Spiorad na Mara Offshore Wind Farm

Offshore Project

Environmental Impact Assessment Report

Chapter 7: Climate Resilience, Volume 2a

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7 CLIMATE RESILIENCE

7.1 INTRODUCTION

7.1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) presents the results of the assessment of the likely significant effects of climate change on the proposed Spiorad na Mara Offshore Wind Farm (hereafter referred to as the 'Offshore Project'). The assessment of Climate Resilience is different from other environmental aspects in that the assessment considers the impacts of climate change on the Offshore Project, the 'climate impact', rather than the impact of the Offshore Project on the environment.

7.1.1.2 This chapter should be read in conjunction with the project description provided in **Chapter 3: Project Description, Volume 1a** and the relevant parts of the following chapters:

- **Chapter 9: Physical and Coastal Processes, Volume 2a** which considers the effect of the Offshore Project with respect to the sub-tidal seabed, coastline, marine feature and water quality. The impacts of climate change on sea level rise, temperature, salinity and extreme weather are considered within the future baseline;
- In addition, the impact of the Offshore Project on climate change has been assessed in **Chapter 8: Greenhouse Gases, Volume 2a**.

7.1.1.3 This technical chapter describes the following:

- Legislation and planning policy that has informed the assessment (Section 7.2: Summary of policy and legislative context);
- Outcome of the Scoping Opinion (Section 7.3: Scoping and Consultation);
- Scope of the Climate Resilience assessment (Section 7.4: Scope of the Assessment);
- The methods of assessment used for baseline data gathering and impact assessment (Section 7.5: Methodology for baseline data gathering and impact assessment);
- Current and future baseline (Section 7.6: Baseline conditions);
- Embedded environmental measures relevant to Climate Resilience and the relevant maximum design scenario (Section 7.7: Basis for Environmental Impact Assessment);
- Assessment of likely significant effects to the Offshore Project as a result of climate change and further mitigation (Section 7.8-7.10: Assessment of effects and mitigation)
- Assessment of Climate Resilience Combined effects (Section 7.11);
- Assessment of Climate Resilience Whole Project effects (Section 7.12);
- Assessment of Climate Resilience Cumulative effects (Section 7.13);
- Assessment of transboundary effects (Section 7.14)
- A summary of residual effects for Climate Resilience (Section 7.15: Summary of residual effects);

- Glossary and abbreviations used in the Climate Resilience assessment (Section 7.16: Glossary of terms and abbreviations);
- Information sources and documentation referred to in this chapter (Section 7.17: References).

7.1.1.4 The chapter is supported by the following appendix:

- **Appendix 7.1: Climate Change Vulnerability Assessment, Volume 2c**.

7.2 SUMMARY OF POLICY AND LEGISLATIVE CONTEXT

7.2.1.1 This section outlines the legislation, policy and guidance that is relevant to the assessment of likely significant effects on Climate Resilience associated with the construction, operation, maintenance and decommissioning of the Offshore Project. 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 EIAR is provided in **Chapter 2: Policy and Legislative Context, Volume 1a**.

7.2.1.2 A summary of the legislation, policy and guidance relevant to Climate Resilience is provided in **Table 7-1** which examined their relevance to the assessment.

Table 7-1 Legislation and Policy in relation to Climate Resilience

Legislation/Policy	Relevance to the Assessment
International Legislation	
Climate Change Act 2008 (HM Goverment, 2008)	The Climate Change Act 2008 sets targets for reducing the UK's impacts on climate change and the need to prepare for managing such impacts and *"make provision about adaptation to climate change"*. The Act requires a Climate Change Risk Assessment (CCRA) to be used to assess the risks from the impact of Climate Change to the UK. The first UK CCRA was presented to Parliament in an Evidence Report in 2012, with the second presented in 2017 and the third (CCAR3) published in 2022. (UK Climate Risk, 2023) The Act also requires the production of a National Adaptation Plan for the UK Government to be ready for the challenges of climate change. The CCRA identifies and assesses climate change impacts and has been used to inform this assessment.
National Legislation and Policy	
National Planning Framework 4 (Scottish Government, 2023)	Scotland's National Planning Framework sets out a long-term spatial strategy with a comprehensive set of national planning policies to form part of the statutory development plan. Policy 2 addresses climate adaptation, stating that "*Development proposals will be sited and designed to adapt to current and future risks from climate change*." The intent of the policy is to "*encourage, promote and facilitate development that minimises emissions and adapts to the current and future impacts of climate change*."

Legislation/Policy	Relevance to the Assessment
Scotland's National Marine Plan (Scottish Government, 2015)	Scotland's National Marine Plan provides a framework to enable sustainable development and use of the marine area. One of the five key objectives of the Framework is Climate Adaptation. Policy GEN5 states that: "*Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change.*" "*Marine planners and decision makers should be satisfied that* [there is] *sufficient regard to the impacts of a changing climate and, where appropriate, provide effective adaptation to its predicted effects. Offshore and coastal developments should be appropriately sited and designed, and use technologies and equipment appropriate for local conditions, now and in the future, giving particular consideration to vulnerability, scale and longevity of operation. The Scottish Climate Change Adaption Programme should be complied with. Where appropriate, marine planning authorities should be satisfied that adequate risk management and contingency plans are in place, particularly in relation to potential changes in sea temperatures, sea level rise, storminess and extreme water levels, using the best scientific evidence available at the time*."
National Islands Plan Annual Report 2019 (Scottish Government, 2019)	The National Islands Plan provides a framework for action for the island communities. Strategic Objective 9 considers climate change and energy, with the objective to *"contribute to climate change mitigation and adaptation and promote clean, affordable and secure energy"*. The Plan makes reference to key climate risk to the islands such as sea level rise and coastal erosion.
Scottish National Adaptation Plan 2024 – 2029 (Scottish Government, 2024)	The Adaptation Plan sets out the actions that the Scottish Government and partners will take to respond to the impacts of climate change. The importance of building resilient critical services such as the energy network is noted within the plan.
Overarching National Policy Statement for Energy (EN-1) 2023 (Department for Energy Security & Net Zero, 2023)	Whilst EN-1 applies only to England and Wales, it has been included here as an example of good practice. Section 4.10 of the EN-1 highlights that applicants and the Secretary of State should take the impacts of climate change into account when developing and consenting to new energy infrastructure. Paragraph 4.10.1 states that: *"…adaptation is also necessary to manage the impacts of current and future climate change. If new energy infrastructure is not sufficiently resilient against the possible impacts of climate change, it will not be able to satisfy the energy needs as outlined in Part 3 of this NPS.*" Paragraph 4.10.2 identifies how climate change is already happening and likely impacts of climatic changes. It concludes that "*Adaptation is therefore necessary to deal with the potential impacts of these changes that are already happening."* Paragraph 4.10.8 states that: *"New energy infrastructure will typically need to remain operational over many decades, in the face of a changing*

Legislation/Policy	Relevance to the Assessment
	climate." Applicants are recommended to consider direct and indirect impacts of climate change when considering the "*location, design, build, operation and, where appropriate, decommissioning of new energy infrastructure."* Paragraph 4.10.11 requires applicants to demonstrate a high level of climate resilience for the predicted lifetime of the Offshore Project. Paragraph 4.10.13 notes that the Secretary of State should be satisfied that the latest UK Climate Projections are used to identify appropriate mitigation or adaptation measures over the lifetime and decommissioning period.
National Policy Statement for Renewable Energy Infrastructure (EN-3) 2023 (Department for Energy Security & Net Zero, 2023)	Whilst EN-3 applies only to England and Wales, it has been included here as an example of good practice. Section 2.4 of the National Policy Statement for Renewable Energy Infrastructure highlights that applicants and the Secretary of State should take the impacts of climate change into account when developing and consenting to new energy infrastructure, as per the Overarching National Policy Statement for Energy. Paragraph 2.4.8 states that: "*Whilst offshore wind farms will not be affected by flooding, applicants should demonstrate that any necessary land-side infrastructure (such as cabling and onshore substations) will be appropriately resilient to climate-change induced weather phenomena. Similarly, applicants should particularly set out how the proposal would be resilient to storms*."
Technical Guidance	
Institute of Environmental Management and Assessment (IEMA) Environmental Impact Assessment (EIA) Guide to: Climate Change Resilience and Adaptation 2020 (Institute of Environmental Management and Assessment, 2020) (IEMA has since been rebranded as the Institute of Sustainability and Environmental Professionals)	The guide provides a framework for the consideration of climate change and resilience and adaptation within the EIA process.

7.3 SCOPING AND CONSULTATION

7.3.1 OVERVIEW

7.3.1.1 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 Climate Resilience assessment. No informal consultation or consultation on the Climate Resilience aspect has been required or undertaken. An overview of engagement undertaken for the Offshore Project as a whole can be found in **Chapter 5: Approach to EIA, Volume 1a** and associated **Appendix 5.2: Response to EIA Scoping Opinion, Volume 1c** and **Appendix 5.4: Stakeholder Consultation and Engagement, Volume 1c**.

7.3.2 SCOPING OPINION

7.3.2.1 Spiorad na Mara Limited (hereafter referred to as 'the Applicant') submitted a Scoping Report (Spiorad na Mara Limited, 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 presented a 'Climate' topic which considered both Greenhouse Gases and Climate Resilience. For the EIAR, the assessments for Climate Resilience and Greenhouse Gases have been separated into 2 separate chapters. This is due to the inherent differences in approach of each assessment in that the Climate Resilience topic considers the impact of climate change on the Offshore Project, whereas the Greenhouse Gases topic considers the impact of emissions on the environment. Given that each approach would need to present a different methodology, baseline and assessment, if presented as a combined chapter, it is considered that this would culminate in a chapter which is hard to follow and comprehend.

7.3.2.2 This Climate Resilience chapter of the EIAR differs from the Scoping Report which noted that the assessment Study Area would comprise both the Offshore Project and the Onshore works. However, as described in **Chapter 1: Introduction**, **Volume 1a**, this EIAR considers only the Offshore Project.

7.3.2.3 The Scoping Report set out that the assessment methodology for the EIAR would be in line with the IEMA EIA Guide to: Climate Change Resilience and Adaptation 2020 (Institute of Environmental Management and Assessment, 2020) (referred to subsequently as the 'IEMA Guidance'), which has been used for this Climate Resilience assessment. The Scoping Report did not provide a baseline for Climate Resilience beyond potential data sources. A baseline for current and future climatic conditions has been presented within this Climate Resilience assessment (see Section 7.6).

7.3.2.4 NatureScot's opinion on the Scoping Report (dated 18 December 2023) noted that the *"impact of climate change effects should be considered both in futureproofing the project design and how certain climate stressors may work in combination with potential effects from the proposed wind farm."* The assessment outlined within this chapter considers the impact of climate change on the Offshore

Project and how design and operational measures will build resilience to climate change and **Chapter 8, Volume 2a** provides the assessment of impact of emissions on the environment. **Chapter 23: Combined Effects Assessment, Volume 2a** presents the In-combination Climate Change Impact (ICCI) assessment.

7.3.3 CONSULTATION

7.3.3.1 No consultation has been required for the Climate Resilience assessment. The approach follows industry standard guidance and data to inform the baseline is from publicly available sources.

7.4 SCOPE OF THE ASSESSMENT

7.4.1 OVERVIEW

7.4.1.1 This section sets out the scope of the assessment for Climate Resilience. This scope has been developed as the Offshore Project design has evolved and builds on the scope described in the Scoping Report (see Section 7.3).

7.4.2 SPATIAL SCOPE AND STUDY AREA

7.4.2.1 The spatial scope for the Climate Resilience assessment relates to the impact of climate change on the Offshore Project (rather than the impact of the Offshore Project on climate change). As such, the Study Area for the Offshore Project is defined by the Offshore Project Boundary, as illustrated in **Figure 3.1**, **Volume 1b** of the EIAR.

7.4.2.2 In the context of the Climate Resilience assessment, all elements of the Offshore Project as part of this application are located within a relatively close proximity of each other. Therefore, the same baseline conditions (current climate) and future baseline (climate projections) apply for all Offshore Project elements. The Offshore Project elements considered are located within the Study Area, however some of the baseline climate data sources are located outside of the Study Area due to the spatial coverage of the data set. The nearest land and marine data sets to the Study areas have been used to inform the baseline conditions.

7.4.3 TEMPORAL SCOPE

7.4.3.1 The temporal scope of the Climate Resilience assessment is the entire lifetime of the Offshore Project, which therefore covers the construction, Operation and Maintenance (O&M), and decommissioning phases.

7.4.3.2 The construction phase is anticipated to commence in 2028/2029. Completion of construction works is anticipated to be in 2033. The design life of the Offshore Project is for a duration of 35 years, with decommissioning anticipated to occur from the year 2068.

7.4.3.3 The Climate Resilience assessment uses climate projections to inform the future baseline. Climate projection data is provided in 29 year timeframes and the 2030s (2020-2049) have been used to assess the construction phase. The climate trends across the 2050s (2040-2069) and 2080s (2070-2099) are used to assess the operational phase which reflects a precautionary approach as the Offshore Project is expected to operate into the late 2060s based on the 35 year design life. The decommissioning phase is assessed under the 2080s future baseline. This approach aligns with a precautionary principle should the Offshore Project be operational longer than the anticipated design life.

7.4.4 POTENTIAL RECEPTORS

7.4.4.1 The spatial and temporal scope of the assessment enables the identification of receptors which may experience a change as a result of the Offshore Project. The main receptors identified that may experience likely significant effects for Climate Resilience are outlined in **Table 7-2**.

Table 7-2 Receptors requiring assessment for Climate Resilience

Receptor Group	Receptors included within group
Building and infrastructure receptors	Offshore Project assets throughout the lifecycle of the Offshore Project. The Climate Resilience assessment includes for: • Construction/O&M/Decommissioning site, materials and equipment (all works below MHWS); • WTGs (along with the OSP); • Offshore Cables; • Landfall including HDD exit pits (below MHWS).
Human receptors	Construction, O&M, and decommissioning workers.

7.4.5 CLIMATE HAZARDS

7.4.5.1 A vulnerability assessment has been undertaken to determine the climate hazards that are relevant to the Climate Resilience Assessment. The vulnerability assessment exercise takes into account:

- The climate related hazards relevant to the Offshore Project location, considering the local geography;
- The timeframes of the construction, O&M and decommissioning phases;
- The exposure of the Offshore Project receptors to climate hazards;
- The extent to which the receptors may be susceptible to damage or other impacts by the climate hazard.

7.4.5.2 The future baseline presented in Section 7.6 has been used to inform the vulnerability assessment.

7.4.5.3 The full vulnerability assessment is presented in **Appendix 7.1, Volume 2c**.

7.4.5.4 **Table 7-3** presents the findings of the vulnerability assessment and includes justification for the inclusion or exclusion of the climate hazard. Receptors and hazards that are shaded grey and marked with a ‘x’ are not considered to result in significant effects and are therefore not assessed further (hazard scoped out of assessment). Receptors and hazards which are shaded green and marked with a ‘✓’ will be taken forward for further assessment (hazard scoped into assessment).

Table 7-3 Climate hazards vulnerability assessment

Climate hazard	Receptor								Justification
	Construction site, materials and equipment (Offshore Project and Landfall below MHWS)	Construction workers (Offshore Project and Landfall below MHWS)	Offshore Wind Farm WTG array (including scenario for OSP)	Offshore Cables	Landfall (below MHWS)	Maintenance workers (Offshore Project and Landfall below MHWS)	Decommissioning site, materials and equipment (Offshore Project and Landfall below MHWS)	Decommissioning workers (Offshore Project and Landfall below MHWS)	
Change in average temperature	x	x	x	x	x	x	x	x	Human receptors have the ability to respond to gradual changes in temperature. Assets and infrastructure will not be susceptible to harm or damage from changes in average temperatures.
Heat stress	x	x	x	x	x	x	x	x	Heat stress affects people and not assets and infrastructure. Heat effects on assets and infrastructure is considered in heatwaves. The potential for significant impacts from heat stress is considered unlikely based on the future climate projection data for the Study Area.
Heatwave	x	x	x	x	x	x	x	x	Heatwaves occur when temperature over 25°C are met for at least 3 consecutive days. Infrastructure and assets can be adversely affected by prolonged extreme temperatures. Personnel have been excluded as the effects of heat stress would address this climate hazard. Based on the future climate projection data, the number of heatwave events within the Study Area are not anticipated to result in significant impacts.
Cold wave	x	x	x	x	x	x	x	x	Occurrences of cold waves and frost days are projected to reduce over time as temperatures increase. As such significant impacts from cold waves are considered unlikely.
Wildfire	x	x	x	x	x	x	x	x	Wildfire events are not applicable to offshore activities and assets.
High winds and storms	✓	✓	✓	✓	x	✓	✓	✓	High winds and storms can cause damage to infrastructure, assets and personnel. High winds and storms can cause changes in sediment transport and scour impacting infrastructure on the seabed.

Climate hazard	Receptor								Justification
	Construction site, materials and equipment (Offshore Project and Landfall below MHWS)	Construction workers (Offshore Project and Landfall below MHWS)	Offshore Wind Farm WTG array (including scenario for OSP)	Offshore Cables	Landfall (below MHWS)	Maintenance workers (Offshore Project and Landfall below MHWS)	Decommissioning site, materials and equipment (Offshore Project and Landfall below MHWS)	Decommissioning workers (Offshore Project and Landfall below MHWS)	
									The Landfall cable exit and entry points are not anticipated to be impacted by high winds and storms, given the construction on concrete chambers, linking to below ground infrastructure.
Change in average precipitation	x	x	x	x	x	x	x	x	Human receptors are not impacted by changes in precipitation rates. Assets and infrastructure will not be susceptible to harm or damage from changes in average precipitation.
Ocean acidification	x	x	✓	✓	x	x	x	x	Ocean acidification comprises an increase of the acidity of the ocean over time.
Saline intrusion	x	x	x	x	x	x	x	x	Saline intrusion is a chronic (long-term) climate impact affecting groundwater and freshwater habitats as saltwater moves into freshwater bodies. The Offshore Project does not require abstraction of groundwater.
Sea level rise	x	x	✓	x	✓	x	x	x	Sea level rise is a chronic climate impact. It may affect the offshore array height and Landfall interface.
Heavy precipitation	x	x	x	x	x	x	x	x	Offshore Project components are designed to withstand heavy rainfall. Infrastructure on the seabed will not be impacted by heavy precipitation.
Flood – fluvial/pluvial	x	x	x	x	x	x	x	x	Offshore activities and assets will not be affected by fluvial or pluvial flooding.
Coastal erosion	x	x	x	x	x	x	x	x	Offshore activities and assets will not be affected by coastal erosion.
Soil erosion	x	x	x	x	x	x	x	x	Offshore activities and assets will not be affected by soil erosion.
Landslide	x	x	x	x	x	x	x	x	Offshore activities and assets will not be affected by landslide.

7.4.6 POTENTIAL CLIMATE-RELATED IMPACTS

7.4.6.1 Potential climate related impacts to the Offshore Project as a result of climate change comprise high winds and storms, ocean acidification and sea level rise.

7.4.6.2 The effects of these impacts to the Offshore Project include:

- Disruption to construction or O&M programmes from high winds and storms which can generate unsafe working conditions and cause damage to plant and equipment;
- Destabilisation and accelerated degradation of Offshore WTGs leading to increased maintenance requirements from high wind and storm conditions, ocean acidification and sea level rise. Operational performance can also be impacted during high winds and storms;
- Loading and sediment transport on the seabed can be affected by high winds and storms, which can impact the integrity of foundations and cabling systems. Ocean acidification can increase corrosion and deterioration of offshore cables.

7.4.6.3 These effects and hazards are assessed in detail in the following sections, with embedded mitigation measures considered as part of the Offshore Project design.

7.5 METHODOLOGY FOR BASELINE DATA GATHERING AND IMPACT ASSESSMENT

7.5.1 METHODOLOGY FOR BASELINE DATA GATHERING

Overview

7.5.1.1 Baseline data collection has been undertaken to obtain information for the Study Area described in Section 7.4. The baseline for Climate Resilience (presented in Section 7.6) has been collected through desktop study and considers the current climate and future climate projections.

7.5.1.2 No site surveys were required to inform the Climate Resilience assessment.

Desk study

7.5.1.3 The data sources that have been collected and used to inform the Climate Resilience baseline assessment is summarised in **Table 7-4**.

Table 7-4 Data sources used to inform the Climate Resilience EIAR

Source	Date	Summary	Coverage of Study Area
Met Office, UK Climate Averages, Stornoway Airport (Met Office, 2020)	October 2024	Current climate baseline data for the 30-year period 1991 – 2020 at Stornoway Airport Climate Station.	Nearest climate station to the site located at Stornoway Airport.
Met Office Northern Scotland: climate (Met Office, 2016)	October 2024	Describes the features of the historic Northern Scottish climate.	Covers Northern Scotland/*Alba* including the Study Area.
National Oceanography Centre, Stornoway tidal gage data (National Oceanography Centre, 2024)	October 2024	Historic tide station data to indicate past sea level rise.	Nearest tidal station to the site located at Stornoway/*Steòrnabhagh*.
Royal Meteorological Society, State of the UK Climate 2023 (Royal Meterological Society, 2025)	October 2024	State of the UK Climate Report summarising UK climate trends and data.	Applicable to the UK.
Met Office, UK Climate Projections User Interface (Met Office, 2024)	October 2024	UKCP18 future climate projections data.	Used to extract data for marine projections (sea level rise) using the grid square nearest to the Study Area (see paragraph 7.6.2.8).
UK Climate Risk Indicators (Nigel Arnell, 2023)	October 2024	Climate Risk Indicators (CRI) future climate projections data.	The Climate Risk Indicators were used to extract UK Climate Projections (UKCP18) data for The Climate Risk Indicators were used to extract UKCP18 data for the local authority area Western Isles/*Na h-Eileanan Siar*.

Source	Date	Summary	Coverage of Study Area
Outer Hebrides Climate Rationale (Outer Hebrides Community Planning Partnership Climate Change Working Group, 2022)	October 2024	Outer Hebrides specific analysis of future high winds and storms.	Western Isles/*Na h-Eileanan an Siar* including the Isle of Lewis/*Eilean Leòdhais* and the Study Area
Climate change maps for the Western Isles/*Na h-Eileanan an Siar* (Western Isles Climate Change Working Group, 2022)	October 2024	Shows natural, historic and built environments within the Western Isles/*Na h-Eileanan Siar* overlaid with tidal, flood risk and anticipated erosion extents data.	The Western Isles/*Na h-Eileanan an Siar* including the Study Area.
Marine Climate Change Impacts Partnership, Ocean Acidification around the UK and Ireland (Marine Climate Change Impacts Partnership, 2022)	October 2024	Research paper on ocean acidification.	Applicable to the UK and Ireland.

7.5.2 DATA LIMITATIONS AND ASSUMPTIONS

7.5.2.1 The following assumptions and limitations have been identified in relation the assessment of climate resilience:

- The UKCP18 projections have been used to infer future changes in a range of climate variables that may affect the vulnerability of the Offshore Project to climate change. At the time of writing, these represent the most up-to-date representation of future climate in the UK. The CRI has been developed using UKCP18 projections;
- There are inherent limitations and uncertainties within the CRI data due to the unknown changes in future human actions, limitations of modelling and natural fluctuations in the climate system. Further information on the methodology used to produce this data can be found in Changing climate risk in the UK: a multi-sectoral analysis using policy-relevant indicators (Nigel Arnell, 2021);
- There are inherent uncertainties associated with climate projections, and they are not predictions of the future. It is possible that future climate will differ from the future baseline

climate against which the resilience of the Offshore Project has been assessed, depending on global emissions over the next century. A 'high' emissions scenario (Representative Concentration Pathways (RCP) 8.5) using the 2030s, 2050s and 2080s time slices have been used to develop the baseline against which resilience has been assessed, this incorporates the construction period during the 2030s and the 35-year design life (2080s). The 2080s baseline has been used to assess the O&M and decommissioning phases based on a precautionary principle should the operation of the Offshore Project exceed the design life;

- Any further research, analysis or decision-making should take account of the accuracies and uncertainties associated with climate projections. It is also important to note that the analysis is based on selected observational data, the results of climate model ensembles and a selected range of existing climate change research and literature available at the time of assessment. Any future decision-making based on this analysis should consider the range of literature, evidence and research available at that time and any changes to this;
- The design principles and embedded mitigation measures used to inform the assessment are considered accurate at the time of writing.

7.5.3 METHODOLOGY FOR ENVIRONMENTAL IMPACT ASSESSMENT

Introduction

7.5.3.1 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 on Climate Resilience receptors only.

7.5.3.2 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.

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

Impact Assessment criteria

Overview

7.5.3.4 The assessment of impacts has been undertaken using an approach based on the IEMA guidance (Institute of Environmental Management and Assessment, 2020). The key steps involved in the Climate Resilience assessment comprise:

- Identification of the spatial and temporal scope of the Offshore Project, considering the Study Areas, and timeframes for the construction, O&M and decommissioning phases;
- Analysis of climate change projections and determination of the climate hazards which are appropriate to the scale, scope and nature of the Offshore Project. This is assessed through a Climate Change Vulnerability Assessment and determines the in-scope climate hazards and the sensitivity of receptors to climate hazards;

- Identification of likely impacts which may occur to the Offshore Project receptors as a result of climate change using literature review and professional judgement;
- Assessment of the likelihood and consequence of climate-related impacts to determine significance of effect.

7.5.3.5 The assessment approach is different to the project-wide generic approach to assessment is set out in **Chapter 5, Volume 1a** as the assessment considers the likelihood and consequence of climate related impacts on the Offshore Project. This approach is aligned with the IEMA guidance (Institute of Environmental Management and Assessment, 2020).

7.5.3.6 To determine the climate hazards which are relevant to the Offshore Project, a vulnerability assessment was undertaken and is presented in **Appendix 7.1, Volume 2c**. The outcome of the vulnerability assessment is presented in Section 7.4.

7.5.3.7 For the in-scope climate hazards (detailed in **Appendix 7.1**, **Volume 2c**), the significance of effects of climate change on the receptors identified has been determined by:

- Identifying potential impacts likely to occur to the receptors as a result of climate change;
- Assessing the likelihood of the impact occurring as a result of climate change;
- Assessing the consequence to the receptors if the impact it did occur.

7.5.3.8 Potential impacts likely to occur are identified through literature review and professional judgement.

7.5.3.9 Likelihood and consequence are qualitatively assessed using the descriptions in **Table 7-5** and **Table 7-6**. These descriptions have been developed using professional judgement, informed by relevant guidance.

7.5.3.10 The assessment of likelihood and consequence (and therefore significance) takes embedded mitigation into account as an assumed part of the design. Embedded mitigation has been identified through engagement with the Offshore Project design team.

Likelihood

7.5.3.11 The likelihood of the climate change impact on the receptor occurring takes into account the climate trends and the anticipated exposure of the receptor to the trend. An indicative scale used for assessing the likelihood of the climate change impact on the receptor is presented in **Table 7-5**.

Table 7-5 Likelihood definitions

Measure of likelihood	Description
Very High	The event occurs multiple times during the lifetime of the Offshore Project e.g., approximately annually.
High	The event occurs several times during the lifetime of the Offshore Project e.g., approximately once every 5 years.
Medium	The event occurs limited times during the lifetime of the Offshore Project e.g., approximately once every 15 years.
Low	The event occurs occasionally during the lifetime of the Offshore Project e.g., once in 60 years.
Very Low	The event may occur once during the lifetime of the Offshore Project.

Consequence

7.5.3.12 The consequence if the climate change impact occurs is the magnitude of the change felt by the receptor. An indicative scale used for assessing the consequence of the climate change impact on the receptor is presented in Error! Not a valid bookmark self-reference..

Table 7-6 Consequence definitions

Measure of consequence	Description
Very large adverse	Permanent damage. Disruption lasting more than 10 days. Early renewal of facility/infrastructure >90%. Severe health effects and/or fatalities. Repairs cost 50% of facility reconstruction cost.
Large adverse	Extensive facility/infrastructure damage. Disruption lasting more than 3 but less than ten days. Early renewal of 50-90% of infrastructure Severe health effects and/or fatalities. Significant effect on the environment, requiring remediation. Repairs cost 50% of facility reconstruction cost.
Moderate adverse	Limited facility/infrastructure damage with damage recoverable by maintenance or minor repair. Disruption lasting more than 1 but less than 3 days. Adverse effects on health and/or the environment. Repairs cost 25% of facility reconstruction cost.
Minor adverse	Localised facility/infrastructure disruption. No permanent damage, minor restoration work required: Facility closure lasting less than 1 day. Slight adverse health or environmental effects. Repairs cost 2% of facility reconstruction cost.
Negligible	No facility/infrastructure damage, minimal adverse effects on health, safety and the environment. Facility doesn’t shut down. No financial loss.

Significance evaluation

7.5.3.13 The level of the risk of the climate change impact on the Offshore Project is concluded in this risk assessment as a function of the likelihood and consequence. This will identify any significant potential risks and where further mitigation and adaptation measures will be required, as shown as significant effects within the matrix in **Table 7-7**.

Table 7-7 Significance rating matrix

Likelihood	**Consequence**				
	Negligible	**Minor adverse**	**Moderate adverse**	**Large adverse**	**Very large adverse**
Very High	Not significant	Significant	Significant	Significant	Significant
High	Not significant	Significant	Significant	Significant	Significant
Medium	Not significant	Not significant	Significant	Significant	Significant
Low	Not significant	Not significant	Not significant	Significant	Significant
Very Low	Not significant	Not significant	Not significant	Not significant	Not significant

7.6 BASELINE CONDITIONS

7.6.1 CURRENT BASELINE

7.6.1.1 This section describes the present conditions which constitute the existing baseline environment for the climate within the Study Area. The current baseline describes the climate variables over the past 3 decades (1991-2020). Where data is not available within this date range it has been noted in the text. For context, impacts of climate change for the region (Scotland/*Alba* North) and the UK are also presented.

UK and Scottish Context

7.6.1.2 According to the latest State of the UK Climate Report (Royal Meterological Society, 2025) the UK's climate is changing, with recent decades warmer, wetter, and sunnier than the 20th century on a national and local scale. This report highlights that the UK land temperatures over the last decade have warmed by 1.24°C compared to 1961-1990, which is at a broadly consistent, though slightly higher, rate than the observed change of 1.23°C for global mean surface temperatures over land. The key findings from the report are:

- The last 3 years have been in the UK's top 5 warmest on record;
- The average highest maximum temperature over the most recent decade 2015–2024, 35.9°C, was 2.3°C higher than 1991–2020 and 4.5°C higher than 1961–1990;
- The UK's average lowest minimum temperature over the most recent decade 2015–2024 was 0.4°C higher than 1991–2020 and 3.9°C higher than 1961–1990;
- The number of days with temperature anomalies exceeding the 1961–1990 average by 5°C has doubled, by 8°C has trebled, and by 10°C has quadrupled for the most recent decade 2015–2024;

- The UK's climate has become steadily wetter since the 1980s, due to an increase in October to March rainfall. Observations suggest a slight increase in heavy rainfall across the UK in recent decades;
- 6 of the 10 wettest October to March time periods have occurred in the 21st Century so far, with October 2023-March 2024 the wettest winter half-year on record of 827 mm;
- October to March rainfall for the most recent decade 2015–2024 has been 6% wetter than 1991–2020 and 16% wetter than 1961–1990, compared to little change for April-September;
- 2024 was the UK's 13th wettest year in the series from 1836 with 109% of average rainfall, the sixth wettest winter (December-February), and the sixth wettest spring (March-May).
- The UK annual mean wind speed from 1969 to 2024 shows a downward trend, consistent with that observed globally;
- 9 named storms hit the UK in 2024. Red warnings were issued for Isha in January and Darragh in December, in comparison to 12 named storms in 2023;
- Over the past 32 years (1993–2024) UK sea level has risen by 13.4 cm. This is higher than the global estimate of 10.6 cm calculated from satellite altimetry over the same period, indicating that sea levels around the UK are rising faster than the global average. However, there are large uncertainties in estimates of sea level rise around the UK;
- The last 3 years were the 3 highest on record for UK annual mean sea level in a series from 1901, with 17 of the highest years occurring between 2001 and 2024.

Local Context

Rainfall and Temperature

7.6.1.3 **Table 7-8** presents the long-term average (1991-2020) seasonal rainfall (mm), long term average, maximum and minimum seasonal temperature (°C), and the long-term average days of air frost (days) for the local climate station, the region, and the UK. The summer season comprises the months of June, July and August. Winter season comprises the months of January, February and December.

Table 7-8 Local, regional and national temperature and rainfall baseline

Climate variable (1991-2020 baseline)	Season	Location		
		Stornoway Airport Climate Station	Scotland North	UK
Long term average seasonal rainfall	Summer	227 mm	316 mm	253 mm
	Winter	396 mm	553 mm	345 mm
Long term average mean seasonal temperature	Summer	13.0°C	12.3°C	14.6°C
	Winter	5.1°C	2.9°C	4.1°C
Long term average maximum temperature	Summer	15.7°C	15.8°C	18.9°C
Long term average minimum temperature	Winter	2.7°C	0.3°C	1.3°C
Long term average days of air frost	Winter	14.9 days	41.9 days	33.0 days

7.6.1.4 The data shows that the local climate is drier in both summer and winter compared to the regional climate (by 89 mm and 157 mm respectively) and is more similar to the UK average rainfall values. The higher rainfall values in the region are likely to be attributed to the higher altitudes of the highlands and mountainous areas of northern Scotland/*Alba*.

7.6.1.5 Local maximum summer temperatures are similar to the regional values but are 3.2°C cooler than the UK average. Conversely, winter minimum temperatures are 1.4°C warmer than the UK average and 2.4°C warmer than the regional average. The local climate also experienced 27 fewer days of air frost compared to the region. The warmer winter temperatures and reduced days of air frost are likely due to the influence of the sea and absence of highland and mountainous regions.

Snow

7.6.1.6 Snowfall is closely linked with temperature, with falls rarely occurring if the temperature is higher than 4°C. In the 1981-2010 period, snowfall at Stornoway/*Steòrnabhagh* was most prevalent in December-March (Met Office, 2016).

Wind

7.6.1.7 The western and northern parts of Northern Scotland/*Alba* are, on average, the windiest in the UK, being fully exposed to the Atlantic and closest to the passage of areas of low pressure. The frequency and depth of these depressions is greatest in the winter half of the year, especially from December-February, and this is when mean speeds and gusts (short duration peak values) are strongest (Met Office, 2016).

Sea level rise

7.6.1.8 The National Tidal and Sea Level Facility at the nearest tide gauge station (located at Stornoway/*Steòrnabhagh*), has been recording sea level since 1977. The data shows that from 1977 to 2023 sea level has risen by 171 mm from 6,983 mm to 7,154 mm (National Oceanography Centre, 2024).

7.6.2 FUTURE BASELINE

7.6.2.1 The UKCP18 probabilistic projections for RCP8.5 (high emission scenarios) have been used to infer future changes in a range of climate variables that may affect the vulnerability of the Offshore Project to climate change (Met Office, 2024). The CRI tool developed as part of the UK Climate Change Resilience Programme has been used to obtain climate projection data to inform the future baseline. This data is used to identify the future climate trends and their potential impact on the Offshore Project for the assessment (Nigel Arnell, 2023). The CRI utilises the UKCP18 projections and allows for a range of climate change related indicators (including but not limited to, Met Office heatwaves, and heat stress). The CRI data for the local authority of the Western Isles/*Na h-Eileanan Siar* has been used to inform this assessment, as the nearest projections data point for the Offshore Project. Climate projection data for sea level rise has been obtained from UKCP18 marine projections, using the nearest grid square to the Offshore Project.

7.6.2.2 The future climate has been presented for the 2030s (2020-2049), the 2050s (2040-2069) and 2080s (2070-2099) to identify the anticipated climate conditions. These projections are provided against the baseline period of 1981-2010 (based on model data), and 1991-2020 (current climate) as an indication of change from the baseline period.

7.6.2.3 **Table 7-9** provides an overview of current and projected summer and winter temperature and rainfall for the local authority of the Western Isles/*Na h-Eileanan Siar*, the nearest land data. Data is presented for 50th percentile with the 10th and 90th percentile values shown in brackets. Values should be considered as positive values, unless prefixed by a '-' denoting a negative value.

7.6.2.4 Indicators of climate risk for the local authority of Western Isles/*Na h-Eileanan Siar* are shown in **Table 7-10**. These provide an indication of sector specific thresholds, which are projected to change in the future. The indicators presented in **Table 7-10** are provided against the model reference period of 1981-2010. These indicators are unavailable for the current baseline period (1991-2020). Data is presented for 50th percentile with the 10th and 90th percentile values shown in brackets. Values should be considered as positive values, unless prefixed by a '-' denoting a negative value.

Table 7-9 Current and projected summer and winter temperature and rainfall for the Western Isles/*Na h-Eileanan Siar*

Climate variable	**Model reference (1981-2010)**	**Current baseline (1991-2020)**	**RCP8.5**			**Direction of climate trend**
			2030	**2050**	**2080**	
Average summer temperature (°C change from model reference)	12.8°C	13.0°C	0.8°C (0.3°C-1.4°C)	1.3°C (0.5°C - 2.2°C)	2.7°C (1.2°C - 4.2°C)	↑
Average winter temperature (°C change from model reference)	4.9°C	5.1°C	0.7°C (0.1°C - 1.4°C)	1.1°C (0.2°C - 2.1°C)	2.1°C (0.6°C - 3.7°C)	↑
Min winter temperature (°C change from model reference)	2.4°C	2.7°C	0.7°C (0.0°C - 1.6°C)	1.2°C (0.2°C - 2.4°C)	2.2°C (0.4°C - 4.1°C)	↑
Max summer temperature (°C change from model reference)	15.5°C	15.7°C	0.7°C (0.1°C - 1.4°C)	1.2°C (0.2°C - 2.2°C)	2.5°C (0.8°C - 4.3°C)	↑
Average summer Rainfall (% change from model reference)	226.6 mm	266.6 mm	-1.8% (-12.8% - 9.7%)	-6.6% (-20.5% - 8.8%)	-15.4% (-33.4% - 6.5%)	↓
Average winter rainfall (% change from model reference)	386.9 mm	396.4 mm	9.6% (-1.4% - 21.9%)	16.6% (0.8% - 33.7%)	28.3% (4.4% - 56.1%)	↑

Table 7-10: Future projections (absolute) of climate risk indicators

Climate variable	Model reference (1981-2010)	RCP8.5			
		2030	2050	2080	Direction of climate trend
Met Office heatwave (3 consecutive days with daily maximum temperature over 25°C) (events/year)	0.02	0.04 (0.02 - 0.08)	0.08 (0.02 - 0.27)	0.37 (0.07 - 1.01)	↑
Heat stress (wet bulb globe thermometer over 25°C) (days/year)	0	0 (0 - 0)	0 (0 - 0)	0.05 (0 - 0.5)	↑
Public health cold weather alert (events/year)	2.7	1.8 (1.2 - 2.5)	1.4 (0.8 - 2.4)	0.9 (0.3 - 2.1)	↓
Frost days (days with minimum temperature below 0°C) (days/year)	29.1	19.7 (13.4 - 27.9)	15.8 (8.8 - 26.6)	10.8 (3.7 - 23.6)	↓

Snow

7.6.2.5 With regards to future changes, rising winter temperatures are likely to reduce the amount of precipitation that falls as snow in winter. Snowfall data is unavailable in the CRI tool and for the UKCP18 probabilistic projections (25 km). However, both the regional (12 km) and the local (2.2 km) show a decrease in both falling and lying snow across the UK for the period of 2061-2080 relative to the 1981-2000 baseline.

Wind

7.6.2.6 UKCP18 depicts a wide spread of future changes in mean surface wind speed, however, there is large uncertainty in projected changes in circulation over the UK and natural climate variability contributes to much of this uncertainty. It is therefore difficult to represent regional extreme winds and gusts within regional climate models.

7.6.2.7 The Met Office has undertaken Outer Hebrides/*Na h-Eileanan Sia* specific analysis of future high winds and storms. It is anticipated that on average, there will be 9 additional days per year of storms by the end of the century. This indicates an average of 31 wet, windy days and impactful weather conditions in winter, and increased uncertainty in storm frequency and magnitude. The biggest changes are expected to be for the 'middling' storm events, rather than 'significant' storm events. Wind speeds in these events are likely to remain largely the same as current events (Outer Hebrides Community Planning Partnership Climate Change Working Group, 2022).

Sea level rise

7.6.2.8 Sea level projections at the closest marine projections data point (Coastal Location (latitude 58.39, longitude -6.58), range from 0.14 m in the 2030s to 0.55 m in the 2080s. (Met Office, 2024) **Table 7-11** depicts the projected sea level rise for the 2030s, 2050s and 2080s using UKCP18 marine projections data. Data is presented for 50th percentile with the 10th and 90th percentile values shown in brackets.

Table 7-11: Sea level rise projections (m) over time

2030	**2050**	**2080**
0.18 m (0.14 m - 0.22 m)	0.31 m (0.23 m - 0.40 m)	0.55 m (0.40 m - 0.74 m)

7.6.2.9 Climate change maps demonstrate the level of coastal erosion predicted by the end of the century. The landfall area is not noted to be at significant risk of coastal erosion (Western Isles Climate Change Working Group, 2022).

7.6.2.10 UKCP18 does not provide information on changes to coastal water properties, such acidification and saline intrusion. Ocean acidification is linked to atmospheric Carbon Dioxide (CO_2) levels. Studies on ocean acidification suggest that up to year 2000, ocean acidification already had become 30% more acidic compared to pre-industrial levels. By 2020 this had increased to 40%.

Models project that seawater pH will continue to decline to year 2050 at similar rates to the present day, with rates then increasing in the second half of the century, depending on the emissions scenario (Marine Climate Change Impacts Partnership, 2022).

7.7 BASIS FOR ENVIRONMENT IMPACT ASSESSMENT

7.7.1 MAXIMUM DESIGN SCENARIO

7.7.1.1 The climate resilience assessment adopts a parameter-based design envelope approach, considering a maximum design scenario (MDS) for the Offshore Project. This ensures that the assessment captures the greatest potential adverse impacts from climate change, while allowing flexibility for future improvements in project design. The maximum adverse scenario establishes the upper bound of potential effects; therefore, impacts of greater significance would not arise should any alternative development scenario be implemented (as described in **Chapter 3, Volume 1a**).

7.7.1.2 For climate resilience, projected climatic changes (e.g., sea level rise, increased storm frequency) are applied consistently across the Offshore Project location. Factors such as construction methods, receptor location, project footprint, or asset number are assessed in the same way, regardless of optionality, as climate hazards are expected to affect all project elements similarly.

7.7.1.3 The maximum parameters and assessment assumptions that have been identified to be relevant to Climate Resilience are outlined in **Table 7-12** and are in line with **Chapter 3, Volume 1a**.

7.7.1.4 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.

7.7.1.5 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.

7.7.1.6 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 7-12: Maximum parameters and assessment assumptions

Climate Hazard	Maximum Design Scenario	Justification
Construction		
Increased frequency and intensity of high winds and storms and high winds resulting in: 1) Disruption to construction programme due to storm damage or high winds delaying works 2) Damage to plant, equipment or materials from high winds 3) Unsafe working conditions due to high winds and storms	All infrastructure and activities within the Offshore Project Boundary. Construction phase: duration up to 5 years.	Impacts associated with increased frequency of high winds and storms considered equally across the Offshore Project Boundary in line with future climate baseline data using a precautionary principle to inform the assessment of effects. Climate data for 2030s (2020-2049) utilised to inform the assessment during construction stage. Climate hazards during construction are managed through standard procedures and embedded mitigation measures (see **Table 7-13**). No specific design parameter is required.
Operation & Maintenance		
Increased frequency and intensity of high winds and storms resulting in: <u>Impacts to the WTGs and OSP (if required)</u> 1) Destabilisation or degradation of turbine mechanical systems, facilities and structures due to increased frequency and intensity of storm events and wave heights.	All infrastructure and activities within the Offshore Project Boundary. O&M phase: duration up to 35 years.	Impacts associated with increased frequency of high winds and storms considered equally across the Offshore Project Boundary in line with future climate baseline data using a precautionary principle to inform the assessment of effects. Climate data for 2050s (2040-2069) and 2080s (2070-2099) utilised to inform the assessment during operation stage. Climate hazards during construction are managed through standard procedures and embedded mitigation measures (see **Table 7-13**).

Climate Hazard	Maximum Design Scenario	Justification
2) Reduced operational performance from turbines due to high winds. 3) Increased rate of maintenance or repair works. 4) Access to infrastructure and working conditions impeded by storm events. <u>Impacts to the Offshore Cables</u> 1) Loading and sediment transport across seabed leading to loss of integrity of foundations and cabling systems from scour and exposure due to increased frequency and intensity of storm events and wave heights. 2) Access to infrastructure and working conditions impeded by storm events.		No specific design parameter is required.
Increase in ocean acidification resulting in increased rate of corrosion or deterioration of WTG/OSP foundations and Offshore Cables	All infrastructure and activities within the Offshore Project Boundary. O&M phase: duration up to 35 years.	Impacts associated with ocean acidification will be considered equally across the Offshore Project Boundary in line with the future climate baseline data, using a precautionary principle to inform the assessment of effects. Climate data for 2050s (2040-2069) and 2080s (2070-2099) utilised to inform the assessment during the O&M stage.

Climate Hazard	Maximum Design Scenario	Justification
		Climate hazards during O&M are managed through standard procedures and embedded mitigation measures (see **Table 7-13**). No specific design parameter is required.
Increase in sea level resulting in: Impacts to the WTGs and OSP (if required) 1) Damage to blades from high waves or storm surges as the distance between sea level and blades is reduced. 2) Corrosion-resistant areas of turbine foundations exposed to saline conditions. Impacts to the Offshore Cables 1) Damage to or failure of cable exit points.	All infrastructure and activities within the Offshore Project Boundary. O&M phase: duration up to 35 years.	Impacts associated with sea level rise will be considered equally across the Offshore Project Boundary in line with the future climate baseline data, using a precautionary principle to inform the assessment of effects. Climate data for 2050s (2040-2069) and 2080s (2070-2099) utilised to inform the assessment during the O&M stage. Climate hazards during O&M are managed through standard procedures and embedded mitigation measures (see **Table 7-13**). No specific design parameter is required.
Decommissioning		
Increased frequency and intensity of high winds and storms and high winds resulting in: 1) Disruption to decommissioning programme due to storm damage or high winds delaying works. 2) Damage to plant, equipment or materials from high winds	All infrastructure and activities within the Offshore Project Boundary. Decommissioning phase: duration up to 5 years.	Impacts associated with increased frequency of high winds and storms considered equally across the Offshore Project Boundary in line with future climate baseline data using a precautionary principle to inform the assessment of effects. Climate data for 2080s (2070-2099) utilised to inform the assessment during decommissioning stage.

Climate Hazard	Maximum Design Scenario	Justification
3) Unsafe working conditions due to high winds and storms		Climate hazards during construction are managed through standard procedures and embedded mitigation measures (see **Table 7-13**). No specific design parameter is required.

7.7.2 EMBEDDED MITIGATION MEASURES

7.7.2.1 As part of the Offshore Project design process (as detailed in **Chapter 3, Volume 1a**), there is optionality within the design to allow the site conditions to influence the final selection and optimise engineering, design, safety and efficiency. This optionality will support the mitigation of climate-related risks though the selection of appropriate design and infrastructure for the Offshore Project. A number of embedded mitigation measures have been adopted to reduce the potential for climate related impacts.

7.7.2.2 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 sectorial standards, they are considered inherently part of the design of the Offshore Project and are set out in this EIAR.

7.7.2.3 **Table 7-13** sets out the relevant embedded mitigation measures within the design, operational management and maintenance commitments and how these are relevant to the Climate Resilience assessment.

Table 7-13: Relevant Climate Resilience embedded mitigation measures

ID	Design and operational management measure proposed	Offshore Project phase measure introduced	How the environmental measures will be secured	Relevance to Climate Resilience assessment
M019	A final Offshore Environmental Management Plan (OEMP) will be developed prior to commencement of construction (building on **Outline Offshore Environmental Management Plan, Volume 3**) in compliance with legislative requirements and/or best practice standards and guidance and adhered to.	Pre-Construction, construction	Secured in the Section 36 Consent and/or Marine Licence via the condition for an OEMP to be submitted to MD-LOT for approval.	The OEMP will be used for the implementation of appropriate environmental management and control measures during the construction phase of the Offshore Project. The OEMP will follow industry best practices to limit weather-related impacts which may affect the construction programme, cause damage to plant and equipment, or create unsafe working conditions.
M020	A Decommissioning Plan will be developed prior to the construction of the Offshore Project in compliance with legislative requirements and/or best practice standards and guidance and adhered to.	Decommissioning	Secured in the Section 36 Consent and/or Marine Licence via the condition for a Decommissioning Plan to be submitted to MD-LOT for approval and the Energy Act 2004.	The Decommissioning Plan will follow industry best practices to limit weather-related impacts which may affect the decommissioning programme, cause damage to plant and equipment, or create unsafe working conditions.
M025	A final Operational & Maintenance (O&M) Plan (building on **Outline Offshore Operational & Maintenance Plan, Volume 3**) will be developed in compliance with	O&M	Secured in the Section 36 Consent and/or Marine Licence via the condition for an EMP to	The O&M Plan will support the identification of any maintenance and repair needs which may be exacerbated by climate change and adverse weather conditions.

ID	Design and operational management measure proposed	Offshore Project phase measure introduced	How the environmental measures will be secured	Relevance to Climate Resilience assessment
	legislative requirements and/or best practice standards and guidance prior to the operation of the Offshore Project and adhered to.		be submitted to MD-LOT for approval.	
M051	The Applicant will comply with the Construction Design and Management (CDM) regulations and complete design risk registers and undertake hazard identifications for all components of the Offshore Project.	Pre-Construction, Construction, O&M and Decommissioning	To be secured through a condition of the Section 36 consent and/or Marine Licence and CDM Regulations.	Adherence to the CDM regulations will limit weather-related impacts which may affect the construction programme, cause damage to plant and equipment, or create unsafe working conditions.
M052	A Service and Maintenance Agreement will be in place, key turbine metrics (vibration/ temperature load sensors etc.) will be monitored as part of the Supervisory Control and Data Acquisition (SCADA) system during and after extreme weather events to determine if any aspect of the structural integrity could be or has been compromised. In the event that the SCADA analysis indicates there is justification in doing so, visual and on-site	Pre-Construction, Construction, O&M and Decommissioning	To be secured through a condition of the Section 36 consent and/or Marine Licence.	The Service and Maintenance Agreement, SCADA system and routine inspections will support the identification of any maintenance and repair needs which may be exacerbated by climate change and adverse weather conditions.

ID	Design and operational management measure proposed	Offshore Project phase measure introduced	How the environmental measures will be secured	Relevance to Climate Resilience assessment
	inspections would be conducted by the O&M team and repairs carried out, as required. The Offshore Project will be subject to routine inspections. These include replacement of consumables, minor and major repairs as necessary. The Applicant expects to carry out routine benchmarking of the assets' health over the course of the Offshore Project lifetime.			

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7.8 ASSESSMENT OF EFFECTS: CONSTRUCTION PHASE

7.8.1.1 As outlined in Section 7.5, the assessment for Climate Resilience considered the likelihood of impacts occurring as a result of climate change, and the consequence to the Offshore Project if they did occur. The assessment takes into account the embedded mitigation outlined in **Table 7-13**. **Table 7-14** provides the assessment for the construction phase. The receptors and climate hazards have been determined by the vulnerability assessment provided in Section 7.4.

Table 7-14: Assessment of effects: Construction phase (Offshore Project, including Landfall below MHWS)

Receptor	Climate hazard	Potential impacts	Likelihood	Consequence	Significance	Relevant embedded measures ID (Table 7-13:)
Construction site, materials and equipment	High winds and storms	Disruption to construction programme due to storm damage or high winds delaying works.	Medium	Minor adverse	**Not Significant**	M019 M051
		Damage to plant, equipment or materials from high winds.	Medium	Minor adverse	**Not Significant**	M019 M051
Construction workers	High winds and storms	Unsafe working conditions due to high winds and storms.	Medium	Minor adverse	**Not Significant**	M019 M051 M052

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7.8.1.2 The short-term impacts of climate change are not anticipated to substantially alter current weather patterns. The inclusion of embedded mitigation including measures to manage adverse and severe weather during the construction phase in line with good practice construction techniques, measures included in the OEMP (M019) and CDM regulations are considered sufficient to ensure the consequence of climate change related impacts are **Not Significant**.

7.9 ASSESSMENT OF EFFECTS: OPERATION AND MAINTENANCE

7.9.1.1 **Table 7-15** provides the assessment for the O&M phase, taking into account the embedded mitigation outlined in **Table 7-13**. The receptors and climate hazards have been determined by the vulnerability assessment provided in Section 7.4.

Table 7-15: Assessment of effects: Operation and maintenance phase

Receptor	Climate hazard	Potential impacts	Likelihood	Consequence	Significance	Relevant embedded measures ID (Table 7-13:)
Offshore WTG array (including scenario with OSP)	High winds and storms	Destabilisation or degradation of turbine mechanical systems, facilities and structures due to increased frequency and intensity of storm events and wave heights.	Low	Moderate adverse	**Not Significant**	M025 M052
		Reduced operational performance from turbines due to high winds.	Medium	Negligible	**Not Significant**	M025 M052
		Increased rate of maintenance or repair works.	Medium	Minor adverse	**Not Significant**	M025 M052
		Thunderstorms and/or torrential rainstorms increasing erosion of the blade leading edge.	Medium	Minor adverse	**Not Significant**	M025 M052
	Ocean acidification	Increased rate of corrosion or deterioration of array foundations.	Low	Minor adverse	**Not Significant**	M025 M052
	Sea level rise	Damage to blades from high waves or storm surges as the distance between sea level and blades is reduced.	Low	Moderate adverse	**Not Significant**	M025 M052
		Corrosion-resistant areas of turbine foundations exposed to saline conditions.	Low	Minor adverse	**Not Significant**	M025 M052
Offshore Cables	High winds and storms	Loading and sediment transport across seabed leading to loss of integrity of foundations and cabling systems from	Medium	Minor adverse	**Not Significant**	M025 M052

Receptor	Climate hazard	Potential impacts	Likelihood	Consequence	Significance	Relevant embedded measures ID (Table 7-13:)
		scour and exposure due to increased frequency and intensity of storm events and wave heights.				
	Ocean acidification	Increased rate of corrosion or deterioration of offshore cables.	Low	Minor adverse	**Not Significant**	M025 M052
Landfall (below MHWS)	Sea level rise	Damage to or failure of cable exit points.	Low	Moderate adverse	**Not Significant**	M025 M052
Maintenance workers	High winds and storms	Access to infrastructure and working conditions impeded by storm events.	Medium	Minor adverse	**Not Significant**	M025 M051 M052

7.9.1.2 The committed design and operational mitigation measures outlined in **Table 7-13** are considered sufficient to lower the effects of climate-related impacts as determined by the likelihood and consequence assessment in **Table 7-15**. As such, **No Significant** effects have been identified in relation to climate resilience for the O&M phase.

7.10 ASSESSMENT OF EFFECTS: DECOMMISSIONING

7.10.1.1 **Table 7-16** provides the assessment for the decommissioning phase, taking into account the embedded mitigation outline in **Table 7-13**. The receptors and climate hazards have been determined by the vulnerability assessment provided in Section 7.4 (see **Appendix 7.1, Volume 2c** for further detail).

Table 7-16: Assessment of effects: Decommissioning phase

Receptor	Climate hazard	Potential impacts	Likelihood	Consequence	Significance	Relevant embedded measures ID (Table 7-13:)
Decommissioning site, materials and equipment	High winds and storms	Disruption to decommissioning programme due to storm damage or high winds delaying works.	Medium	Minor adverse	**Not Significant**	M020 M051 M052
		Damage to plant, equipment or materials from high winds.	Medium	Minor adverse	**Not Significant**	
Decommissioning workers	High winds and storms	Unsafe working conditions due to high winds and storms.	Medium	Minor adverse	**Not Significant**	

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7.10.1.2 The consideration of severe weather-related impacts and management of those impacts incorporated into the Decommissioning Plan are considered sufficient to mitigate any climate-related impacts. As such, **No Significant** effects have been identified in relation to climate resilience for the Decommissioning phase.

7.11 ASSESSMENT OF COMBINED EFFECTS

7.11.1.1 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 receptor, or group of receptors. 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**.

7.11.1.2 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 receptor than in one phase alone.

7.11.1.3 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 receptor. These effects may be short-term, temporary, transient, or longer-term.

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

7.12 CONSIDERATION OF ONSHORE TRANSMISSION WORKS PROJECT

7.12.1.1 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.

7.12.1.2 This EIAR has considered the additive interactions between the Offshore Project and OTW Project to understand if there is the potential for any change to the assessment outcomes as a result of both elements of the Project. The approach to identify and consider potential interactions between the Offshore Project and OTW Project is set out in **Chapter 5, Volume 1a** and key design parameters associated with the OTW Project are summarised in **Chapter 3**, **Volume 1a**.

7.12.1.3 The potential for effects identified in Section 7.4 to interact with effects associated with the OTW Project at a common receptor has been considered. However, the Zone of Influence associated with Climate Resilience is limited spatially to the marine environment and only has the potential to cause an effect on receptors which are in the marine environment. Following consideration of the OTW Project and likely ZOI, and influence on common receptors, there are no pathways that have the potential to effect Climate Resilience receptors. As a result of this, there is no pathway for these effects to interact in addition to the OTW Project and this is not considered further.

7.13 ASSESSMENT OF CUMULATIVE EFFECTS

7.13.1 APPROACH

7.13.1.1 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 followed in identifying and assessing potential cumulative effects is set out in **Chapter 5, Volume 1a**.

7.13.1.2 The Climate Resilience assessment looks at the potential impacts of environmental change on the Offshore Project, rather than impacts of the Offshore Project on the environment. As such the receptor is the Offshore Project. As there are no receptors in common with other assessments, no assessment of cumulative effects is undertaken.

7.13.1.3 In terms of cumulative effects, the effect of other proposed developments in the vicinity of the Offshore Project are unlikely to impact weather or climatic conditions which would result in significant adverse effects on the Offshore Project receptors.

7.14 TRANSBOUNDARY EFFECTS

7.14.1.1 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.

7.14.1.2 The Climate Resilience assessment assesses the effects of climate change on the Offshore Project as a receptor. No transboundary effects are anticipated on the basis that climate change adaptation effects and impacts are specific to the Offshore Project and will not result in impacts to an adjacent state.

7.15 SUMMARY OF RESIDUAL EFFECTS

7.15.1.1 **Table 7-17** presents a summary of the assessment of significant impacts, any relevant mitigation measures, and residual effects on Climate Resilience receptors.

Table 7-17 Summary of residual effects for the Climate Resilience assessment

Activity and impact	Receptor	Likelihood	Consequence	Embedded mitigation measures	Significance of effect (significance)	Further environmental mitigation	Significance of residual effect (significance)
Construction							
Disruption to construction programme due to storm damage or high winds delaying works	Construction site, materials and equipment	Medium	Minor adverse	M019 M051	**Not Significant**	N/A	**Not Significant**
Damage to plant, equipment or materials from high winds	Construction site, materials and equipment	Medium	Minor adverse	M019 M051	**Not Significant**	N/A	**Not Significant**
Unsafe working conditions due to high winds and storms	Construction workers	Medium	Minor adverse	M019 M051 M052	**Not Significant**	N/A	**Not Significant**
OPERATION AND MAINTENANCE							
Destabilisation or degradation of turbine mechanical systems, facilities and structures due to increased frequency and intensity of storm events and wave heights.	Offshore WTG array (including scenario for OSP)	Low	Moderate adverse	M025 M052	**Not Significant**	N/A	**Not Significant**
Reduced operational performance from turbines due to high winds.	Offshore WTG array (including scenario for OSP)	Medium	Negligible	M025 M052	**Not Significant**	N/A	**Not Significant**
Increased rate of maintenance or repair works due to increased frequency and intensity of storm events and wave heights.	Offshore WTG array (including scenario for OSP)	Medium	Minor adverse	M025 M052	**Not Significant**	N/A	**Not Significant**
Thunderstorms and/or torrential rainstorms increasing erosion of the blade leading edge due to increased frequency and intensity of storm events and wave heights.	Offshore WTG array (including scenario for OSP)	Medium	Minor adverse	M025 M052	**Not Significant**	N/A	**Not Significant**
Increased rate of corrosion or deterioration of array foundations due to ocean acidification.	Offshore WTG array (including scenario for OSP)	Low	Minor adverse	M025 M052	**Not Significant**	N/A	**Not Significant**
Damage to blades from high waves or storm surges as the distance between sea level and blades is reduced.	Offshore WTG array (including scenario for OSP)	Low	Moderate adverse	M025 M052	**Not Significant**	N/A	**Not Significant**
Corrosion-resistant areas of turbine foundations exposed to saline conditions due to sea level rise.	Offshore WTG array (including scenario for OSP)	Low	Minor adverse	M025 M052	**Not Significant**	N/A	**Not Significant**
Loading and sediment transport across seabed leading to loss of integrity of foundations and cabling systems from scour and exposure due to increased frequency and intensity of storm events and wave heights.	Offshore cables	Medium	Minor adverse	M025 M052	**Not Significant**	N/A	**Not Significant**
Increased rate of corrosion or deterioration of offshore cables due to ocean acidification.	Offshore Cables	Low	Minor adverse	M025 M052	**Not Significant**	N/A	**Not Significant**
Damage to or failure of cable exit points due to sea level rise.	Landfall (below MHWS)	Low	Moderate adverse	M025 M052	**Not Significant**	N/A	**Not Significant**

Activity and impact	Receptor	Likelihood	Consequence	Embedded mitigation measures	Significance of effect (significance)	Further environmental mitigation	Significance of residual effect (significance)
Access to infrastructure and working conditions impeded by storm events.	Maintenance workers	Medium	Minor adverse	M025 M051 M052	**Not Significant**	N/A	**Not Significant**
Decommissioning							
Disruption to decommissioning programme due to storm damage or high winds delaying works.	Decommissioning site, materials and equipment	Medium	Minor adverse	M020 M051 M052	**Not Significant**	N/A	**Not Significant**
Damage to plant, equipment or materials from high winds.	Decommissioning site, materials and equipment	Medium	Minor adverse	M020 M051 M052	**Not Significant**	N/A	**Not Significant**
Unsafe working conditions due to high winds and storms.	Decommissioning workers	Medium	Minor adverse	M020 M051 M052	**Not Significant**	N/A	**Not Significant**

7.16 GLOSSARY OF TERMS AND ABBREVIATIONS

7.16.1.1 A list of key terms and acronyms used in this chapter are provided in **Table 7-18** and **Table 7-19**.

Table 7-18 Acronyms and abbreviation

Term	Definition
°C	Degrees Celsius
CCRA	Climate Change Risk Assessment
CEA	Cumulative effects assessment
CDM	Construction (Design and Management)
CO_2	Carbon Dioxide
CRI	Climate Risk Indicators
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
FEED	Front-end Engineering Design
H&S	Health and Safety
ICCI	In-combination Climate Change Impact
IEMA	Institute of Environmental Management and Assessment
MD-LOT	Marine Directorate Licensing Operations Team
MHWS	Mean High Water Springs
MSL	Mean sea level
O&M	Operation and Maintenance
OEMP	Offshore Environmental Management Plan
OSP	Offshore Substation Platform
RCP	Representative Concentration Pathways
SCADA	Supervisory Control and Data Acquisition
SEPA	Scottish Environment Protection Agency
SOV	Service Operating Vessels
UKCP	UK Climate Projections
WTG	Wind turbine generators

Table 7-19 Glossary

Term	Meaning
the Applicant	Spiorad na Mara Limited (the Project owner)
Climate hazard	The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.
Climate impact	"Impact" is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate change or hazardous climate events occurring within a specific time-period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts and sea level rise, are a subset of impacts called "physical impacts".
Climate trend	Climate trends refer to the pattern of climate change over decades to understand how the climate is changing. Trends indicate potential climate hazards that may arise in a climate parameter.
Combined Effects	Combined effect of the individual development on one particular receptor; for example noise, dust and visual. This includes Project-Lifetime Effects and Receptor-Led 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.
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.
Offshore Application	The application for a marine licence under the Marine (Scotland) Act 2010 (between 0 and 12nm) and a Section 36 consent under the Electricity Act 1989.
Offshore Cables	Electrical and communication cables located within the Array Area and Offshore Cable Area of Search. The Offshore Cables consist of Array Cables, Array Cables to Landfall, and Export Cables.
Offshore Cable Area of Search (OCAS)	The area within which the offshore cable infrastructure between the Array Area and Landfall up to Mean High Water Springs (MHWS) will be located.

Term	Meaning
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	The offshore components of the Spiorad na Mara offshore wind farm (the Project) located seaward of Mean High Water Springs (MHWS).
Offshore Project Boundary	The ‘red line boundary’ encompassing the Offshore Project.
Offshore Substation Platform (OSP)	The optional offshore substation located within the Turbine Area. Includes the platform and associated components which allows the voltage to be increased to meet onward transmission requirements.
Project-Lifetime Effects	Assessment of the scope for combined effects that occur throughout more than one phase of the project (i.e. construction, operation and maintenance, decommissioning), to interact to potentially create an effect of greater significance than if assessed just within individual/isolated project phases.
Receptor-Led Effects	Assessment of the scope for all combined effects to interact, spatially and temporally, to create an effect on a receptor of greater significance than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects.
Resilience	The capacity of systems and its component to anticipate and cope with a hazardous event or trend or disturbance, and accommodate, or recover from the effects of a hazardous event or trend in a timely and efficient manner.
Transboundary effects	Assessment of changes to the environment caused by the combined effect of past, present and future human activities and natural processes on other European Economic Area Member States.
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.
Vulnerability	Propensity or predisposition to be adversely affected.
Western Isles	Also known as the Outer Hebrides/*Na h-Eileanan Siar*, they are the islands situated to the Northwest of Scotland/*Alba*.
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

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