-	45.1	45.1	45.1	45.1	45.5	46.4	47.6	49.2	50.8	52.5
WTN Level [B]	-	16.9	19.9	25.4	29.3	31.7	31.9	31.9	31.9	31.9	31.9
Compliance [B-A]	-	-28.2	-25.1	-19.6	-15.7	-13.8	-14.4	-15.7	-17.2	-18.9	-20.6

Table 19-40: Noise limit assessment, $L_{A90,T}$ dB(A) - Option 2 - Downwind conditions

	Wind Speed Referenced to 10 m Height (Standardised U_{10}), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 1 – Garenin/Na Gearrannan – Daytime											
Daytime Limit [A]	40.0	40.0	40.5	41.9	43.3	44.7	46.1	47.5	48.9	50.4	51.9
WTN Level [B]	-	27.8	31.2	36.3	40.4	42.7	42.7	42.7	42.7	42.7	42.7
Compliance [B-A]		-12.2	-9.3	-5.6	-2.9	-2.0	-3.4	-4.8	-6.2	-7.7	-9.2
NSR 1 – Garenin/Na Gearrannan – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.3	44.1	45.0	46.1	47.3	48.7	50.2	51.9
WTN Level [B]	-	27.8	31.2	36.3	40.4	42.7	42.7	42.7	42.7	42.7	42.7
Compliance [B-A]	-	-15.2	-11.8	-7.0	-3.7	-2.3	-3.4	-4.6	-6.0	-7.5	-9.2
NSR 2 – Dalmore/Dail Mhor – Daytime											
Daytime Limit [A]	47.5	47.5	48.5	49.5	50.4	51.4	52.4	53.5	54.6	56.0	57.5
WTN Level [B]	-	27.8	31.2	36.3	40.4	42.7	42.7	42.7	42.7	42.7	42.7
Compliance [B-A]	-	-19.7	-17.3	-13.2	-10.0	-8.7	-9.7	-10.8	-11.9	-13.3	-14.8
NSR 2 – Dalmore/Dail Mhor – Night-time											
Night-time Limit [A]	47.4	47.4	48.8	50.0	50.9	51.8	52.6	53.5	54.5	55.7	57.2
WTN Level [B]	-	27.8	31.2	36.3	40.4	42.7	42.7	42.7	42.7	42.7	42.7
Compliance [B-A]	-	-19.6	-17.6	-13.7	-10.5	-9.1	-9.9	-10.8	-11.8	-13	-14.5
NSR 3 – South Shawbost/Siabost bho Dheas – Daytime											
Daytime Limit [A]	46.0	46.0	46.9	47.9	49.0	50.2	51.6	53.1	54.7	56.4	58.2
WTN Level [B]	-	29.4	32.8	37.9	42.0	44.3	44.3	44.3	44.3	44.3	44.3
Compliance [B-A]	-	-16.6	-14.1	-10	-7.0	-5.9	-7.3	-8.8	-10.4	-12.1	-13.9
NSR 3 – South Shawbost/Siabost bho Dheas – Night-time											
Night-time Limit [A]	46.3	46.3	47.1	48.1	49.2	50.3	51.6	53.0	54.6	56.2	58.1
WTN Level [B]	-	29.4	32.8	37.9	42.0	44.3	44.3	44.3	44.3	44.3	44.3
Compliance [B-A]	-	-16.9	-14.3	-10.2	-7.2	-6.0	-7.3	-8.7	-10.3	-11.9	-13.8
NSR 4 – Labost – Daytime											
Daytime Limit [A]	42.9	42.9	44.2	45.5	46.8	48.1	49.3	50.5	51.8	53.0	54.3
WTN Level [B]	-	29.3	32.7	37.8	41.9	44.2	44.2	44.2	44.2	44.2	44.2
Compliance [B-A]	-	-13.6	-11.5	-7.7	-4.9	-3.9	-5.1	-6.3	-7.6	-8.8	-10.1
NSR 4 – Labost – Night-time											
Night-time Limit [A]	43.3	43.3	44.6	45.8	47.0	48.2	49.4	50.7	52.0	53.3	54.6
WTN Level [B]	-	29.3	32.7	37.8	41.9	44.2	44.2	44.2	44.2	44.2	44.2
Compliance [B-A]	-	-14	-11.9	-8.0	-5.1	-4.0	-5.2	-6.5	-7.8	-9.1	-10.4
NSR 5 – Brue/Brù – Daytime											
Daytime Limit [A]	47.8	47.8	49.2	50.4	51.5	52.5	53.5	54.6	55.6	56.8	58.2
WTN Level [B]	-	27.2	30.6	35.7	39.8	42.1	42.1	42.1	42.1	42.1	42.1
Compliance [B-A]	-	-20.6	-18.6	-14.7	-11.7	-10.4	-11.4	-12.5	-13.5	-14.7	-16.1

	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 5 – Brue/Brù – Night-time											
Night-time Limit [A]	47.8	47.8	49.2	50.4	51.5	52.5	53.5	54.6	55.6	56.8	58.2
WTN Level [B]	-	27.2	30.6	35.7	39.8	42.1	42.1	42.1	42.1	42.1	42.1
Compliance [B-A]	-	-20.6	-18.6	-14.7	-11.7	-10.4	-11.4	-12.5	-13.5	-14.7	-16.1
NSR 6 – Ballantrushal/Baile an Truiseil – Daytime											
Daytime Limit [A]	43.8	43.8	44.4	45.2	46.1	47.2	48.3	49.6	51.0	52.4	53.8
WTN Level [B]	-	26.2	29.6	34.7	38.8	41.1	41.1	41.1	41.1	41.1	41.1
Compliance [B-A]	-	-17.6	-14.8	-10.5	-7.3	-6.1	-7.2	-8.5	-9.9	-11.3	-12.7
NSR 6 – Ballantrushal/Baile an Truiseil – Night-time											
Night-time Limit [A]	44.8	44.8	45.4	46.0	46.7	47.5	48.4	49.3	50.4	51.5	52.7
WTN Level [B]	-	26.2	29.6	34.7	38.8	41.1	41.1	41.1	41.1	41.1	41.1
Compliance [B-A]	-	-18.6	-15.8	-11.3	-7.9	-6.4	-7.3	-8.2	-9.3	-10.4	-11.6
NSR 7 – 17A Ballantrushal/Baile an Truiseil – Daytime											
Daytime Limit [A]	-	44.0	44.4	45.1	45.9	46.9	48.0	49.3	50.8	52.2	53.7
WTN Level [B]	-	25.9	29.3	34.4	38.5	40.8	40.8	40.8	40.8	40.8	40.8
Compliance [B-A]	-	-18.1	-15.1	-10.7	-7.4	-6.1	-7.2	-8.5	-10.0	-11.4	-12.9
NSR 7 – 17A Ballantrushal/Baile an Truiseil – Night-time											
Night-time Limit [A]	-	45.0	45.4	45.9	46.5	47.2	48.0	49.0	50.1	51.3	52.5
WTN Level [B]	-	25.9	29.3	34.4	38.5	40.8	40.8	40.8	40.8	40.8	40.8
Compliance [B-A]	-	-19.1	-16.1	-11.5	-8.0	-6.4	-7.2	-8.2	-9.3	-10.5	-11.7
NSR 8 – Morven/A' Mhorbhairne – Daytime											
Daytime Limit [A]	-	43.8	44.4	45.2	46.1	47.2	48.3	49.6	51.0	52.4	53.8
WTN Level [B]	-	26.1	29.5	34.6	38.7	41.0	41.0	41.0	41.0	41.0	41.0
Compliance [B-A]	-	-17.7	-14.9	-10.6	-7.4	-6.2	-7.3	-8.6	-10.0	-11.4	-12.8
NSR 8 – Morven/A' Mhorbhairne – Night-time											
Night-time Limit [A]	-	44.8	45.4	46.0	46.7	47.5	48.4	49.3	50.3	51.5	52.7
WTN Level [B]	-	26.1	29.5	34.6	38.7	41.0	41.0	41.0	41.0	41.0	41.0
Compliance [B-A]	-	-18.7	-15.9	-11.4	-8.0	-6.5	-7.4	-8.3	-9.3	-10.5	-11.7
NSR 9 – 4 Cnoc A Charnain – Daytime											
Daytime Limit [A]	-	46.0	46.9	47.8	48.9	50.1	51.5	53.0	54.6	56.4	58.2
WTN Level [B]	-	28.2	31.6	36.7	40.8	43.1	43.1	43.1	43.1	43.1	43.1
Compliance [B-A]	-	-17.8	-15.3	-11.1	-8.1	-7.0	-8.4	-9.9	-11.5	-13.3	-15.1
NSR 9 – 4 Cnoc A Charnain – Night-time											
Night-time Limit [A]	-	46.3	47.1	48.1	49.1	50.3	51.5	53.0	54.5	56.2	58.0
WTN Level [B]	-	28.2	31.6	36.7	40.8	43.1	43.1	43.1	43.1	43.1	43.1
Compliance [B-A]	-	-18.1	-15.5	-11.4	-8.3	-7.2	-8.4	-9.9	-11.4	-13.1	-14.9

Table 19-41: Noise limit assessment, $L_{A90,T}$ dB(A) - Option 2 – Upwind conditions

	Wind Speed Referenced to 10 m Height (Standardised U_{10}), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 1 – Garenin/Na Gearrannan – Daytime											
Daytime Limit [A]	41.1	41.1	41.1	41.3	41.8	42.7	43.9	45.4	47.1	48.9	50.8
WTN Level [B]	-	21.8	25.2	30.3	34.4	36.7	36.7	36.7	36.7	36.7	36.7
Compliance [B-A]	-	-19.3	-15.9	-11.0	-7.4	-6.0	-7.2	-8.7	-10.4	-12.2	-14.1
NSR 1 – Garenin/Na Gearrannan – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.0	43.3	44.9	46.6	48.5	50.5
WTN Level [B]	-	21.8	25.2	30.3	34.4	36.7	36.7	36.7	36.7	36.7	36.7
Compliance [B-A]	-	-21.2	-17.8	-12.7	-8.6	-6.3	-6.6	-8.2	-9.9	-11.8	-21.2
NSR 2 – Dalmore/Dail Mhor – Daytime											
Daytime Limit [A]	42.5	42.5	42.5	42.6	43.3	44.6	46.4	48.5	50.8	53.3	55.8
WTN Level [B]	-	21.8	25.2	30.3	34.4	36.7	36.7	36.7	36.7	36.7	36.7
Compliance [B-A]	-	-20.7	-17.3	-12.3	-8.9	-7.9	-9.7	-11.8	-14.1	-16.6	-19.1
NSR 2 – Dalmore/Dail Mhor – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.1	44.9	47.0	49.3	51.8	54.5
WTN Level [B]	-	21.8	25.2	30.3	34.4	36.7	36.7	36.7	36.7	36.7	36.7
Compliance [B-A]	-	-21.2	-17.8	-12.7	-8.6	-6.4	-8.2	-10.3	-12.6	-15.1	-17.8
NSR 3 – South Shawbost/Siabost bho Dheas – Daytime											
Daytime Limit [A]	45.5	45.5	45.5	45.5	45.7	46.2	47.0	48.0	49.1	50.4	51.7
WTN Level [B]	-	23.4	26.8	31.9	36.0	38.3	38.3	38.3	38.3	38.3	38.3
Compliance [B-A]	-	-22.1	-18.7	-13.6	-9.7	-7.9	-8.7	-9.7	-10.8	-12.1	-13.4
NSR 3 – South Shawbost/Siabost bho Dheas – Night-time											
Night-time Limit [A]	45.1	45.1	45.1	45.1	45.2	45.7	46.6	47.9	49.3	50.9	52.6
WTN Level [B]	-	23.4	26.8	31.9	36.0	38.3	38.3	38.3	38.3	38.3	38.3
Compliance [B-A]	-	-21.7	-18.3	-13.2	-9.2	-7.4	-8.3	-9.6	-11.0	-12.6	-14.3
NSR 4 – Labost – Daytime											
Daytime Limit [A]	43.3	43.3	43.3	43.3	43.5	44.0	44.8	45.7	46.8	48.1	49.4
WTN Level [B]	-	23.3	26.7	31.8	35.9	38.2	38.2	38.2	38.2	38.2	38.2
Compliance [B-A]	-	-20	-16.6	-11.5	-7.6	-5.8	-6.6	-7.5	-8.6	-9.9	-11.2
NSR 4 – Labost – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.2	43.7	44.5	45.5	46.6	47.9
WTN Level [B]	-	23.3	26.7	31.8	35.9	38.2	38.2	38.2	38.2	38.2	38.2
Compliance [B-A]	-	-19.7	-16.3	-11.2	-7.1	-5.0	-5.5	-6.3	-7.3	-8.4	-9.7
NSR 5 – Brue/Brù – Daytime											
Daytime Limit [A]	42.1	42.1	42.1	42.1	42.1	42.2	42.7	43.4	44.4	45.5	46.8
WTN Level [B]	-	21.2	24.6	29.7	33.8	36.1	36.1	36.1	36.1	36.1	36.1
Compliance [B-A]	-	-20.9	-17.5	-12.4	-8.3	-6.1	-6.6	-7.3	-8.3	-9.4	-10.7

	Wind Speed Referenced to 10 m Height (Standardised U ₁₀), m/s										
	2	3	4	5	6	7	8	9	10	11	12
NSR 5 – Brue/Brù – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7	45.2	46.9
WTN Level [B]	-	21.2	24.6	29.7	33.8	36.1	36.1	36.1	36.1	36.1	36.1
Compliance [B-A]	-	-21.8	-18.4	-13.3	-9.2	-6.9	-6.9	-6.9	-7.6	-9.1	-10.8
NSR 6 – Ballantrushal/Baile an Truiseil – Daytime											
Daytime Limit [A]	40.6	40.6	40.6	40.6	40.9	41.3	41.9	42.6	43.5	44.4	45.4
WTN Level [B]	-	20.2	23.6	28.7	32.8	35.1	35.1	35.1	35.1	35.1	35.1
Compliance [B-A]	-	-20.4	-17	-11.9	-8.1	-6.2	-6.8	-7.5	-8.4	-9.3	-10.3
NSR 6 – Ballantrushal/Baile an Truiseil – Night-time											
Night-time Limit [A]	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	45.6
WTN Level [B]	-	20.2	23.6	28.7	32.8	35.1	35.1	35.1	35.1	35.1	35.1
Compliance [B-A]	-	-22.8	-19.4	-14.3	-10.2	-7.9	-7.9	-7.9	-7.9	-8.9	-10.5
NSR 7 – 17A Ballantrushal/Baile an Truiseil – Daytime											
Daytime Limit [A]	-	40.7	40.5	40.4	40.2	40.1	40.3	41.0	42.2	43.4	44.6
WTN Level [B]	-	19.9	23.3	28.4	32.5	34.8	34.8	34.8	34.8	34.8	34.8
Compliance [B-A]	-	-20.8	-17.2	-12.0	-7.7	-5.3	-5.5	-6.2	-7.4	-8.6	-9.8
NSR 7 – 17A Ballantrushal/Baile an Truiseil – Night-time											
Night-time Limit [A]	-	43.0	43.0	42.9	42.6	42.2	41.8	41.6	41.5	42.8	44.9
WTN Level [B]	-	19.9	23.3	28.4	32.5	34.8	34.8	34.8	34.8	34.8	34.8
Compliance [B-A]	-	-23.1	-19.7	-14.5	-10.1	-7.4	-7.0	-6.8	-6.7	-8.0	-10.1
NSR 8 – Morven/A' Mhorbhairne – Daytime											
Daytime Limit [A]	-	40.6	40.6	40.6	40.9	41.3	41.9	42.6	43.5	44.4	45.4
WTN Level [B]	-	20.1	23.5	28.6	32.7	35.0	35.0	35.0	35.0	35.0	35.0
Compliance [B-A]	-	-20.5	-17.1	-12.0	-8.2	-6.3	-6.9	-7.6	-8.5	-9.4	-10.4
NSR 8 – Morven/A' Mhorbhairne – Night-time											
Night-time Limit [A]	-	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	45.6
WTN Level [B]	-	20.1	23.5	28.6	32.7	35.0	35.0	35.0	35.0	35.0	35.0
Compliance [B-A]	-	-22.9	-19.5	-14.4	-10.3	-8.0	-8.0	-8.0	-8.0	-9.0	-10.6
NSR 9 – 4 Cnoc A Charnain – Daytime											
Daytime Limit [A]	-	45.5	45.5	45.4	45.6	46.0	46.8	47.8	48.9	50.3	51.6
WTN Level [B]	-	22.2	25.6	30.7	34.8	37.1	37.1	37.1	37.1	37.1	37.1
Compliance [B-A]	-	-23.3	-19.9	-14.8	-10.8	-8.9	-9.7	-10.7	-11.9	-13.2	-14.5
NSR 9 – 4 Cnoc A Charnain – Night-time											
Night-time Limit [A]	-	45.1	45.1	45.1	45.1	45.5	46.4	47.6	49.2	50.8	52.5
WTN Level [B]	-	22.2	25.6	30.7	34.8	37.1	37.1	37.1	37.1	37.1	37.1
Compliance [B-A]	-	-22.9	-19.5	-14.4	-10.3	-8.4	-9.3	-10.5	-12.1	-13.7	-15.4

Magnitude

19.9.1.46 In line with the impact magnitude scale for operational WTN, see **Table 19-11**. When the WTN is compared to the applicable noise limit and it is less than 0 dB and greater than -5 dB, the magnitude of impact is categorised as Low. When the WTN is less than -5 dB, the magnitude of impact is categorised as Slight. The worst-case magnitude of impact is Low.

Sensitivity or value of receptor

19.9.1.47 The selected NSRs are all categorised as having a high sensitivity. NSR sensitivity is defined in **Table 19-9**.

Significance of effect

19.9.1.48 WTN will occur during the operational phase of the Offshore Project. Considering the embedded mitigation described in **Table 19-22**, the WTN significance of effect on NSRs are summarised in **Table 19-42**.

Table 19-42 Significance of effect of Offshore Airborne Noise during the operational phase

NSR	Time-period	Magnitude	Sensitivity	Embedded mitigation measures	Significance of effect	Significance	Commentary
NSR1 Garenin/ <i>Na Gearrannan</i>	Daytime and night-time	Low	High	N/A	Minor	Not Significant	Operation WTN levels comply with noise limits under all wind conditions and at all times.
NSR2 Dalmore/ <i>Dail Mhor</i>	Daytime and night-time	Slight	High	N/A	Negligible	Not Significant	Operation WTN levels comply with noise limits under all wind conditions and at all times.
NSR3 South Shawbost/ <i>Siabost bho Dheas</i>	Daytime and night-time	Slight	High	N/A	Negligible	Not Significant	Operation WTN levels comply with noise limits under all wind conditions and at all times.
NSR4 Labost	Daytime and night-time	Low	High	N/A	Minor	Not Significant	Operation WTN levels comply with noise limits under all wind conditions and at all times.
NSR5 Brue/ <i>Brù</i>	Daytime and night-time	Slight	High	N/A	Negligible	Not Significant	Operation WTN levels comply with noise limits under all wind conditions and at all times.
NSR6 Ballantrushal/ <i>Baile an Truiseil</i>	Daytime and night-time	Slight	High	N/A	Negligible	Not Significant	Operation WTN levels comply with noise limits under all wind conditions and at all times.
NSR7 17A Ballantrushal/ <i>Baile an Truiseil</i>	Daytime and night-time	Slight	High	N/A	Negligible	Not Significant	Operation WTN levels comply with noise limits under all wind conditions and at all times.

NSR	Time-period	Magnitude	Sensitivity	Embedded mitigation measures	Significance of effect	Significance	Commentary
NSR8 Morven/A' Mhorbhairne	Daytime and night-time	Slight	High	N/A	Negligible	Not Significant	Operation WTN levels comply with noise limits under all wind conditions and at all times.
NSR9 Cnoc A Charnain	Daytime and night-time	Slight	High	N/A	Negligible	Not Significant	Operation WTN levels comply with noise limits under all wind conditions and at all times.

Further environmental Mitigation and residual effect

19.9.1.49 No further environmental mitigation is required as predicted operation WTN levels are below daytime and night-time limits at all NSRs during downwind, crosswind and upwind conditions.

19.10 ASSESSMENT OF COMBINED EFFECTS

19.10.1.1 The combined effects assessment considers likely significant effects from multiple impacts and activities from the construction, O&M, and decommissioning phases of the Offshore Project on the same NSR, or group of NSRs. The overall method following in identifying and assessing potential Combined Effects in relation to the offshore environment is set out in **Chapter 5, Volume 1a**.

19.10.1.2 Combined effects could potentially arise in one of two ways. The first type of combined effect is a Project lifetime effect, where multiple phases of the Project (construction, O&M, and decommissioning) interact to create a potentially more significant effect on a NSR than in one phase alone.

19.10.1.3 The second type of combined effect is receptor-led effects. Receptor-led effects are where effects from different environmental aspects combine spatially and temporally on a NSR. These effects may be short-term, temporary, transient, or longer-term.

19.10.1.4 Receptor-led effects have been considered, where relevant, in this chapter for potential interactions between Airborne Noise and the following environmental aspects:

- **Chapter 6, Volume 2a;**
- **Chapter 20, Volume 2a;**
- **Chapter 22, Volume 2a.**

19.10.1.5 Full results of the Project lifetime effects and receptor-led effects assessment can be found in **Chapter 23: Combined Effects Assessment, Volume 2a**.

19.11 CONSIDERATION OF ONSHORE TRANSMISSION WORKS PROJECT

19.11.1.1 A separate application for the Project's onshore elements (the OTW Project) that includes all infrastructure landwards of Mean Low Water Springs (MLWS) within the Onshore Transmission Works Boundary will be made, under the Town and Country Planning (Scotland) Act 1997 to Comhairle nan Eilean Siar (CnES). The OTW Project EIAR will provide a full description of the onshore elements of the Project landward of MLWS, and include an assessment of the associated likely significant effects.

19.11.1.2 This EIAR has considered the combined effects of the Offshore Project and OTW Project to determine whether their interaction could alter the assessment outcomes. The approach to identify and evaluate potential interactions between the Offshore Project and OTW Project is set out in

Chapter 5, Volume 1a, the key design parameters for the OTW Project are summarised in **Chapter 3, Volume 1a**.

19.11.1.3 The potential for effects identified in **Table 19-4** to interact with effects associated with the OTW Project at a Common Receptor has been considered for Offshore Airborne Noise. **Table 19.43** provides a summary of the pathways considered in this chapter and the potential for interaction. Where required, this table provides the relevant MDS information for the OTW Project that has been used to inform this assessment.

Table 19.43 Summary of Offshore Airborne Noise pathways and potential for interaction with the OTW Project

Assessment pathways considered and receptors	Maximum Design Scenario
Construction	
Resultant noise emissions from the Offshore Project, together with the proposed OTW Project, to residential receptors on the west coast of the Isle of Lewis.	<p><u>Offshore Project</u></p> <ul style="list-style-type: none"> - See MDS outlined in Table 19-21. <p><u>OTW Project</u></p> <p>As outlined in Section 3.6, Chapter 3, Volume 1a - construction works associated with:</p> <ul style="list-style-type: none"> - up to 13 Horizontal Directional Drilling (HDD) entry points near a coastal cliff at Barvas/<i>Barabhas</i> (Scenario 2); - an onshore temporary construction HDD compound (approximately 465 m x 480 m) and temporary access road; - up to 12 circuits of buried Onshore Cables will connect from the TJBs to the Landfall Substation located near Barvas/<i>Barabhas</i> (Scenario 2); - Landfall Substation with a platform of approximately 150 m by 150 m and a maximum height of 15m, plus several other, smaller buildings housing electrical and other equipment. Within the site compound, there will also be safety features such as lightning masts and access paths/roads.
Operation and maintenance	
Resultant noise emissions from the Offshore Project, together with the proposed OTW Project, to residential receptors on the west coast of the Isle of Lewis.	<p><u>Offshore Project</u></p> <ul style="list-style-type: none"> - See MDS outlined in Table 19-21. <p><u>OTW Project</u></p> <ul style="list-style-type: none"> - Operational noise associated with the Landfall Substation (Scenario 2).
Decommissioning	
Potential impacts associated with the decommissioning phase of the Offshore Project have been scoped out from further assessment on the basis that it will result in similar to or lower noise effects than assessed during the construction phase (see Table 19-5).	

Construction

Resultant noise emissions from the Offshore Project, together with the proposed OTW Project, to residential receptors on the west coast of the Isle of Lewis/Eilean Leòdhais.

- 19.11.1.4 There is the potential for temporary adverse effects associated with the construction of the Offshore Project in combination with the OTW Project during the period of the percussive piling installation (i.e. April – October over a 2 year period), because the construction phases overlap.
- 19.11.1.5 The closest Common Receptor (the closest NSR located between the Offshore Project and OTW Project, which therefore has the greatest potential to experience airborne noise from the construction works of both projects) is Morven/A' Mhorbhairne, this is a residential receptor and is considered high sensitivity. Assessing the closest Common Receptor between the two projects enables the identification of the worst-case scenario of the potential overlap of impacts between the developments that could result in a greater impact. This receptor is located approximately 9 km from the nearest offshore infrastructure requiring percussive piling, and approximately 1 km from the OTW Project construction works Landfall location.
- 19.11.1.6 Following the implementation of mitigation measures, offshore piling noise impacts at the closest Common Receptor would be reduced to a **Minor Adverse** effect, which is **Not Significant** in EIA terms.
- 19.11.1.7 The estimated noise levels from the OTW Project construction activities are not publicly available at the time of this assessment. However, based on the scale of the proposed works, the anticipated noise impact on residential receptors along the west coast of the Isle of Lewis/Eilean Leòdhais is expected to be **Minor Adverse**.
- 19.11.1.8 Based on the information currently available, the combined construction phase noise effects of the Offshore Project and the OTW Project are expected to be no more significant than the effects of the Offshore Project alone.
- 19.11.1.9 Therefore, the magnitude of impact for construction airborne noise on residential receptors located on the west coast of the Isle of Lewis/Eilean Leòdhais as a result of the Offshore Project in addition with the OTW Project is assessed as **Minor Adverse**, which is **Not Significant** in EIA terms.

Operation and Maintenance

Resultant noise emissions from the Offshore Project, together with the proposed OTW Project, to residential receptors on the west coast of the Isle of Lewis/Eilean Leòdhais.

- 19.11.1.10 There is the potential for adverse effects associated with the operation of the Offshore Project in combination with the OTW Project, because the operation phases overlap.
- 19.11.1.11 The closest Common Receptor between the Offshore Project and the OTW Project is Morven/A' Mhorbhairne, this is a residential and is considered high sensitivity. This receptor is located

approximately 9 km from the nearest offshore infrastructure, and approximately 1 km from the OTW Project Landfall location.

- 19.11.1.12 Operational WTG Noise levels assessed for the Offshore Project are below daytime and night-time limits at all receptors (including the Common Receptor) during all conditions. The Offshore Airborne Noise assessment concluded that the impact of operational WTG noise on the Common Receptor is **Negligible/Minor Adverse**, which is **Not Significant** in EIA terms.
- 19.11.1.13 The estimated noise levels from the OTW Project operational activities are not publicly available at the time of this assessment. However, based on the scale of the anticipated operational activities and consequent noise levels, the anticipated noise impact on residential receptors along the west coast of the Isle of Lewis/*Eilean Leòdhais* is expected to be **Negligible/Minor Adverse**.
- 19.11.1.14 Based on the information currently available, the combined operational phase noise effects of the Offshore Project and the OTW Project are expected to be no more significant than the effects of the Offshore Project alone.
- 19.11.1.15 Therefore, the magnitude of impact for operational airborne noise on residential receptors located on the west coast of the Isle of Lewis/*Eilean Leòdhais* as a result of the Offshore Project in addition with the OTW Project is assessed as **Negligible/Minor Adverse**, which is **Not Significant** in EIA terms.

19.12 ASSESSMENT OF CUMULATIVE EFFECTS

19.12.1 APPROACH

- 19.12.1.1 A cumulative effects assessment (CEA) examines the potential for impacts of the Offshore Project in addition with 'Other Developments' on the same single receptor or resource and the contribution of the Offshore Project to those impacts. The overall method following in identifying and assessing potential cumulative effects in relation to the offshore environment is set out in **Chapter 5, Volume 1a**.

19.12.2 CUMULATIVE EFFECTS ASSESSMENT

Construction Noise

- 19.12.2.1 For Offshore Airborne Noise, a Zone of Influence (ZOI) has been applied to ensure direct and indirect cumulative effects can be appropriately identified and assessed. The construction Offshore Airborne Noise ZOI is a search distance of 15 km for offshore construction activities.
- 19.12.2.1 A short list of Other Developments that may interact with the Offshore Project ZOIs during their construction, operation, or decommissioning is presented in **Appendix 5.3: Cumulative effects assessment shortlisted developments, Volume 1c**. This list has been generated applying criteria

set out in **Chapter 5, Volume 1a** and has been collated up to the finalisation of the EIA through desk study, consultation, and engagement.

19.12.2.2 All 'other developments' fall outside the construction Offshore Airborne Noise ZOI and are excluded from this assessment.

Operational WTN

19.12.2.3 The operational WTN assessment in Section 19.9 fully considers the cumulative impact of noise from the Offshore Project together with existing WTN from other developments. The assessment follows the ETSU-R-97 guidelines and the IOA GPG. The methodology outlined in these documents fully accounts that all potential cumulative effects are addressed by including every WTG that could make an acoustically relevant contribution to the noise levels at the NSRs.

19.12.2.4 The completed assessment has therefore included account of the additive effect of the Offshore Project operating simultaneously with all other WTGs which have the potential to generate an acoustically relevant contribution at the NSRs.

19.12.2.5 This has included account of the noise levels potentially generated by the existing onshore BaT and Horshader Wind Farms, through the determination of 'residual' noise level limits which are then adopted in the completed assessment. The residual noise limits are set taking full account of the noise levels potentially generated by those existing wind farms.

19.12.2.6 Other WTGs, both onshore and offshore, have been scoped-out of the assessment after considering their size and location, as they fundamentally would not generate an acoustically relevant level at the nearest NSRs.

19.12.2.7 Further cumulative assessment is therefore not required because potential cumulative effects have already been accounted for in the completed assessment.

19.13 TRANSBOUNDARY EFFECTS

19.13.1.1 Transboundary effects occur when a development in one European Economic Area (EEA) State impacts the environment of another EEA State(s). A screening of potential transboundary effects was undertaken within the **Scoping Report**.

19.13.1.2 No transboundary effects are expected, as the magnitude of Offshore Airborne Noise pathways (including construction percussive piling noise, operation WTN) is insufficient to impact NSRs within other EEA States.

19.14 SUMMARY OF RESIDUAL EFFECTS

19.14.1.1 **Table 19-44** presents a summary of the assessment of significant impacts, any relevant mitigation measures, and residual effects on NSRs.

Table 19-44: Summary of residual effects

Activity and impact	Receptor	Time-period	Magnitude of impact	Receptor and sensitivity	Embedded mitigation measures	Significance of effect (significance)	Further environmental mitigation	Significance of residual effect (significance)
Construction								
Offshore percussive piling noise	NSR1 Garenin/ <i>Na Gearrannan</i>	Day	Slight	High	M019	Negligible (Not Significant)	N/A	N/A
		Evening	Low	High		Minor (Not Significant)	N/A	N/A
		Night	High	High		Major (Significant)	A007	Minor (Not Significant)
	NSR2 Dalmore/ <i>Dail Mhor</i>	Day	Slight	High	M019	Negligible (Not Significant)	N/A	N/A
		Evening	Low	High		Minor (Not Significant)	N/A	N/A
		Night	High	High		Major (Significant)	A007	Minor (Not Significant)
	NSR3 South Shawbost/ <i>Siabost bho Dheas</i>	Day	Slight	High	M019	Minor (Not Significant)	N/A	N/A
		Evening	Medium	High		Moderate (Significant)	A007	Minor (Not Significant)
		Night	High	High		Major (Significant)	A007	Minor (Not Significant)

Activity and impact	Receptor	Time-period	Magnitude of impact	Receptor and sensitivity	Embedded mitigation measures	Significance of effect (significance)	Further environmental mitigation	Significance of residual effect (significance)
	NSR4 Labost	Day	Slight	High	M019	Minor (Not Significant)	N/A	N/A
		Evening	Medium	High		Moderate (Significant)	A007	Minor (Not Significant)
		Night	High	High		Major (Significant)	A007	Minor (Not Significant)
	NSR5 Brue/Brù	Day	Slight	High	M019	Negligible (Not Significant)	N/A	N/A
		Evening	Low	High		Minor (Not Significant)	N/A	N/A
		Night	High	High		Major (Significant)	A007	Minor (Not Significant)
	NSR6 Ballantrushal/Baile an Truiseil	Day	Slight	High	M019	Negligible (Not Significant)	N/A	N/A
		Evening	Low	High		Minor (Not Significant)	N/A	N/A
		Night	High	High		Major (Significant)	A007	Minor (Not Significant)
Operation and maintenance								
Operational WTN	NSR1 Garenin/Na Gearrannan	Daytime and night-time	Low	High	N/A	Negligible/Minor (Not Significant)	N/A	N/A

Activity and impact	Receptor	Time-period	Magnitude of impact	Receptor and sensitivity	Embedded mitigation measures	Significance of effect (significance)	Further environmental mitigation	Significance of residual effect (significance)
	NSR2 Dalmore/ <i>Dail Mhor</i>	Daytime and night-time	Low	High	N/A	Negligible/Minor (Not Significant)	N/A	N/A
	NSR3 South Shawbost/ <i>Siabost bho Dheas</i>	Daytime and night-time	Low	High	N/A	Negligible/Minor (Not Significant)	N/A	N/A
	NSR4 Labost	Daytime and night-time	Low	High	N/A	Negligible/Minor (Not Significant)	N/A	N/A
	NSR5 Brue/ <i>Brù</i>	Daytime and night-time	Low	High	N/A	Negligible/Minor (Not Significant)	N/A	N/A
	NSR6 Ballantrushal/ <i>Baile an Truiseil</i>	Daytime and night-time	Low	High	N/A	Negligible/Minor (Not Significant)	N/A	N/A
	NSR7 17A Ballantrushal/ <i>Baile an Truiseil</i>	Daytime and night-time	Low	High	N/A	Negligible/Minor (Not Significant)	N/A	N/A
	NSR8 Morven/ <i>A' Mhorbhairne</i>	Daytime and night-time	Low	High	N/A	Negligible/Minor (Not Significant)	N/A	N/A
	NSR9 Cnoc A Charnain	Daytime and night-time	Low	High	N/A	Negligible/Minor (Not Significant)	N/A	N/A



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19.15 GLOSSARY OF TERMS AND ABBREVIATIONS

19.15.1.1 A list of key terms and acronyms used in this chapter are provided in **Table 19-45** and **Table 19-46**.

Table 19-45 Acronyms and abbreviations

Term	Definition
BaT	Baile an Truseil (an existing onshore wind farm)
dB	Decibel
dB(A)	A-weighted decibel
BEIS	Department for Business, Energy and Industrial Strategy
BS	British Standard
CEA	Cumulative Effects Assessment
CnES	Comhairle nan Eilean Siar
EEA	European Economic Area
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ETSU	Energy Technology Support Unit
ETSU-R-97	Energy Technology Support Unit's R-97 document: The Assessment and Rating of Noise from Wind Farms (1996)
FI	Financially Involved
FLiDAR	Floating Light Detection and Ranging
GMT	Greenwich Mean Time
GPG	Good Practice Guide
HDD	Horizontal Directional Drilling
Hz	Hertz
INTOG	Innovation and Targeted Oil & Gas
IOA	Institute of Acoustics
IOA GPG	The Institute of Acoustics' guidance document: <i>A Good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise</i> (2013)
k	kilo
km	Kilometre
kW	Kilowatt
kWh	Kilowatt hour
LT	Long Term
m	metres
m/s	metres per second
MD-LOT	Marine Directorate Licensing Operations Team
MLWS	Mean Low Water Springs
MW	Megawatt
Non-FI	Non-Financially Involved
NPF	National Planning Framework 4 (2023)

Term	Definition
NSR	Noise Sensitive Receptor
O&M	Operation and Maintenance
OHLDP	Outer Hebrides Local Development Plan (2018)
OnWPS	Onshore Wind Policy Statement (2022)
OS	Ordnance Survey
OTW	Onshore Transmission Work
OWESMP	Offshore Wind Energy – Draft updated Sectoral Marine Plan (2025)
PAN	Planning Advice Note 1/2011: Planning and Noise (2011)
SGN	Supplementary Guidance Note
TAN	Technical Advice Note
UK	United Kingdom
UTC	Coordinated Universal Time
WCCE	West Coast Community Energy (a proposed onshore wind farm)
WTN	Wind Turbine Noise
WTG	Wind Turbine Generator
ZOI	Zone of Influence

Table 19-46 Glossary

Term	Meaning
The Applicant	Spiorad na Mara Limited (the Project owner)
Array Area	The offshore area within which the offshore wind turbine generators (WTGs), associated foundations, Offshore Cables, and Offshore Substation Platform (OSP) (if required), will be located. This area encompasses the Turbine Area that will contain all above water surface infrastructure (WTGs / OSP) and an additional area within which further below water infrastructure (foundations and cables) may also be located.
A-weighting	Frequency weighted sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Common Receptor	A Common Receptor is an NSR that could be affected by more than one type of impact from the same project and is therefore assessed for combined or cumulative intra-project effects.
Cumulative Effects	Considers the likely significant effects of multiple impacts and activities from several developments.
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria
Environmental Impact Assessment Report (EIAR)	The Environmental Impact Assessment Report (EIAR) prepared to assess the likely significant effects of the Project on the environment. Do not use EIA Report within the EIAR.

Term	Meaning
Embedded or 'Designed-in' Mitigation	Mitigation measures to avoid or reduce environmental effects that are directly incorporated into the preferred design for the Project. This can include standard practice in accordance with or without guidance. Embedded mitigation is considered as part of the impact assessment, before effect significance is identified.
Impact	Change that is caused by an action; for example, foundation installation (action) during construction which results in habitat loss (impact).
Landfall	This consists of works from offshore Horizontal Directional Drill (HDD) exit pits (located below MLWS) to onshore at the Transition Joint Bays (TJB) (located above MHWS). The infrastructure and installation methods associated with the Landfall involves both onshore and offshore components.
$L_{A90,T}$	A statistical noise index defined as the level that is exceeded for 90% of the time over the measurement time-period T. The 'A' denotes that the level is determined with 'A-weighting' applied.
$L_{Aeq,T}$	The 'continuous equivalent sound level' noise index. A single-figure noise index that represents the constant sound level that would contain the same sound energy as the fluctuating noise experienced over the time-period 'T'. The 'A' denotes that the level is determined with 'A-weighting' applied.
L_{WA}	A-weighted sound power level
Maximum Design Scenario	The scenario within the Project Design Envelope with the potential to result in the greatest impact on a particular topic receptor, and therefore the one that should be assessed for that topic receptor. See Chapter 3: Project Description, Volume 1a for detailed description.
Offshore Landfall Area	The area seaward of Mean High Water Springs (MHWS) within the Offshore Cable Area of Search (OCAS) that includes works associated with the Horizontal Directional Drill (HDD) installation, including HDD exit pit(s) (located below MLWS) and offshore cable connection to the onshore (TJB) (located above MHWS).
Offshore Project	Components of the Project seaward of Mean High Water Springs (MHWS) which includes Array Area and Offshore Cable Area of Search.
Offshore Project Boundary	The 'red line boundary' encompassing the Offshore Project.
Scoping Opinion	A report presenting the written opinion of the Scottish Ministers, with input from Comhairle nan Eilean Siar (CnES) for the OTW, as to the scope and level of detail of information to be provided in the Environmental Impact Assessment (EIA) for the Project.
Turbine Area	A reduced area within the Array Area where above water surface infrastructure would be located i.e. wind turbine generators (WTG) or Offshore Substation Platform (OSP) (if required). This area has been developed and refined through stakeholder consultation and environmental assessment.
Wind Turbine Generator (WTG)	The wind turbines that generate electricity consisting of tubular towers and blades attached to a nacelle housing mechanical and electrical generating equipment.
U_{10}	Wind speed at standardised 10 m height
Z_0	Standard ground roughness length of 0.05 m
σ	Measurement uncertainty

19.16 REFERENCES

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