CALEDONIA
Offshore Wind Farm

Code: UKCAL-CWF-CON-EIA-RPT-00006-6003

Volume 6 Intertidal and Combined Assessments

Chapter 3 Climate Change Resilience

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Volume 6 Chapter 3 Climate Change Resilience

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Acronyms and Abbreviations

°C	Degree Celsius
CCR	Climate Change Resilience
CIA	Cumulative Impact Assessment
CEDA	Centre for Environmental Data Analysis
CEMP	Construction Environmental Management Plan
CMIP6	Coupled Model Intercomparison Project Phase 6
CMS	Construction Method Statement
EEA	European Economic Area
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMP	Environmental Management Plan
GHG	Greenhouse Gases
ICCI	In-Combination Climate Change Impacts
IEMA	Institute of Environmental Management and Assessment
IPCC	Intergovernmental Panel on Climate Change
km	Kilometre
MCCIP	Marine Climate Change Impacts Partnership
MD-LOT	Marine Directorate Licensing Operations Team
MHWS	Mean High Water Springs
MS-LOT	Marine Scotland Licensing Operations Team
NAP3	Third National Adaptation Programme
NPF4	National Planning Framework 4

PPP	Planning Permission in Principle
RCP 8.5	Representative Concentration Pathway 8.5
RLB	Red Line Boundary
SSSI	Site of Special Scientific Interest
UK	United Kingdom
UKCP18	United Kingdom Climate Projections 2018
UKCP09	United Kingdom Climate Projections 2009
WTG	Wind Turbine Generator

Executive Summary

This chapter of Volume 6 of the Environmental Impact Assessment Report (EIAR) assesses the Climate Change Resilience (CCR) of the Proposed Development. This CCR assessment identifies the potential effects of future changes to climate hazards (driven by climate change) on receptors within the Proposed Development, assessing how resilient the development is to such future climate hazards. The assessment looks at both the construction, operational and decommissioning periods of the Proposed Development, and is a combined assessment for both onshore and offshore.

This chapter also assesses the impact of climate change on other environmental topics within the In-combination Climate Change Impact (ICCI) assessment. This assessment investigates whether climate change will exacerbate any potential effects of the Proposed Development on all other environmental receptors identified within in the EIAR.

For both assessments, weather hazards which are projected to change in future were used to identify risks and potential effects. These include:

- Increased frequency and intensity of extreme heat events;
- Increased risk of drought;
- Increased heavy rainfall events and resultant flooding;
- Increased frequency of storm events;
- Sea level rise; and
- Increased ocean temperatures.

Climate Change Resilience

Within the CCR assessment, receptors include various physical assets (e.g. Wind Turbine Generators (WTGs), cables, Onshore Substations) within the Proposed Development and staff operations; receptors were grouped by whether these were located onshore or offshore. Receptors included lower value assets such as landscaping and car parks as well as higher value receptors such as electrical equipment and staff.

For the CCR assessment, the potential risks caused by these climate hazards included:

- Risk of damage to assets (built and partially built) both direct and indirect;
- Risk of physical loss or damage to materials or equipment and plant (construction phase);
- Risk of disruption and delay to construction or dismantling processes (construction and decommissioning phase);
- Risk of disruption or delay of checks and maintenance (operational phase); and
- Health and safety risks to staff.

Embedded mitigation considered within the assessment includes:

- The following of best practice health and safety procedures, these are expected to evolve as the climate changes into the future;

- The design of assets to withstand different weather thresholds higher than currently expected and within what is likely within the operational life of the Proposed Development; and
- The pausing of construction during extreme weather events.

No significant effects were identified. As a result, no additional mitigation has been proposed beyond the embedded mitigation outlined. There are also no significant residual effects identified.

In-combination Climate Change Impacts

For the ICCI assessment, receptors identified were those included within each individual topic chapter within the EIAR. Embedded mitigation identified as part of the ICCI assessment is contained within each individual topic chapter within the EIAR. No significant effects were identified. As a result, no additional mitigation has been proposed beyond the embedded mitigation outlined. There are also no significant residual effects identified.

3 Climate Change Resilience

3.1 Introduction

3.1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) identifies the potential effects from climate change on the construction, operation and decommissioning of the Caledonia Offshore Wind Farm (OWF) and other identified environmental receptors covering both the offshore (marine) and onshore (terrestrial) environments.

3.1.1.2 The Caledonia OWF comprises, Caledonia North and Caledonia South, collectively referred to as the Proposed Development (Offshore) and the Onshore Transmission Infrastructure (OnTI) required to transfer the power from the Proposed Development (Offshore) to a connection to the National Electricity Transmission System (NETS), referred to as the Proposed Development (Onshore).

3.1.1.3 Collectively, the Proposed Development (Offshore) and Proposed Development (Onshore) are referred to as the "Proposed Development".

3.1.1.4 This chapter is supported by the following technical appendices:

- Volume 7F, Appendix 3-1: Climate Change Resilience Assessment which provides full details of the assessment methodology, assessment assumptions and conclusions;
- Volume 7F, Appendix 3-2: In-combination Climate Change Impacts Assessment which provides full details of the assessment methodology, assessment assumptions and conclusions; and
- Volume 7F, Appendix 3-3: Climate Change Policy which provides further detail on the legislation, policy and guidance relating to the Climate Change Resilience assessment.

3.1.1.5 There are two assessments within the Climate Change Resilience (CCR) topic which have been undertaken:

- CCR assessment – this identifies what changes to climate are projected to occur in the future, and the vulnerability of the Proposed Development to those identified changes in climate; and
- In-combination Climate Change Impact (ICCI) assessment – this identifies where a changing climate will combine with or exacerbate environmental impacts arising from the Proposed Development, resulting in significant effects on environmental receptors within the scope of the Environmental Impact Assessment (EIA) which are not present under current climate conditions.

3.2 Legislation, Policy and Guidance

3.2.1.1 Volume 1, Chapter 2: Legislation and Policy, of this EIAR sets out the policy and legislation associated with the Proposed Development.

3.2.1.2 Legislation, Policy and Guidance that relate to the CCR assessment are identified and summarised in Table 3-1. CCR policy is typically incorporated into the same policy documents and structures as with Greenhouse Gas (GHG) emissions policy; therefore, this section should be read in conjunction with Section 4.2 of Volume 6, Chapter 4: Greenhouse Gases. Further details of all Climate Change Resilience legislation, policy and guidance are presented in Volume 7F, Appendix 3-3: Climate Change Policy.

Table 3-1: Legislation Policy and Guidance

Relevant Legislation, Policy, and Guidance	Description
The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (Scottish Parliament, 2017[1]) Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) (UK Parliament, 2007[2]) (for Scottish offshore waters) and the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (as amended) (Scottish Parliament, 2017[3]) (for Scottish inshore waters) Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (as amended) (Scottish Parliament, 2017a[4]).	The EIA regulations require assessments to include climate change (both mitigation of GHG emissions and adaptation/vulnerability of projects) within the assessment and decision-making process.
Climate Change Act 2008 (UK Parliament, 2008[5])	UK legislation to address climate change, committing the UK to the reduction and reporting of GHG emissions. It also stipulates the requirements for a national adaptation programme and the periodic publication of a climate change risk assessment every five years.
UK Climate Change Risk Assessment 2017 (UK Government, 2017[6])	A report that outlines the UK Government's views on the key climate change risks and opportunities that the UK faces.
UKCP18 Headline Findings (Met Office, 2021[7])	A report providing an overview of the projected changes to the UK's climate for both low and high GHG emission scenarios across the rest of this century.

Relevant Legislation, Policy, and Guidance	Description
The Third National Adaptation Programme (NAP3) and the Fourth Strategy for Climate Adaptation Reporting (2023 – 2028) (UK Parliament, 2023[8])	A report that sets out a strategic five-year plan to boost resilience and protect people, homes, businesses and the UK's cultural heritage against climate change risks such as flooding, drought and heatwaves.
UK Adaptation Reporting Power (UK Parliament, 2021a[9])	The Climate Change Act 2008[5] gives the Secretary of State the power to direct reporting authorities (bodies with 'functions of a public nature' and 'statutory undertakers') to produce reports on what they are doing to adapt to climate change.
National Planning Framework 4 (NPF4) (Scottish Government, 2023[10])	This policy document sets out the long-term plan for Scotland to 2045 and sets out how to tackle and adapt to climate change, and how to make progress towards the target of net zero emissions, including the importance of offshore renewables in transitioning to net zero.
Climate Change Resilience and Adaptation (Institute of Environmental Management and Assessment (IEMA), 2020[11]).	The IEMA guidance sets out the methodology that should be followed to conduct climate change resilience assessments for EIA.

3.3 Stakeholder Engagement

3.3.1 Overview

3.3.1.1 The Offshore Scoping Report was submitted to Marine Directorate Licensing Operations Team (MD-LOT)[i] in September 2022, who then circulated the report to relevant consultees. A Scoping Opinion was received from MD-LOT on 13 January 2023. Similarly, the Onshore Scoping Report was submitted to Aberdeenshire Council in December 2022 who then circulated the report to relevant consultees. A Scoping Opinion was received from Aberdeenshire Council on 1 February 2023 and no specific responses relevant to Climate Change Resilience were received. Relevant comments from the Proposed Development (Offshore) Scoping Opinion specific to the Climate Change Resilience assessment are provided in Table 3-2.

[i] In 2023, Marine Scotland was renamed Marine Directorate, and thus the marine licensing and consents team is now referred to as Marine Directorate Licensing Operations Team (MD-LOT).

Table 3-2: Scoping Opinion Response

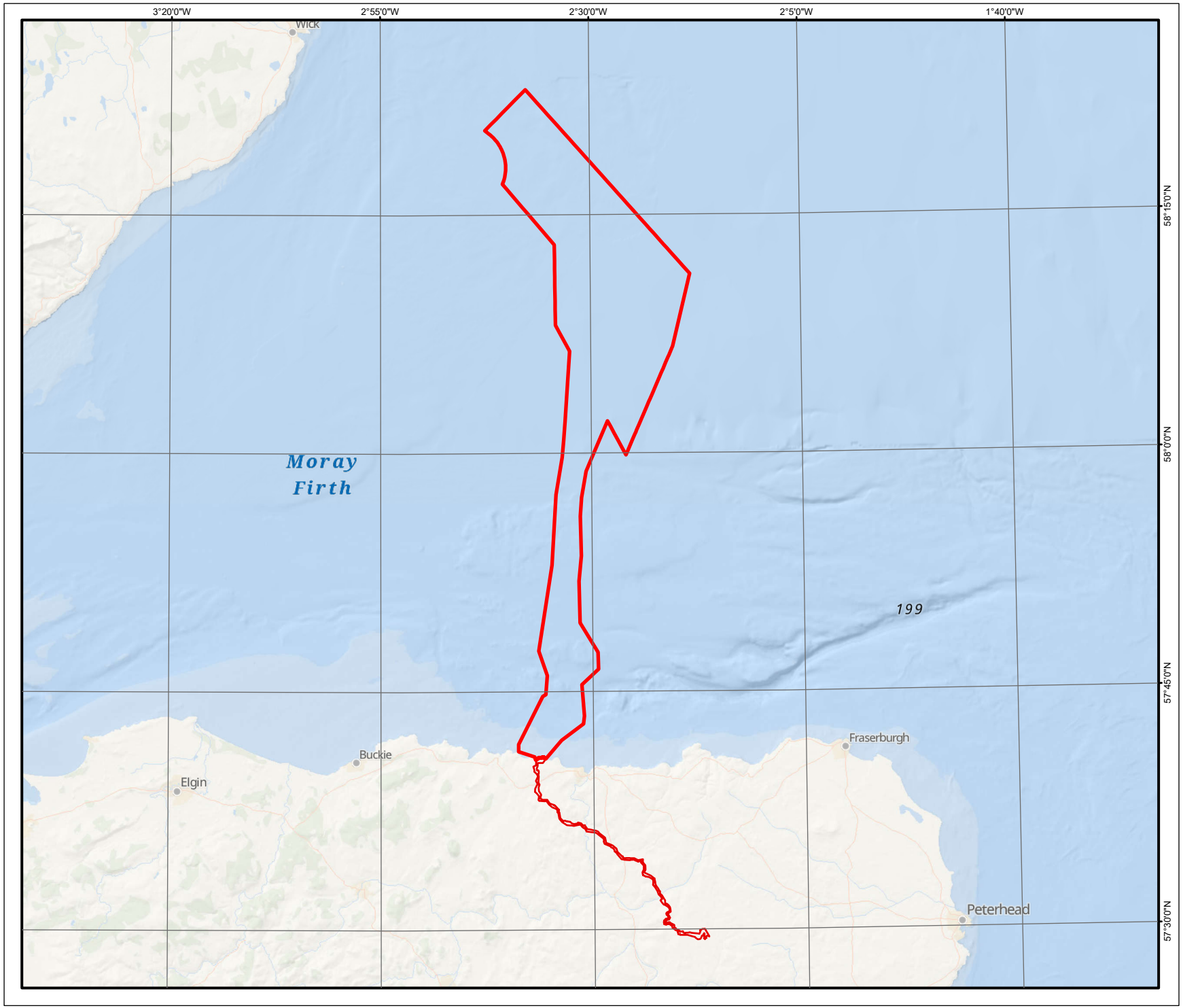
Consultee	Comment	Response
NatureScot	The impact of climate change effects should be considered, both in future proofing the project design and how certain climate stressors may work in combination with potential effects from the proposed wind farm.	This chapter of the EIAR considers the impact of climate change effects both on the Proposed Development and on other environmental receptors. Aligning with the IEMA guidance (IEMA, 2020[11]), the CCR assessment considers the impact of climate change effects on the Proposed Development. The ICCI assessment considers the impact of climate change effects on the other environmental receptors within the EIAR.

3.4 Baseline Characterisation

3.4.1 Study Area

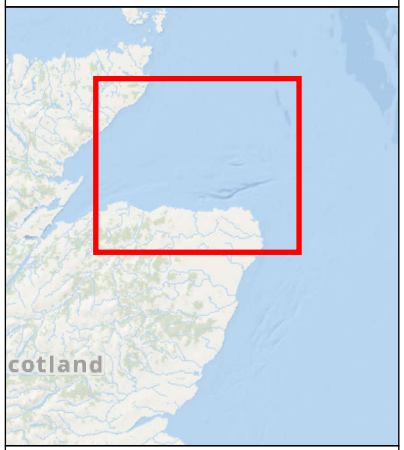
Climate Change Resilience Assessment

3.4.1.1 The study area for the CCR assessment is the construction footprint of the Proposed Development, including both temporary and completed works within the within the consent boundaries, refer to Figure 3-1.



Proposed Development (Offshore) Application Area

Onshore Transmission Infrastructure Red Line Boundary



0 5 10 15 20 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
03	30/08/2024	Approved	CW	GS	EC
02	31/07/2024	For Review	CW	GS	EC
01	17/05/2024	For Review	CW	JN	EC

CALEDONIA Offshore Wind Farm

ARUP

CONTRACTOR DRAWING NO: UKCAL1_ARP_WNF_ENV_MAP_00468

CONTRACTOR REV: 03

GEODETIC PARAMETERS: WGS 84 / UTM Zone 30N (EPSG:32630)

DRAWING TITLE

Figure 3-1: CCR Study Area

STATUS: Approved

SCALE: 1:600,000

DRAWING NUMBER: N/A

SHEET NO: 01 of 01

REV: N/A

3.4.1.2 The assessment considers potentially significant climate hazards for infrastructure and assets associated with the Proposed Development over the full appraisal period which includes the construction period, the 35-year operational phase, and decommissioning (2020s until 2080s).

In-combination Climate Change Impacts Assessment

3.4.1.3 The study area for the ICCI assessments is in the same as the study area for each of the respective environmental disciplines as described in the individual topic chapters of the EIAR.

3.4.2 Data Sources

Desk Study

3.4.2.1 The data sources that have been used to inform this CCR chapter of the EIAR are presented within Table 3-3.

3.4.2.2 The following source of information has been used to inform the observed baseline for the CCR assessment:

- Meteorological Office (Met Office) HadUK-Grid – Gridded climate observations for the UK (Met Office, 2020[12]) to establish the baseline climate conditions.

3.4.2.3 Two UK climate change projection 18 (UKCP18) data sources were used to gather the future projected climate data:

- The changes in average climate conditions were obtained from the UKCP18 probabilistic projections (Met Office, 2022[13]) of climate change at 25km grid cells; and
- The changes in extreme weather events were obtained from the UKCP18 regional projections (Met Office, 2019[14]) summarised at 12km grid cells.

3.4.2.4 For variables where projection data is not available or less reliable, Met Office fact sheets and projections summaries, or general trends (rather than quantified data) have also been used to understand the likely chances.

3.4.2.5 The baseline data is applicable to both the CCR and ICCI assessments.

Table 3-3: Summary of key publicly available datasets for Climate Change Resilience

Title	Year	Author
HadUK-Grid observation data overview[12]	2020	Met Office
UKCP18 Probabilistic Projections[13]	2022	Met Office
UKCP18 Regional (12km) and Local (2.2km)[14]	2019	Met Office

Title	Year	Author
The Marine Climate Change Impacts Partnership (MCCIP) Impacts Hub[15]	2022	MCCIP
UKCP09: Marine data for UK waters from past and future multi-level ocean model simulations[16]	2017	Centre for Environmental Data Analysis (CEDA) Archive
Coupled Model Intercomparison Project Phase 6 (CMIP6)[17]	2021	Intergovernmental Panel on Climate Change (IPCC) Interactive Atlas

Site Specific Surveys

3.4.2.6 No site-specific surveys are required for the CCR or ICCI assessments.

3.4.3 Baseline Description

3.4.3.1 This section provides the baseline climate change projection data required for both the CCR and ICCI assessments.

3.4.3.2 Information regarding historical climate conditions for the Proposed Development were obtained from the HadUK observation data (Met Office, 2020[12]), this included a number of climate metrics which are the same metrics as the climate projection data and so provide context for the future baseline.

3.4.3.3 Future projected climate data for average conditions and extreme weather events were also collected for the Proposed Development. This is due to the assessment considering the changed future climate compared with the observed baseline weather for the location. Climate projection data is usually defined in 20- or 30-year time periods. The time period used for the construction period of the Proposed Development is from 2020-2049. For operation and decommissioning, the dates used are 2050-2079 as this reflects the furthest possible time in the future where the Proposed Development will be in operation due to the construction scenarios considered, refer to Volume 1, Chapter 5: Proposed Development Phasing for more information.

Onshore

3.4.3.4 There is more information and consensus on the onshore climate change projections provided by the Met Office in UKCP18, than offshore projections. Table 3-4 contains both the baseline information and climate change projection data for multiple meteorological metrics representing average weather conditions and presented for different probability levels within the Representative Concentration Pathway 8.5 (RCP 8.5) high emissions scenario.

Table 3-4: UKCP18 climate change probabilistic projections for average weather metrics for the local area for 2060s to 2080 (under the RCP 8.5 high emissions scenario)[ii].

Metrics	Observed baseline (1981-2010)	2020-2049 (Construction)			2050-2079 (Operation)		
		Min	Mean	Max	Min	Mean	Max
Mean winter temperature (℃)	3.1	3.05	3.85	4.75	3.3	4.6	6
Winter means daily minimum temperature (℃)	0.15	0.05	0.95	1.85	0.25	1.75	3.25
Mean summer temperature (℃)	13.3	13.4	14.1	14.85	14	15.3	16.7
Summer means daily maximum temperature (℃)	17.4	17.3	18.2	19.05	17.8	19.45	21.15
Observations: average mm per day during Winter months **Projections**: Change in Winter average daily precipitation (%)	2.2	+6.35	+22.1	+39.45	+7.45	+27.65	+52.5
Observations: average mm per day during summer months **Projections**: Change in Summer average daily precipitation (%)	2.05	-4	+7.85	+20.35	-20.85	-2.2	18.3

3.4.3.5 Table 3-5 contains both the baseline information and climate change projection data for multiple meteorological metrics representing extreme weather conditions, are presented for different probability levels within the RCP 8.5 high emissions scenario.

[ii] The minimum (10th percentile), mean (50th percentile) and maximum (90th percentile) are provided to illustrate the spread within the models. Figure 3-2 provides the grid cells used as coordinates for the projection data.

Table 3-5: UKCP18 climate change probabilistic projections for average weather metrics for the local area for 2060s to 2080 (under the RCP 8.5 high emissions scenario)[iii].

Parameter	Variable	Observed baseline (1981-2000)	2021-2050 (Construction)			2051-2080 (Operation)		
			Min	Mean	Max	Min	Mean	Max
Temperature	Number of frost days (daily minimum temperature equal or lower than 0°C).	70.35	35.90	44.90	63.25	14.65	26.85	50.45
	Number of hot days (daily maximum temperature higher than 25°C).	1.75	2.30	4.10	8.80	5.85	11.95	20.05
	Heatwaves (3 days with maximum temperature higher than 25°C)	0.35	0.35	0.58	1.03	0.62	1.43	2.37
Precipitation	Annual number of days per year when precipitation is greater than 25mm per day (representative of 'heavy rain').	1.95	1.65	2.20	3.55	1.75	2.40	3.50
	Dry spells (10 days or more with no precipitation)	1.48	1.52	1.70	1.92	1.57	1.74	1.93

3.4.3.6 Overall, the results suggest that the following future weather hazards are likely to be applicable to the Proposed Development:

- Warmer winters: During both construction and operation, as Table 3-4 shows, both the winter average and average minimum temperatures are increasing. Table 3-4 also suggests the number of frost days will also reduce, with fewer than a third compared to the baseline during the latter end of the operational period;
- Wetter winters and drier summers: The data presented in Table 3-4 suggests some seasonal shift in rainfall patterns. During construction 22% more precipitation might be expected over the winter months, this increase is less for the summer months. The increases in winter precipitation

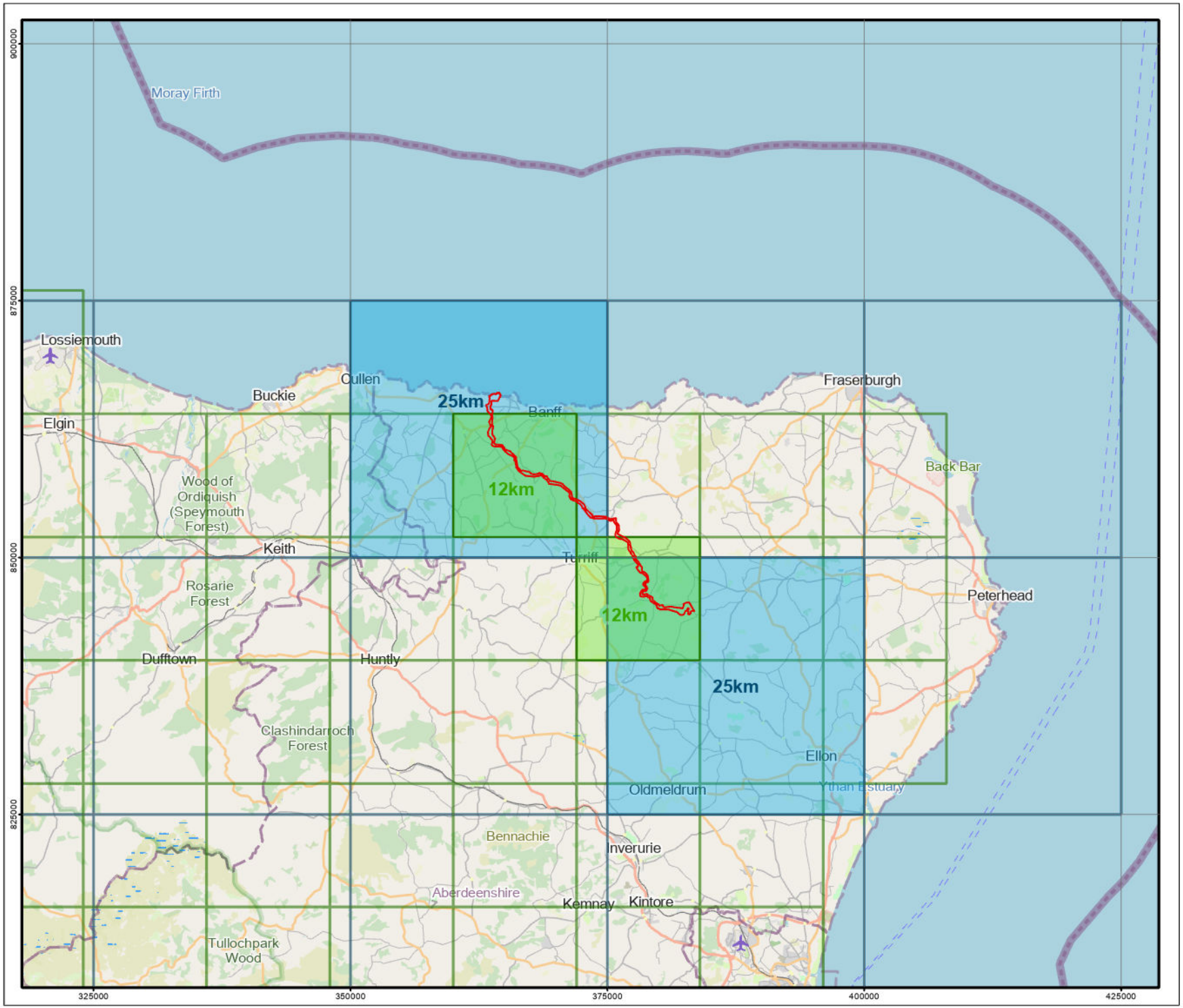
[iii] Figure 3-2 provides the grid cells used as coordinates for the projection data.

continue throughout operation. However, the results also suggest summer precipitation will begin to decrease during operation;

- Increased heavy rainfall: The data presented in Table 3-5 suggests that the number of heavy rainfall events will increase, potentially bringing increased risks of flooding, especially when combined with the overall increases in winter precipitation. This pattern begins during the construction period and increases further throughout operation; and
- Hotter summers and increases in extreme heat: The average summer temperatures are projected to increase, as are the number of days above 25℃ (the regional threshold used by the Met Office for heatwaves), which are set to rise from less than 2 in the baseline period to over double that throughout construction. This trend continues with an increase of nearly 12 days by the end of operation according to the projections presented here. This indicates that summers will include more extreme heat.

3.4.3.7 The latest Met Office information about future changes to other variables suggests the following trends:

- Storms – There are no compelling trends in changes to storminess, as determined by maximum gust speeds, from the UK wind network over the last four decades. From 2050 onwards, increases in the frequency of winter storms are expected over the UK with deeper and more intense storms (Met Office, 2021a[7]);
- Wind – From 2050 onwards, there is an increase in near surface wind speeds over the UK the winter season. Surface wind speeds increase more over western parts of the UK and over the ocean in winter and decrease across the UK in summer (Met Office, 2021b[18]); and
- Lightning – There is likely to be an increase in lightning frequency over the UK in summer and spring, with a decrease in autumn. In winter, future decreases in lightning are seen over the sea to the north and west of the UK, where high flash rates are currently seen (Met Office, 2021a[7]).



Onshore Transmission Infrastructure Red Line Boundary

UKCP18 Climate Change Projection Grids

25km 12km Selected Grid Cell

25km 12km Available Grid Cell

0 5 10 15 20 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
03	19/08/2024	Approved	CW	GS	GS
02	31/07/2024	For Review	CW	GS	GS
01	17/06/2024	For Review	CE	GS	GS

CALEDONIA Offshore Wind Farm

ARUP

CONTRACTOR DRAWING NO: UKCAL1_ARP_WNF_ENV_MAP_00460

CONTRACTOR REV: 03

GEODETIC PARAMETERS: OSGB36 / British National Grid (EPSG:27700)

DRAWING TITLE

Figure 3-2: Onshore Climate Change Projections - Grid Cells used in the Assessment

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REV: N/A

Offshore

3.4.3.8 Offshore climate change projections in the UK are not as well researched as onshore climate change projections. As such, it is not possible to confirm one consistent timescale across each of the offshore climate change projections.

3.4.3.9 The offshore projections from have come from a combination of academic literature, UKCP09, UKCP18 and the Marine Climate Change Impacts Partnership (MCCIP), as highlighted in Table 3-3. These can be summarised as follows:

- Wind, waves and storms – there is likely to be a decrease in wave height in the north of the UK. However, there is a general consensus within the MCCIP of low confidence in the future projections for wind, storms and waves;
- Sea surface and near bottom temperatures – there is a general trend that temperatures are expected to increase in surface and near bottom sea temperatures;
- Dissolved oxygen – dissolved oxygen levels are decreasing in the North Sea as a result of increasing sea temperatures;
- Salinity – there is no clear long-term trend in salinity;
- Stratification – UKCP09 data suggests that the average number of seasonally stratified days (where different layers of ocean water do not mix) will decrease slightly;
- Ocean acidification – acidification is expected to increase as the effects of climate change increase throughout the century; and
- Sea level rise and coastal flooding – sea level rise off the Aberdeenshire coast is expected to be less than other areas of the UK. Due to the cliffs surrounding the Landfall Site, sea level rise is not anticipated to be an issue for the Proposed Development, for both coastal onshore components and offshore infrastructure.

3.4.3.10 Full details of the research undertaken for offshore climate projection data are presented in Volume 7F, Appendix 3-1: Climate Change Resilience Assessment.

3.4.4 Data Gaps and Limitations

3.4.4.1 Data on the climate baseline and future projections are based on freely publicly available information from third parties, including the historical meteorological variables recorded by the Meteorological Office (Met Office) and the UK Climate Projections (UKCP18) (Met Office, 2021a[7]) developed by the Met Office.

3.4.4.2 A literature review of climate change projections for the marine environment has been undertaken as part of this assessment. Due to the age of the marine climate change projection data from UKCP09 (CEDA Archive, 2017[16]), this has

been supplemented by a number of reports published by the Marine Climate Change Impacts Partnership (MCCIP, 2022[15]) which provide a comprehensive overview of evidence and predictions for changes in the UK marine climate. As a result, the marine climate change projections are not available in the same quantitative format as the land projections over the same period; marine projections are provided qualitatively. Further information is provided within Volume 7F, Appendix 3-1: Climate Change Resilience Assessment.

3.4.4.3 Climate projections are not predictions or forecasts but simulations of potential scenarios of future climate, under a range of hypothetical emissions scenarios and assumptions. Therefore, the results from running the climate models cannot be treated as exact or factual, but as future possibilities. Scenarios exclude outlying "surprise" or "disaster" scenarios in the literature, and any scenario includes, out of necessity, subjective elements and is open to various interpretations. In general, global projections are more certain than regional projections, and temperature projections are more certain than those for precipitation. Furthermore, the degree of uncertainty associated with all climate change projections increases for projections further into the future.

3.4.4.4 In order to address uncertainty in model projections, UKCP18 (Met Office, 2021a[7]) provides probabilistic projections for some climate variables, that is, likelihoods are assigned to different levels of change. The existence of probabilistic projections and available information can be used to provide an estimate of the level of confidence for the magnitude and direction of changes in climate. Probabilistic projections, however, are not available for all relevant climate variables, particularly those relating to extreme climate events. Information regarding extremes can be obtained from a set of Regional Climate Model projections, although this data only goes up to 2079.

3.4.4.5 The CCR assessment has the following limitations:

- There is limited guidance on climate change resilience assessment in EIA from UK Government;
- There is inherent uncertainty in climate change projections as described above; and
- There is often uncertainty in the relationship between changes in climate hazards and the respective response in terms of asset performance. This uncertainty has been assessed qualitatively within this EIAR chapter.

3.4.4.6 Assessments made in relation to 'sensitivity' and 'magnitude' relied on professional judgement and evidence gathered through other environmental discipline assessments within the EIAR.

3.4.4.7 The CCR assessment has assumed that mitigation measures for effects assessed by other topics will be implemented effectively and that an Environmental Management Plan for both onshore and offshore works will be developed for the construction phase of the Proposed Development that will be effectively implemented and provide appropriate mitigation for extreme weather-related effects during construction.

3.5 EIA Approach and Methodology

3.5.1 Overview

3.5.1.1 This section outlines the methodology for assessing the likely significant effects from climate change on the construction, operation and decommissioning of the Proposed Development. Full details of the methodology, including relevant assumptions and limitations, are presented in Volume 7F, Appendix 3-1: Climate Change Resilience Assessment.

3.5.2 Impacts Scoped into the Assessment

3.5.2.1 The Offshore Scoping Report was submitted to MS-LOT in September 2022, while the Onshore Scoping Report was submitted to Aberdeenshire Council in December 2022. The Scoping Reports set out the overall approach to assessment and allowed for the refinement of the Proposed Development over the course of the assessment. Climate resilience for both construction and operation for both the onshore and offshore Proposed Development works was scoped in. Further detail is provided in Table 3-6.

Table 3-6: Climate Change Resilience Scope of Assessment

Potential Impact	Phase	Nature of Impact
Impact of future heat on key receptors	Construction an operation for both onshore and offshore	Direct impact on key identified receptors within EIAR.
Impact of future storms on key receptors	Construction an operation for both onshore and offshore	Direct impact on key identified receptors within EIAR.
Impact of changing future precipitation patterns (e.g. potential flooding or drought) on key receptors	Construction an operation for both onshore and offshore	Direct impact on key identified receptors within EIAR.
Impact of sea level rise on key receptors	Construction an operation for both onshore and offshore	Direct impact on key identified receptors within EIAR.

3.5.3 Impacts Scoped out of the Assessment

3.5.3.1 No impacts from climate change resilience were scoped out of the assessment at scoping.

3.5.4 Assessment Methodology

3.5.4.1 The project-wide approach to assessment is set out in Volume 1, Chapter 7: EIA Methodology. The assessment methodology for CCR for the EIAR is consistent with that provided in both the Onshore and Offshore Scoping Reports.

3.5.4.2 The methodology for the assessment of CCR and ICCI is set out in full in Volume 7F, Appendix 3-1: Climate Change Resilience Assessment and Volume 7F, Appendix 3-2: In-combination Climate Change Impacts Assessment. An overview is provided in the following sections.

Climate Change Resilience Assessment

3.5.4.3 The CCR assessment considers the resilience of the Proposed Development to the physical impacts of climate change. The IEMA guidance (IEMA, 2020[11]) defines Climate Change Resilience as the *"ability to respond to changes in climate. If a receptor or project has good climate change resilience, it is able to respond to the changes in climate in a way that ensures it retains much of its original function and form. A receptor or project that has poor climate change resilience will lose much of its original function or form as the climate changes*".

3.5.4.4 In line with IEMA guidance (IEMA, 2020[11]), the CCR assessment qualitatively assesses the impacts and risks of climate change on the scheme based on professional expertise and judgement. The assessment differs from many other EIA topics in that it considers how the resilience of a development may be affected by an external factor (climate change), not how environmental receptors may be affected by a development. A risk-analysis based approach was used for the CCR assessment.

3.5.4.5 The methodology for the CCR risk assessment is as follows:

1. Identify the receptors (for example, assets and asset groups) included within the Proposed Development that would be potentially at risk from climate change impacts;
2. Use future climate data to identify climate change hazards (such as floods, heatwaves or droughts) based on the Proposed Development, its location and the changes identified by reviewing climate change data;
3. Determine the potential impact of climate change on the receptors, noting that the assessment was qualitative using expert judgement;
4. Consider the risk level and initial significance rating of each impact based on risk scoring framework (full details of which are presented in Volume 7F, Appendix 3-1: Climate Change Resilience Assessment);
5. Determine initial significance conclusions based on the matrix in Table 3-7;

6. If significant effects are identified, consider further mitigation within the design on those receptors marked significant within initial assessment; and
7. Repeat Step 4 above for all receptors where significant effects have been identified, taking into account further mitigation and determine final significance conclusions based on the risk matrix given in Table 3-7.

3.5.4.6 Steps 4 and 6 above consist of scoring the risks to determine if impacts would be significant. Significant scores are determined by a combination of sensitivity and magnitude.

3.5.4.7 Sensitivity is made up of a combination of:

- Value of the receptor – the value refers to both a function of economic value and the scale of importance geographically; and
- Susceptibility of the receptor – the susceptibility considers how likely the climate hazard was to negatively impact upon the receptor based on characteristics of the receptor.

3.5.4.8 Magnitude is made up of a combination of:

- Frequency of the climate hazard – the frequency scoring looks at both the number of times a hazard was likely to occur during the lifetime of the Proposed Development and how long the hazards was likely to last; and
- Consequence of impact – the consequence of an impact occurring was also scored by understanding possible economic impacts, the associated safety risks, reputational damage that might occur from the risk happening, and its environmental impact. The consideration of risks to physical assets and infrastructure are considered in terms of environmental and safety aspects. The consideration of ongoing risks to operations (and the environmental benefits that accrue from these operations) are considered in terms of the economic and reputational aspects. All four aspects of consequence (environmental, safety, economic and reputational) were considered separately for each risk and the aspect with the highest score was taken for the overall consequence score.

3.5.4.9 Full definitions for the four components of the scoring (value, susceptibility, consequence, and frequency) are presented in Volume 7F, Appendix 3-1: Climate Change Resilience Assessment.

3.5.4.10 The evaluation of significance is a product of sensitivity and magnitude of each impact (Table 3-7). Final significance conclusions for each impact have been reached following consideration of the design and mitigation measures.

Table 3-7: CCR Significance Matrix

		Sensitivity			
		High	**Medium**	**Low**	**Negligible**
Magnitude	**High**	Major (S)	Major/Moderate (S)	Moderate/Minor (NS)	Minor/Negligible (NS)
	Medium	Major/Moderate (S)	Moderate (NS)	Minor (NS)	Negligible (NS)
	Low	Moderate/Minor (NS)	Minor (NS)	Minor (NS)	Negligible (NS)
	Negligible	Minor/Negligible (NS)	Negligible (NS)	Negligible (NS)	Negligible (NS)
S= Significant | NS = Not Significant					

In-combination Climate Change Impacts Assessment

3.5.4.11 The ICCI assessment determines the extent to which climate change exacerbates a potential effect of the Proposed Development on any environmental receptors. The ICCI assessment methodology was developed in line with the IEMA guidance (IEMA, 2020[11]). The ICCI assessment followed the same approach to assessing impacts, identifying receptors, and determining significance as for each of the individual EIAR topics, but with the added consideration of future climate change projections. Please refer to the methodology sections for the respective topics within the EIAR chapters for further information.

3.5.4.12 The initial assessment of significant environmental receptors was conducted by each environmental discipline as per each relevant EIAR topic chapter. Once all other environmental disciplines had completed their assessments, reviews took place between the climate resilience team and the relevant environmental expert. The assessment of significance was completed by the climate change specialist and environmental specialists from the relevant topics working together to provide a qualitative assessment of significance.

3.5.4.13 Different EIAR topics use different criteria for determining significance, and as such there is no single approach to determining the significance of an ICCI. The effect of an ICCI has been considered significant if:

- An effect which was previously not significant becomes significant in terms of the significance criteria used by the EIAR topic owing to the influence of climate change (for example, an increase in consequence of effect or an increase in scale of change); and/or

- An existing significant effect is exacerbated in terms of the significance criteria used by the EIAR topic owing to the influence of climate change (for example, a further increase in the consequence of effect or a further increase in scale of change).

3.5.4.14 If an effect was not previously significant and any exacerbation by climate change does not change this, the ICCI effect is not significant.

3.5.5 Approach to Cumulative Effects

3.5.5.1 The Cumulative Impact Assessment (CIA) assesses the impact associated with the Proposed Development together with other relevant plans, projects and activities. Cumulative effects are therefore the combined effect of the Proposed Development in combination with the effects from a number of different projects, on the same receptor or resource.

3.5.5.2 The approach to the CIA for CCR follows the process outlined in Volume 1, Chapter 7: EIA Methodology.

3.5.5.3 The list of relevant developments for inclusion within the CIA is outlined in Volume 7A, Appendix 7-1: Cumulative Impact Assessment Methodology.

3.5.5.4 The CCR assessment considers the resilience of the Proposed Development to climate change, not the combined impact from a range of different activities, sources of other surrounding developments and therefore an assessment of CCR cumulative effects is not required.

3.5.5.5 The ICCI assessment is an assessment of the exacerbating impact of climate change on existing effects as identified by each environmental discipline; a separate climate change cumulative effects assessment is therefore not required.

3.5.6 Embedded Mitigation

3.5.6.1 Where possible, mitigation measures will be embedded into the design of the Proposed Development.

3.5.6.2 Where embedded mitigation measures have been developed into the design of the Proposed Development with specific regard to CCR, these are described in Table 3-8. The impact assessment presented in Sections 3.7 to 3.9 takes into account this embedded mitigation.

3.5.6.3 The CCR assessment identifies and considers existing resilience measures (embedded mitigation) for each climate variable where these are either already in place or identified as being included within the Proposed Development design.

3.5.6.4 The Proposed Development will be designed to be resilient to potential future extreme weather events in accordance with current planning, design and engineering practice, standards, and codes and the CCR assessment assumes these design practices have been followed.

Table 3-8: Embedded Mitigation

Code	Mitigation Measure	Securing Mechanism
M-3	Development of and adherence to a Construction Method Statement (CMS). The CMS will confirm construction methods and the roles and responsibilities of parties engaged in construction. It will detail any construction-related mitigation measures.	The CMS will be secured through a condition attached to the Planning Permission in Principle (PPP) and to be secured as a condition of the Generation Asset and Transmission Asset Marine Licences.
M-8	Development of and adherence to an Offshore Environmental Management Plan. The Offshore Environmental Management Plan will set out mitigation measures and procedures relevant to environmental management, including but not limited to the following topics: Chemical usage, invasive non-native marine species, dropped objects, pollution prevention and contingency planning, and waste management.	To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences.
M-39	An Outline Construction Environmental Management Plan (CEMP) has been produced and included alongside the EIAR to support the PPP (Volume 7, Appendix 10: Outline Construction Environment Management Plan). The Outline CEMP includes measures on pollution prevention, noise control, biosecurity, and waste management. The Outline CEMP will then be developed further through the final design process and this will result in a detailed CEMP being submitted for discharge. The CEMP will be implemented to avoid, minimise or mitigate effects on the environment during the construction and decommissioning phases of the Proposed Development (Onshore).	Detailed CEMP secured through a condition attached to the PPP.
M-59	Climate change projections on precipitation will be taken into consideration through the drainage design strategy.	Outlined within the Outline Drainage Impact Assessment (Application Document 6) and secured by condition attached to the PPP for a detailed Drainage Strategy.

Code	Mitigation Measure	Securing Mechanism
M-82	Drainage and associated infrastructure to be designed to withstand a heavy precipitation - 1 in 100 yrs + allowances for future climate change.	Outlined within the Outline Drainage Impact Assessment (Application Document 6) and secured by condition attached to the PPP for a detailed Drainage Strategy.
M-83	In times of heavy precipitation or storms trenching, groundwork and drainage activities will be halted when necessary.	Outlined within the Outline CEMP and secured by condition attached to the PPP for a detailed CEMP.
M-84	The Proposed Development will be designed to be resilient to impacts arising from weather events and climatic conditions in accordance with current planning, design and engineering practice, standards, and codes.	Design review undertaken at detailed design stage and secured through condition to the PPP. Also to be secured as a condition of the Generation Asset and Transmission Asset Marine Licences.

3.6 Key Parameters for Assessment

3.6.1.1 Volume 1, Chapter 3: Proposed Development Description (Offshore) and Volume 1, Chapter 4: Proposed Development Description (Onshore) detail the parameters of the Proposed Development using the Rochdale Envelope approach. This section identifies those parameters during construction, operation and decommissioning relevant to potential impacts on Climate Change Resilience.

3.6.1.2 The worst-case assumptions with regard to Climate Change Resilience are summarised in Table 3-9.

Table 3-9 Worst Case Assessment Scenario Considered for Each Impact as Part of the Assessment of Likely Significant Effects

Potential Impact	Assessment Parameter	Explanation
Construction		
Impact of future heat on key receptors Impact of future storms on key receptors Impact of changing future precipitation patterns (e.g. potential flooding or drought) on key receptors Impact of sea level rise on key receptors	**Receptors assessed (Offshore):** ▪ Wind Turbine Generators (WTG), both floating and fixed (partially built or complete); ▪ Vessels; ▪ Offshore Substation Structure (partially built or complete); ▪ Offshore Substation (partially built or complete) electrical equipment; ▪ Harbour/onshore storage facilities (buildings, materials, plant and other equipment); ▪ Construction staff; and ▪ Construction materials, plant and equipment (stored offshore). Receptors assessed (onshore): ▪ Car parking and access roads; ▪ Drainage and associated assets; ▪ Buildings and structures; ▪ Electrical equipment; ▪ Sewerage and septic tank; ▪ Landscaping; ▪ Fencing; ▪ Underground cabling; ▪ Construction staff; ▪ Vehicle movements; ▪ Stored construction materials; ▪ Construction plant/equipment; and ▪ Trenching.	The elements and processes within the construction phases should be considered as receptors within the assessment, as per IEMA guidance (IEMA, 2020[11]).

Potential Impact	Assessment Parameter	Explanation
Operation		
Impact of future heat on key receptors Impact of future storms on key receptors Impact of changing future precipitation patterns (e.g. potential flooding or drought) on key receptors Impact of sea level rise on key receptors	**Receptors assessed (Offshore):** ▪ Vessels (maintenance trips); ▪ Vessels (maintenance trips); ▪ Maintenance; ▪ WTGs (floating and fixed); ▪ Inter-array cables and Offshore Export Cables; ▪ Offshore substation structure; and ▪ Offshore substation electrical equipment. Receptors assessed (onshore): ▪ Car parking and access roads; ▪ Drainage and associated assets; ▪ Buildings and structures; ▪ Electrical equipment; ▪ Sewerage and septic tank; ▪ Landscaping; ▪ Fencing; ▪ Underground cabling; ▪ Perimeter fencing; ▪ Maintenance; and ▪ Transition joint bays.	The elements and processes within the operational phase should be considered as receptors within the assessment, as per IEMA guidance (IEMA, 2020[11]).
Decommissioning		
Impact of future heat on key receptors Impact of future storms on key receptors	See parameters for construction phase.	The elements and processes within the construction phases should be considered as receptors within the assessment, as per IEMA guidance (IEMA, 2020[11]).

Potential Impact	Assessment Parameter	Explanation
Impact of changing future precipitation patterns (e.g. potential flooding or drought) on key receptors Impact of sea level rise on key receptors		

3.7 Potential Effects

3.7.1.1 This section summarises the findings of the CCR assessment for the Proposed Development. The CCR assessment is a qualitative assessment to identify whether anticipated changing climate conditions and resulting weather events are likely to have significant adverse effects on the Proposed Development (Onshore) and Proposed Development (Offshore). It considers the potential impacts and risks of climate change on the Proposed Development (Onshore) and Proposed Development (Offshore) based on professional expertise and judgement.

3.7.1.2 Sections 3.7.2 to 3.7.4 provide a high-level summary of the findings for construction, operation, and decommissioning. Full details of the CCR assessment can be found in Volume 7F, Appendix 3-1: Climate Change Resilience Assessment.

3.7.2 Construction

3.7.2.1 No significant effects were identified within the construction phase of the Proposed Development (Onshore) and Proposed Development (Offshore). An important assumption informing this conclusion is that comprehensive health and safety measures will be in place as per the Environmental Management Plans for the Proposed Development (Onshore) and Proposed Development (Offshore). It is expected these will include the halting of construction processes during adverse or inappropriate weather conditions, and therefore weather-related risks will be minimised.

Heat

3.7.2.2 Extreme high temperatures are identified as posing impacts to several receptors within the Proposed Development (Onshore) and Proposed Development (Offshore) during the construction phase. The assessment considered: malfunctioning of equipment; risks to assets; and heat health risks to staff. In most cases receptors were considered to be of 'Low' Value or 'Low' Susceptibility to heat; as a result, most receptors – both onshore and offshore – were assigned a 'Low' sensitivity to extreme high temperatures. In general, these conclusions are based on a combination of lower differences in extreme heat due to climate change during the construction period (prior to more significant climate change happening later), and asset will be designed to withstand increasing temperatures during the scheduled construction period.

3.7.2.3 The receptor of 'staff' was assigned a 'Medium' sensitivity to extreme heat; this is mainly due to their classification as 'High' value receptors. Despite this, during the construction phase all offshore and onshore risks were assigned a 'Low' magnitude score. This was primarily driven by both a 'Low' frequency (it was not likely that temperatures high enough to cause

such risks would be experienced during the construction phase) and 'Low' consequence rating.

3.7.2.4 In conclusion, no significant effects from extreme heat were identified for the Proposed Development (Onshore) and Proposed Development (Offshore) construction phase.

Storms

3.7.2.5 Storms (including high winds and lightning) are identified as posing several impacts to the Proposed Development (Onshore) and Proposed Development (Offshore) during construction. These risks include: physical damage for assets; construction delays; as well as health and safety risks for staff. For the receptors of staff, and of construction processes, it is assumed that construction would not continue in particularly adverse or dangerous storms. Therefore the expected consequences for these receptors arise from disruptions to the construction schedule, although it is assumed that contingency time will be built into the Proposed Development (Onshore) and Proposed Development (Offshore) program to mitigate this potential impact.

3.7.2.6 For asset receptors, it is assumed that these will be designed to withstand the degree of storms anticipated during the construction phase. Furthermore as assets likely comprise materials, or partially built elements during the construction phase, these were assigned a lower values during construction phase, than when compared to what they will represent during operation.

3.7.2.7 In conclusion, no significant effects from storms were identified for the Proposed Development (Onshore) and Proposed Development (Offshore) construction phase.

Drought

3.7.2.8 Drought was identified as having potential to pose some impacts to the Proposed Development during construction. Climate change has the potential to increase drought due to reduced summer rainfall and increased dry spells. Drought can cause ground cracking and subsistence, with potential secondary impacts for roads, car parks and drainage systems, or buried cables. However, it is thought unlikely that drought would have significant consequences for the project, with standard design-based mitigation providing adequate protection to groundworks. Therefore, all drought related risks were scored with a 'Low' magnitude for construction phase. All at-risk receptors were also assigned 'Low' sensitivities to this hazard.

3.7.2.9 In conclusion, no significant effects from drought were identified for the Proposed Development (Onshore) and Proposed Development (Offshore) construction phase.

Precipitation

3.7.2.10 Heavy rainfall and related surface water flooding have potential to pose several impacts to the Proposed Development (Onshore) during construction. These risks include direct damage to assets, and interference with construction processes. However, no flood risk was identified within Volume 5, Chapter 6: Hydrology and Hydrogeology allowing for climate change. It is also assumed that if flooding were to become a risk during construction, then construction activities would be halted, and appropriate health and safety measures put into place as per the CEMP for the Proposed Development (Onshore) until such time as risks from flooding have reduced. This effective mitigation would result in low risks for staff.

3.7.2.11 In conclusion, no significant effects from heavy rainfall were identified for the Proposed Development (Onshore) construction phase.

Wave height

3.7.2.12 The evidence for future hazards relating to increased wave height is not comprehensive. Were incidences to occur during extreme weather it could pose risks to the Proposed Development (Offshore) during construction processes. Risks to both construction processes in terms of delays, and risks to assets or materials were considered. It is assumed that no risks would be posed to staff during construction as offshore construction activities would be paused during extreme wave heights if they occurred. However, as the assets will be designed to withstand changing wave heights, and the frequency of this event occurring is low, no significant effects from extreme waves identified for the Proposed Development (Offshore) construction phase.

3.7.3 Operation

3.7.3.1 During the operational phase of the Proposed Development (Onshore) and Proposed Development (Offshore), there is potential for the anticipated changes to the climate and extreme weather events to impact the Proposed Development in the medium to longer-term. As a general assumption within the assessment, it has been assumed that the value of most receptors is likely to increase in the operational phase, as compared with the construction phase prior to when the Proposed Development (Onshore) and Proposed Development (Offshore) will be generating electricity.

3.7.3.2 As with the construction phase, no significant effects were identified within the operational phase of the Proposed Development (Onshore) and Proposed Development (Offshore). The assessment concluded that all climate change risks during the operational phase of the Proposed Development (Onshore) and Proposed Development (Offshore) are effectively mitigated through appropriate consideration within the design

process or delivered through monitoring and maintenance regimes assumed to be in place throughout operation.

Heat

3.7.3.3 Extreme high temperatures are identified as posing potential effects to several receptors within the Proposed Development (Onshore) and Proposed Development (Offshore) during the operational phase. Extreme heat is projected to become more frequent and more intense during the operational period, with more days experiencing temperatures above 25℃ (the definition of a heat wave in Scotland). This has the potential to cause the malfunctioning of equipment, more rapid asset deterioration and heat health risks to staff. However, due to a combination of receptors having 'Low' value or 'Low' susceptibility to heat, most receptors both onshore and offshore were assigned a 'Low' sensitivity to extreme high temperatures. It is assumed that the assets will be designed to withstand increasing temperatures during this period, as current designs consider temperatures well above climate change projections.

3.7.3.4 The receptor of 'staff' was assigned a 'Medium' sensitivity to extreme heat; this is mainly due to their classification as 'High' value receptors. However, it is expected that health and safety measures will be in place to protect staff. Moreover, staff will not be on site regularly during operation, with it anticipated that operation would require more infrequent periods for maintenance and periodic checking, further reducing their susceptibility.

3.7.3.5 All offshore and onshore risks were assigned a 'Low' magnitude score. This was primarily driven by both a low consequence and medium frequency.

3.7.3.6 In conclusion, no significant effects from extreme heat were identified for the Proposed Development (Onshore) and Proposed Development (Offshore) operation phase.

Storms

3.7.3.7 Storms (including high winds and lightning) are identified as posing several potential effects to the Proposed Development (Onshore) and Proposed Development (Offshore) during operation. These include physical damage for assets, as well as health and safety risks for staff. For asset-based receptors, it is assumed that they would be designed to withstand storms anticipated during the operational phase and that despite the fact storms are projected to increase, storms strong enough to cause significant damage to heavy and secure structures would not occur frequently. It is assumed that periodic checking or maintenance would not continue in particularly adverse or dangerous storms resulting in relatively minor consequences such as a delayed maintenance schedule but not health and safety impacts for staff.

3.7.3.8 In conclusion, no significant effects from storms were identified for the Proposed Development (Onshore) and Proposed Development (Offshore) operation phase.

Drought

3.7.3.9 Drought was identified as having potential to pose some effects to the Proposed Development during operation. Drought could cause ground cracking and subsidence with knock on effects for receptors such as road, car parks and drainage systems or buried cables. However, though there is some evidence that an increased risk of drought may occur in the future, the Proposed Development (Onshore) is not particularly vulnerable to subsidence. Moreover, it is thought unlikely that drought would have significant consequences for the Proposed Development (Onshore), with standard design-based mitigation protecting ground works. In conclusion, no significant effects from drought were identified for the Proposed Development (Onshore) operation phase.

Precipitation

3.7.3.10 Heavy rainfall and related surface water flooding have potential to pose several impacts to the Proposed Development (Onshore) during operation. These risks include direct damage to assets from flooding. However, no flood risk was identified in Volume 5, Chapter 6: Hydrology and Hydrogeology including when allowing for climate change. It is also assumed that if flooding was to become a risk during operation, then (where required) operations would be halted and appropriate health and safety measures put into place while the flood subsided, resulting in little risks for staff. Therefore, no significant impacts from heavy rainfall were identified for the Proposed Development operation phase.

Wave height

3.7.3.11 The evidence for future hazards relating to increased wave height is not comprehensive. Were incidences to occur during extreme weather it could pose risks to offshore assets of the Proposed Development (Offshore). It is assumed that no risks would be posed to staff during operation as offshore activities could be paused during extreme wave heights if they occurred. However, as assets are designed with withstand changing wave heights, and it is assumed these events will be minimal, no significant effects from extreme waves were identified for the Proposed Development (Offshore) operation phase.

3.7.4 Decommissioning

3.7.4.1 During the decommissioning phase of the Proposed Development (Onshore) and Proposed Development (Offshore), anticipated changes in

climate and extreme weather events may impact the decommissioning phase in the long term.

3.7.4.2 It is assumed that most risks identified in the construction phase would be relevant in the decommissioning phase. Due to the decommissioning phase likely to be in the latter half of this century (post 2050), it is also anticipated that some climate hazards will have either intensified, or become more frequent, or both. However, it is also assumed that best practice in health and safety and decommissioning techniques will have evolved with regards to climate risks as these risks have emerged and become more generally recognised. Additionally, receptors in terms of the assets to be dismantled are likely to have a lower value than in both construction and operation. Therefore, no significant effects are anticipated during decommissioning.

3.8 In-combination Effects

3.8.1.1 In-combination effects may occur through the inter-relationship of a changing climate with another EIA topic whereby a future climate may lead to different, or greater environmental, effects than under existing climate conditions.

3.8.1.2 There is also the potential for in-combination impacts resulting from onshore and offshore works. These are identified within Volume 6, Chapter 5: Intertidal Assessment, and are therefore not repeated here.

3.8.1.3 A summary of the potential ICCI effects is provided in Table 3-10 below. The full results of the ICCI assessment are available in Volume 7F, Appendix 3-2: In-combination Climate Change Impacts.

Table 3-10: Summary of ICCI assessment conclusions

Chapter	ICCI Assessment Conclusion
Volume 2, Chapter 3: Marine Water and Sediment Quality	Climate change has the potential to alter water quality through increased ocean temperature. However, it is unlikely that climate change will directly exacerbate any impacts from the Proposed Development upon these receptors. Therefore, no significant ICCI effects were identified.
Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology	No significant impacts were found arising from the Proposed Development. Some impacts classified as not significant are likely to be exacerbated by climate change pressures on the receptors. For example, temporary habitat disturbance from jack-up vessels and cable maintenance works is one of the identified potential impacts of the Proposed Development could be exacerbated by habitat loss and negative pressures from changes to seawater temperature, sea level rise, increased storm surge and changes to weather (hotter temperatures). However, as these impacts from the Proposed Development are considered not significant and climate change will not significantly alter that finding, it is unlikely that climate change will exacerbate any current impacts the Proposed Development has on these receptors. Therefore, no significant ICCI effects were identified.
Volume 2, Chapter 5: Fish and Shellfish Ecology	The key impact on receptors from the Proposed Development is a result of increased underwater noise from piling. This is not considered to be significant. Moreover, climate change is not likely to significantly interact and exacerbate this impact. Therefore, no significant ICCI effects were identified.
Volume 2, Chapter 6: Offshore Ornithology	The main impact pathways assessed in this chapter are the Proposed Development's impact on collision risk and distributional responses. If climate change were to significantly alter the population of receptors this may exacerbate the impact of collision risk. However, it is difficult to establish within the Proposed Development's appraisal period whether significant changes to population distributions due to climate change will occur. Therefore, no significant ICCI effects were identified.

Chapter	ICCI Assessment Conclusion
Volume 2, Chapter 7: Marine Mammals	Climate change is likely to have a range of impacts upon marine mammals. However, little is known specifically about the effects on individual species. Therefore, there is expected to be no significant ICCI effects.
Volume 2, Chapter 8: Commercial Fisheries	The Proposed Development may have a significant impact on fishery access during the construction phase, particularly during cable laying. However, most of this access will be reinstated once operation commences. Significant impacts from climate change are unlikely to coincide with construction due to this being closer to present day and so the climate projections are similar to the weather experienced now. During the operation phase of the Proposed Development there is likely to be a significant impact from the Proposed Development from Caledonia South (floating section) on commercial fisheries, by potentially restricting access to fishing areas. There is a possibility that climate change (specifically warming sea temperatures) could cause white fish (notably cod and haddock) to move into this area, and were the fisheries in this area to become inaccessible this would cause a possible significant ICCI. Given the uncertainty of fish resource distribution trends as a result of future climate change effects, and timelines of if or when these may occur, potential ICCI effects are identified as not significant for the Proposed Development (Offshore).
Volume 2, Chapter 9: Shipping and Navigation	It has been noted that the Proposed Development may significantly impact the Serco NorthLink Ferries' adverse weather routeing, and this may mean that under certain conditions they need to delay or cancel delay sailings as a result of the Proposed Development. However, climate change is unlikely to have a significantly exacerbate this impact. Therefore, no significant ICCI effect were identified.
Volume 2, Chapter 11: Military and Civil Aviation	Based on the current evidence it is unlikely that climate change will exacerbate any current impacts the Proposed Development has on these receptors. Therefore, no significant ICCI effects were identified.
Volume 2, Chapter 13: Other Human Activities	Based on the current evidence it is unlikely that climate change will exacerbate any current impacts the Proposed Development has on these receptors. Therefore, no significant ICCI effects were identified.
Volume 5, Chapter 2: Land Use	Climate change is likely to have some impact on agricultural land both positive and negative. A potentially significant impact of the Proposed Development is construction on agricultural land. Additionally hotter and drier weather could result in increased soil repellence to water, and secondary impacts of soils being damaged during storage in the construction period. However, during the construction period climate change is not likely to have a significant exacerbating impact on this identified effect. Therefore, no significant ICCI effects were identified.

Chapter	ICCI Assessment Conclusion
Volume 5, Chapter 3: Terrestrial Ecology	Climate change is likely to have some impacts on the receptors identified within this chapter, refer to Volume 7F, Appendix 3-2: In-combination Climate Change Impacts for further details. Though surveys are not yet complete (at the time of writing) the proposed Onshore Substations could have a significant impacts on bats. However, embedded mitigation is included in the design to minimise these impacts and climate change will not directly exacerbate this potential impact. Watercourses are also likely to be impacted by the Proposed Development where the Onshore Export Cable route crosses them, due to trenching. However, this impact is temporary as it is only applicable to the construction phase. Potentially impacts on watercourses could be exacerbated by anticipated changes to rainfall (drier summers could mean drying out, and wetter winters could result in faster flows). However, based on the current evidence it is unlikely that climate change will exacerbate any current potential impact the Proposed Development has on these receptors. Therefore, no significant ICCI effects were identified.
Volume 5, Chapter 4: Landscape and Visual and Volume 2, Chapter 12: Seascape Landscape and Visual Impact Assessment	Climate change is not expected to either impact upon receptors or exacerbate any current impacts from the Proposed Development. Therefore, no significant ICCI effects were identified.
Volume 5, Chapter 7: Geology, Soils, and Contaminated Land	Sea level rise and increased coastal erosion might impact on the protected geology Site of Special Scientific Interest (SSSI). However, cliffs are hard wearing and should be relatively resilient to erosion. Peat may be negatively impacted by both hotter and drier summers causing the drying out of peat deposits. The Proposed Development is not anticipated to have any significant effect on the environmental receptors considered within this topic assessment. Therefore, no significant ICCI effect were identified.
Volume 5, Chapter 8: Airborne Noise and Vibration	The impact of noise from the Proposed Development to environmental receptors is anticipated to be minimal, and climate change is not expected to exacerbate this potential effect. Therefore, no significant ICCI effects were identified.
Volume 5, Chapter 9: Traffic and Transport	Based on the current evidence it is unlikely that climate change will exacerbate any current impacts the Proposed Development has on these receptors. Therefore, no significant ICCI effects were identified.
Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation	Climate change may have some impact on both tourism and agriculture, though the extent of impact and whether the impact is negative or positive is unknown. Based on the current evidence it is unlikely that climate change will exacerbate any current impacts the Proposed Development has on these receptors. Therefore, no significant ICCI effects were identified.

3.9 Transboundary Effects

3.9.1.1 Transboundary effects arise where development within one European Economic Area (EEA) state affects the environment of another EEA state(s). for the CCR assessments, none of the effects arising from the Proposed Development are considered to be significant in EIA terms. Therefore, there are no significant transboundary effects to the climate resilience of the Proposed Development.

3.10 Mitigation Measures and Monitoring

3.10.1.1 As far as is practicable, mitigation measures will be embedded into the design of the Proposed Development.

3.10.1.2 No additional mitigation is required.

3.11 Residual Effects

3.11.1.1 There are no residual significant effects when considering the resilience of the Proposed Development to climate change and in-combination climate change impacts.

3.12 Summary of Effects

3.12.1.1 Table 3-11 presents a summary of the significant effects for Climate Change Resilience during both construction and operation assessed within this EIAR, any mitigation required, and the residual effects are provided. The summary of significant effects for the Proposed Development (Offshore) in Table 3-11 are the same for the Caledonia North and Caledonia South.

3.12.1.2 Table 3-11 provides an overview of the key risks only, for the full assessment please see Volume 7F, Appendix 3-1: Climate Change Resilience Assessment. In this table climate hazards are combined (whilst scored separately in the full assessment); where different hazards are combined the highest score is included within this table.

3.12.1.3 Decommissioning encompasses the same receptors and climate hazards as highlighted in the construction phase. The scoring will be similar, though climate change will be greater during the likely decommissioning time periods, health and safety and decommissioning techniques are expected to have evolved with the changing climate. Therefore, no significant decommissioning risks are anticipated.

3.12.1.4 Table 3-12 presents a summary of the significant effects for the In-combination Climate Change Impacts during both construction and operation assessed within the EIAR, any mitigation required and the residual effects are provided.

Table 3-11: Summary of Effects for Climate Change Resilience

Potential Impact	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
Construction – Proposed Development (Onshore)					
Extreme weather events (storms and heatwaves) causing damage to above ground structures and assets (car park, landscaping, Onshore Substation buildings and structures) – partially or fully built	Low	Low	Minor (not significant)	No additional mitigation is required above embedded mitigation as described in section 3.5.6.	Not significant
Flooding causing damage to underground assets (built or partially built) such as: ▪ Onshore cabling; ▪ Trenching; ▪ Drainage; ▪ Septic tank; and ▪ Transition Joint Bays.	Low	Low	Minor (not significant)	No additional mitigation is required above embedded mitigation as described in section 3.5.6.	Not significant
Drought causing cracking or ground subsidence and subsequent damage to underground assets such as: ▪ Onshore cabling; ▪ Septic tank; and ▪ Transition Joint Bays.	Medium	Low	Minor (not significant)	No additional mitigation is required above embedded mitigation as described in section 3.5.6.	Not significant
Extreme weather (storms and heatwaves) causing risks to construction staff	Low	Medium	Minor (not significant)	Best practice health and safety measures will be in place to protect staff.	Not significant

Potential Impact	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
				Construction work will not be carried out during in appropriate weather.	
Construction – Proposed Development (Offshore)					
Extreme weather events leading to: ▪ Delays to vessel trips. ▪ Delays to construction schedule.	Low	High	Minor (not significant)	Built in contingency within construction program. Movements planned to coincide with times of year with less severe weather. Movement plans will be adapted around individual storm events as part of standard risk assessments.	Not significant
Extreme weather events (storms, heatwaves, extreme wave height) causing damage to WTG's floating and fixed.	Low	Medium	Minor (not significant)	Both current WTG design standards and construction techniques are resilient to extreme weather likely to occur during the construction period. Construction will also be paused during extreme weather which causes risks to the project.	Not significant

Potential Impact	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
Extreme weather events (storms, heatwaves, extreme wave height) causing safety risks to Construction Staff	Low	Medium	Minor (not significant)	Standard best practice in health and safety will be followed. Specific hot weather plans will be created and adhered too during heatwaves. Work will be halted, and staff will not work during extreme and in appropriate weather such as storms.	Not significant
Extreme weather events (storms, heatwaves, extreme wave height) causing damage to The Onshore Substation structures.	Low	High	Minor (not significant)	Both current substation design standards and construction techniques are resilient to extreme weather likely to occur during the construction period. Construction will also be paused during extreme weather	Not significant
Extreme weather events (storms, heatwaves, extreme wave height) causing damage to The Onshore Substations electrical equipment.	High	Low	Minor (not significant)	Electrical equipment will be covered and kept high on the substation platform so is not suitable to damage from storms or extreme waves. Electrical equipment is also assumed to be designed	Not significant

Potential Impact	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
				to function in temperature thresholds far greater than is expected during the construction process.	
Increase in sea temperatures causing damage to: ▪ Offshore structures ▪ Offshore equipment ▪ Offshore cabling (built of partially built)	Low	Low	Minor (not significant)	No additional mitigation is required above embedded mitigation as described in section 3.5.6. Sea temperature is due to increase minimally during the construction periods and is unlikely to impact upon offshore infrastructure.	Not significant
Operation – Proposed Development (Offshore)					
Extreme weather events leading to: ▪ Delays to vessel trips. ▪ Delays to maintenance schedule.	Negligible	Medium	Minor (not significant)	Maintenance likely to be planned at times of the year when extreme events are less likely. There will also be some flexibility in when maintenance needs to take place.	Not significant
Extreme weather events (storms, heatwaves, extreme wave height)	Low	Low	Minor (not significant)	WTGs will be designed to be resilient to thresholds in terms of temperature	Not significant

Potential Impact	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
causing damage to WTG's floating and fixed.				and wind above the expected future conditions.	
Extreme weather events (storms, heatwaves, extreme wave height) causing safety risks to Maintenance Staff	Negligible	Negligible	Negligible (not significant)	Periodic checking and maintenance will only be carried out continuously and so the frequency is very low. Also, schedules can change easily if severe weather were to occur during planned maintenance.	Not significant
Extreme weather events (storms, heatwaves, extreme wave height) causing damage to The Onshore Substation structures.	Low	Low	Minor (not significant)	Offshore substation structure will be designed to be resilient to extreme weather events. These are likely to be thresholds higher than expected during the operational period.	Not significant
Extreme weather events (storms, heatwaves, extreme wave height) causing damage to The Onshore Substations electrical equipment.	Low	Medium	Minor (not significant)	Electrical equipment will be covered on the substation platform so will not be susceptible to damage from storms or extreme wave heights. Electrical equipment will also be designed to function in temperature	Not significant

Potential Impact	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
				thresholds far greater than is expected during the construction process.	
Increase in sea temperatures causing damage to: ▪ Offshore structures ▪ Offshore equipment ▪ Offshore caballing	Low	Medium	Minor (not significant)	Substructures will be designed to accommodate some marine growth and marine growth will be removed on a regular basis, as required.	Not significant
Operation – Proposed Development (Onshore)					
Extreme weather events (storms and heatwaves,) causing damage to above ground structures and assets (car park, landscaping, Onshore Substation buildings and structures)	High (buildings and structures, low or medium for other assets).	Low	Minor (not significant)	Assets will be designed to withstand with future extreme weather. Lower value assets i.e. fencing will not impact the functioning of the Proposed Development if damaged.	Not significant
Flooding causing damage to underground assets such as: ▪ Onshore cabling ▪ Septic tank ▪ Transition Joint Bay	Medium	Low	Minor (not significant)	Drainage and associated infrastructure to be designed to withstand a heavy precipitation - 1 in 100 yrs + allowances for future climate change	Not significant

Potential Impact	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
Drought causing cracking or ground subsidence and subsequent damage to underground assets such as: ▪ Onshore cabling ▪ Septic tank ▪ Transition Joint Bay	Medium	Low	Minor (not significant)	No additional mitigation is required above embedded mitigation as described in section 3.5.6.	Not significant

Table 3-12: Summary of Effects for the In-combination Climate Change Impacts Assessment

Potential Impact	Significance	Mitigation Measure	Residual Effect
Climate Changes on Marine Water and Sediment Quality Receptors	Not Significant	N/A	N/A
Climate changes on Benthic Subtidal and Intertidal Ecology receptors	Not Significant	N/A	N/A
Climate Changes on Fish and Shellfish Ecology receptors	Not Significant	N/A	N/A
Climate Changes on Offshore Ornithology receptors	Not Significant	N/A	N/A
Climate Changes on Marine Mammals	Not Significant	N/A	N/A

Potential Impact	Significance	Mitigation Measure	Residual Effect
Climate Changes on Commercial Fisheries receptors	Not Significant	N/A	N/A
Climate Changes on Shipping and Navigation receptors	Not Significant	N/A	N/A
Climate changes on Other Human Activities receptors	Not Significant	N/A	N/A
Climate Changes on Land Use receptors	Not Significant	N/A	N/A
Climate Changes on Terrestrial Ecology Receptors	Not Significant	N/A	N/A
Climate Changes on Onshore Landscape and Visual and Seascape Landscape and Visual	Not Significant	N/A	N/A
Climate Changes on Geology, Soils and Contaminated Land	Not Significant	N/A	N/A
Climate Changes on Airbourne Noise and Vibration	Not Significant	N/A	N/A
Climate Changes on Traffic and Transport	Not Significant	N/A	N/A
Climate Changes on Socioeconomics, Tourism and Recreation	Not Significant	N/A	N/A

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