Muir Mhòr Offshore Wind Farm

Environmental Impact Assessment Report

Volume 2, Chapter 18: Climate

Revision No.	Date	Reason for Issue	Author	Reviewer	Approver
01	22/11/2024	Final	SLR Consulting Ltd	GoBe Consultants Ltd	MMOWF Ltd

Document Information

Document ID	**MMH-GBE-A004-ENV-0006-212**
Revision	01
Date	22/11/2024

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Glossary

Term	Definition
Annual time-mean sea level anomaly	The annual time-mean sea level anomaly refers to the average deviation of the sea level from a long-term mean over the course of a year. This measurement considers the changes in sea level relative to a baseline or reference value, typically taken from a multi-year average. Anomalies can be positive or negative, indicating higher or lower sea levels compared to the baseline.
Anomaly	Anomaly values represent the change in the climate variable compared to the baseline period.
Array Area	The area in which the generation infrastructure (including Wind Turbine Generators and associated foundations, and inter-array cables) and Offshore Electrical Platform(s) and an interconnector cable will be located.
Developer	Muir Mhòr Offshore Wind Farm Limited.
EIA Regulations	Collectively the term used to refer to The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, The Marine Works (Environmental Impact Assessment) Regulations 2007, and The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017.
Floating Foundations	The floating structures on which the wind turbine generators are installed.
Foundation anchors	The structures which anchor the floating foundations to the seabed, connected to the foundation mooring.
Inter-array cables	Cables which link the wind turbines generators to each other and the Offshore Electrical Platform(s).
Interconnector cable	Cable which links the Offshore Electrical Platform(s)s to one another, allowing for power to be transferred between the platforms
IPCC AR5	The IPCC AR5 is the Fifth Assessment Report of the Intergovernmental Panel on Climate Change published in 2014.
Landfall	The area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS) where the offshore export cables are brought onshore.
MD-LOT	The Marine Directorate – Licensing Operations Team is the regulator responsible for determining marine license applications on behalf of the Scottish Ministers in the Scottish inshore region.
Offshore Electrical Platform(s) (OEP)	Offshore platform consisting of High Voltage Alternating Current (HVAC) equipment, details depending on the final electrical set up of the Project.
Offshore Export Cable Corridor (ECC)	The area within which the offshore export cables will be installed.
Offshore export cables	The subsea electricity cable circuits running from the Offshore Electrical Platform(s) to the landfall which will transmit the electricity generated by the offshore wind farm to the onshore export cable(s) for transmission onwards to the onshore substation and the national electrical transmission system along with auxiliary cables such as fibre optic cables.
Offshore transmission infrastructure	The proposed transmission infrastructure comprising: Offshore Electrical Platform(s) and associated foundations and substructures; the offshore export cable(s); and the landfall area up to Mean High Water Springs (MHWS).
Project	Muir Mhòr Offshore Wind Farm – comprises the wind farm and all associated offshore and onshore components.
Proposed	The offshore Muir Mhòr Offshore Wind Farm project elements to which this

Term	Definition
Development	Offshore EIA Report relates.
Representative Concentration Pathways (RCPs)	RCPs are a method for capturing a set of assumptions about the economic, social and physical changes to our environment that will influence climate change within a set of scenarios. RCPs span a wide range of plausible future emissions scenarios with each pathway resulting in a different range of global mean temperature increases over the 21st century.
RCP8.5	RCP8.5 is a high emissions scenario that models a change in temperature of 4.3°C (best estimate) over 2081-2100 compared to the pre-industrial period.
Regridded	Regridding refers to a method used by the Met Office to process raw climate model data taken from several different coordinate systems to make it consistent with the British National Grid coordinate system.
Relative humidity	Relative humidity is a measure of the amount of water vapor present in the air compared to the maximum amount the air can hold at a given temperature. It is expressed as a percentage. Higher relative humidity indicates that the air is closer to being saturated with water vapor, while lower relative humidity means the air is drier.
Return period	The average interval of time between floods of a certain intensity or size. It represents a statistical measure to estimate the likelihood of a flood event occurring in any given year. For example, a 100-year return period for a flood means there is a 1% chance of such a flood occurring in any given year.
Scenario	The level of global warming used for the projections, which in this case was the RCP8.5 scenario, a high warming reasonable worst-case scenario.
Specific humidity	Specific humidity is a measure of the mass of water vapor present in a unit mass of moist air. It is expressed as a ratio, typically in grams of water vapor per kilogram of air (g/kg). Unlike relative humidity, which depends on temperature and pressure, specific humidity is an absolute measure of the water vapor content in the air and remains constant as air temperature or pressure changes, as long as no water vapor is added or removed from the air mass.
UKCP18	UKCP18 is the Met Office's UK's climate projection dataset, providing detailed, localised future scenarios based on varying greenhouse gas emissions levels. It informs climate adaptation and mitigation strategies using advanced models and covers short to long-term forecasts, essential for policymakers and planners.
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.

Acronyms

Term	Definition
BEIS	Department for Business, Energy and Industrial Strategy
ECC	Export Cable Corridor
CaP	Cable Plan
CCR	Climate Change Resilience
CMIP6	Coupled Model Intercomparison Project Phase 6
CMS	Construction Method Statement
CoP	Construction Programme
DP	Decommissioning Programme
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Fields
FMMS	Fisheries Management and Mitigation Strategy
FTE	Full Time Employee
GHG	Greenhouse Gas
GW	Gigawatt
IAC	Inter-array Cable
ICCI	In-Combination Climate Impacts
ICCP	Impressed Current Cathodic Protection
IEMA	Institute of Environmental Management and Assessment
INTOG	Innovation and Targeted Oil & Gas
IPCC	Intergovernmental Panel on Climate Change
IPCC AR5	Intergovernmental Panel on Climate Change Fifth Assessment Report
IPCC AR6	Intergovernmental Panel on Climate Change Sixth Assessment Report
LCA	Life Cycle Assessment
LSE	Likely Significant Effects
MD-LOT	Marine Directorate – Licensing Operations Team
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MPS	Marine Policy Statement
MSL	Mean Sea Level
NG	National Grid
NMP	National Marine Plan
NPF4	National Planning Framework 4
NSP	Navigational Safety Plan
OEP(s)	Offshore Electrical Platform(s)
O&M	Operation and Maintenance

Term	Definition
OWF	Offshore Wind Farm
PEMP	Project Environmental Monitoring Programme
RCP	Representative Concentration Pathways
SPM	Suspended Particulate Matter
UWWTD	Urban Waste Water Treatment Directive
VMP	Vessel Management Plan
WPA	Whole Project Assessment
WTG	Wind Turbine Generator

18. CLIMATE

18.1. INTRODUCTION

18.1.1. Muir Mhòr Offshore Wind Farm Limited (hereafter referred to as 'the Developer') is proposing to develop the Muir Mhòr Offshore Wind Farm (hereafter 'the Project'). The Project is made up of both offshore and onshore components. The subject of this offshore Environmental Impact Assessment Report (EIAR) is the offshore infrastructure of the Project seaward of Mean High-Water Springs (MHWS) which is hereafter referred to as 'the Proposed Development'.

18.1.2. The Muir Mhòr Array Area covers an area of approximately 200 km^2 and is located approximately 63 km east of Peterhead on the east coast of Scotland. The offshore infrastructure of the Proposed Development includes Wind Turbine Generators (WTGs) and associated floating foundations, the Offshore Electrical Platform(s) (OEP(s)) and associated foundations, inter-array cables, interconnector cable, offshore export cables and landfall.

18.1.3. This chapter of the EIAR presents an assessment of the potential impacts and associated Likely Significant Effects (LSE) to the climate from the Proposed Development and its resilience to changes in the climate during construction, Operation and Maintenance (O&M), and decommissioning. In addition, to assessing potential impacts and associated LSE, the chapter discusses appropriate mitigation and monitoring as required to address any significant effects.

18.1.4. In alignment with the Institute of Environmental Management and Assessment (IEMA) Environmental Impact Assessment (EIA) Guide to Climate Change Resilience and Adaptation (IEMA, 2020), and the requirements of the Infrastructure Planning Environmental Impact Assessment Regulations (2017) (Department of Communities and Local Government, 2017), the climate change assessment includes an evaluation of the following:

- Greenhouse Gas (GHG) emissions impact assessment: a carbon assessment across the Project's lifetime, including both onshore and offshore elements from construction through to decommissioning. This includes the nature and magnitude of GHG emissions and an assessment of carbon mitigation actions, see Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report);
- Vulnerability to climate change: the Climate Change Resilience (CCR) assessment evaluates the potential impacts of climate change on the Proposed Development and how these impacts can be, and have been, ameliorated through the project design and planning stages; and
- In-combination Climate Impact (ICCI) effects: the extent to which climate change exacerbates the effects of the Proposed Development on other environmental receptors.

18.1.5. ICCI effects assess the extent to which climate change may impact the probability and/or consequence of effects identified elsewhere in the EIAR are considered in-depth within this chapter and at a high-level within other relevant topic chapters.

18.1.6. This Chapter should be read alongside the following other Chapters:

- Volume 2, Chapter 7 (Marine and Coastal Processes);
- Volume 2, Chapter 8 (Marine Water and Sediment Quality);
- Volume 2, Chapter 9 (Benthic, Subtidal and Intertidal Ecology);
- Volume 2, Chapter 10 (Fish and Shellfish Ecology);

- Volume 2, Chapter 11 (Offshore and Intertidal Ornithology);
- Volume 2, Chapter 12 (Marine Mammals);
- Volume 2, Chapter 13 (Commercial Fisheries); and
- Volume 2, Chapter 15 (Marine Archaeology and Cultural Heritage)

18.1.7. This Chapter refers to the design of the Proposed Development as described in Volume 1, Chapter 3 (Project Description) of the EIAR.

18.1.8. This Chapter has been prepared by SLR Consulting Limited on behalf of the Developer.

18.2. PURPOSE OF THE CHAPTER

18.2.1. The primary purpose of the EIAR is defined in Volume 1, Chapter 1 (Introduction).

18.2.2. The key objective of this Chapter is to provide Scottish Ministers and statutory and non-statutory stakeholders, the information required to assess for LSE on climate. This assessment will consider those effects from the Proposed Development in isolation, and also cumulative effects (the effects of the Proposed Development combined with the effects from other plans and projects).

18.2.3. This Chapter includes the following:

- A detailed description of current and future climatic conditions. These have been established using the UK Climate Projections 2018 (UKCP18) produced by the Met Office and based on the latest climate science;
- A discussion of assumptions and any limitations with respect to the information used to define the baseline;
- The identification of potential impacts and any resulting LSE on the climate related to Proposed Development activities, and potential impacts and any resulting LSE on the Proposed Development due to changes in the climate. This process is informed by the application of embedded commitments;
- The consideration of the need for any 'secondary' mitigation measures (in addition to embedded commitments) to avoid, minimise, reduce, or offset LSE identified as part of the GHG, CCR or ICCI assessments;
- The consideration of any residual effects following application of secondary mitigation; and
- The identification of monitoring measures to support proposed mitigation.

18.3. LEGISLATION AND POLICY CONTEXT

18.3.1. Overarching legislation, policy, and guidance in relation to the EIAR for the Proposed Development is provided in Volume 1, Chapter 2 (Legislation and Policy) of the EIAR. Below is provided a summary of legislation, policy, and guidance directly relevant to climate.

LEGISLATION AND POLICY

18.3.2. At global, national, and local level, there are several legislative acts and policies which are relevant to the Proposed Development.

18.3.3. All legislation directly applicable to climate, including both the CCR assessment and GHG impact assessment, is illustrated in Table 18-1.

18.3.4. All national and local policy directly applicable to climate, including both the CCR assessment and GHG impact assessment, is illustrated in Table 18-2.

Table 18-1 Legislation relevant to Climate

Legislation	Summary	How Chapter has considered this
The Paris Agreement	The Paris Agreement is a legally binding, international treaty on climate change, adopted at COP21 in December 2015, coming into force in November 2016. The Agreement aims to hold the increase in the global average temperature to below 2°C above pre-industrial levels, as well as limit the temperature increase to 1.5°C above pre-industrial levels. There is an additional overall aim to reduce GHG emissions by 43% by 2030. The Paris Agreement also provides a framework for technical, financial, and capacity building support for representative countries (UNFCCC, 2024).	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emissions of the Proposed Development and how it supports the commitments of the Paris Agreement.
Marine Scotland Act 2010	The Marine (Scotland) Act 2010 provides the legislative and management framework for the marine environment within Scottish Territorial Waters MHWS out to 12 nm. Under section 21 of the Marine (Scotland) Act 2010, the Proposed Development requires a Marine Licence for marine licensable activities below (MHWS).	To address the requirements of The Marine Scotland Act 2010, the Climate chapter has aligned with Scotland's National Marine Plan (NMP), the implementation framework put in place to enact the requirements of the Marine Scotland Act 2010. Specific details of how requirements relating to climate have been met are provided in Table 18-2.
Marine and Coastal Access Act 2009	The Marine and Coastal Access Act 2009 provides devolved authority to Scottish Ministers for marine planning and conservation powers in the Scottish Offshore Region (from 12 to 200 nm). Under section 66 of the Marine and Coastal Access Act 2009 (in the context of the Scottish Offshore Region), the proposed development requires a Marine Licence for the marine licensable activities beyond 12 nm. In addition, the Marine and Coastal Access Act 2009 requires Scottish Ministers to seek to ensure that a marine plan is in place in the offshore region when a Marine Policy Statement is in effect.	To address the requirements of The Marine and Coastal Access Act 2009, the Climate chapter has aligned with the UK Marine Policy Statement (MPS), the implementation framework put in place to enact the requirements of the Marine and Coastal Access Act 2009. Specific details of how requirements relating to climate have been met are provided in Table 18-2.
Climate Change Act 2008 (Department for Business, Energy and Industrial Strategy	This act, as amended in 2019, sets out the UK Government's 2050 net zero target. The act commits the UK to reduce its net GHG emissions by at least 100% below 1990 levels by 2050.	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emissions of the Proposed Development and how it supports the UK's net zero

Legislation	Summary	How Chapter has considered this
(BEIS), 2019)		target through renewable energy generation.
Climate Change (Scotland) Act 2009	This act sets out the Scottish Parliament's carbon reduction targets, including its long-term 2050 target and its annual targets for the reduction of greenhouse gas emissions.	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emissions of the Proposed Development and how it supports Scotland's carbon reduction targets through renewable energy generation.
Climate Change (Emissions Reduction Targets) (Scotland) Act 2019	The Climate Change (Emissions Reduction Targets) Act 2019 amends the Climate Change Act 2009 and increases the ambition of Scotland's emission reduction targets. The 2019 act sets out Scotland's revised commitment to reduce all greenhouse gas emissions to 100% by 2045. It includes interim targets to reduce emissions by 75% by 2030, against a 1990 baseline, and to reduce emissions by 90% by 2040.	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emissions of the Proposed Development and how it supports Scotland's carbon reduction targets through renewable energy generation.
The Carbon Budgets Order (DECC, 2009), (DECC, 2011), (DECC, 2016), (BEIS, 2021)	This legislation places a restriction on the total amount of GHG emissions the UK can emit over a 5-year period, in line with the carbon budgets set out in the Climate Change Act 2008. The carbon budgets are: • 2008-2012 budgetary period is 3,018 mega tonnes of carbon dioxide equivalent (MtCO2e); • 2013-2017 budgetary period is 2,782 MtCO2e; • 2018-2022 budgetary period is 2,544 MtCO2e; • 2023-2027 budgetary period is 1,950 MtCO2e; the carbon budget for the 2028-2032 budgetary period is 1,725 MtCO2e; and • 2033-2037 budgetary period is 965 MtCO2e.	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emissions of the Proposed Development and how it supports carbon reduction in line with the UK carbon budgets through renewable energy generation.
Energy Act 2023 (DESNZ, 2023d)	The Energy Act 2023 is a UK Act of Parliament to make provision about energy production, security, and the regulation of the	The Proposed Development will directly support the Offshore Wind Environmental Package by increasing

Legislation	Summary	How Chapter has considered this
	energy market. The Act provides primary powers to implement the Offshore Wind Environmental Improvement Package. This package addresses the impacts of offshore wind infrastructure in the marine environment and is designed to help streamline the consenting process for offshore wind.	UK generated renewable wind energy. The Proposed Development's carbon emissions pay-back period is estimated in the Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) to highlight the necessity of renewable energy infrastructure in meeting renewable energy targets.
The Energy Act 2004	The Energy Act 2004 makes provisions for, among other aspects, the development, regulation, and encouragement of the use of renewable energy sources and giving effect to international agreements relating to pipelines and offshore installations. Safety zones can be created by Scottish Ministers, under section 95 of the Energy Act 2004. This will ensure the safety of the renewable energy installation or other installations in the vicinity during construction, operation, extension, or decommissioning. Safety zones may create exclusion zones for non-OWF vessels from navigating through a designated area for a specific period. Sections 105 to 114 of the Energy Act 2004 make provision for the Scottish Ministers to require a decommissioning programme for an offshore renewable energy installation in Scottish Waters to be approved by the Scottish Ministers.	The CCR assessment presented in Section 18.7 includes an assessment of potential effects across construction, O&M, and decommissioning. The assessment considers embedded mitigation, including the creation of safety zones. Additional details of embedded commitments including those relating to Climate can be found in Volume 3, Appendix 6.1 (Commitments Register).
The UK's Net Zero Strategy (HM Government, 2021)	The 2021 Report to Parliament: Progress in Reducing Emissions highlighted that whilst the UK Government has made historic climate promises, it has been too slow to follow these with delivery. Therefore, sustained reductions in emissions will require a strong Net Zero Strategy. The Strategy includes policies and proposals for decarbonising all sectors of the UK economy to meet net zero by 2050.	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emissions of the Proposed Development and how it supports the UK's net zero target through renewable energy generation.

Table 18-2 Policy relevant to Climate

Policy	Summary	How/Where Chapter has considered this
National Planning Framework 4 (NPF4) (Scottish Government, 2023)	The NPF4 is the national spatial strategy for Scotland, setting out Scotland's spatial principles, regional priorities, national developments, and national planning policy. The framework includes NPF4 policy 2 (climate mitigation and adaptation) which aids the integration of climate considerations into development proposals and requires that development proposals will be "designed to minimize lifecycle greenhouse gas emissions as far as possible" and "adapt to current and future risks from climate change". NPF4 policy 11 (energy) states that development proposals for all forms of renewable, low-carbon and zero emissions technologies will be supported. In considering the impacts of proposed developments, policy 11 confirms that "significant weight will be placed on the contribution of the proposal to renewable energy generation targets and on greenhouse gas emissions reduction targets".	The CCR assessment presented in Section 18.7 identifies the significant effects likely to affect the resilience of the Proposed Development across construction, O&M and decommissioning. The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emission of the Proposed Development and how it supports Scotland's carbon reduction targets through renewable energy generation. The Proposed Developments carbon emissions pay-back period is estimated in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report).
Climate Change Plan 2018-2032 – update (Scottish Government, 2020)	The Climate Change Plan sets out the Scottish Government's pathway to achieve its climate targets sets by the Climate Change Act 2019. The plan includes a renewable, all energy consumption target of 50% by 2030, covering electricity, heat, and transport.	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emission of the Proposed Development and how it supports Scotland's carbon reduction targets through renewable energy generation. The Proposed Developments carbon emissions pay-back period is estimated in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report).
Climate Ready Scotland: Climate Change Adaptation Programme 2019-2024 (Scottish Government, 2019)	A five year programme to prepare Scotland for the challenges of climate change. The programme is a requirements of the Climate Change (Scotland) Act 2009 and addresses the risks set out in the UK Climate Change Risk Assessment (UK CCRA 2017, published under section 56 of the UK Climate Change Act 2008.	The CCR assessment presented in Section 18.7 identifies the significant effects likely to affect the resilience of the Proposed Development across construction, O&M and decommissioning and assesses whether additional adaptation measures are needed.

Policy	Summary	How/Where Chapter has considered this
Draft Energy Strategy and Just Transition Plan (Scottish Government, 2023)	The strategy sets out key ambitions for Scotland's energy sector, including more than 20 Gigawatt (GW) of additional renewable electricity on- and offshore by 2030.	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emission of the Proposed Development and how it supports Scotland's carbon reduction targets through renewable energy generation.
Offshore Wind Policy Statement (Scottish Government, 2020)	Sets out Scotland's ambitions for the future of offshore wind in Scotland and sets the context for Marine Scotland's Sectoral Marine Plan for Offshore Wind. The statement supports the development of between 8 and 11 GW of offshore wind capacity by 2030.	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emission of the Proposed Development and how it supports Scotland's carbon reduction targets through renewable energy generation.
United Kingdom (UK) Marine Policy Statement (MPS) (HM Government, 2011)	The UK MPS is the implementation framework for section 44 of the Marine and Coastal Access Act 2009 which oversees decisions affecting the UK marine environment. The MPS aligns with Scotland's National Marine Plan to ensure coherent and sustainable management of marine resources. This policy alignment ensures that marine and terrestrial planning are integrated, and that Scotland's renewable energy and environmental goals are pursued effectively. As per paragraph 2.6.7.7, marine planning and decision making should consider how the marine environment can adapt to the impacts of climate change. This includes assessing "likely and potential impacts from climate change and their implications for the location of timing of development and activities over the plan period and beyond"[1]. In particular developments/projects should take account of risks such as increased land and sea temperatures and sea level rise and possible increase in risk from extreme events such as flooding and coastal erosion.	The CCR assessment presented in Section 18.7 assesses likely and potential impacts from climate change on the Proposed Development across construction, O&M and decommissioning. Assessment of climate change impacts are based on Met Office UKCP18 projections, including projections of temperature and sea level rise. The scope of the Climate chapter is limited to Proposed Development's offshore elements, therefore, increased risk from flooding is not assessed in this chapter.

[1] *10164_Marine Statement_Cov.indd (publishing.service.gov.uk)*

Policy	Summary	How/Where Chapter has considered this
Scotland's NMP (Scottish Government, 2015)	Scotland's NMP was adopted to implement the Marine (Scotland) Act 2010 and covers the management of Scottish inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles). The plan provides an overarching framework for the sustainable use of Scotland's marine area. The plan includes six general planning principles including GEN 5 Climate change which requires that marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change. Expected mitigation measures include facilitating a transition to a low carbon economy and reducing greenhouse gas emissions. Adaptation measures include addressing the impacts of a changing climate, taking into consideration the vulnerability, scale, and longevity of an operation, and providing effective adaptation to its predicted effects. 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. Paragraph 2.27 of Section Marine planning in a changing climate requires that "in order to consider adaptation, planners need projections of how future climate may change and estimates of the impacts these future climate scenarios may have on marine ecosystems and regions"[2].	The assessment of LSE includes an assessment of the impact of the Proposed Development on climate (referred to as the GHG assessment) and the vulnerability of the Proposed Development to climate change (referred to as the CCR assessment). The outcomes of the GHG assessment and CCR assessment can be found in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) and Section 18.7 respectively. In both assessments, embedded mitigation is considered. Where additional mitigation is deemed necessary, details of this are provided. Assessment of climate change impacts are based on Met Office UKCP18 projections, including projections of temperature and sea level rise. The interaction between climate change and other environmental receptors, including marine ecology, are considered in Section 18.10.
Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020)	The "Sectoral Marine Plan for Offshore Wind Energy (2020)" provides a strategic framework for the future development of offshore wind energy in Scottish waters. It outlines the process and criteria for seabed leasing under	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emissions of the Proposed Development and how it supports Scotland's carbon

[2] Scotland's National Marine Plan: A Single Framework for Managing Our Seas (www.gov.scot)

Policy	Summary	How/Where Chapter has considered this
	the ScotWind leasing round, aiming to support Scotland's climate and energy targets. The plan emphasises sustainable development, ensuring minimal environmental impact and maximising economic benefits by identifying suitable areas for wind energy projects. It aligns with Scotland's National Marine Plan and the UK Marine Policy Statement, integrating national and regional policies to facilitate the expansion of offshore wind energy while considering ecological and social impacts.	reduction targets through renewable energy generation. The interaction between climate change and other significant effects, including ecological and social effects, are considered in Section 18.10. Specific details on the site selection process can be found in Volume 1, Chapter 4 (Site Selection and Consideration of Alternatives).
Aberdeenshire Local Development Plan (2023)	The location of the Proposed Development is off the coast of Aberdeen, Scotland and the landfall site of the Proposed Development is to be located in Peterhead. The Proposed Development is therefore subject to the requirements laid out in the Aberdeenshire Local Development Plan. Scottish Planning Policy in Aberdeenshire promotes sustainable development and includes measures to combat climate change, focusing on energy conservation, water conservation, renewable energy production, and maintaining natural carbon stores. Policy C1 mandates that all developments reduce carbon emissions, meet the Target Emissions Rate of Scottish building regulations, and achieve a 'Gold' sustainability rating. Developments should incorporate low and zero carbon technologies and focus on energy and water efficiency. Policy C2 states that the acceptability of renewable energy developments will take account of any effects on renewable energy targets and greenhouse gas emissions. The Aberdeenshire Local Development Plan aligns with the Strategic Landscape Capacity Assessment for Wind Energy	The GHG impact assessment presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) identifies the carbon emissions of the Proposed Development and how it supports Scotland's carbon reduction targets through renewable energy generation. The Proposed Developments carbon emissions pay-back period is estimated in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report). The interaction between climate change and other significant effects, including ecological and social effects, are considered in Section 18.10. Specific details on the site selection process can be found in Volume 1, Chapter 4 (Site Selection and Consideration of Alternatives).

Policy	Summary	How/Where Chapter has considered this
	in Aberdeenshire Final Report 2014, requiring wind energy projects to be appropriately sited to minimize environmental and cumulative impacts. Changes to wind farms, like larger blades or full repowering, typically require a new application, whereas minor upgrades may not. Wind turbine planning must consider health and safety, avoid impacting aviation or telecommunications, and minimize noise and disruption to local amenities and wildlife.	

GUIDANCE

18.3.5. In undertaking the assessments contained within this chapter, a range of technical guidance documents have been drawn upon to guide alignment with regulatory requirements and best practice. The IEMA EIA Guide to Climate Change Resilience and Adaptation (IEMA, 2020) provides the most comprehensive guidance on the inclusion of climate change within an EIAR and is therefore referenced throughout this chapter.

18.3.6. A full list of guidance documents considered relevant to both the CCR assessment and GHG assessment, is provided below:

- IEMA Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation (IEMA, 2020);
- IEMA Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2022);
- The UKCP18 National Climate Projections (Met Office, 2018);
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Centre for Environment, Fisheries and Aquaculture Science (Cefas), 2012);
- Environmental Impact Assessment Handbook (Scottish Natural Heritage, 2018);
- EIA of Projects – Guidance of Projects – Guidance on the preparation of the EIAR (European Commission, 2017); and
- Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (European Commission, 1999).

18.4. CONSULTATION

18.4.1. Ongoing statutory and non-statutory consultation and incorporation of feedback is an integral part of developing a robust EIAR. The Offshore Scoping Report (Volume 3, Appendix 5.1 (Offshore Scoping Report)) for the Proposed Development (Muir Mhòr Offshore Wind Farm Limited, 2023) was submitted to the Marine Directorate – Licensing Operations Team (MD-LOT) in June 2023. MD-LOT issued a detailed response to the Scoping Report's content in the September 2023 Scoping Opinion (Volume 3, Appendix 5.2 (Offshore Scoping Opinion), covering its own opinion on the Scoping Report as well as the statutory and non-statutory consultees' advice on each topic.

18.4.2. Table 18-3 provides a summary of the stakeholder consultation activities specific to climate. The issues raised and actions to address and incorporate this feedback into the EIAR are outlined.

18.4.3. Further detail on the Proposed Development's overall EIA stakeholder consultation process and actions is presented in Volume 1, Chapter 5 (Consultation) of the EIAR.

Table 18-3 Consultation relevant to Climate

Date	Consultee and Type of Consultation	Description/ Issues Raised	How this has been considered in this Chapter
25th August 2023	Aberdeenshire Council Scoping Opinion, Appendix I: Consultation Responses & Advice, 2023	It is noted that responsibility for the inter-tidal zone is shared between Marine and Terrestrial Planning. Whilst the Planning Service has little by way of additional comment to make on this matter, the proposed scope of assessment appears to be logical in so far as our interests. The decision to consider sites designated for ornithology through an HRA is welcomed.	The Proposed Development's offshore infrastructure and activities are the focus of this EIAR. The CCR and ICCI assessment therefore includes the inter-tidal area, up to the MHWS. Consideration of how offshore effects may interact with onshore effects is included in the Whole Project Assessment presented in Section 18.7.13. A full assessment of the onshore aspects of the Project is presented in a separate onshore EIAR which is being prepared and will provide a description of the onshore elements of the Project landward of MLWS, and an assessment of the associated LSE. Outcomes of the CCR assessment are presented in Section 18.7. ICCI effects, including those affecting ornithology receptors, are assessed in Section 18.10.
11th August 2023	NatureScot Scoping Opinion, Appendix I: Consultation Responses & Advice, 2023	We are currently facing two crises, that of climate change and biodiversity loss and as the Scottish Government's adviser on nature, our work seeks to inspire, enthuse and influence others to manage our natural resources sustainably. We recognise that this proposal is a lease awarded through the ScotWind process in an area identified through the Sectoral Marine Plan process for Offshore Wind. The impact of climate change effects should be considered, both in	Assessment of the emissions reductions of the Proposed Development compared to the project baseline scenarios of 'Gas' and 'all non-renewables' derived electricity is provided in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report). Dependent on the scenario and assumptions chosen, the carbon payback period will be in a range between 1.8 - 7

Date	Consultee and Type of Consultation	Description/ Issues Raised	How this has been considered in this Chapter
		futureproofing the project design and how certain climate stressors may work in combination with potential effects from the proposed wind farm. The EIA Report should also consider the carbon cost of the wind farm (including supply chain) and to what extent this is offset through the production of green energy. We recognise that some aspects of this are addressed in Section 18 (Climate). The potential re-exposure of a trenched cable(s) at landfall should be assessed as an additional operational impact, especially given the anticipated increases in rates and extent of erosional retreat at the coast due to accelerating sea-level rise. This is to reduce any potential need for future hard engineering, which could in turn disrupt coastal processes, with potential impacts on Loch of Strathbeg SSSI as a receptor. This effect should arguably also be part of the 'in-combination climate change impact of operational period' assessment. As other landfalls are currently proposed in the same general area, it may also be relevant to the cumulative impact assessment considerations proposed at Section 18.6.5.	years. Assessment of the vulnerability of the Proposed Development to climate change, including its adaptive capacity and embedded mitigation measures, is provided in Section 18.7 and Section 18.10. Potential exposure of offshore trenched cables, including those up to MHWS, due to sea level rise and increased erosion are assessed within the CCR assessment. Assessment of how climate change may interact with other environmental effects resulting from the Proposed Development including Marine and Coastal Processes; Marine Water and Sediment Quality; and Benthic, Subtidal, and Intertidal Ecology; are presented in Section 18.10. Further detail on these topic areas can be found in the following chapters: Volume 2, Chapter 7 (Marine and Coastal Processes); Volume 2, Chapter 8 (Marine Water and Sediment Quality); Volume 2, Chapter 9 (Benthic, Subtidal and Intertidal Ecology). As explained in Section 18.9, cumulative impacts have been scoped out of the Climate chapter due to the global nature of climate change.

Date	Consultee and Type of Consultation	Description/ Issues Raised	How this has been considered in this Chapter
9th August 2023	Natural England Scoping Opinion, Appendix I: Consultation Responses & Advice, 2023	As the application is located outside English waters, advice from NatureScot and JNCC, the statutory nature conservation bodies for Scottish waters, should be sought. Due to our remit, we have restricted our comments to impacts to species from English Marine Protected Areas and to species in English waters: marine mammals, fish and birds. We note that Natural England's advice on ornithological modelling differs from NatureScot's advice. Although for the Muir Mhòr project we advise that we agree with the conclusions of the screening (for English protected sites and species), we are mindful of these differences and want to highlight them here. The increasing number of offshore wind projects could lead to adverse effect on English and Scottish birds in combination with other plans or projects in the future. Although Natural England do not agree fully with the methods in the impact assessment, we do not expect the applicant to undertake a separate impact assessment based on Natural England's advice.	Assessment of how climate change may interact with other environmental effects resulting from the Proposed Development, including ornithology, are presented in Section 18.10. Further detail on the significance of effects and mitigation measures can be found in Volume 2, Chapter 11 (Offshore and Intertidal Ornithology).
11th August 2023	Dee District Salmon Fishery Board Scoping Opinion, Appendix I: Consultation Responses & Advice, 2023	Offshore developments have the potential to directly and indirectly impact diadromous fish. We would therefore expect developers to assess and, where necessary, mitigate the potential impacts of the development. These potential impacts have been highlighted through ScotMER, and include: • Avoidance (including exclusion from particular rivers and subsequent impacts on local populations); • Disorientation effects that could potentially affect behaviour, susceptibility to predation or by-catch; and • Impaired ability to locate normal feeding grounds or river of origin; and delayed migration The following issue should therefore be considered in full, including	Assessment of how climate change may interact with other environmental effects resulting from the Proposed Development including Commercial Fisheries, Fish and Ecology; and Benthic, Subtidal and Intertidal Ecology; are presented in Section 18.10. Further detail on the significance of effects and mitigation measures can be found in the following chapters: Volume 2, Chapter 10 (Fish and Ecology); Volume 2, Chapter 13 (Commercial Fisheries); Volume 2, Chapter 9 (Benthic, Subtidal and Intertidal Ecology).

Date	Consultee and Type of Consultation	Description/ Issues Raised	How this has been considered in this Chapter
		consideration of new research where information is lacking: iii. Disturbance or degradation of the benthic environment (including secondary effects on prey species) It is important to ensure that such effects are quantified and assessed in the EIAR. Consideration should be given to potential effects on important habitats for feeding and shelter for the marine phase of sea trout (a priority marine feature) and any area that might impact early feeding opportunities for all diadromous species.	
15th August 2023	Fisheries Management Scotland Scoping Opinion, Appendix I: Consultation Responses & Advice, 2023	We recognise the importance of reducing CO2 emissions of offshore energy assets. However, there remain several outstanding questions and concerns about the potential negative effects of the proposed development on diadromous fish, including Atlantic salmon and sea trout. The following issues should therefore be considered in full, including consideration of new research where information is lacking: iii. Disturbance or degradation of the benthic environment (including secondary effects on prey species) It is important to ensure that such effects are quantified and assessed in the EIAR. Particular consideration should be given to potential effects on important habitats for feeding and shelter for the marine phase of sea trout (a priority marine feature) and any area that might impact early feeding opportunities for all diadromous species. iv. Aggregation effects Construction of wind turbines often result in the loss of some habitat types (such as soft sediment) and creation of new, artificial vertical habitats. The associated increase in species diversity can attract fish and ultimately predators. The potential for these structures to aggregate predators, and act as predation 'hot-spots', particularly when located in marine areas utilised by diadromous fish for feeding or migration, should be assessed in full. This is an important	Assessment of the emission reductions of the Proposed Development compared to the project baseline scenarios of 'Gas' and 'all non-renewables' derived electricity is provided in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report). Assessment of how climate change may interact with other environmental effects resulting from the Proposed Development including Commercial Fisheries, Fish and Ecology; and Benthic, Subtidal and Intertidal Ecology; are presented in Section 18.10. Further detail on the significance of effects and mitigation measures can be found in the following chapters: Volume 2, Chapter 10 (Fish and Ecology); Volume 2, Chapter 13 (Commercial Fisheries); Volume 2, Chapter 9 (Benthic, Subtidal and Intertidal Ecology).

Date	Consultee and Type of Consultation	Description/ Issues Raised	How this has been considered in this Chapter
		consideration in the case for seals, and some species of birds. Whilst the scoping report recognised the potential for new hard substrates to act as a fish aggregating device, and potentially attract larger predators, the impact of those predators on species passing through the development does not appear to have been considered. The secondary impact of predators on diadromous fish should be fully considered in the EIA.	
11th July 2023	Ugie District Salmon Fishery Board Scoping Opinion, Appendix I: Consultation Responses & Advice, 2023	On behalf of the Ugie district salmon Fishery Board, I would like assurances that the migrating wild salmon and sea trout in the sea and in the River Ugie, will not be adversely affected by this project in the construction phase and throughout the operating life of the of the project.	Assessment of how climate change may interact with other environmental effects resulting from the Proposed Development including Commercial Fisheries, and Fish and Ecology; are presented in Section 18.10. Further detail on the significance of effects and mitigation measures can be found in the following chapters: Volume 2, Chapter 10 (Fish and Ecology); Volume 2, Chapter 13 (Commercial Fisheries).

18.5. BASELINE ENVIRONMENT

18.5.1. This section presents a summary of the baseline environment study area, the methodology, baseline conditions and limitations and assumptions of the data used within the CCR assessment and the GHG impact assessment.

STUDY AREA

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.5.2. The study area for the both the CCR assessment and the ICCI assessment encompasses the Proposed Development boundary and includes the following:

- Proposed Development Array Area;
- Offshore Export Cable Corridor (ECC); and
- Intertidal area seaward of MHWS;

18.5.3. To collect the climate projections data needed to undertake the CCR and ICCI assessments, three collections of UKCP18 data were used:

1) “Variables from local projections (2.2 km) regridded to 5 km over UK for monthly, seasonal, or annual datasets”. These datasets cover all basic climate variables that can be used for an assessment of how climate may impact aspects of the Proposed Development;
2) “Sea level anomalies for marine projections around the UK coastline, 2007-2100”. This dataset provides projected sea-level anomaly information; and
3) “Variables from the probabilistic projections of climate extremes (25 km) over the UK, 1961-2100”. This dataset provides additional extreme weather indicators that may be used to provide an assessment of the impact of extreme weather events on the Proposed Development.

18.5.4. For each of the UKCP18 collections, it is necessary to select specific spatial parameters to collect the relevant data. As noted in Section 18.5 Data Limitations and Assumptions paragraph 18.5.26, UKCP18 projections use land areas as the basis of the projections and therefore do not extend offshore. Therefore, for each of the three datasets, the spatial parameters closest to the study area have been selected.

18.5.5. For the variables from local projections (2.2 km), the East Scotland administrative region was selected (Figure 18-1).

18.5.6. For the 21st century sea level anomaly projections (Marine), the coordinates closest to the Proposed Development were used (57.39, -1.75) (Figure 18-2).

18.5.7. For the variables from probabilistic projections of climate extremes (25 km), the coordinates closest to the Proposed Development (57.39, -1.75) was used (Figure 18-3).

188000 307000 426000

783000

664000

Legend:

- Array Area
- Offshore Export Cable Corridor
- Local Projections Spatial Parameter Area

Project: Muir Mhòr	Report: Environmental Impact Assessment

Title:
United Kingdom Climate Projections 2018
Local Projections (2.2km) Spatial Parameter Area

Figure: 18-1	Drawing No: 425.065187.00001.0001.0		
Revision:	Date:	Drawn:	Checked:
01	08/07/2024	MM	JO

Map scale 1:1,250,000 @ A3 0 25 50 km

Co-ordinate system: ETRS 1989 UTM ZONE 30N **EPSG:** 25830

MUIR MHÒR OFFSHORE WIND FARM
A joint venture between Fred. Olsen Seawind & Vattenfall

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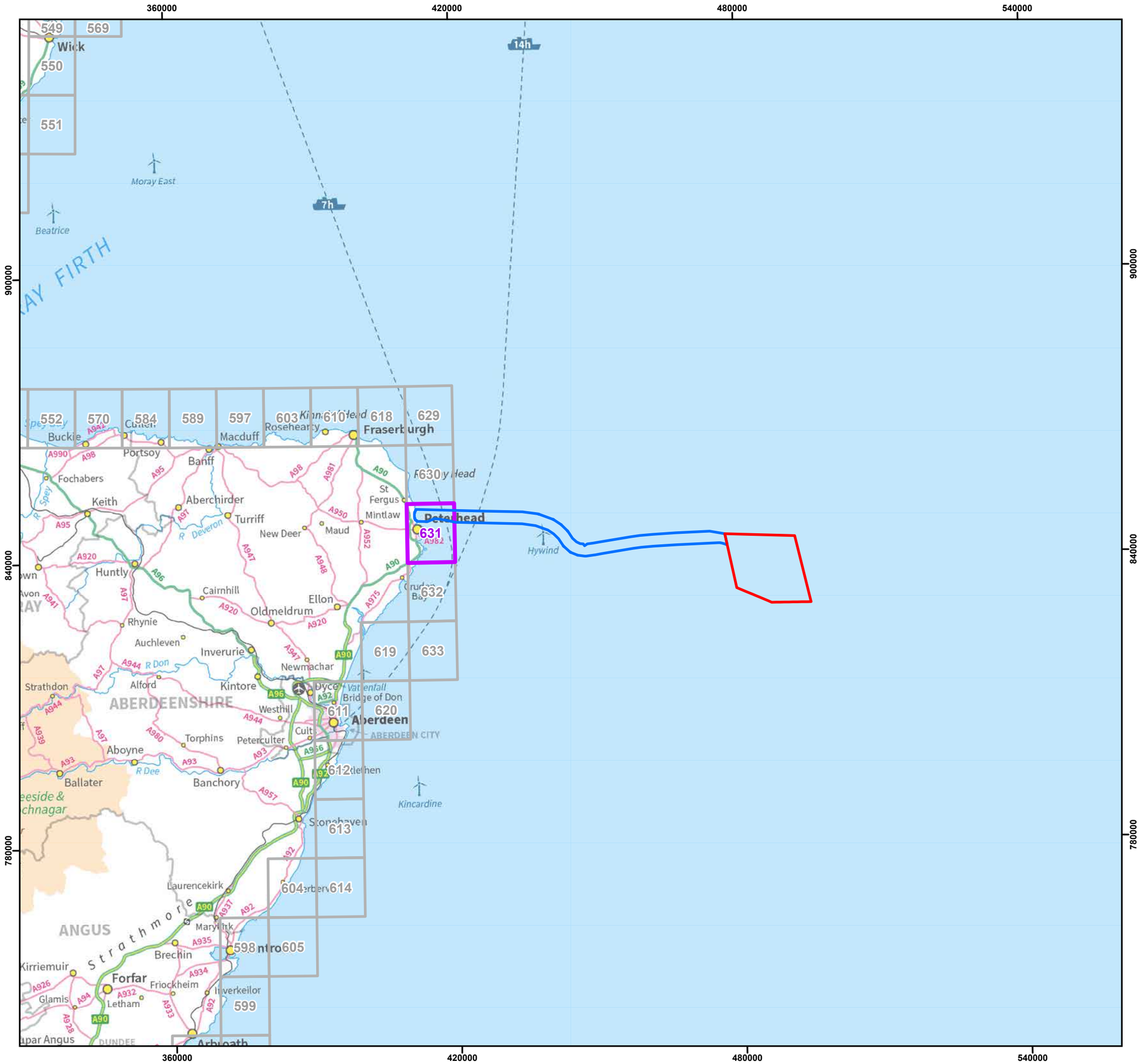

Legend:

- Array Area
- Offshore Export Cable Corridor
- 21st Century Marine Projections Spatial Parameter Area
- United Kingdom Climate Projections 2018 Coastal Locations

Project:	Report:
Muir Mhòr	Environmental Impact Assessment

Title:

21st Century Projections Marine Spatial Parameter Area

Figure: 18-2	Drawing No: 425.065187.00001.0002.0		
Revision:	Date:	Drawn:	Checked:
01	08/07/2024	MM	JO

Map scale 1:800,000 @ A3 0 10 20 km

Co-ordinate system: ETRS 1989 UTM ZONE 30N **EPSG:** 25830

MUIR MHÒR OFFSHORE WIND FARM
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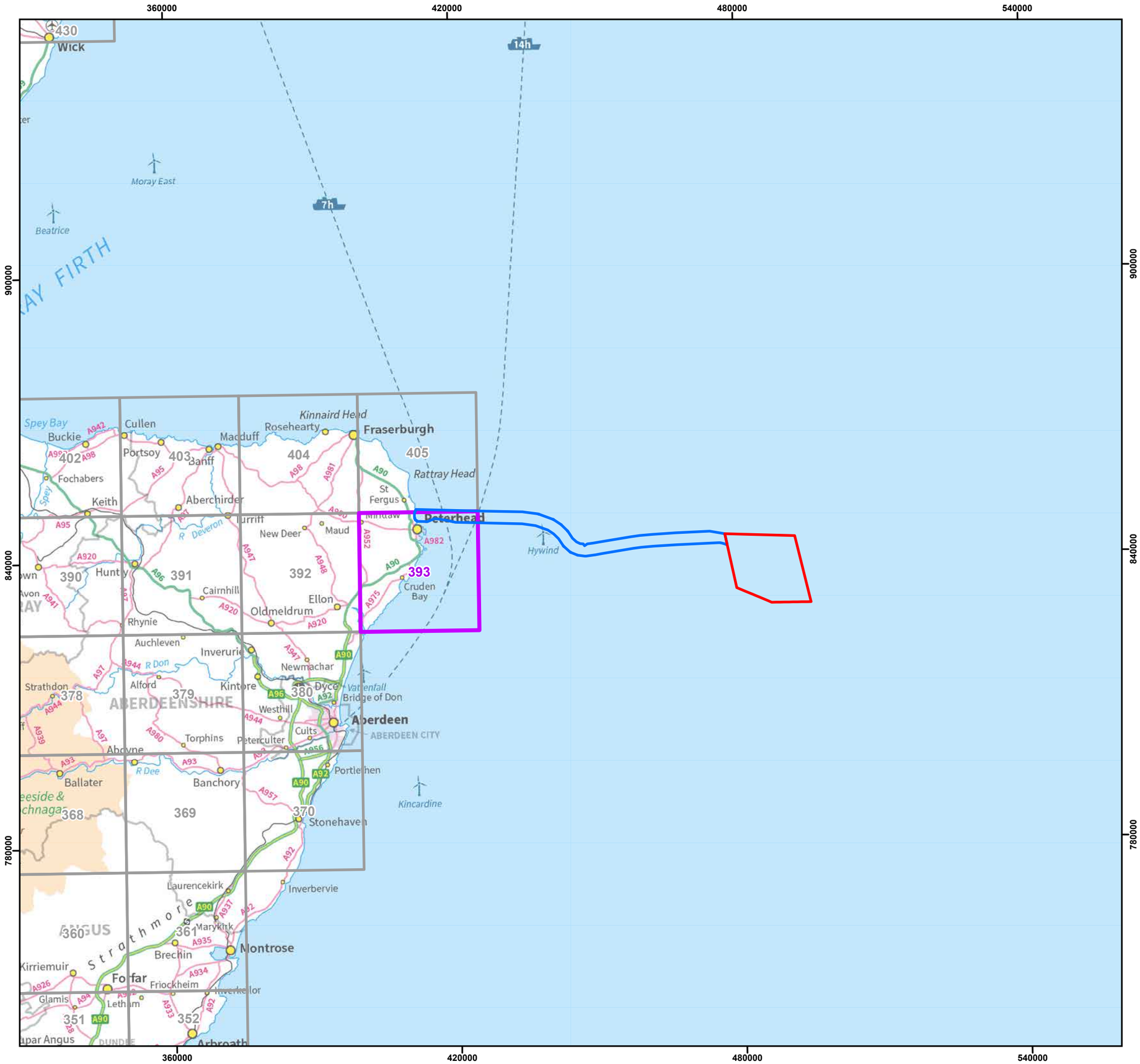

Legend:

- Array Area
- Offshore Export Cable Corridor
- Probabilistic Projections of Climate Extremes Spatial Parameter Area
- United Kingdom Climate Projections 2018 25km Grid Cell

Project: Muir Mhòr	Report: Environmental Impact Assessment

Title: Probabilistic Projections of Climate Extremes (25km) Spatial Parameter Area

Figure: 18-3	Drawing No: 425.065187.00001.0003.0		
Revision:	Date:	Drawn:	Checked:
01	08/07/2024	MM	JO

Map scale 1:800,000 @ A3 0 10 20 km

Co-ordinate system: ETRS 1989 UTM ZONE 30N **EPSG:** 25830

MUIR MHÒR OFFSHORE WIND FARM
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GREENHOUSE GAS ASSESSMENT

18.5.8. The study area for the GHG impact assessment is the array of turbines themselves, together with the infrastructure required to bring their electricity to land and connect to the National Grid (NG). The end point for the study is the onshore substation.

METHODOLOGY

18.5.9. For the purposes of this Climate Chapter, a desk-based review was undertaken using relevant spatial and scientific data sources. The baseline data used to inform the CCR and ICCI assessments was collected using the three Met Office UKCP18 datasets specified in the previous Study Area section.

18.5.10. When collecting the data, a specific set of parameters was used to ensure that the data was spatially and scientifically relevant to the Proposed Development. These parameters are presented in Table 18-4.

18.5.11. Additional data sets and literature encompassing the Proposed Development study area and used within the CCR and ICCI assessments, are presented in Table 18-5.

Table 18-4 Data Specification for UKCP18 Climate Projections

Parameter	Notes:
Data	Three collections of UKCP18 data were used: 1) The variables from local projections (2.2 km) regridded to 5 km over UK for monthly, seasonal, or annual datasets. These datasets cover all basic climate variables that can be used for an assessment of how climate may impact aspects of the Proposed Development. 2) Sea level anomalies for marine projections around the UK coastline, 2007-2100. This dataset provides projected sea-level anomaly information. 3) The variables from the probabilistic projections of climate extremes (25 km) over the UK, 1961-2100 dataset. This dataset provides additional extreme weather indicators that may be used to provide an assessment of the impact of extreme weather events on the Proposed Development.
Temporal Average	An annual average has been used for most indicators. For indicators related to minimum or maximum temperature averages, the averages from the coldest month in winter for the minimum and the hottest month in summer for the maximum have been provided.
Area	For each of the variables from local projections (2.2 km), the East Scotland administrative region was selected. For the 21st century projections (Marine), the coordinates closest to the offshore location were used (57.39, -1.75). For the variables from probabilistic projections of climate extremes (25 km), the coordinates closest to the offshore location (57.39, -1.75) were used.
Return Period	The return period is only relevant for variables from the probabilistic projections of climate extremes (25 km) over the UK, 1961-2100, where a 1 in 50-year return period event has been provided.
Baseline	For the local projections (2.2 km) and the probabilistic projections (25 km) the baseline used was 1980-2000. For the marine projections, a baseline of 2007 was used. It is not possible to download earlier data for marine projections.
Scenario	RCP8.5 (high emissions) scenario was used across all variables. RCP8.5 is a high emissions scenario that models a change in temperature of 4.3°C (best estimate) over 2081-2100 compared to the pre-industrial period.
Climate Change Type	The Met Office defines the climate change type of a value as an anomaly or absolute. Anomaly values represent the change in the climate variable compared to the baseline period. For the local projections (2.2 km) absolute values have been used for the baseline period and anomaly values have been used for 2040 and 2060. For marine projections, only anomaly values are available. For variables from probabilistic projections of climate extremes (25 km) only absolute values are available. The climate change type is specified in the header of each table column.

Table 18-5 Additional Sources of Climate Literature and Data

Source, Author, and Year	Summary	Coverage of Proposed Development Study Area
The Future of the Sea: Ocean Acidification Report, UK Government Office of Science, 2017	This study aims to investigate the impacts of increasing ocean acidification in seas around the UK since these were not available from the UKCP18 dataset.	Full coverage of the study area
Coupled Model Intercomparison Project Phase 6 (CMIP6) Projections of Changes in Sea Surface Temperature, 2019	CMIP6 projections consist of 100 distinct models produced across 49 different modelling groups that underpin the 2021 Intergovernmental Panel on Climate Change (IPCC) sixth assessment report (AR6). These projections provide data for projected changes in sea surface temperature since these were not available from the UKCP18 dataset.	Full coverage of the study area
UKCP18 Factsheet: Sea level rise and storm surge, UK Met Office, 2018	This factsheet highlights the potential changes in the severity of future storm surge events and contains projection narratives since these were not available from the UKCP18 dataset.	Full coverage of the study area
UKCP18 Overview Report, UK Met Office, 2018	This report provides projection data for mean significant wave heights around the UK coastline since these were not available from the UKCP18 dataset.	Full coverage of the study area
AR5, IPCC, 2014	Conversion factors for greenhouse gas emissions.	Full coverage of the study area
Inventory of Carbon and Energy (ICE), University of Bath, 2008	Embodied carbon footprints.	Full coverage of the study area
Characterisation factors, Ecoinvent, 2023	Embodied and activity carbon footprints.	Full coverage of the study area
ISO 14040:2006 Environmental Management – Life Cycle Assessment – Principles and Framework, ISO, 2006	Principles and framework for Life Cycle Assessment (LCA).	Full coverage of the study area
Drone flight data reveal energy and greenhouse gas emissions savings for very small package delivery – ScienceDirect, Thiago A. Rodrigues *et al*., 2022	Greenhouse gas emissions of drones	Full coverage of the study area

DESCRIPTION OF BASELINE ENVIRONMENT

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.5.12. A summary of the CCR baseline environment is provided in the following sections.

18.5.13. Historic climate data from the Met Office for the period 1981-2001 has been used to determine the current baseline using the spatial parameters defined in Section 18.5 Study Area. The current baseline climate data for 1981-2001 is presented in the following tables: Table 18-6, Table 18-7, and Table 18-8. This enables a comparison of the future changes against this current baseline.

18.5.14. To provide a broad overview of the baseline climate for the Scotland, the State of the UK Climate 2022 report (International Journal of Climatology, 2023) is summarised below:

TEMPERATURE:

18.5.15. Scotland has experienced an upward trend in mean annual temperatures. Specifically, the most recent decade (2013–2022) has been 0.2°C warmer compared to the 1991–2020 average and 1.1°C warmer relative to the 1961–1990 baseline.

PRECIPITATION:

18.5.16. The annual rainfall intensity in Scotland has slightly increased, with values showing a marginal rise from 7.4 millimetres per day (mm/day) during 1961–1990 to 7.8 mm/day in 2013–2022.

18.5.17. Scotland saw a 52% increase in rainfall during February over the 1961–1990 baseline, reflecting a broader trend of increased precipitation intensity during the colder months.

WIND:

18.5.18. Wind speeds have shown no significant long-term change, maintaining a consistent annual mean wind speed around 11.2 knots (kt) in recent years. Notably, the named storms Malik and Corrie brought extreme wind speeds in January 2022, with gusts exceeding 100 kt on Scotland's mountain summits.

SEA LEVEL:

18.5.19. Sea level around Scotland is rising, in line with global trends. The rate of sea-level rise since the 1960s has increased to approximately 2.4 ± 0.3 millimetres per year (mm/year). Notably, the period from 1993 to 2022 saw an increase in sea level by 11.4 cm around the UK, indicative of accelerated sea-level rise during recent decades.

18.5.20. For more location-specific data, the current baseline climate data for 1981-2001 is presented in Table 18-6, Table 18-7, and Table 18-8.

GREENHOUSE GAS ASSESSMENT

18.5.21. The GHG impact assessment is presented in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report). For the Baseline Environment, we consider how electricity will be generated if the windfarm is not built. It is generally accepted that, when the windfarm comes online, its additional electricity will not replace nuclear or other renewable generating technologies. Rather, it will displace whatever generation technology would have been “the last to be turned on” – not the grid mix, therefore, but the so-called “marginal mix”.

18.5.22. In the UK, for the foreseeable future, the marginal mix technology is expected to be gas, namely Combined Cycle Gas Turbine (CCGT) which has a carbon intensity of about 371 grams per kilowatt-hour (g/kWh)[3]. Alternatively, RenewableUK recommends[4] using the DUKES "all non-renewable fuels" (coal, oil, gas and other solid fuels including non-renewable waste) emission factor of 424g/kWh[1]. These are the baseline emission factors that the windfarm should exceed.

FUTURE BASELINE CONDITIONS

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.5.23. In line with the EIA Regulations, this EIAR requires a "description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the Proposed Development as far as natural changes from the baseline scenario can be assessed with reasonable effort, on the basis of the availability of environmental information and scientific knowledge". This reflects how the baseline relevant to the climate is expected to evolve without the Proposed Development. Predicted baseline changes as per the UKCP18 projections of climatic variables are presented in the following tables:

18.5.24. Table 18-6, Table 18-7, and Table 18-8. Data relating to the current baseline are also included to enable a comparative understanding of the scale of changes expected to occur over the lifetime of the Proposed Development. As explained in Table 18-4, UKCP18 projections are either available as anomaly or absolute values. Anomaly values represent the change in the climate variable compared to the baseline period (e.g. an anomaly projection of 1.92°C annual mean air temp at 1.5m in 2040 represents an average increase of 1.92°C between the baseline period and 2040). Absolute values represent a specific value that has been projected (e.g. an absolute projection of 44.58mm spring 1-day total precipitation in 2040 projects 44.58mm as the average total rainfall to fall in one day during the spring months of 2040). For the local projections (2.2 km) absolute values have been used for the baseline period and anomaly values have been used for 2040 and 2060. For marine projections, only anomaly values are available. For variables from probabilistic projections of climate extremes (25 km) only absolute values are available. The climate change type (absolute or anomaly) is specified in the heading of the below tables for clarity.

18.5.25. See Table 18-4 for further information concerning the data presented in Table 18-6, Table 18-7, and Table 18-8.

Table 18-6 Variables from local projections (2.2 km)

Climate Variables	1981-2000 (Absolute)	2040 (Anomaly)	2061 (Anomaly)
Annual precipitation rate (%)	3.51 (mm/day).	0.02	8.73
Annual mean air temp at 1.5 m (°C)	6.26	1.92	2.77
Summer max air temp at 1.5 m (°C)	15.53 **1991 values	17.53 **2031 values	20.27 **2071 values

[3] Taken from DUKES 2023 data, Table 5.14:

https://assets.publishing.service.gov.uk/media/64c1292090b545000d3e8396/DUKES_5.14.xlsx

[4] See https://www.renewableuk.com/page/UKWEDExplained

Climate Variables	1981-2000 (Absolute)	2040 (Anomaly)	2061 (Anomaly)
Winter minimum air temp at 1.5 m (°C)	-1.54 **1990 values	0.02 **2030 values	1.73 ** 2070 values
Annual northward wind at 10 m (m s-1)	0.72	0.02	0.13
Annual eastward wind at 10 m (m s-1)	1.51	0.2	0.08
Annual wind speed at 10 m (m s-1)	4.82	-0.14	-0.16
Annual wind speed gust maximum at 10 m (m s-1)	7.78	-0.24	-0.24
Annual sea level pressure (hPa)	1013.19	0.14	-0.75
Annual relative humidity at 1.5 m (%)	85.14	-0.95	-1.29
Annual specific humidity at 1.5 m (%)	0.06(1)***	12.75	19.25

**Values for these variables only available in unit of measurement (mm/day) for absolute values.*
***Air temperature variables only given for one specific year as opposed to a range of years.*
****Values for this variable only available in the unit of measurement (1) for absolute values.*

Table 18-7 Variables from 21st century marine projections

Climate Variables	1981-2000 (Absolute)	(2040 Anomaly)	(2060 Anomaly)
Annual time-mean sea level anomaly	0.00	0.16	0.29

**Values only available from 2007 onwards for this dataset.*

Table 18-8 Variables from probabilistic projections of climate extremes (25 km)

Climate variable	1981-2000 (Absolute)	2040 (Absolute)	2060 (Absolute)
Spring 1-day total precipitation (mm)	41.91	44.58	46.36
Summer 1-day total precipitation (mm)	57.06	59.64	61.33
Autumn 1-day total precipitation (mm)	63.26	69.39	73.50
Winter 1-day total precipitation (mm)	46.13	49.33	51.47
Seasonal average 1-day total precipitation (mm)	52.09	55.74	58.17
Spring 5-day total precipitation (mm)	97.19	102.06	105.33

Climate variable	1981-2000 (Absolute)	2040 (Absolute)	2060 (Absolute)
Summer 5-day total precipitation (mm)	95.14	96.48	97.32
Autumn 5-day total precipitation (mm)	110.81	117.43	121.96
Winter 5-day total precipitation (mm)	93.63	99.91	104.07
Seasonal average 5-day total precipitation (mm)	99.19	103.97	107.17
Summer max air temp at 1.5 m (°C)	27.97	29.94	31.28

DATA LIMITATIONS AND ASSUMPTIONS

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.5.26. UKCP18 Marine projections are currently limited to projections on sea levels. Sea level projections are used by the Met Office to inform conclusions regarding tidal characteristics and storm surges; however, for most climate variables marine projections are unavailable. Unless otherwise stated, the projected values used within the CCR assessment are land-based projections. It is noted that conditions offshore may vary from land-based projections, however, they serve as a good proxy from which a climate risk assessment can be made.

18.5.27. The Met Office notes the following caveats and limitations (BEIS, 2018) in relation to UKCP18 results and data:

- Climate projections are dependent on future greenhouse gas assumptions;
- Estimated ranges for future climate are conditional;
- UKCP18 does not capture all possible future outcomes;
- Substantial additional sea level rise cannot be ruled out;
- UK climate projections are likely to evolve;
- Finer model resolution does not necessarily provide greater confidence; and
- Climate models provide greater confidence for long-term climate averages than extreme events or time series of daily or sub-daily values (In recognition of this bias, annual and seasonal averages have been used in all cases, see Table 18-4.

GREENHOUSE GAS ASSESSMENT

18.5.28. Assumptions have been made for the GHG assessment, for further details see Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report).

18.6. ASSESSMENT METHODOLOGY

18.6.1. Assessment of effects in this Chapter will follow the general approach outlined in Volume 1, Chapter 4 (EIA Methodology) of the EIAR.

18.6.2. Specific assessment criteria and recognised guidance within the CCR, ICCI and GHG assessments are provided below.

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.6.3. The CCR assessment considers the likely effects of climate change impacts across the construction, O&M, and decommissioning phases of the Proposed Development. To assess the resilience of the Proposed Development to projected changes in the climate, the CCR assessment considers the Proposed Development itself as the receptor. To facilitate a detailed assessment of each potential impact and effect, each of the following receptors have been assessed:

- WTGs;
- OEP(s);
- Offshore export cables;
- Inter-array cables (IAC);
- IAC junction boxes;
- Interconnector cable;
- Mooring and anchoring;
- Floating foundations;
- Fixed foundations; and
- Personnel associated with the Proposed Development.

18.6.4. For each potential impact, the sensitivity of the receptor and the magnitude of the impact was assessed according to the criteria outlined in Section 18.6 (Criteria for Assessment, paragraph 18.6.15 *et seq.*). Informed by the UKCP18 projections data presented in Section 18.5 under Future Baseline, expert judgment informed the determination of the level of sensitivity attributable to each receptor and the magnitude attributable to each impact across the lifetime of the Proposed Development. Given the maximum 35-year operational lifetime of the Proposed Development, 2040 data is used to inform the CCR assessment of climate change impacts affecting the construction and operational stages, and 2070 data is used to inform the assessment of decommissioning stage impacts.

18.6.5. The outcomes of the CCR assessment are presented in Table 18-18, Table 18-20, and Table 18-22.

18.6.6. As part of the climate vulnerability and resilience assessment, potential ICCI effects are also considered. The ICCI assessment methodology follows the guidance outlined by IEMA (IEMA, 2020) to consider whether projected climate conditions can be expected to change the significance of the environmental effects identified elsewhere in the EIAR. Further details of this assessment and its outcomes can be found in Section 18.10.

GREENHOUSE GAS ASSESSMENT

18.6.7. The complete methodology applied for the Greenhouse Gas Assessment can be found in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report). In brief, the significance of the Proposed Development in relation to GHG emissions, determined aligned with the significance matrix depicted in Table 18-15, is dependent on the net GHG impacts compared to the without project baseline scenario impacts (described in Section 18.5) and overall net zero aspirations.

18.6.8. The goal and scope of the assessment were framed by key considerations reproduced in Table 18-9.

Table 18-9 Scope of GHG Assessment

Topic	Decision
Study goal:	To determine the GHG emissions from the lifetime operations of the Proposed Development, and to compare them with emissions that would otherwise arise from generating the same electricity
Scenarios:	Four scenarios, considering deployment of two turbine sizes and two foundation types
Time:	Based in the near present and so using current estimations of material production impacts
Geography:	Located in Scotland, but also cognisant of materials sourced from around the world
Functional unit:	Calculations to initially determine the total emissions across the lifetime of the installation, then factor in the total electricity produced to scale emissions to a carbon intensity of generation, in gCO2/kWh.
Impact criteria:	Only global warming potential (climate change) over a 100-year timeframe was considered in this study.
Data sources:	A combination of primary data from the developers and literature data
Life-cycle stages:	All life cycle stages, from cradle to grave

18.6.9. Data were gathered from the project on as many aspects of the design and construction details as were available and supplemented with proxy data from similar previous projects. Together, these described the materials, energy, freight, emissions and wastes across the project lifetime. Emission factors were applied to translate this activity data into carbon emission equivalents and summed across life cycle stages to determine the total impacts of the Project.

18.6.10. A systems expansion approach was adopted in the GHG assessment to account for the benefits of the electricity generated across the lifetime of the Project, which is anticipated to displace UK marginal electricity, expected to be derived from gas until at least 2035. The net significance of the GHG impacts was quantified through comparison of the Project derived electricity to the marginal electricity mix. In addition, a sensitivity was performed against the UK Government's "all non-renewables" technology mix.

GUIDANCE

18.6.11. In addition to the general approach and guidance outlined in Volume 1, Chapter 4 (EIA Methodology), the Climate EIAR has also been developed in line with the IEMA EIA Guide to: Climate Change Resilience and Adaptation (IEMA, 2020), IEMA EIA Guide to: Assessing GHG Emissions and Evaluating their Significance (IEMA, 2022), IPCC AR5 (2014) and ISO 14040:2006 Environmental Management: Life Cycle Assessment – Principles and Framework (2006).

CRITERIA FOR ASSESSMENT

18.6.12. The process for determining the significance of effects for both the CCR assessment and the GHG impact assessment is a two-stage process that involves defining the magnitude of the potential impacts and the sensitivity of the receptors. This section describes the criteria

applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors.

18.6.13. The terms used to define impact magnitude and receptor sensitivity for Climate are based on those outlined by IEMA (IEMA, 2020) as well as specific criteria for the Project outlined in Volume 1, Chapter 6 (Environmental Impact Assessment Methodology).

MAGNITUDE

18.6.14. In determining magnitude, each assessment considered the probability and consequence of an impact. The probability of an impact indicates the chance of the impact occurring within the lifetime of the Project. The consequence of an impact reflects the scale of the impact, which encompasses geographic extent, number of receptors affected, complexity of impact, degree of harm to those affected, duration, frequency, and reversibility.

18.6.15. The probability criteria for Climate are provided in Table 18-10. The consequence criteria for Climate are provided in Table 18-11.

Table 18-10 Impact Probability Criteria for Climate

Probability Value	Description
Minimal probability	Equivalent to a 0-10% probability of occurring during the lifetime of the Project. This can otherwise be thought of as 'very unlikely' to occur.
Low probability	Equivalent to a 10-33% probability of occurring during the lifetime of the Project. This can otherwise be thought of as 'unlikely' to occur.
Medium probability	Equivalent to a 33-66% probability of occurring during the lifetime of the Project. This can otherwise be thought of as 'possible' to occur.
High probability	Equivalent to a 66-100% probability of occurring during the lifetime of the Project. This can otherwise be thought of as 'likely' to occur.
Very high probability	Equivalent to a 90-100% probability of occurring during the lifetime of the Project. This can otherwise be thought of as 'very likely' to occur.

Table 18-11 Impact Consequence Criteria for Climate

Consequence Value	Description
Negligible impact	The scale of the impact is expected to be immaterial for the Project.
Low impact	The scale of the impact is expected to be minor and not considered material for the Project.
Medium impact	The scale of the impact has the potential to be material for the Project.
High impact	The scale of impact has the potential to be significant and material for the Project.
Very high impact	The scale of the impact has the potential to be existentially material for the Project.

18.6.16. Each receptor was given a separate score of between 1 and 5 for the probability of the impact and the consequence of the impact. These scores were multiplied together and then normalised to give a combined overall magnitude score from 1 to 100. Scores between 1-15 were 'negligible' magnitude, scores between 16-35 were 'low' magnitude, scores between 36-63 were 'medium' magnitude, scores above 64 were 'high' magnitude.

18.6.17. The magnitude of the impact was then also assigned a direction: adverse or beneficial. The majority of impacts were defined as adverse. One impact relating to reduced wind speeds improving the safety of working conditions during construction, O&M, and decommissioning was defined as beneficial.

18.6.18. The effects of the Proposed Development are deemed to be of beneficial significance regarding the reduction of GHG emissions in reference to Table 18-15, when compared to the baseline scenarios of electricity derived from 'Gas' or 'All non-renewable' sources. The full Greenhouse Gas assessment can be found in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report).

SENSITIVITY

18.6.19. Sensitivity was assessed as a combination of the susceptibility, vulnerability, and importance of the receptor. The susceptibility of a receptor indicates a receptor's ability to be affected by a change and can also be thought of as the opposite of resilience. The vulnerability of a receptor measures the potential exposure of a receptor to change, in this case changes in the climate. The importance of the receptor reflects the economic value of the receptor and/or the number of dependencies associated with the receptor.

18.6.20. The susceptibility criteria for Climate receptors are provided in Table 18-12. The vulnerability criteria for Climate receptors are provided in Table 18-13. The importance criteria for Climate receptors are provided in Table 18-14.

Table 18-12 Receptor Susceptibility Criteria for Climate

Susceptibility Value	Description
Low	The receptor has the ability to withstand or not be substantially altered by the projected changes to the existing/prevailing climatic factors (e.g., retain much of its original function and form).
Medium	The receptor has some ability to withstand or not be substantially altered by the projected changes to the existing/prevailing climatic factors (e.g., lose much of its original function and form).
High	The receptor has no ability to withstand or not be substantially altered by the projected changes to the existing/prevailing climatic factors (e.g., lose much of its original function and form).

Table 18-13 Receptor Vulnerability Criteria for Climate

Vulnerability Value	Description
Low	The receptor is directly dependent on existing/prevailing climatic factors and reliant on these specific existing climatic factors continuing in future or only able to tolerate a very limited variation in climate conditions.
Medium	The receptor is dependent on some climatic factors but able to tolerate a range of conditions.
High	The receptor is directly dependent on existing/prevailing climatic factors and reliant on these specific existing climatic factors

Vulnerability Value	Description
	continuing in future or only able to tolerate a very limited variation in climate conditions.

Table 18-14 Receptor Importance Criteria for Climate

Importance Value	Description
Low	Low economic value, low number of dependencies that are important to the functioning of the Project.
Medium	Moderate economic value, moderate number of dependencies that are important to the functioning of the Project.
High	High economic value, large number of dependencies that are important to the functioning of the Project.

18.6.21. Each receptor was given a separate score of between 1 and 3 for its susceptibility, vulnerability, and importance. These scores were multiplied together and then normalised to give a combined overall sensitivity score from 1 to 100. Scores of 1-6 were 'negligible' sensitivity, scores between 7-29 were 'low' sensitivity, scores between 30-66 were 'medium' sensitivity, scores above 67 were 'high' sensitivity.

18.6.22. By assigning and combining magnitude and sensitivity criteria, overall effect significance upon Climate receptors can be determined (Table 18-15).

Table 18-15 Matrix Used for the Assessment of Significance of the Effect

MUIR MHÒR OFFSHORE WIND FARM A joint venture between Fred. Olsen Seawind & Vattenfall		Magnitude of Impact			
		Negligible	**Low**	**Medium**	**High**
Sensitivity of Receptor	**Negligible**	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Negligible	Minor	Minor
	Medium	Negligible	Minor	Moderate	Moderate
	High	Negligible	Minor	Moderate	Major

18.6.23. A level of effect of moderate or more will be considered a 'significant' effect for the purpose of the EIA. A level of effect of minor or less will be considered 'not significant'. Effects of moderate significance or above are therefore considered important in the decision-making process, whilst effects of minor significance or less warrant little, if any, weight in the decision-making process.

EMBEDDED COMMITMENTS

18.6.24. As part of the project design process, several designed-in measures have been proposed to reduce the potential for impacts on environmental receptors. This includes mitigation measures embedded into the project design to minimise the impacts of GHG emissions and to strengthen the resilience of the Project to changes in the climate.

18.6.25. The embedded commitments collectively aim to mitigate the impact of the Proposed Development on the climate and the impact of the climate on the project receptors. Commitments such as the use of scour protection (C-01) and commitments relating to the installation, protection and maintenance of cables (C-02, C-23, C-29, C-32 and C-41) safeguard seabed integrity, preventing scour and erosion of the seabed and avoiding where possible impacts to the structural integrity of cables and other project components such as fixed foundations and mooring and anchoring. Adherence to plans like the Cable Plan (CaP) (C-02) will ensure that installation, routing, and construction are optimised to minimise erosion of the seabed. Additional commitments such as those secured in the Environmental Management Plan (C-07), the Vessel Management Plan (C-10), the Fisheries Management and Mitigation Strategy (C-12), the Navigational Safety Plan (C-16, C-18, C-19 and C-22), the creation of safety zones (C-17) safeguard the safety of project personnel and vessels in a changing climate., A Decommissioning Programme (DP) (C-09) ensures long-term mitigation of GHG emissions and minimisation of future impacts to the Proposed Development and surrounding environment.

18.6.26. As there is a commitment to implementing these measures, they are considered inherently part of the design of the Project and have therefore been considered in the assessment (i.e., the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development.

18.6.27. The embedded commitments relevant to Climate are presented in Table 18-16. Volume 3, Appendix 6.1 (Commitments Register) provides additional information on how these commitments are secured.

Table 18-16 Embedded Commitment Measures of relevance to Climate

Code	Commitment	Type (Primary, Secondary or Tertiary)	How Commitment Secured
C-01	Scour protection or other appropriate mitigation to be employed around seabed infrastructure where there is the potential risk for significant scour to develop. The use of scour protection will help to mitigate any increased risk of scour arising due to sea level rise altering the hydrodynamics of the marine environment.	Tertiary	Cable Plan (CaP)
C-02	Development of and adherence to a CaP. The CaP will confirm planned cable routing, installation methods, cable specifications and any additional protection and requirement for any post installation monitoring. Adherence to a CaP will help to mitigate potential risks that might arise during the O&M and decommissioning phases. For example, the risk of damage to exposure of the inter-array cables or offshore export cables is mitigated by the adoption of appropriate cable specifications, protection and post-installation	Tertiary	CaP

Code	Commitment	Type (Primary, Secondary or Tertiary)	How Commitment Secured
	monitoring.		
C-04	The infrastructure will be designed in such a way to minimise the impacts and will be within the key parameters set out in the EIA Project Description and EIAR.	Primary	Design Statement
C-05	Development of a Construction Method Statement (CMS). This will detail the construction procedures (including piling), good working practices for constructing the works, and how the construction-related mitigation steps are to be delivered. Adherence to the CMS will ensure that safe working practices are adopted throughout the construction phase, mitigating the potential for increased safety risks manifesting due to changes in climate variables.	Tertiary	CMS
C-06	Development of and adherence to a Construction Programme (CoP). This will detail the timeline and duration of the primary construction and commissioning activities. The CCR assessment and the climate data used to inform this assessment is based on a construction timeline covering a five5-year period between 2029 and 2034. The CoP will help to ensure that this timeline is delivered, and the working hours set out in the worst-case design scenario in Table 18-17 are not exceeded.	Tertiary	CoP
C-07	All dropped objects will be reported. Where recovery is possible and the dropped object may cause a hazard, object will be retrieved. Reporting dropped objects will help to mitigate the safety risk of fire emerging due to dropped objects resulting in the leakage of flammable substances.	Tertiary	Environmental Management Plan
C-09	Development of and adherence to a DP. The DP will outline measures for the decommissioning of the Project. The DP will include all mitigation measures deemed necessary at the time of development.	Tertiary	DP
C-10	Development of and adherence to a Vessel Management Plan (VMP). The VMP will confirm the types and numbers of vessels that will be engaged on the Project and consider vessel coordination including indicative transit route planning. Adherence to a VMP will help to mitigate increased safety risk to vessels and project personnel arising due to changes in wind speeds and wave heights. Furthermore, the VMP will guarantee that the maximum number of vessels outlined in the worst-case design scenario (Table 18-17) is not exceeded.	Tertiary	VMP
C-12	Ongoing liaison with fishing fleets will be maintained during construction, maintenance and decommissioning operations via an appointed Fisheries Liaison Officer and Fishing Industry Representative. The FMMS will help to mitigate	Tertiary	Fisheries Management and Mitigation Strategy (FMMS)

Code	Commitment	Type (Primary, Secondary or Tertiary)	How Commitment Secured
	increased safety risk to project vessels and project personnel, as well as local fishing fleets, arising due to changes in wind speeds and wave heights.		
C-16	Development of and adherence to a Navigational Safety Plan (NSP). The NSP will describe measures put in place by the Project related to navigational safety, including information on Safety Zones, charting, construction buoyage, temporary lighting and marking, and means of notification of the Project activity to other sea users (e.g., via Notifications to Mariners). Adherence to an NSP will help to mitigate increased safety risk to vessels and project personnel arising due to changes in wind speeds and wave heights.	Tertiary	NSP
C-17	Applications to be made, where appropriate, for Safety Zones (500m) for construction and major maintenance works, and for pre commissioning works (50m). Safety Zones will help to mitigate increased safety risk to vessels and project personnel arising due to changes in wind speeds and wave heights.	Secondary	Energy Act 2004 and Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007
C-18	Use of guard vessels where deemed appropriate to ensure adherence with Safety Zones or advisory passing distances, as defined by risk assessment, to mitigate any impact which poses a risk to surface navigation during construction, maintenance and decommissioning phases. Such impacts may include partially installed structures or cables, extinguished navigation lights or other unmarked hazards. The use of guard vessels where appropriate will help to mitigate increased safety risk to vessels and project personnel arising due to changes in wind speeds and wave heights.	Secondary	NSP
C-19	Advance warning and accurate location details of construction, maintenance and decommissioning operations, associated Safety Zones and advisory passing distances will be given via Notifications to Mariners and Kingfisher Bulletins. Regular updates will help to mitigate increased safety risk to vessels and project personnel arising due to changes in wind speeds and wave heights.	Tertiary	NSP
C-21	Compliance with Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 654 (MCA, 2024) and its annexes where applicable (including consideration of a Search and Rescue (SAR) checklist, an Emergency Response and Cooperation Plan (ERCoP) and Under Keel Clearance. Consideration will also be given to MGN 543 Search and Rescue (SAR) Annex 5 (MCA, 2018). Compliance with the listed protocols will help to mitigate the effects of an	Tertiary	CaP CMS Development Specification and Layout Plan

Code	Commitment	Type (Primary, Secondary or Tertiary)	How Commitment Secured
	increased safety risk to vessels and project personnel should an emergency occur, and quick responses be required.		
C-22	Compliance of all project vessels with international marine regulations as adopted by the Flag State, notably the International Regulations for Preventing Collisions at Sea (COLREGs) (IMO, 1974) and the International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974). Compliance with international marine regulations will help to mitigate increased safety risk to vessels and project personnel arising due to changes in climate variables.	Tertiary	NSP
C-23	Notification of damage or decay to cables to the Maritime and Coastguard Agency (MCA), Northern Lighthouse Board (NLB) Kingfisher and UK Hydrographic Office (UKHO) within 24 hours of discovery.	Tertiary	CaP NSP
C-26	Compliance with regulatory expectations on moorings for floating wind and marine devices published by Maritime and Coastguard Agency (MCA) and the Health and Safety Executive (HSE). Compliance with regulatory expectations will help to ensure that the installation, O&M and decommissioning of moorings align with best practice guidelines, therefore mitigating future risks such as the accelerated corrosion of mooring components or damage to mooring components arising due to changes in climate variables.	Tertiary	CMS
C-27	Crossing and proximity agreements with known existing pipeline and cables operators will be sought.	Tertiary	Commercial agreements with pipeline and cable operators
C-29	Where practicable, cable burial will be the preferred means of cable protection. Cable burial will be informed by the cable burial risk assessment (CBRA) and detailed within the CaP. In areas where CBRA deems burial not feasible, suitable implementation and monitoring of cable protection will be employed.	Primary	CaP
C-32	Cable protection surveys of offshore export cables will be undertaken post construction where mechanical protection of cables laid on the seabed has been deployed. This may include over-trawl surveys and/or side-scan sonar. Cable monitoring of offshore export cables will be undertaken post construction to monitor Electromagnetic Fields (EMF).	Tertiary	CaP
C-33	Minimum blade clearance of 30 m above Mean Sea Level (MSL). Maintaining a minimum blade clearance for all turbines will help to mitigate the risk of sea level rise impacting the clearance of blades and affecting	Primary	Development Specification and Layout Plan

Code	Commitment	Type (Primary, Secondary or Tertiary)	How Commitment Secured
	power generation.		CMS
C-38	Development of and adherence to a Project Environmental Monitoring Programme (PEMP), which will set out commitments to environmental monitoring in pre-, during and post-construction phases. Robust monitoring processes throughout the full construction stage will help to ensure that any potential issues are identified early and potential risks are mitigated.	Tertiary	PEMP
C-40	Development of and adherence to a Wet Storage Plan (WSP) to provide details on requirements (if applicable) for assembled WTGs and cabling.	Tertiary	WSP
C-41	Where offshore export cables must cross third party infrastructure, such as existing cables and pipelines, both the third-party asset and the installed cables will be protected. Appropriate protection will help to mitigate any damage to the inter-array or offshore export cables.	Tertiary	CaP

IMPACTS SCOPED OUT OF THE ASSESSMENT

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.6.28. No impacts were scoped out of the assessment.

GREENHOUSE GAS ASSESSMENT

18.6.29. No impacts were scoped out of the assessment.

WORST CASE DESIGN SCENARIO

18.6.30. The Developer has adopted a design envelope approach to impact assessment (also known as a 'Rochdale Envelope'). In line with guidance from the Scottish Government (2022), the design envelope approach offers flexibility in the EIA process by enabling impact assessment to be carried out against several potential design options.

18.6.31. The assessment of Climate impacts has been undertaken with respect to the details provided in Volume 1, Chapter 3 (Project Description). A 'worst case' design scenario has been selected for each impact which would lead to the greatest impact for all receptors or receptor groups, when selected from a range of values. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within Volume 1, Chapter 3 (Project Description) (e.g., different infrastructure layout), to that assessed here, be taken forward in the final design scheme.

18.6.32. Table 18-17 presents the worst-case design scenario for each impact associated with LSE assessment on Climate along with justification.

Table 18-17 Worst Case Design Scenarios with respect to the CCR Assessment.

Impact	Embedded Commitment	Worst Case Design Scenario	Justification
Construction			
Increased safety risk to construction workers due to changes in climate variables	C-05, C-06, C-07, C-17, C-21	• Offshore construction safety zone radius: 500 m • Offshore core construction working hours: 24/7 working offshore	500 m is the standard approach and judged to be a sensible precaution. Working hours may be shorter for routine maintenance but 24/7 is assessed as the maximum scenario
Increased safety risk to construction workers operating vessels associated with the Proposed Development due to changes in climate variables	C-05, C-06, C-10, C-12, C-16, C-18, C-19, C-20, C-22	Maximum number of construction vessels on site at the same time: • Total number of vessels for Construction support: Six • Total number of vessels for installation works: 22 • Total number of vessels for WTG Integration and Commissioning: Six • Total number of vessels for Export Cable Installation: Seven • Total number of vessels for OEP installation and commissioning: Six • Total number of vessels for miscellaneous works: Two	The worst-case design scenario includes the maximum total number of construction vessels on site at the same time. It is unlikely that each of the packages will use their maximum quantity of vessels and very unlikely that this occurs simultaneously, however, the maximum possible total has been included as a worst-case design scenario.
Operation and Maintenance			
Risk of damage to OEP(s)	C-25, C-26, C-38, C-42	• Maximum number of OEPs: Two High Voltage Alternating Current (HVAC) OEP(s) with a maximum capacity of 1000 MW per substation • Transformer failure: 0.5 during lifetime	The worst-case design scenario includes the maximum number of OEP(s) and assumes that damage to both OEP(s) is possible.
Risk of damage and / exposure of offshore export cables, interconnector cable and inter-array cables	C-02, C-23, C-27, C-29, C-32, C-38, C-39, C-40, C-42	• Up to three export cables, each up to 90 km in length, one 3 km interconnector cable and up to 250 km of inter-array cables. All export cabling seaward of MHWS to the limit of the Array Area. • Offshore export cable repair/reburial: One failure per cable per five years • Interconnector cable repair/reburial: One failure per cable per five years • IAC cable repair/reburial: Seven failures during lifetime of wind farm	The worst-case design scenario includes the maximum number of cables, and the maximum number of cable failures anticipated and assumes disturbance throughout the offshore ECC and Array Area, therefore the greatest area of seabed disturbance.
Risk of damage to WTGs	C-25, C-26, C-33, C-38, C-40, C-42	• Maximum number of WTGs: 67 • Maximum blade tip height Mean Sea Level: 340 m • Maximum blade tip clearance Mean Sea Level: 30 m • Maximum rotor diameter: 300 m • Number of rotor blades: Three • Minimum turbine spacing (centre to centre): 1000 m	The worst-case design scenario includes the maximum number of WTGs and assumes that damage to all WTGs is possible.
Risk of changes in wind activity affecting power output of WTGs	C-25, C-26, C-33, C-38, C-40, C-42	• Maximum number of WTGs: 67 • Maximum blade tip height Mean Sea Level: 340 m • Maximum blade tip clearance Mean Sea Level: 30 m • Maximum rotor diameter: 300 m • Number of rotor blades: Three • Minimum turbine spacing (centre to centre): 1000 m • Maximum cut-in wind speed: 5 m/s • Minimum cut-out wind speed: 20 m/s	Multiple options for wind turbine design are included in the worst-case design scenario. The cut-in wind speed and cut-out wind speed determine the range within which the WTGs are able to generate power. The smaller the range is, the greater the risk is that changes in wind speeds will impact power output. The worst-case design therefore uses the maximum cut-in windspeed and the minimum cut-out windspeed to assess the smallest possible range.
Risk of scouring or structural damage in relation to WTG and OEP(s) foundations and anchors	C-01, C-26, C-38, C-42	• OEP Scour Protection 2 OEPs - 12,800 m^2 • WTG Anchor Scour Protection - 737,000 m^2 • IAC Junction Boxes scour protection – max area for 20 units = 9,000 m^2 to a maximum height of 2 m above the seabed	The worst-case design scenario includes materials in line with conventional scour protection that can be seen as the worst-case scenario.

Impact	Embedded Commitment	Worst Case Design Scenario	Justification
Risk of damage to mooring or anchoring e.g. due to corrosion or exposure	C-26, C-38, C-42	• Maximum number of mooring lines per WTG: 12 • Maximum mooring length: 1600 m • Maximum mooring line radius: 1500 m • Maximum number of anchors per floating foundation: Nine • Maximum anchor seabed footprint: 500 m² • Maximum anchor penetration depth: 60 m	The worst-case design scenario assumes the maximum parameters apply to all mooring and anchoring type based on the assumption that the greatest number of mooring lines and anchors presents the greatest potential for damage to the mooring and anchoring infrastructure.
Risk of damage to floating foundations and / or fixed foundations	C-26, C-38, C-42	• Total area occupied by WTGs: 66,000 m² • Height of foundation main access platform floor above Mean Sea Level: >5 m	The worst-case design scenario uses the maximum total area occupied by the floating area to assess the maximum exposure to damage. The minimum height of foundation main access is used to assess the impact of rising sea level on limiting access to the foundation.
Increased safety risk to maintenance workers due to changes in climate variables	C-07, C-17, C-21	• O&M personnel: 50-100 personnel. • Offshore core working hours: 24/7 working offshore	Offshore O&M working hours are likely to be 07:00 – 19:00 for routine maintenance during daylight hours, however, 24/7 working hours are assumed for the worst-case design scenario to represent the greatest number of maintenance workers over the longest working hours. Safe operating procedures apply to all employees involved in O&M phase, including direct Full Time Employment (FTE) and indirect workers in the local area.
Increased safety risk to O&M workers operating vessels associated with the Proposed Development due to changes in climate variables	C-10, C-12, C-16, C-18, C-19, C-20, C-22	• Maximum number of O&M vessels on site at the same time: 12 • Total vessel round trips to port for O&M works: 259	Peak number of O&M vessels operating on site at any given time. maximum vessel numbers for each vessel class represents a worse case due to the increased exposure to climate hazards.
Decommissioning			
Risk of removal of all components associated with the Proposed Development	C-09, C-38	The decommissioning of these components is assessed in Table 18-22. The general approach to decommissioning is set out in Volume 1, Chapter 3 (Project Description).	
Increased safety risk to decommissioning workers due to changes in climate variables	C-09, C-38	In the absence of detailed information regarding decommissioning works, the worst-case design scenario for decommissioning would be the same or less than during construction. The approach to decommissioning is set out in Volume 1, Chapter 3 (Project Description).	
Increased safety risk to decommissioning workers operating vessels associated with the Proposed Development due to changes in climate variables	C-09, C-38	In the absence of detailed information regarding decommissioning works, the worst-case design scenario for decommissioning would be the same or less than during construction. The approach to decommissioning is set out in Volume 1, Chapter 3 (Project Description).	

18.7. ASSESSMENT OF LSE

18.7.1. Assessment of LSE on Climate has been undertaken for all phases of the Proposed Development. A detailed description of each impact, informed by Volume 1, Chapter 3 (Project Description), baseline information and various analytical methods including modelling is provided below.

18.7.2. To ensure that each potential effect is assessed to an appropriate level of detail, the impacts presented in the worst case design scenarios in Table 18-17 are split out and presented by climate variable in Table 18-18, Table 18-20 and Table 18-22. This allows for each effect to be individually assessed, using the relevant climate projections for each variable presented in Section 18.5.

CONSTRUCTION PHASE

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.7.3. The construction phase is planned to take place over a 5-year period between 2029 and 2034. The differences between the baseline conditions from 1981-2001 and the projected conditions for 2040 demonstrate that the Proposed Development will be subject to climate change impacts over this period, however, the severity of these changes are lesser than those projected for 2040 to 2070. Whilst the construction phase of the Proposed Development will likely be exposed to some climate impacts, in particular increased annual temperatures combined with decreased summer precipitation and increased winter precipitation, the magnitude of the impact will be lesser than in the operational phase. Consequently, the potential effects are less severe than in later phases and will likely be mitigated through measures such as through the adoption of safe working practices.

18.7.4. The results of the CCR assessment for the construction phase are presented in Table 18-18. All identified effects were deemed to be of negligible significance for this phase of the Proposed Development.

Table 18-18 CCR of the Proposed Development during construction

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Construction workers	Increased wind speed	Increased safety risk during construction due to high winds.	Safe working practices will be employed for all construction activities and secured via the CMS.	Low	Negligible	Negligible (Adverse)
Construction workers	Increased temperatures and frequency of heat waves	Increased health and safety risk from construction workers experiencing heat exhaustion due to increased temperatures.	Safe working practices will be employed for all construction activities and secured via the CMS.	Low	Negligible	Negligible (Adverse)
Construction workers	Increased temperatures and frequency of heat waves	Increased safety risk due to increased probability of fire e.g. due to overheating of fuel canisters.	Safe working practices will be employed for all construction activities and secured via the CMS.	Low	Negligible	Negligible (Adverse)
Construction workers	Increased precipitation, especially in winter months	Increased safety risk due to slips, trips and falls on board vessels.	Safe working practices will be employed for all construction activities and secured via the CMS.	Low	Negligible	Negligible (Adverse)
Construction workers	Increased wave height	Increased safety risk due to high waves.	Safe working practices will be employed for all construction activities and secured via the CMS.	Low	Negligible	Negligible (Adverse)

SECONDARY MITIGATION AND RESIDUAL EFFECT

18.7.5. No additional Climate mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the commitments outlined in Section 18.6) is not significant in EIA terms.

GREENHOUSE GAS ASSESSMENT

18.7.6. The construction phase of the Proposed Development is broken down into life cycle stages for quantifying the carbon impacts, these are Raw Materials, Manufacturing and Transport. Further detail of the activities and materials included, and the resultant impacts can be found in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report). Table 18-19 summarises the impacts for the different scenarios, in units of tCO2e. 'Scenario 1' consists of 44 larger WTGs, while 'Scenario 2' consists of 67 smaller WTGs. Additionally, there are two foundation scenarios, with the foundations being constructed using either steel or concrete.

Table 18-19 Climate change impact (in t CO2e) contributions from construction phase

Life Cycle Stage	Scenario 1 (steel foundation)	Scenario 1 (concrete foundation)	Scenario 2 (steel foundation)	Scenario 2 (concrete foundation)
Raw Materials	3,018,000	2,784,000	3,911,000	3,728,000
Manufacture	1,354,000	985,000	1,501,000	1,145,000
Transport	261,000	471,000	293,000	589,000

OPERATION AND MAINTENANCE

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.7.7. The operational phase is planned to take place over an anticipated 35-year period between 2034 and 2069. The projected variables for 2040 and for 2070 are therefore both relevant to this phase. The effects of climate change over this period may disrupt operations through the potential increase in the likelihood and/or magnitude of extreme weather events, as well as chronic changes such as increased temperatures and sea level rise. The results of the CCR assessment for the O&M phase are presented in Table 18-20. All identified effects were deemed to be of negligible to minor significance for this phase of the Proposed Development.

Table 18-20 CCR of the Proposed Development during O&M

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Maintenance workers	Increased wave height	Increased safety risk due to high waves.	Safe working practices will be employed for all O&M activities.	Low	Negligible	Negligible (Adverse)
Maintenance workers	Increased temperatures and frequency of heat waves	Increased health and safety risk from workforce, including regular site users and maintenance workers, experiencing heat exhaustion due to increased temperatures.	Safe working practices will be employed for all O&M activities.	Low	Negligible	Negligible (Adverse)
Maintenance workers	Increased precipitation, especially in winter months	Increased safety risk due to slips, trips and falls on board vessels.	Safe working practices will be employed for all O&M activities.	Low	Negligible	Negligible (Adverse)
Maintenance workers	Increased temperatures and frequency of heat waves	Increased safety risk due to increased possibility of fire e.g. due to overheating of fuel canisters.	Safe working practices will be employed for all O&M activities.	Low	Negligible	Negligible (Adverse)
Maintenance workers	Increased wind speed	Increased safety risk during construction due to high winds.	Safe working practices will be employed for all O&M activities.	Low	Negligible	Negligible (Adverse)
Floating foundations and	Increased sea level and wave height	Risk of damage to foundations due to	Floating foundations are	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
fixed foundations		rising sea levels and increased wave height applying additional hydrodynamic loads on foundations leading to a higher risk of structural fatigue over the asset's lifespan.	protected against corrosion using sacrificial protection/ Impressed Current Cathodic Protection (ICCP)/ coatings designed to account for corrosion.			
Floating foundations and fixed foundations	Increased salinity	Risk of damage to foundations due to increased salinity in the marine environment accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or reducing the operational life of these components.	Floating foundations are protected against corrosion using sacrificial protection/ ICCP/ coatings designed to account for corrosion.	Low	Negligible	Negligible (Adverse)
Floating foundations and fixed foundations	Decreased pH levels	Risk of damage to foundations due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the foundations,	Floating foundations are protected against corrosion using sacrificial protection/ ICCP/ coatings designed to account for corrosion.	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		increasing the need for repairs and/or reducing the operational life of these components.				
Floating foundations and fixed foundations	Increased humidity	Risk of damage to foundations due to increased humidity combined with saltwater in the offshore environment could accelerate corrosion and/or the formation of condensation and mould/microbial contamination increasing the need for repairs and/or reducing the operational life of these components.	Floating foundations are protected against corrosion using sacrificial protection/ ICCP/ coatings designed to account for corrosion.	Low	Negligible	Negligible (Adverse)
Inter-array Cables	Decreased pH levels	Risk of damage to inter-array cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the inter-array cables, increasing	IAC and its accessories are protected against corrosion using cathodic protection techniques or by incorporating a corrosion allowance in their design. The pH level is factored into the system	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		the need for repairs and/or reducing the operational life of these components.	design to ensure appropriate measures are taken for corrosion protection.			
Inter-array Cables	Increased salinity	Risk of damage to inter-array cables due to increased salinity in the marine environment accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or reducing the operational life of these components.	IAC and its accessories are protected against corrosion using cathodic protection techniques or by incorporating a corrosion allowance in their design. The pH level is factored into the system design to ensure appropriate measures are taken for corrosion protection.	Low	Negligible	Negligible (Adverse)
Inter-array Cables	Sea level rise	Risk of damage and/or burial of inter-array cables due to sea level rise altering hydrodynamics of ocean environment.	IAC cables are tested to operate within project pressure range. The projected rise in sea level will be incorporated with the design pressure envelope.	Low	Negligible	Negligible (Adverse)
Interconnector Cables	Decreased pH levels	Risk of damage to interconnector cables due to	Cables are protected against corrosion using	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the interconnector cables, increasing the need for repairs and/or reducing the operational life of these components.	cathodic protection techniques or by incorporating a corrosion allowance in their design. The pH level is factored into the system design to ensure appropriate measures are taken for corrosion protection.			
Interconnector Cables	Increased salinity	Risk of damage to interconnector cables due to increased salinity in the marine environment accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or reducing the operational life of these components.	Cables are protected against corrosion using cathodic protection techniques or by incorporating a corrosion allowance in their design. The pH level is factored into the system design to ensure appropriate measures are taken for corrosion protection.	Low	Negligible	Negligible (Adverse)
Interconnector Cables	Sea level rise	Risk of damage and/or burial of inter-array cables due to sea level rise altering hydrodynamics of	Cables are tested to operate within project pressure range. The projected rise in sea level will be	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		ocean environment.	incorporated with the design pressure envelope.			
Mooring and Anchoring	Sea level rise	Risk of scouring or structural damage in relation to mooring or anchoring due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations.	Scour around foundations to be mitigated by the use of scour protection measures.	Low	Low	Minor (Adverse)
Mooring and Anchoring	Decreased pH levels	Risk of damage to mooring or anchoring due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the mooring and anchoring, increasing the need for repairs and/or reducing the operational life of these components.	Mooring and anchor cables are designed to account for corrosion.	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
IAC Junction Boxes	Sea level rise	Risk of scouring or structural damage impacting junction boxes due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations.	Scour around foundations to be mitigated by the use of scour protection measures.	Low	Low	Minor (Adverse)
IAC Junction Boxes	Decreased pH levels	Risk of damage to junction boxes due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the mooring and anchoring, increasing the need for repairs and/or reducing the operational life of these components.	Junction boxes are designed to account for corrosion.	Low	Negligible	Negligible (Adverse)
Offshore Export Cables	Increased sea level and wave height	Risk of damage and/or exposure of offshore export cables due to rising sea levels and increased wave	Export cables and accessories are rated for pressure levels orders of magnitude greater than the projected	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		height exacerbating seabed erosion, leading to the exposure of offshore cables and impacting the reliability of energy transmission.	increase in sea level. Export cables are tested to operate within Proposed Development pressure range. The projected rise in sea level will be incorporated with the design pressure envelope.			
Offshore Export Cables	Decreased pH levels	Risk of damage to offshore export cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the offshore export cables, increasing the need for repairs and/or reducing the operational life of these components.	Export cables and accessories are protected against corrosion using cathodic protection techniques or are designed to account for corrosion allowance. The pH level is factored into the system design to ensure appropriate measures are taken for corrosion protection.	Low	Negligible	Negligible (Adverse)
Offshore Export Cables	Increased salinity	Risk of damage to offshore export cables due to increased salinity in the marine environment	Export cables and accessories are protected against corrosion using cathodic protection techniques or are	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or reducing the operational life of these components.	designed to account for corrosion allowance.			
Offshore Electrical Platform(s)	Sea level rise	Risk of damage to OEP(s) due to greater environmental loads on the structures due to the increased heights at which tidal and wave loads act on the structures.	This receptor is at an early concept design stage, sea level rise will be incorporated into the design and the air gap from sea level to top side will accommodate sea level rise for project life span.	Low	Negligible	Negligible (Adverse)
Offshore Electrical Platform(s)	Increased air temperatures	Risk of damage to OEP(s) due to increased temperatures challenging the efficiency of cooling systems leading to overheating of critical components such as transformers and converters.	The design process already considers the impact of climate change on maximum temperatures. It ensures that appropriate parameters are embedded into the design. High temperatures are also unlikely to occur when the	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
			windfarm is at full operating capacity.			
Offshore Electrical Platform(s)	Sea level rise	Risk of damage to OEP(s) due to rising sea levels flooding the OEP(s) and causing damage to energy storage units and transmission infrastructure and/or limiting access for maintenance and repairs.	This receptor is at an early concept design stage, sea level rise will be incorporated into the design and the air gap from sea level to top side will accommodate sea level rise for Proposed Development life span.	Low	Negligible	Negligible (Adverse)
Offshore Electrical Platform(s)	Increased humidity	Risk of damage to OEP(s) due to increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mould/microbial contamination increasing the need for repairs and/or reducing the operational life of these components.	This receptor is protected against corrosion using sacrificial protection/ ICCP/ coatings/ designed to account for corrosion.	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Offshore Electrical Platform(s)(s)	Sea level rise	Risk of scouring or structural damage in relation to OEP(s) due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations.	Scour to be mitigated using scour protection measures.	Low	Low	Minor (Adverse)
Wind Turbine Generators	Increased wind speed	Risk of changes in wind activity affecting power output of WTGs due to high wind speed above the cut-out wind speed.	Developments in technology are increasing the range of wind speeds at which WTGs can operate, enabling a gradual ramp up and ramp down of output to support operation of the NG.	Medium	Negligible	Minor (Adverse)
Wind Turbine Generators	Decreased wind speed	Risk of changes in wind activity affecting power output of WTGs due to low wind speed below the cut-in wind speed.	Developments in technology are increasing the range of wind speeds at which WTGs can operate, enabling a gradual ramp up and ramp down of output to support operation	Medium	Negligible	Minor (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
			of the NG.			
Wind Turbine Generators	Increased humidity	Risk of damage to WTGs due to increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mould/microbial contamination causing damage to the WTG equipment and structure e.g. turbine tower, nacelle, monopiles and jackets.	WTGs and foundations will have corrosion protection and cathodic protection systems to control and limit corrosion. In addition, WTGs typically have internal dehumidification systems. A projected 20% increase in humidity is not expected to have any significant impact to the WTGs. Specifications of turbines to be confirmed once final equipment designs and suppliers are chosen.	Low	Negligible	Negligible (Adverse)
Wind Turbine Generators	Increased wind speed and wave height	Risk of damage to WTGs due to fatigue damage from loading resulting in structural failure due to the propagation of	Extreme and operational environmental parameters applied in design will consider likely changes due to climate change.	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		small cracks over the design life of a WTG, which could grow to a critical size, threatening the integrity of the structure.	Structures will be subject to routine inspections.			
Wind Turbine Generators	Sea level rise	Risk of damage to WTGs due to greater environmental loads due to the increased heights at which tidal and wave loads act on the structures.	This receptor is at an early concept design stage, sea level rise will be incorporated into the design.	Low	Negligible	Negligible (Adverse)
Wind Turbine Generators	Increased salinity	Risk of damage to WTGs due to increased salinity in the marine environment accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or reducing the operational life of these components.	Corrosion protection system used as standard.	Low	Negligible	Negligible (Adverse)
Wind Turbine Generators	Decreased pH levels	Risk of damage to WTGs due to decreased pH levels, indicating	Corrosion protection system used as standard.	Low	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		an increase in ocean acidification, accelerating corrosion of the materials used in the WTGs, increasing the need for repairs and/or reducing the operational life of these components.				
Wind Turbine Generators	Sea level rise	Risk of scouring or structural damage in relation to WTGs due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations.	Scour to be mitigated using scour protection measures.	Low	Low	Minor (Adverse)

SECONDARY MITIGATION AND RESIDUAL EFFECT

18.7.8. No additional Climate mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the commitments outlined in Section 18.6) is not significant in EIA terms.

GREENHOUSE GAS ASSESSMENT

18.7.9. During the O&M of the Proposed Development, routine maintenance of all project components will be required to keep the Proposed Development in good working order throughout the lifetime. The impacts from these transportation movements are summarised in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report). It is anticipated the Proposed Development will consume a relatively low level of grid electricity throughout its operational lifetime and require routine replacement components and materials. Assumptions concerning these activities are also detailed in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report). The total estimated emissions from the operational phase (assumed 35 years) are summarised in Table 18-21.

Table 18-21 Climate change impact (in t CO2e) contributions from operational phase

Life Cycle Stage	Scenario 1 (steel foundation)	Scenario 1 (concrete foundation)	Scenario 2 (steel foundation)	Scenario 2 (concrete foundation)
Operational Phase	297,000	285,000	318,000	307,000

DECOMMISSIONING

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.7.10. The decommissioning phase is planned to take place over a 2.5-year period. For the purposes of the CCR assessment, this is assumed to be between 2069 and 2072. As with the operational phase, the projected variables for 2070 indicate a potential increase in the likelihood and/or magnitude of extreme weather events. It is possible therefore that the effects of climate change may cause some disruption to the decommissioning stage of the Proposed Development. The results of the CCR assessment for the decommissioning phase are presented in Table 18-22. The identified effects were deemed to be of negligible significance for this phase of the Proposed Development.

Table 18-22 CCR of the Proposed Development during decommissioning

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Decommissioning workers	Increased wave height	Increased safety risk during decommissioning due to high waves.	Safe working practices will be employed for all decommissioning activities.	Low	Negligible	Negligible (Adverse)
Decommissioning workers	Increased temperatures and frequency of heat waves	Increased health and safety risk from decommissioning workers experiencing heat exhaustion due to increased temperatures.	Safe working practices will be employed for all decommissioning activities.	Low	Negligible	Negligible (Adverse)
Decommissioning workers	Increased temperatures and frequency of heat waves	Increased safety risk due to increased possibility of fire e.g. due to overheating of fuel canisters.	Safe working practices will be employed for all decommissioning activities.	Low	Negligible	Negligible (Adverse)
Decommissioning workers	Increased precipitation, especially in winter months	Increased safety risk due slips, trips and falls onboard vessels.	Safe working practices will be employed for all decommissioning activities.	Low	Negligible	Negligible (Adverse)
Decommissioning workers	Increased wind speed	Increased safety risk during decommissioning due to high winds.	Safe working practices will be employed for all decommissioning activities.	Low	Negligible	Negligible (Adverse)
Floating foundations and fixed foundations	Increased sea level and wave height	Risk of removal of foundations due to rising sea levels	Safe working practices will be employed for all	Negligible	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		and increased wave height applying additional hydrodynamic loads on the foundations leading to a higher risk of structural fatigue over the asset's lifespan and impacting the ease of removal.	decommissioning activities.			
Floating foundations and fixed foundations	Decreased pH levels	Risk of removal of foundations due to decreased PH levels, indicating an increase in ocean acidification, accelerating corrosion of the foundations, impacting the ease of removal.	Floating foundations are protected against corrosion using sacrificial protection/ ICCP/ coatings are designed to account for corrosion.	Negligible	Negligible	Negligible (Adverse)
Floating foundations and fixed foundations	Increased salinity	Risk of removal of foundations due to increased salinity in the marine environments accelerating corrosion of the foundations, impacting the ease of removal.	Floating foundations are protected against corrosion using sacrificial protection/ ICCP/ coatings are designed to account for corrosion.	Negligible	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Floating foundations and fixed foundations	Increased humidity	Risk of removal of foundations due to increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mould/microbial contamination causing damage to the offshore foundations and impacting the ease of removal.	Floating foundations are protected against corrosion using sacrificial protection/ ICCP/ coatings are designed to account for corrosion.	Negligible	Negligible	Negligible (Adverse)
Inter-array Cables	Decreased pH levels	Risk of removal of inter-array cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the inter-array cables, impacting the ease of removal.	IAC and its accessories are protected against corrosion using cathodic protection techniques or by incorporating a corrosion allowance in their design. The pH level is factored into the system design to ensure appropriate measures are taken for corrosion protection.	Negligible	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Inter-array Cables	Increased salinity	Risk of removal of inter-array cables due to decreased increased salinity in the marine environments accelerating corrosion of the inter-array cables, impacting the ease of removal.	IAC and accessories are protected against corrosion using cathodic protection techniques or are designed to account for corrosion allowance.	Negligible	Negligible	Negligible (Adverse)
Inter-array Cables	Sea level rise	Risk of removal of inter-array cables due to decreased sea level rise altering hydrodynamics of ocean environment resulting in damage to inter-array cables and impacting the ease of removal.	IAC cables are tested to operate within project pressure range. The projected rise in sea level will be incorporated with the design pressure envelope.	Negligible	Negligible	Negligible (Adverse)
Interconnector Cables	Decreased pH levels	Risk of removal of interconnector cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the interconnector cables, impacting the ease of removal.	Cables are protected against corrosion using cathodic protection techniques or by incorporating a corrosion allowance in their design. The pH level is factored into the system design to ensure appropriate	Negligible	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
			measures are taken for corrosion protection.			
Interconnector Cables	Increased salinity	Risk of removal of interconnector cables due to decreased increased salinity in the marine environments accelerating corrosion of the interconnector cables, impacting the ease of removal.	Cables are protected against corrosion using cathodic protection techniques or are designed to account for corrosion allowance.	Negligible	Negligible	Negligible (Adverse)
Interconnector Cables	Sea level rise	Risk of removal of interconnector cables due to decreased sea level rise altering hydrodynamics of ocean environment resulting in damage to interconnector cables and impacting the ease of removal.	Cables are tested to operate within project pressure range. The projected rise in sea level will be incorporated with the design pressure envelope.	Negligible	Negligible	Negligible (Adverse)
Mooring and Anchoring	Sea level rise	Risk of removal of mooring and anchoring due to sea level rise altering hydrodynamics of	Scour around foundations to be mitigated using scour protection measures, where assessed as	Low	Low	Minor (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		ocean environment leading to exacerbation of scouring on offshore foundations weakening the stability of the foundations and impacting ease of removal.	required during design. Routine inspections will be carried out and repair/ replenishment of scour protection has been considered in the worst-case design scenario.			
Mooring and Anchoring	Decreased pH levels	Risk of removal of mooring and anchoring due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the mooring and anchoring, impacting the ease of removal.	Mooring and anchor cables are designed to account for corrosion.	Negligible	Negligible	Negligible (Adverse)
IAC Junction Boxes	Sea level rise	Risk of removal of junction boxes due to sea level rise altering hydrodynamics of ocean environment leading to exacerbation of scouring on offshore foundations weakening the	Scour around foundations to be mitigated using scour protection measures, where assessed as required during design. Routine inspections will be carried out and repair/ replenishment of	Low	Low	Minor (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		stability of the foundations and impacting ease of removal.	scour protection has been considered in the worst-case design scenario.			
IAC Junction Boxes	Decreased pH levels	Risk of removal of junction boxes due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the junction boxes, impacting the ease of removal.	Junction boxes are designed to account for corrosion.	Negligible	Negligible	Negligible (Adverse)
Offshore Export Cables	Decreased pH levels	Risk of removal of offshore export cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the offshore export cables, impacting the ease of removal.	Export cables and accessories are protected against corrosion using cathodic protection techniques or by incorporating a corrosion allowance in their design. The pH level is factored into the system design to ensure appropriate measures are taken for corrosion protection.	Negligible	Negligible	Negligible (Adverse)
Offshore Export Cables	Increased salinity	Risk of removal of offshore export	Export cables and accessories are	Negligible	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		cables due to increased salinity in the marine environments accelerating corrosion of the offshore export cables, impacting the ease of removal.	protected against corrosion using cathodic protection techniques or are designed to account for corrosion allowance.			
Offshore Export Cables	Increased sea level and wave height	Risk of removal of offshore export cables due to rising sea levels and increased wave height exacerbating seabed erosion, resulting in the exposure and/or exposure of offshore cables and leading to physical damage and/or faults impacting the ease of removal.	Export cables and accessories are rated for pressure levels magnitude orders of magnitude greater than the projected sea level increase.	Negligible	Negligible	Negligible (Adverse)
Offshore Electrical Platform(s)	Sea level rise	Risk of removal of OEP(s) due to rising sea levels and increased wave height applying additional hydrodynamic loads on project receptors leading	The receptor is at an early concept design stage, sea level rise will be incorporated into the design and the air gap from sea level to top side will accommodate sea	Negligible	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		to a higher risk of structural fatigue over the asset's lifespan and impacting the ease of removal.	level rise for the life span of the Proposed Development.			
Offshore Electrical Platform(s)	Sea level rise	Risk of removal of OEP(s) due to rising sea levels flooding the OEP(s), impacting accessibility and ease of removal.	The receptor is at an early concept design stage, sea level rise will be incorporated into the design and the air gap from sea level to top side will accommodate sea level rise for the life span of the Proposed Development.	Negligible	Negligible	Negligible (Adverse)
Offshore Electrical Platform(s)	Increased humidity	Risk of removal of OEP(s) due to increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mould/microbial contamination causing damage to the OEP(s) and impacting the ease of removal.	Protected against corrosion using sacrificial protection/ ICCP/ coatings are designed to account for corrosion.	Negligible	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Offshore Electrical Platform(s)	Sea level rise	Risk of removal of OEP(s) due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations weakening the stability of the foundations and impacting ease of removal.	Scour to be mitigated using scour protection measures.	Low	Low	Minor (Adverse)
Wind Turbine Generators	Increased wind speed and wave height	Risk of removal of WTGs due to fatigue damage from loading resulting in structural failure due to the propagation of small cracks over the design life of a WTG, which could grow to a critical size, threatening the integrity of the structure.	Extreme and operational environmental parameters applied in design will consider likely changes due to climate change. Structures will be subject to routine inspections.	Low	Negligible	Negligible (Adverse)
Wind Turbine Generators	Sea level rise	Risk of removal of WTGs due to rising sea levels and increased wave	The receptor is at an early concept design stage, and sea level rise will	Negligible	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		height applying additional hydrodynamic loads on project receptors leading to a higher risk of structural fatigue over the asset's lifespan and impacting the ease of removal.	be incorporated into the design.			
Wind Turbine Generators	Increased salinity	Risk of removal of WTGs due to increased salinity in the marine environments accelerating corrosion of the WTGs, impacting the ease of removal.	Corrosion protection system used as standard.	Negligible	Negligible	Negligible (Adverse)
Wind Turbine Generators	Decreased pH levels	Risk of removal of WTGs due to decreased PH levels, indicating an increase in ocean acidification, accelerating corrosion of the WTGs, impacting the safety and ease of removal.	Corrosion protection system used as standard.	Negligible	Negligible	Negligible (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Wind Turbine Generators	Increased humidity	Riks of removal due to increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mould/microbial contamination causing damage to the WTG equipment and structure e.g. turbine tower, nacelle, monopiles and jackets and impacting the ease of removal.	WTGs and foundations will have corrosion protection and cathodic protection systems to control and limit corrosion. In addition, WTGs typically have internal dehumidification systems. Do not consider a 20% increase in humidity to have any significant impact to the WTGs. Specifications of turbines to be confirmed once final equipment design and supplier are chosen.	Negligible	Negligible	Negligible (Adverse)
Wind Turbine Generators	Sea level rise	Risk of removal of WTGs due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore	Scour to be mitigated using scour protection measures.	Low	Low	Minor (Adverse)

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		foundations weakening the stability of the foundations and impacting ease of removal.				

SECONDARY MITIGATION AND RESIDUAL EFFECT

18.7.11. No additional Climate mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the commitments outlined in Section 18.6) is not significant in EIA terms.

GREENHOUSE GAS ASSESSMENT

18.7.12. It is anticipated that the Project infrastructure will require transportation at the end of life, to the location of recycling or disposal. Whilst the disposal impacts are included in the analysis, once the materials reach the point where they are recycled, they exit the analysis boundary and are not considered further, these are instead seen to be a part of a new lifecycle. Further detail can be found in Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report).

PROPOSED MONITORING

18.7.13. No climate monitoring is proposed to test the predictions made within the assessment of LSE on climate receptors as no LSE were predicted during construction, O&M and decommissioning phases of the Proposed Development.

18.8. WHOLE PROJECT ASSESSMENT

18.8.1. The Proposed Development's infrastructure and activities are the focus of this EIAR. However, where the potential exists for onshore elements of the Project (the onshore infrastructure landward of Mean Low Water Springs (MLWS)) to impact the offshore receptors, these have been identified and assessed below in the Whole Project Assessment (WPA).

18.8.2. A separate onshore EIAR is being prepared which will provide a description of the onshore elements of the Project landward of MLWS, and an assessment of the associated likely significant effects.

18.8.3. The onshore aspects of the Project have been considered in relation to the impacts assessed in Section 18.7. Offshore elements that overlap with the onshore elements of the Project are limited to the offshore export cables. The combined impacts from the activities relating to the installation and disassembly of the offshore export cables and the onshore connection points such as the transition joint bays have been assessed and it is not anticipated that there will be any additional impacts from the onshore Project on the offshore receptors assessed in this chapter. All other receptors are considered to be fully marine.

18.9. CUMULATIVE EFFECTS ASSESSMENT

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.9.1. It is recognised that, when considered in conjunction with neighbouring renewable energy projects, e.g. ScotWind and Innovation and Targeted Oil and Gas (INTOG), the Proposed Development will contribute to a combined mitigatory effect regarding the impacts of climate change. The cumulative contribution of these projects to the UK's carbon reduction commitments via their input of renewable energy into the grid will help to mitigate the impacts of climate change by lowering the levels of greenhouse gases emitted through energy production. It is, however, not possible to directly link any resulting reductions in GHG emissions to the specific climate change impacts experienced by the Proposed Development itself due to the global nature of climate change. Global emissions and the subsequent

impacts of climate change are influenced by activities worldwide meaning that changes in climate impacts cannot be attributed to location-specific emission reductions. Similarly, emissions can be held in the atmosphere for extensive periods of time meaning that the temporal relationship between climate impacts and specific emission reductions is difficult to define. Consequently, cumulative effects have not been assessed as part of the CCR or ICCI assessment.

GREENHOUSE GAS ASSESSMENT

18.9.2. Cumulative Effects in relation to GHGs have been scoped out of the assessment.

PROPOSED MONITORING

18.9.3. No climate monitoring is proposed to test the predictions made within the assessment of cumulative effects on climate receptors as no LSE were predicted during construction, O&M and decommissioning phases of the Proposed Development.

18.10. INTER-RELATED EFFECTS

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.10.1. Inter-related effects may occur due to multiple impacts on a receptor or a group of receptors from the Proposed Development. If a particular receptor is affected by multiple impacts arising from the same project in different ways, this may result in a more significant effect than when an impact is considered in isolation. In the context of climate change vulnerability and resilience, the projected impacts of climate change may interact with an effect already identified by another topic, resulting in a combined impact on a receptor with the potential to exacerbate the significance of the effect. These interacting impacts are referred to as in-combination climate impact (ICCI) effects.

18.10.2. As noted in Section 18.6 under Assessment Methodology, assessment of ICCI effects is included within the scope of this chapter and the assessment methodology follows the IEMA EIA guidance on Climate Change Resilience and Adaptation (IEMA, 2020).

18.10.3. An assessment of ecosystem level effects for the Proposed Development is provided in Volume 3, Appendix 6.4 (Ecosystem Level Effects).

18.10.4. Climate change related effects identified within the following chapters were considered to be negligible and therefore not significant in EIA terms, and have therefore not been considered within the in-combination impact assessment:

- Volume 2, Chapter 14 (Shipping and Navigation);
- Volume 2, Chapter 16 (Military and Civil Aviation);
- Volume 2, Chapter 17 (Socio-economics, Tourism and Recreation); and
- Volume 2, Chapter 19 (Infrastructure and Other Users).

18.10.5. Several topic areas were scoped in for the ICCI assessment due to the potential for climate change to have a direct impact on the issues identified within each of the chapters. The following chapters indicate those that were deemed to be of particular relevance to climate change:

- Volume 2, Chapter 7 (Marine and Coastal Processes);
- Volume 2, Chapter 8 (Marine Water and Sediment Quality);

- Volume 2, Chapter 9 (Benthic, Subtidal and Intertidal Ecology);
- Volume 2, Chapter 10 (Fish and Shellfish Ecology);
- Volume 2, Chapter 11 (Offshore and Intertidal Ornithology);
- Volume 2, Chapter 12 (Marine Mammals);
- Volume 2, Chapter 13 (Commercial Fisheries); and
- Volume 2, Chapter 15 (Marine Archaeology and Cultural Heritage).

18.10.6. Initial research for the assessment included a series of consultations held with experts from topic areas included elsewhere in the EIAR to confirm the likely environmental effects already identified throughout the EIA process. In addition to considering effects already identified, topic leads were requested to consider whether future climate conditions could result in completely new effects arising during construction, O&M, and decommissioning phases. UKCP18 projections on future baseline conditions, as presented in Section 18.5, were then used to inform an expert judgement on whether the significance of the identified effect would be greater or lesser due to projected changes to the climate when compared with existing baseline conditions.

18.10.7. As explained in Section 18.6, mitigation measures are considered when assigning the significance of an effect. The relevant mitigation measures for each topic area are outlined in the corresponding topic chapter. The outcomes of the ICCI assessment are presented in Table 18-23. The level of significance identified for all effects was deemed to be unchanged. This is in part due to many identified effects relating to the construction phase. The UKCP18 projections of climatic variables for 2040 presented in Section 18.5 indicate that climate change effects projected for the period of 2027-2030, when construction is planned to take place, are not expected to be severe. Therefore, the conclusion is that climate change is not likely to exacerbate the environmental effects identified below.

Table 18-23 ICCI Assessment of the Proposed Development across its lifetime

EIA Topic	Receptor(s)	Climate Variable(s)	Potential Impact	Change in Significance
Volume 2, Chapter 7 (Marine and Coastal Processes)	Designated sites, including those designated for coastal features, notable geology, coastal geomorphology and coastal habitats. Annex I reefs. Landfall. Undesignated seabed morphology. Stratification and frontal frequency.	Wave height and frequency. Storm and storm surge frequency. Sea level rise.	Sea level rise may cause beach regression and transgression. Changes in the number of storms affecting the wave climate and the deposition and erosion rates on the beaches as well as increased sea cliff erosion may contribute to changes in the identified receptors. Multiple climate variables may contribute to a variation in stratification.	No change. The receptors have a high capacity to change; however, the function of the receptors will remain the same therefore significance has been assessed to be low.
Volume 2, Chapter 8 (Marine Water and Sediment Quality)	Designated bathing waters. Coastal and transitional waterbodies. Urban Waste Water Treatment Directive (UWWTD) Sensitive Areas. Wider marine environment.	Precipitation. Sea surface temperature. Sea surface salinity. pH levels.	Increased precipitation may result in increased run off leading to nutrient loading and increased Suspended Particulate Matter (SPM) in coastal waters. Decreased availability of dissolved oxygen levels and decreased pH levels resulting from ocean acidification could impact the identified receptors. Changes to sea surface salinity may affect water clarity and quality through changes in ocean circulation and buoyancy.	No change. Changes to physical processes are expected to be limited, therefore no higher level of significance associated with water clarity. Changes to freshwater inputs and contaminant concentrations are expected to be minimal due to onshore management of channels and the managed landscape.
Volume 2, Chapter 9 (Benthic,	Sub-tidal and inter-tidal receptors. Ecological receptors including	Increased temperatures.	Elevated temperatures coupled with decreased pH levels could lead to habitat loss and exert adverse	No change. Habitat cycles are shorter than

EIA Topic	Receptor(s)	Climate Variable(s)	Potential Impact	Change in Significance
Subtidal and Intertidal Ecology)	sediment type and characteristics. Designated site features. Protected sites.	Sea level rise. Storm surges and wave height.	effects on native species. Alterations in sea levels and wave patterns might escalate stress on intertidal habitats and native species due to long term shifts in habitat structure and morphology.	long-term climate change effects.
Volume 2, Chapter 10 (Fish and Ecology)	Valued ecological receptors. Designated sites.	Increased temperatures. Sea level rise. Storm surges and wave height.	Increased temperatures may result in changes to population distribution of substrate dependence species unable to adapt their distribution (e.g. herring and sand eel). Decreases in pH levels may impact population levels of calcifying species (e.g. shellfish). Sea level rise may impact habitat availability for some intertidal species and intertidal habitats. Potential impact on species who may rely on brackish water for survival.	No change. Limited changes to physical processes and benthic ecology indicated, therefore no higher level of significance associated with effects on habitat availability and intertidal fish and shellfish receptors. Increased temperatures may increase the vulnerability of fish and shellfish stocks; however, the expectation is that most species' ranges will shift in response to food availability therefore there is no change in significance.
Volume 2, Chapter 11 (Offshore and Intertidal Ornithology)	Designated sites. Sea birds. Migratory species. Intertidal species.	Increased air temperature and sea surface temperature. Sea level rise.	Increased sea surface temperatures may affect prey species thus affecting identified receptors. Increased temperatures may affect migration seasons and/or availability of prey. Rising sea levels may reduce	No change. The Proposed Development is not expected to exacerbate impacts to marine food webs, therefore, no higher level of significance associated with successful foraging. Terrestrial climate change impacts to

EIA Topic	Receptor(s)	Climate Variable(s)	Potential Impact	Change in Significance
			intertidal habitats of dependent species.	breeding success are likely to be relatively minor, with no higher level of significance expected.
Volume 2, Chapter 12 (Marine Mammals)	Marine mammal receptors. Protected sites.	Increased sea surface temperatures. Sea level rise. Storm surges and wave height. pH levels.	Increased sea surface temperatures could result in changes to marine mammal range shifts as well as changes to prey abundance and distribution and increased occurrence of biotoxin exposure from harmful algal blooms. Changes to sea level and storm surges could result in the loss or disturbance of suitable habitats e.g. seal haul-out sites, as well as increased seal pup and calf mortality and/or changes to foraging habitat quality. Species likely to be most affected in the future will be those that have relatively narrow habitat requirements. Shelf sea species like the harbour porpoise, white-beaked dolphin and minke whale may come under increased pressure with reduced available habitat if their range shifts northward.	No change. All effects are assessed to be no greater than negligible (adverse). Any climate change related effects are only expected to be apparent in the long term and, as such, it is not expected that climate change will result in any significant changes to the baseline over the lifetime of the Proposed Development.
Volume 2, Chapter 13 (Commercial Fisheries)	Fish and shellfish stocks	Increased temperatures. Storm surges.	Temperature changes could affect abundance of fish and shellfish stocks in the commercial fisheries study area. For white fish fisheries, such as haddock or cod, climate change could have an impact via warming	There may be an in-combination climate change effect where fishers cannot access Muir Mhòr during the operational phase, combined with a shift of species, making the Northern North Sea more important as a fishery.

EIA Topic	Receptor(s)	Climate Variable(s)	Potential Impact	Change in Significance
			seas which in turn may reduce the area within the North Sea that is suitable for these fish species. This could cause fish to migrate to the Northern North Sea, making these areas more important as a fishery.	There is however high uncertainty as to the potential of this effect occurring and the timeframe of any shift in species distribution. This effect relates specifically to the floating array during operation and the potential for restrictions on commercial fishing. This increase in importance will exacerbate the potential effects from the Proposed Development (restricted areas) on fisheries.
Volume 2, Chapter 15 (Marine Archaeology and Cultural Heritage)	Unknown marine historic environment, including maritime and aviation sites. Submerged prehistoric landscapes.	Sea level rise. Storm surges and wave height. Increased temperatures.	Deeper water resulting from rising sea levels could result in collapse of receptors e.g., shipwrecks. Changes in sea temperatures combined with decreases in pH levels could increase rate of degradation of receptors through chemical and biological factors. Storminess and changes in wave climate could exacerbate seabed movement and increase rate of receptor degradation.	No change. Any medium- and long-term climate impacts to offshore marine heritage receptors are unlikely to be realised during the lifetime of the Proposed Development.

GREENHOUSE GAS ASSESSMENT

18.10.8. The inter-relationships in relation to GHGs do not require an assessment.

18.10.9. An assessment of ecosystem level effects for the Proposed Development is provided in Volume 3, Appendix 6.4 (Ecosystem Level Effects).

18.11. ASSESSMENT SUMMARY

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

18.11.1. The assessment provided in this chapter has considered the resilience of the Proposed Development to climate change and the exacerbating effect of climate change on other environmental receptors.

18.11.2. The approach taken was based upon the Institute of Environmental Management and Assessment (IEMA) EIA Guide to Climate Change Resilience and Adaptation (IEMA, 2020).

18.11.3. A summary of the findings of the CCR and ICCI assessments undertaken in Section 18.7 and Section 18.10 is given in Table 18-24 and Table 18-25 respectively. This includes residual effect significance after any required secondary mitigation and proposed monitoring. As concluded in the table, when considering the mitigation outlined in Section 18.6, the assessed significance of the identified effects varies from minor adverse to negligible. Overall, all identified effects across construction, O&M, and decommissioning are considered to be not significant in terms of the EIA regulations.

18.11.4. Furthermore, the outcomes of the ICCI assessment, as summarised in Section 18.10, conclude that climate change is not likely to affect the conclusions made by other chapters contained within this EIAR.

Table 18-24 Summary of Effects

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
Construction							
Increased safety risk during construction due to high winds.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased health and safety risk from construction workers experiencing heat exhaustion due to increased temperatures.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased safety risk due to increased probability of fire e.g. due to overheating of fuel canisters.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased safety risk due to slips, trips and falls on board vessels.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased safety risk during construction due to high waves.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Operation and Maintenance							
Increased safety risk during construction due to high winds.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased health and safety risk from workforce, including regular site users and maintenance workers, experiencing heat exhaustion due to increased temperatures.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
Increased safety risk due to increased possibility of fire e.g. due to overheating of fuel canisters.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased safety risk due to slips, trips and falls on board vessels.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased safety risk due to high waves.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to floating foundations due to rising sea levels and increased wave height applying additional hydrodynamic loads on floating foundations leading to a higher risk of structural fatigue over the asset's lifespan.	Floating Foundations	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to floating foundations due to increased salinity in the marine environment accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or reducing the operational life of these components.	Floating Foundations	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to floating foundations due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the floating	Floating Foundations	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
foundations, increasing the need for repairs and/or reducing the operational life of these components.							
Risk of damage to floating foundations due to increased humidity combined with saltwater in the offshore environment could accelerate corrosion and/or the formation of condensation and mould/microbial contamination increasing the need for repairs and/or reducing the operational life of these components.	Floating Foundations	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to inter-array cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the inter-array cables, increasing the need for repairs and/or reducing the operational life of these components.	Inter-array Cables	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to inter-array cables due to increased salinity in the marine environment accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or	Inter-array Cables	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
reducing the operational life of these components.							
Risk of damage and/or burial of inter-array cables due to sea level rise altering hydrodynamics of ocean environment.	Inter-array Cables	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to interconnector cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the interconnector cables, increasing the need for repairs and/or reducing the operational life of these components.	Interconnector Cables	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to interconnector cables due to increased salinity in the marine environment accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or reducing the operational life of these components.	Interconnector Cables	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage and/or burial of interconnector cables due to sea level rise altering hydrodynamics of ocean environment.	Interconnector Cables	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
Risk of scouring or structural damage in relation to mooring or anchoring due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations.	Mooring and Anchoring	Low	Low	Minor (Adverse)	None	No significant residual effect	None
Risk of damage to mooring or anchoring due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the mooring and anchoring, increasing the need for repairs and/or reducing the operational life of these components.	Mooring and Anchoring	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of scouring or structural damage impacting junction boxes due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations.	IAC Junction Boxes	Low	Low	Minor (Adverse)	None	No significant residual effect	None
Risk of damage to junction boxes anchoring due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the junction boxes,	IAC Junction Boxes	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
increasing the need for repairs and/or reducing the operational life of these components.							
Risk of damage and/or exposure of offshore export cables due to rising sea levels and increased wave height exacerbating seabed erosion, leading to the exposure of offshore cables and impacting the reliability of energy transmission.	Offshore Export Cables	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to offshore export cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the offshore export cables, increasing the need for repairs and/or reducing the operational life of these components.	Offshore Export Cables	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to offshore export cables due to increased salinity in the marine environment accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or reducing the operational life of	Offshore Export Cables	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
these components.							
Risk of damage to OEP(s) due to greater environmental loads on the structures due to the increased heights at which tidal and wave loads act on the structures.	Offshore Electrical Platform(s)	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to OEP(s) due to increased temperatures challenging the efficiency of cooling systems leading to overheating of critical components such as transformers and converters.	Offshore Electrical Platform(s)	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to OEP(s) due to rising sea levels flooding the OEP(s) and causing damage to energy storage units and transmission infrastructure and/or limiting access for maintenance and repairs.	Offshore Electrical Platform(s)	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to OEP(s) due to increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mould/microbial contamination increasing the need for repairs and/or reducing the operational life of these components.	Offshore Electrical Platform(s)	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
Risk of scouring or structural damage in relation to OEP(s) due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations.	Offshore Electrical Platform(s)	Low	Low	Minor (Adverse)	None	No significant residual effect	None
Risk of changes in wind activity affecting power output of WTGs due to high wind speed above the cut-out wind speed.	Wind Turbine Generators	Medium	Negligible	Minor (Adverse)	None	No significant residual effect	None
Risk of changes in wind activity affecting power output of WTGs due to low wind speed below the cut-in wind speed.	Wind Turbine Generators	Medium	Negligible	Minor (Adverse)	None	No significant residual effect	None
Risk of damage to WTGs due to increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mould/microbial contamination causing damage to the WTG equipment and structure e.g. turbine tower, nacelle, monopiles and jackets.	Wind Turbine Generators	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to WTGs due to fatigue damage from loading resulting in structural failure	Wind Turbine Generators	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
due to the propagation of small cracks over the design life of a WTG, which could grow to a critical size, threatening the integrity of the structure.							
Risk of damage to WTGs due to greater environmental loads due to the increased heights at which tidal and wave loads act on the structures.	Wind Turbine Generators	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to WTGs due to increased salinity in the marine environment accelerating corrosion of the materials used in the receptor, increasing the need for repairs and/or reducing the operational life of these components.	Wind Turbine Generators	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of damage to WTGs due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the materials used in the WTGs, increasing the need for repairs and/or reducing the operational life of these components.	Wind Turbine Generators	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of scouring or structural damage in relation to WTGs due to rising sea levels altering hydrodynamics of the marine	Wind Turbine Generators	Low	Low	Minor (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
environment leading to an exacerbation of scouring on the offshore foundations.							
Decommissioning							
Increased safety risk during decommissioning due to high winds.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased health and safety risk from decommissioning workers experiencing heat exhaustion due to increased temperatures.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased safety risk due to increased possibility of fire e.g. due to overheating of fuel canisters.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased safety risk due slips, trips and falls onboard vessels.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Increased safety risk during decommissioning due to high waves.	Construction workers	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of floating foundations due to rising sea levels and increased wave height applying additional hydrodynamic loads on the floating foundations leading to a higher risk of structural fatigue over the asset's lifespan and impacting the ease of removal.	Floating Foundations	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
Risk of removal of floating foundations due to decreased PH levels, indicating an increase in ocean acidification, accelerating corrosion of the floating foundations, impacting the ease of removal.	Floating Foundations	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of floating foundations due to increased salinity in the marine environments accelerating corrosion of the floating foundations, impacting the ease of removal.	Floating Foundations	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of floating foundations due to increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mold/microbial contamination causing damage to the offshore floating foundations and impacting the ease of removal.	Floating Foundations	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of inter-array cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the	Inter-array Cables	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
inter-array cables, impacting the ease of removal.							
Risk of removal of inter-array cables due to decreased increased salinity in the marine environments accelerating corrosion of the inter-array cables, impacting the ease of removal.	Inter-array Cables	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of inter-array cables due to decreased sea level rise altering hydrodynamics of ocean environment resulting in damage to inter-array cables and impacting the ease of removal.	Inter-array Cables	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of interconnector cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the interconnector cables, impacting the ease of removal.	Interconnector Cables	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of interconnector cables due to decreased increased salinity in the marine environments accelerating corrosion of the interconnector cables, impacting the ease of removal.	Interconnector Cables	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
Risk of removal of interconnector cables due to decreased sea level rise altering hydrodynamics of ocean environment resulting in damage to interconnector cables and impacting the ease of removal.	Interconnector Cables	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of mooring and anchoring due to sea level rise altering hydrodynamics of ocean environment leading to exacerbation of scouring on offshore foundations weakening the stability of the foundations and impacting ease of removal.	Mooring and Anchoring	Low	Low	Minor (Adverse)	None	No significant residual effect	None
Risk of removal of mooring and anchoring due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the mooring and anchoring, impacting the ease of removal.	Mooring and Anchoring	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of junction boxes due to sea level rise altering hydrodynamics of ocean environment leading to exacerbation of scouring on offshore foundations weakening the stability of the	IAC Junction Boxes	Low	Low	Minor (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
foundations and impacting ease of removal.							
Risk of removal of junction boxes due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the mooring and anchoring, impacting the ease of removal.	IAC Junction Boxes	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of offshore export cables due to decreased pH levels, indicating an increase in ocean acidification, accelerating corrosion of the offshore export cables, impacting the ease of removal.	Offshore Export Cables	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of offshore export cables due to increased salinity in the marine environments accelerating corrosion of the offshore export cables, impacting the ease of removal.	Offshore Export Cables	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of offshore export cables due to rising sea levels and increased wave height exacerbating seabed erosion, resulting in the exposure and/or exposure of offshore cables and leading to physical damage and/or faults	Offshore Export Cables	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
impacting the ease of removal.							
Risk of removal of OEP(s) due to rising sea levels and increased wave height applying additional hydrodynamic loads on project receptors leading to a higher risk of structural fatigue over the asset's lifespan and impacting the ease of removal.	Offshore Electrical Platform(s)	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of OEP(s) due to rising sea levels flooding the OEP(s), impacting accessibility and ease of removal.	Offshore Electrical Platform(s)	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of OEP(s) due to increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mold/microbial contamination causing damage to the OEP(s) and impacting the ease of removal.	Offshore Electrical Platform(s)	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of OEP(s) due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations weakening the stability of the foundations and impacting	Offshore Electrical Platform(s)	Low	Low	Minor (Adverse)	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
ease of removal.							
Risk of removal of WTGs due to fatigue damage from loading resulting in structural failure due to the propagation of small cracks over the design life of a WTG, which could grow to a critical size, threatening the integrity of the structure.	Wind Turbine Generators	Low	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of WTGs due to rising sea levels and increased wave height applying additional hydrodynamic loads on project receptors leading to a higher risk of structural fatigue over the asset's lifespan and impacting the ease of removal.	Wind Turbine Generators	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of WTGs due to increased salinity in the marine environments accelerating corrosion of the WTGs, impacting the ease of removal.	Wind Turbine Generators	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Risk of removal of WTGs due to decreased PH levels, indicating an increase in ocean acidification, accelerating corrosion of the WTGs, impacting the safety and ease of removal.	Wind Turbine Generators	Negligible	Negligible	Negligible (Adverse)	None	No significant residual effect	None
Riks of removal due to	Wind Turbine	Negligible	Negligible	Negligible	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
increased humidity combined with saltwater in the offshore environment accelerating corrosion and/or the formation of condensation and mold/microbial contamination causing damage to the WTG equipment and structure e.g. turbine tower, nacelle, monopiles and jackets and impacting the ease of removal.	Generators			(Adverse)			
Risk of removal of WTGs due to rising sea levels altering hydrodynamics of the marine environment leading to an exacerbation of scouring on the offshore foundations weakening the stability of the foundations and impacting ease of removal.	Wind Turbine Generators	Low	Low	Minor (Adverse)	None	No significant residual effect	None

Table 18-25 Summary of ICCI Assessment of Effects on Climate

EIA Topic	Effect	Receptor	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
Volume 2, Chapter 7 (Marine and Coastal Processes)	Sea level rise causing beach regression and transgression. Changes in the	Designated sites, including those designated for coastal features, notable geology, coastal geomorphology and	No change	None	No significant residual effect	None

EIA Topic	Effect	Receptor	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
	number of storms affecting the wave climate and the deposition and erosion rates on the beaches as well as increased sea cliff erosion may contribute to changes in the identified receptors. Multiple climate variables may contribute to a variation in stratification.	coastal habitats. Annex I reefs. Landfall. Undesignated seabed morphology. Stratification and frontal frequency.				
Volume 2, Chapter 8 (Marine Water and Sediment Quality)	Increased precipitation may result in increased run off leading to nutrient loading and increased suspended particulate matter in coastal waters. Decreased availability of dissolved oxygen levels and decreased pH levels resulting from	Designated bathing waters. Coastal and transitional waterbodies. Urban Waste Water Treatment Directive Sensitive Areas. Wider marine environment.	No change	None	No significant residual effect	None

EIA Topic	Effect	Receptor	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
	ocean acidification could impact the identified receptors. Changes to sea surface salinity may affect water clarity and quality through changes in ocean circulation and buoyancy.					
Volume 2, Chapter 9 (Benthic, Subtidal and Intertidal Ecology)	Elevated temperatures coupled with decreased pH levels could lead to habitat loss and exert adverse effects on native species. Alterations in sea levels and wave patterns might escalate stress on intertidal habitats and native species due to long term shifts in habitat structure and morphology.	Sub-tidal and inter-tidal receptors. Ecological receptors including sediment type and characteristics. Designated site features. Protected sites.	No change	None	No significant residual effect	None
Volume 2,	Increased	Valued ecological	No change	None	No significant	None

EIA Topic	Effect	Receptor	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
Chapter 10 (Fish and Shellfish Ecology)	temperatures may result in changes to population distribution of substrate dependence species unable to adapt their distribution (e.g. herring and sand eel). Decreases in pH levels may impact population levels of calcifying species (e.g. shellfish). Sea level rise may impact habitat availability for some intertidal species and intertidal habitats. Potential impact on species who may rely on brackish water for survival.	receptors. Designated sites.			residual effect	
Volume 2, Chapter 11 (Offshore and Intertidal Ornithology)	Increased sea surface temperatures may affect prey species thus affecting	Designated sites. Sea birds.	No change	None	No significant residual effect	None

EIA Topic	Effect	Receptor	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
	identified receptors. Increased temperatures may affect migration seasons and/or availability of prey. Rising sea levels may reduce intertidal habitats of dependent species.	Migratory species. Intertidal species.				
Volume 2, Chapter 12 (Marine Mammals)	Increased sea surface temperatures could result in changes to marine mammal range shifts as well as changes to prey abundance and distribution and increased occurrence of biotoxin exposure from harmful algal blooms. Changes to sea level and storm surges could result in the loss or disturbance of	Marine mammal receptors. Protected sites.	No change	None	No significant residual effect	None

EIA Topic	Effect	Receptor	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
	suitable habitats e.g. seal haul-out sites, as well as increased seal pup and calf mortality and/or changes to foraging habitat quality. Species likely to be most affected in the future will be those that have relatively narrow habitat requirements. Shelf sea species like the harbour porpoise, white-beaked dolphin and minke whale may come under increased pressure with reduced available habitat if their range shifts northward.					
Volume 2, Chapter 13 (Commercial Fisheries)	Temperature changes could affect abundance of fish and shellfish stocks in the commercial fisheries study area. For white fish	Fish and shellfish stocks.	No change	None	No significant residual effect	None

EIA Topic	Effect	Receptor	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
	fisheries, such as haddock or cod, climate change could have a large impact via warming sea and in turn reduce the area within the North Sea that is suitable for these fish species. This could cause fish to migrate to the Northern North Sea, making these areas more important as a fishery.					
Volume 2, Chapter 15 (Marine Archaeology and Cultural Heritage)	Deeper water resulting from rising sea levels could result in collapse of receptors e.g., shipwrecks. Changes in sea temperatures combined with decreases in pH levels could increase rate of degradation of receptors through chemical and	Unknown marine historic environment, including maritime and aviation sites. Submerged prehistoric landscapes.	No change	None	No significant residual effect	None

EIA Topic	Effect	Receptor	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
	biological factors. Storminess and changes in wave climate could exacerbate seabed movement and increase rate of receptor degradation.					

GREENHOUSE GAS ASSESSMENT

18.11.5. The total impacts of the different scenarios, across their entire lifetimes, are presented in Table 18-26. As can be seen, the impacts vary from 4.5-6.0 MtCO2e.

18.11.6. The assessed significance of the identified effects varies from minor adverse to negligible. Overall, all identified effects across construction, O&M, and decommissioning, are considered to be not significant in terms of the EIA regulations.

Table 18-26 Climate change impact (in t CO2e) contributions from each life cycle stage

Life Cycle Stage	Scenario 1 (steel foundation)	Scenario 1 (concrete foundation)	Scenario 2 (steel foundation)	Scenario 2 (concrete foundation)
Construction				
Raw Materials	3,018,000	2,784,000	3,911,000	3,728,000
Manufacture	1,354,000	985,000	1,501,000	1,145,000
Transport	261,000	471,000	293,000	589,000
Installation	0	0	0	0
O&M				
Use	297,000	285,000	318,000	307,000
Decommissioning				
End Of Life	0	0	0	0
Total	4,930,000	4,525,000	6,023,000	5,769,000

18.11.7. Over the operational lifetime of the windfarm, Volume 3, Appendix 18.1 (Greenhouse Gas Technical Report) estimates that 163,000 (Scenario 1) to 178,000 (Scenario 2) GWh of electricity will be generated (depending on scenario). Dividing the total carbon emissions across this energy outputs yields a carbon intensity between 25.4 and 36.9g CO2e/kWh. These figures are a factor of at least ten smaller than the CCGT (371) and “all non-renewable fuels” (424) emission factors that the windfarm displaces.

18.11.8. Using these figures, the Greenhouse Gas Technical Report also estimates that the Proposed Development is anticipated to achieve carbon pay-back in as little as 1.8 years in the best case scenario, or up to 7 years in the worst-case scenario. These scenarios are based on varying levels of Load Factor and annual electricity production.

18.12. REFERENCES

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