FIVE ESTUARIES OFFSHORE WIND FARM

ENVIRONMENTAL STATEMENT

VOLUME 6, PART 4, CHAPTER 1: CLIMATE CHANGE

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DEFINITION OF ACRONYMS

Term	Definition
CCR	Climate Change Resilience
CIRIA	Construction Industry Research and Information Association
CoCP	Code of Construction Practice
CCGT	Combined Cycle Gas Turbine
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ECC	Export Corridor Cable
ES	Environmental Statement
FRA	Flood Risk Assessment
FTE	Full Time Employee
GHG	Greenhouse Gas
ICCI	In-Combination Climate Impacts
IEMA	Institute of Environmental Management and Assessment
NG	National Grid
NPPF	National Planning Policy Framework
NPS	National Policy Statements
NSIP	Nationally Significant Infrastructure Projects
O&M	Operation and maintenance
OnSS	Onshore Substation
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
SoS	Secretary of State
TJB	Transition Joint Bay
VE	Five Estuaries
The Applicant	Five Estuaries Offshore Windfarm Limited
WTG	Wind Turbine Generator

GLOSSARY OF TERMS

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.
IPCC AR5	The IPCC AR5 is the Fifth Assessment Report of the Intergovernmental Panel on Climate Change published in 2014.
Net surface long wave flux	Net surface longwave flux refers to the balance of incoming and outgoing longwave (infrared) radiation at the Earth's surface. The net flux can be either positive or negative, depending on whether more longwave radiation is absorbed by the surface or emitted from it.
Regridded	Regridding refers to a method used by the Met Office to process raw climate model data taken from a number of 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

Term	Definition
	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 scenario.
Snowfall flux at surface	Snowfall flux at the surface refers to the rate at which snow falls and accumulates on the ground over a specific period.
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. It informs climate adaptation and mitigation strategies using advanced models and covers short to long-term forecasts, essential for policymakers and planners.

1 CLIMATE CHANGE

1.1 INTRODUCTION

1.1.1 This chapter presents the findings of the Environmental Impact Assessment (EIA) concerning the potential impacts of the Five Estuaries Offshore Wind Farm project (hereafter referred to as VE), on the climate, and VE's resilience to changes in the climate during construction, operation and maintenance (O&M), and decommissioning.

1.1.2 In alignment with the Institute of Environmental Management and Assessment (IEMA) 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 VE's lifetime from construction through to decommissioning, including the nature and magnitude of GHG emissions and an assessment of carbon mitigation actions (see Volume 6, Part 4, Annex 1.1: GHG Assessment).
> Vulnerability to climate change: the Climate Change Resilience (CCR) assessment evaluates the potential impacts of climate change on VE and how these impacts can be, and have been, ameliorated through the project design and planning stages.
> In-combination Climate Impact (ICCI) effects: the extent to which climate change exacerbates the effects of VE on other environmental receptors.

1.1.3 In-combination Climate Change Impacts which assess the extent to which climate change may impact the probability and/or consequence of effects identified elsewhere in the Environmental Statement (ES) are considered in-depth within this chapter and at a high-level within other relevant topic chapters.

1.1.4 This chapter should be read in conjunction with the following ES chapters, for which climate change has been judged to be of particular relevance:

> Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes
> Volume 6, Part 2, Chapter 3: Marine Water and Sediment Quality
> Volume 6, Part 2, Chapter 4: Offshore Ornithology
> Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology
> Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology
> Volume 6, Part 2, Chapter 7: Marine Mammals
> Volume 6, Part 2, Chapter 8: Commercial Fisheries
> Volume 6, Part 2, Chapter 10: Seascape, Landscape and Visual Impact Assessment
> Volume 6, Part 2, Chapter 11: Offshore Archaeology and Cultural Heritage
> Volume 6, Part 3, Chapter 2: Onshore Landscape and Visual Impact Assessment
> Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation
> Volume 6, Part 3, Chapter 5: Ground Conditions and Land Use

- Volume 6, Part 3, Chapter 6: Hydrology and Flood Risk
- Volume 6, Part 3, Chapter 7: Onshore Archaeology and Cultural Heritage

1.2 STATUTORY AND POLICY CONTEXT

PLANNING AND CLIMATE POLICY CONTEXT

1.2.1 At both the national and local level, there are several policies which are relevant to VE. In particular, the Energy National Policy Statements (NPSs) set out the key expectations for decisions by the Secretary of State in relation to Nationally Significant Infrastructure Projects (NSIP).

1.2.2 In November 2023, the government published revised versions of the NPS documents in reflection to the March 2023 consultation on the draft statements. Since publication, the guidance was updated in January 2024 and in through this update it has come into effect. It is expected that the statements will be reviewed every five years, which will ensure that they reflect evolving policy and legislative changes.

1.2.3 National and local policy documents relevant to the CCR assessment and the GHG emissions impact assessment are included in Table 1.1and Table 1.2respectively.

Table 1.1: National and Local Planning Policy Context for CCR Assessment

Planning Policy	Requirement in relation to Climate Change	Where this has been addressed in the ES
EN-1 Overarching National Policy Statement for Energy (DESNZ, 2023a)	EN-1 sets out the assessment principles for projects subject to the EIA Regulations. As per EN-1 Section 4.3, the likely significant environmental, social, and economic effects of the project should be assessed, as well as the measures for avoiding or mitigating significant adverse effects. The interaction between effects should also be considered. EN-1 Section 4.10 stipulates that energy infrastructure must be shown to be sufficiently resilient against the possible impacts of climate change.	The CCR assessment presented in Section 1.9, Section 1.10 and Section 1.11identifies the significant effects likely to affect the resilience of VE across construction, operational and decommissioning phases. The interaction between climate change and other significant effects are considered in Section 1.13.
EN-3 National Policy Statement for Renewable Energy Infrastructure (DESNZ, 2023b)	EN-3 applies to specified renewable generation proposals, including offshore wind >100MW in England. EN-3 Section 2.4, Paragraph 8 specifies that applicants should demonstrate the resilience of any land-side infrastructure to	The CCR assessment presented in Section 1.9, Section 1.10 and Section 1.11includes assessment of effects associated with onshore

Planning Policy	Requirement in relation to Climate Change	Where this has been addressed in the ES
	climate change, with specific attention given to the resilience to storms.	and offshore project components across construction, operation, and decommissioning phases. Future baseline changes to storm variables are discussed in Section 1.6.
EN-5 National Policy Statement for Electricity Networks Infrastructure (DESNZ, 2023c)	EN-5 is relevant to the consideration of grid connection associated with VE. EN-5 Section 2.3, paragraph 2 states that applicants should set out to what *"extent the proposed development is expected to be vulnerable, and as appropriate, how it has been designed to be resilient to:* • *flooding, particularly for substations that are vital to the network; and especially in light of changes to groundwater levels resulting from climate change;* • *the effects of wind and storms on overhead lines;* • *higher average temperatures leading to increased transmission losses;* • *earth movement or subsidence caused by flooding or drought (for underground cables); and* • *coastal erosion – for the landfall of offshore transmission cables and their associated substations in the inshore and coastal locations respectively."*	The CCR assessment presented in Section 1.9, Section 1.10 and Section 1.11includes assessment of potential climate impacts and effects across construction, operation, and decommissioning phases, including those impacts specified in EN-5.
National Planning Policy Framework (NPPF) (DLUHC, 2023)	The NPPF states in paragraph 153 that *"plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures."*	The CCR assessment presented in Section 1.9, Section 1.10 and Section 1.11identifies the significant effects likely to affect the resilience of VE across construction, operational and decommissioning.

Planning Policy	Requirement in relation to Climate Change	Where this has been addressed in the ES
	Paragraph 154 states that planning for new developments should: a) *"avoid increased vulnerability to the range of impacts arising from climate change."*	
Flood and coastal erosion risk management: policy statement (HM Government, 2020)	This policy statement sets out the government's long-term ambition to create a nation more resilient to flood and coastal erosion, including ensuring that new infrastructure is resilient to flooding and coastal erosion.	Flood Risk Assessments (FRA) were submitted as part of the following Application Documents: Volume 5, Report 3.1: Flood Risk Assessment – Cable Route and Volume 5, Report 3.2: Flood Risk Assessment – Onshore Substation. Consideration of coastal change is included in the CCR as shown in Section 1.9, Section 1.10 and Section 1.11.
Essex County Council Climate Action Plan (Essex County Council, 2022)	The Essex County Council Climate Action Plan describes the actions being taken to progress its climate commitments. This includes its Capital Flood Programme, which is *"aimed at reducing surface water flood risk to the communities of Essex. The current programme has been highlighted as a priority up to 2024/25. The projects delivered through the capital programme will not only reduce surface water flood risk, but they will incorporate Natural Flood Management and Green Infrastructure measures that will provide environmental benefits such as habitat creation, carbon reduction/sequestration and health & wellbeing."*	Flood Risk Assessments were submitted as part of the following Application Documents: Volume 5, Report 3.1: Flood Risk Assessment – Cable Route and Volume 5, Report 3.2: Flood Risk Assessment – Onshore Substation
East Suffolk Council – Suffolk Coastal Local Plan (East Suffolk Council, 2020)	The plan sets out the vision for Suffolk Coastal from 2018-2036, including issues related to climate change, flooding, coast, and estuaries. The plan states that proposals for Major Energy Infrastructure Projects will need to	The CCR assessment presented in Section 1.9, Section 1.10 and Section 1.11 includes assessment of potential climate impacts and effects across

Planning Policy	Requirement in relation to Climate Change	Where this has been addressed in the ES
	consider specified policy requirements, including: "*appropriate flood and erosion defences, including the effects of climate change are incorporated into the Project to protect the site during the construction, operational and decommissioning stages.*" The Council recognises that the East Suffolk Coast will change and defines coastal adaptation as "*making changes to prepare for and negate the effects of climate change, thereby reducing the vulnerability of communities and ecosystems. By adapting to cope with the effects of climate change, communities, enterprises, and institutions can build up their climate change resilience.*"	construction, operation, and decommissioning, including flooding and coastal change. Flood Risk Assessments were submitted as part of the following Application Documents: Volume 5, Report 3.1: Flood Risk Assessment – Cable Route and Volume 5, Report 3.2: Flood Risk Assessment – Onshore Substation

Table 1.2: National and Local Planning Policy Context for GHG Impact Assessment

Planning Policy	Requirement in relation to Climate Change	Where this has been addressed in the ES
EN-1 Overarching National Policy Statement for Energy (2023)	EN-1 sets out the government policy context for major energy infrastructure. This includes the need to meet legally binding targets to cut greenhouse gas emissions, transition to a low carbon economy and decarbonise the power sector. As per EN-1 Section 5.3, all proposals for energy infrastructure projects should include a GHG assessment as part of their ES.	The GHG impact assessment presented in Volume 6, Part 4, Annex 1.1answers to the requirements in EN-1 that all proposals for energy infrastructure projects should include a GHG assessment.
EN-3 National Policy Statement for Renewable Energy Infrastructure (2024)	EN-3 underlines the importance of the generation of electricity from renewable sources by stating that electricity generation from renewable sources of energy is an important element in the government's development of a low-carbon economy. It stresses that there are ambitious renewable energy targets in place and that a significant increase in	The GHG impact assessment presented in Volume 6, Part 4, Annex 1.1 include comparison of the carbon intensity of the renewable energy generated from the project.

Planning Policy	Requirement in relation to Climate Change	Where this has been addressed in the ES
	generation from large-scale renewable energy infrastructure is necessary.	VE's carbon emission pay-back period is also estimated in Volume 6, Part 4, Annex 1.1 to highlight the necessity of renewable energy infrastructure in meeting renewable energy targets.
National Planning Policy Framework (DLUHC, 2023)	NPPF states in paragraph 152 that it applies a number of core planning principles that are to underpin planning decision making, including to support the transition to a low carbon future in a changing climate. Planning should help to shape places in ways that contribute to radical reductions in greenhouse gas emissions and support renewable and low carbon energy and associated infrastructure.	The GHG impact assessment presented in Volume 6, Part 4, Annex 1.1 identifies the carbon emission of VE and how it supports the transition to a low carbon future.

LEGISLATIVE CONTEXT

1.2.4 Legislation relevant to both the CCR assessment and the GHG emissions impact assessment are included in Table 1.3.

Table 1.3 Legislative Context for CCR Assessment and GHG Impact Assessment

Legislative Instrument	Implications
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (DCLG, 2017)	The 2017 Regulations apply to the environmental impact assessment ("EIA") of certain infrastructure developments which are consented under the Planning Act 2008. The EIA Directive from which the regulations derive prohibits the granting of consent for development which is likely to have a significant effect on the environment unless the decision maker has considered the likely significant effects on the environment of the proposed development. EIA is the process by which such effects are identified, assessed and reported. The 2017 regulations require that EIA under those regulations include an assessment of "the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change" (schedule 4, paragraph 5(f)).

Legislative Instrument	Implications
Climate Change Act 2008 (BEIS, 2019)	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 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: > the carbon budget for the 2008-2012 budgetary period is 3,018 mega tonnes of carbon dioxide equivalent (MtCO2e); > the carbon budget for the 2013-2017 budgetary period is 2,782 MtCO2e; > the carbon budget for the 2018-2022 budgetary period is 2,544 MtCO2e; > the carbon budget for the 2023-2027 budgetary period is 1,950 MtCO2e; > the carbon budget for the 2028-2032 budgetary period is 1,725 MtCO2e; and the carbon budget for the 2023-2037 budgetary period is 965 MtCO2e.
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 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.
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.

TECHNICAL GUIDANCE

1.2.5 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 ES and is therefore referenced throughout this chapter. A full list of the technical guidance used to inform the CCR Assessment and the GHG Impact Assessment is listed in Table 1.4 and Table 1.5respectively.

Table 1.4: Technical Guidance relevant to CCR Assessment

Guidance Document	Requirement in relation to Climate Change	Where this has been addressed in the ES
IEMA Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation (IEMA, 2020)	The IEMA guidance provides a framework for the effective consideration of climate change resilience and adaptation in the EIA process in line with EIA Regulations 2017.	The methodologies for the CCR and ICCI Assessment, detailed in Section 1.3, Section 1.4 and Section 1.13, are in line with this guidance.
UKCP18 projections	The UKCP18 National Climate Projections have been produced by the Met Office and are based on the latest developments in climate science. The projections provide users with the most recent scientific evidence on projected climate changes in the United Kingdom.	A description of how UKCP18 Projections have been used within the CCR assessment is provided in Section 1.6.

Table 1.5: Technical Guidance relevant to GHG Impact Assessment

Guidance Document	Requirement in relation to Climate Change	Where this has been addressed in the ES
International Standards Organisation (ISO), in its series ISO 14040-44	ISO 14040-44 defines lifecycle assessments to be the "compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle"	The methodology for the GHG impact assessment, detailed Volume 6, Part 4, Annex 1.1 are in line with this guidance.
The Fifth Assessment Report (AR5) of the Intergovernmental	AR5 provide the latest scientific opinion on the global warming potential (GWP) factors that should be used.	A description of how the GWP from the AR5 have been used within the GHG impact assessment is provided

Guidance Document	Requirement in relation to Climate Change	Where this has been addressed in the ES
Panel on Climate Change (IPCC)		in Volume 6, Part 4, Annex 1.1.

1.3 CONSULTATION

1.3.1 As part of the EIA for VE, consultation has been undertaken with various statutory and non-statutory authorities through the agreed Evidence Plan process. Following submission of the Scoping Report (VE OWFL, 2021), a formal Scoping Opinion was sought from the relevant Secretary of State (SoS). The Scoping Opinion (VE OWFL, 2021) was issued in November 2021 by PINS.

1.3.2 Key consultees included local councils as well as wider stakeholders such as environmental non-departmental public bodies and relevant charities. Comments specific to climate change provided during the Scoping Opinion, Evidence plan phases and informal consultation are summarised in Table 1.6, which also provides a high-level response on how these comments have been addressed throughout the chapter. A full record of all consultation responses and a detailed overview of the consultation approach is provided in Volume 5, Report 1: Consultation Report.

Table 1.6: Summary of Consultation Responses for Climate

Consultee, date, and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
PINS on behalf of SoS November 2021 Scoping Opinion (VE OWFL, 2021)	The ES should include a description and assessment (where relevant) of the likely significant effects the Proposed Development has on climate (for example having regard to the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change. Where relevant, the ES should describe and assess the adaptive capacity that has been incorporated into the design of the Proposed Development. This may include, for example, alternative measures such as changes in the use of materials or construction and design techniques that will be more resilient to risks from climate change.	The likely significant effects of the Project on the climate are assessed through the GHG impact assessment. GHG emissions including embodied and operational carbon are provided in Volume 6, Part 4, Annex 1.1, Section 1.4. Assessment of the vulnerability of the Project to climate change is provided in the following sections: Section 1.9, Section 1.10, Section 1.11,

Consultee, date, and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
		Section 1.12, and Section 1.13 The adaptive capacity of VE, including mitigation measures, is provided in Section 1.8.
Essex County Council May 2023 Section 42	Essex County Council welcomes the support the Government's Energy Security Strategy gives for offshore wind expansion and goal of 50 GW of offshore wind production by 2030.	Assessment of VE's contribution to the UK Government's 50 GW goal is addressed in Volume 6, Part 4, Annex 1.1, Section 1.4 Paragraphs 15 to 18.
Essex County Council May 2023Section 42	The ES should detail how Green House Gas (GHG) emissions, including embodied and operational carbon, will be minimised throughout the lifetime of the development. It is also important that emissions reduction measures are sought at each stage of VE to achieve net zero development at all stages of VE and within each element of VE's infrastructure. Reliance on the positive impact of renewable energy production should not be relied upon for mitigation.	Assessment of GHG emissions including embodied and operational carbon provided in Volume 6, Part 4, Annex 1.1, Section 1.4. VE will endeavour to minimise GHG emissions across the project lifetime.
Essex County Council May 2023Section 42	The potential impact on not just the UK to meet its climate GHG reduction commitments and wind energy targets, but the impact on Essex and the various commitments by Essex County Council and its boroughs/districts should also be considered within the Preliminary Environmental Information Report (PEIR) and future assessments/reports.	The Essex County Council commitments aligns with the UK nation-wide commitments on GHG reduction. Assessment of GHG impact is provided in Volume 6, Part 4, Annex. 1.1, specifically Section 1.4 demonstrates the net benefit of VE regarding lifetime carbon emission reduction compared to the project baseline scenarios of 'Gas' and

Consultee, date, and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
		'all non-renewables' derived electricity, were VE not to be developed.
Essex County Council May 2023Section 42	Essex County Council notes that each PEIR chapter, where relevant, considers the issue of climate change, this being set against both National and County expectations. It states: Further information in relation to climate change will be included in the ES which will accompany the Development Consent Order (DCO) application when more detailed project information will be available." Essex County Council looks forward to the receipt of the as promised details at DCO submission.	In-depth consideration has been given to climate change throughout this chapter. List of additional chapters where climate change is relevant provided in Section 1.1.
Suffolk County Council (SCC) May 2023Section 42	SCC endorses schemes that support the decarbonisation of heat and transport, reduce energy poverty, and improve the climate adaptive resilience of both the natural environment and communities.	Outcomes of CCR assessment presented in Section 1.9, Section 1.10 and Section 1.11.
Essex Wildlife Trust May 2023Section 42	Essex Wildlife Trust's core charitable objectives are the protection of wildlife and securing nature's recovery in Essex. The current climate and nature emergency and the accompanying alarming decline in wild species and natural habitats is now widely recognised. Almost half of all UK wildlife is in long term decline and 15% of species are at risk of extinction. The climate emergency is hastening this destruction of the natural environment, damaging habitats, and disrupting ecosystems. Yet it is these very habitats that have the potential to lock up carbon and fight back against rising global temperatures. Nature's recovery is vital for tackling climate change. Nature fundamentally underpins a thriving and sustainable economy and a healthy society. It is essential that we not only protect natural and semi-natural spaces but let them thrive	The UK recognises that reductions in GHG emissions are needed as part of its strategy to restore nature (DEFRA, 2023). Assessment of the emission reductions of VE compared to the project baseline scenarios of 'Gas' and 'all non-renewables' derived electricity is provided in Volume 6, Part 4, Annex. 1.1 Section 1.4. ICCI effects, including those affecting ecological receptors, are assessed in Section 1.13.

Consultee, date, and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
	- for the benefit of people, wildlife, and the planet.	Further details on the impact of climate change on UK wildlife have been discussed in Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation.
Environment Agency April 2023 Section 42	PEIR Section 6.7, Paragraph 62 states that the defences are considered acceptable for this phase of the development and that VE is cognisant of the potential Managed Realignment site, yet there are no proposals on how the compounds will be protected against potential flood waters, no mitigation, or contingency proposals. This has been highlighted during the Expert Topic Group meetings also, and yet no further information has been provided to mitigate or provide contingency measures. The challenge for the area is that economic justification to maintain the defences in the longer term will be difficult and although the SMP Policies are set, they are non-statutory and provide no guarantees that funding will be made available to achieve the aspirational policy. Therefore, allowance needs to be made to account for not just the current situation, but the impacts that climate change and sea level rise will have on the flood risk area and ensure that adequate protective measures are incorporated into any new developments.	As outlined in Volume 6, Part 3, Chapter 6: Hydrology and Flood Risk, Section 6.7, VE will ensure design of the cable route from landfall inland is cognisant of the potential for managed realignment towards the end of the design life of the onshore cable. The cables and TJBs will take into account the potential for increased flood risk towards the end of the design life of the structure. National climate change allowances have been considered within the assessments presented in Volume 6, Part 3, Chapter 6: Hydrology and Flood Risk, Section 6.7.
Environment Agency April 2023 Section 42	PEIR Section 4.2 (55) & (56): The reference to the standard of protection for the tidal defences being 0.5% AEP is for present day, but this will reduce over time due to the impacts of Climate Change and Sea Level Rise. Therefore, any infrastructure within the Flood Zone will be	The flood risk baseline and future baseline presented in Volume 5, Report 3.1: Flood Risk Assessment - Cable

Consultee, date, and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
	at increased risk of flooding in the future and appropriate consideration should be given to mitigate for the future risks. This is also important given comments above in relation to uncertainty of the frontline defences being maintained in the longer term.	route and Volume 5, Report 3.2: Flood Risk Assessment - Onshore substation has been established using data from recent hydraulic models, which take into account climate change effects. National climate change allowances have been considered in within the assessments presented in Volume 6, Part 3, Chapter 6: Hydrology and Flood Risk, Section 6.7.
Natural England (NE) May 2023Section 42	NE advise that consideration is given to beach lowering over the lifetime of VE, including climate change impacts. This should be used to inform HDD operation.	ICCI effects, including those affecting marine geology, oceanography, and physical processes, are assessed in Section 1.13. Further details on the impact of climate change on coastal morphology is discussed in Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical processes.
RSPB May 2023Section 42	A successful colony needs to be safe from flooding (climate-change related increases in storm frequency and sea level rise are affecting colonies such as the Ribble Estuary).	ICCI effects, including those affecting ornithology in the local area, are assessed in Section 1.13. Details on the impact of climate change on ornithology is discussed

Consultee, date, and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
		in Volume 6, Part 2, Chapter 4: Offshore Ornithology.

SCOPE OF THE ASSESSMENT

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

IMPACTS SCOPED OUT OF ASSESSMENT

1.3.3. No impacts were scoped out of the assessment.

IMPACTS SCOPED IN FOR ASSESSMENT

1.3.4 Impacts scoped in for assessment relate to the potential impacts of climate change upon VE, as included in the CCR assessment, and the extent to which climate change exacerbates the effects of VE on other environmental receptors, included in the ICCI assessment.

1.3.5 The spatial scope of the assessment covers the onshore and offshore area of VE, including the onshore and offshore export cable corridor (ECC), proposed Onshore Substation (OnSS), landfall location, and array areas.

1.3.6 The temporal scope of the assessment is dictated by the proposed development period for VE, including the construction, operation, and decommissioning phases. As per the VE project timeline, the projected construction period is 3 years (2027-2030). For the purposes of the CCR assessment, the operation phase is assumed to be 40 years (2030-2070). Decommissioning phase is assumed to be 1 year (2070-2071).

1.3.7 The receptors included in the CCR assessment have been categorised into four categories:

- Offshore built assets and infrastructure;
- Onshore built assets and infrastructure;
- Construction workers and site users; and
- Drainage systems.

1.3.8 The project components assessed within each of these categories include the following:

- **Offshore built assets and infrastructure:**
  - Offshore export cables
  - Inter-array cables
  - Wind Turbine Generators (WTGs)
  - Offshore Substation Platforms (OSPs)

  - Foundations in the array areas
- **Onshore built assets and infrastructure:**
  - Site access routes
  - Onshore export cables
  - Transition Joint Bays (TJBs)
  - OnSS
  - Grid connection
- **Construction workers and site users:**
  - Construction workers
  - Workers undertaking maintenance
  - Visitors
  - Project vessels
- **Drainage systems:**
  - Site drainage systems
  - Local drainage systems

GREENHOUSE GAS IMPACT ASSESSMENT

1.3.9 All GHG emissions arising from VE will be assessed through the lifecycle assessment (LCA). Direct emissions from activities taking place within VE including the construction, operation and decommissioning, indirect emissions from activities outside of VE and embodied carbon within construction materials are all considered as part of the study area for the GHG impact assessment.

1.3.10 VE has enlisted data and information that underpins the lifecycle GHG impact assessment, which has been evaluated using the methodology set out below.

1.3.11 The detailed scope and methodology of the GHG impact assessment is presented in Volume 6, Part 4, Annex 1.1.

STUDY AREA

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.3.12 The study area for the CCR assessment is defined by the area parameters selected for each of the UKCP18 datasets used within the assessment.

1.3.13 Three datasets from the Met Office UKCP18 Projections have been used within the CCR assessment: local projections (2.2 km) regridded to 5 km over UK, marine projections around UK coastline 2007-2100, and probabilistic projections of climate extremes (25 km) over UK. Section 1.6 provides an explanation of how these datasets have been used and the differences between the three. When defining the study area for each of the datasets, the following spatial parameters were selected: for variables from local projections (2.2 km) the East of England administrative region was selected (Figure 1.1); for the 21st century projections (Marine) Felixstowe pier was selected (Figure 1.2); for variables from probabilistic projections of climate extremes (25 km), the coordinates (637500.0, 262500.0) were used (Figure 1.3). Felixstowe Pier and the specified coordinates were selected as the closest locations to the Offshore Wind Farm (OWF) location.

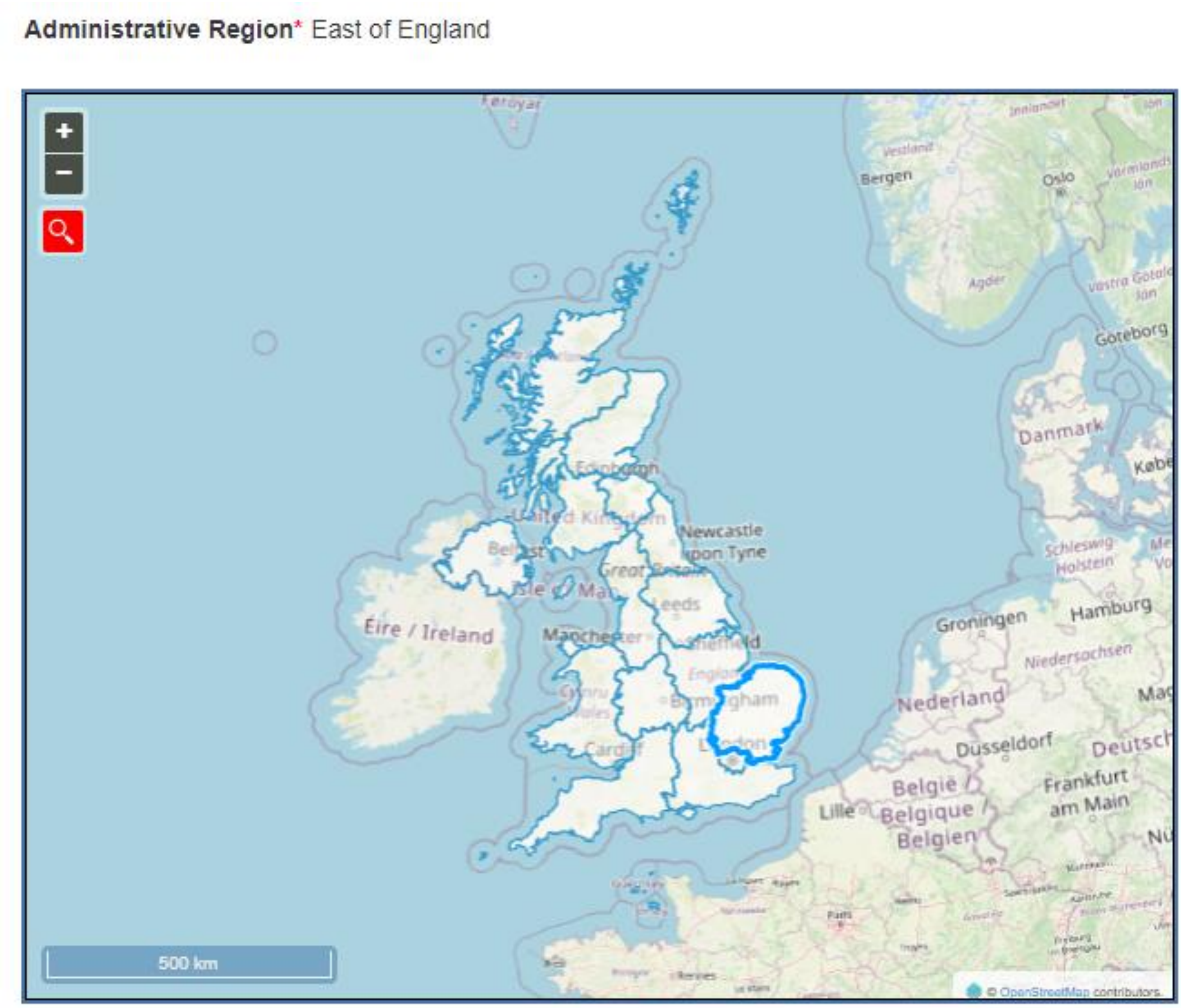

Figure 1.1: UKCP18 Local Projections (2.2km) Assessment Area

Tide Gauge Location:* FelixstowePier

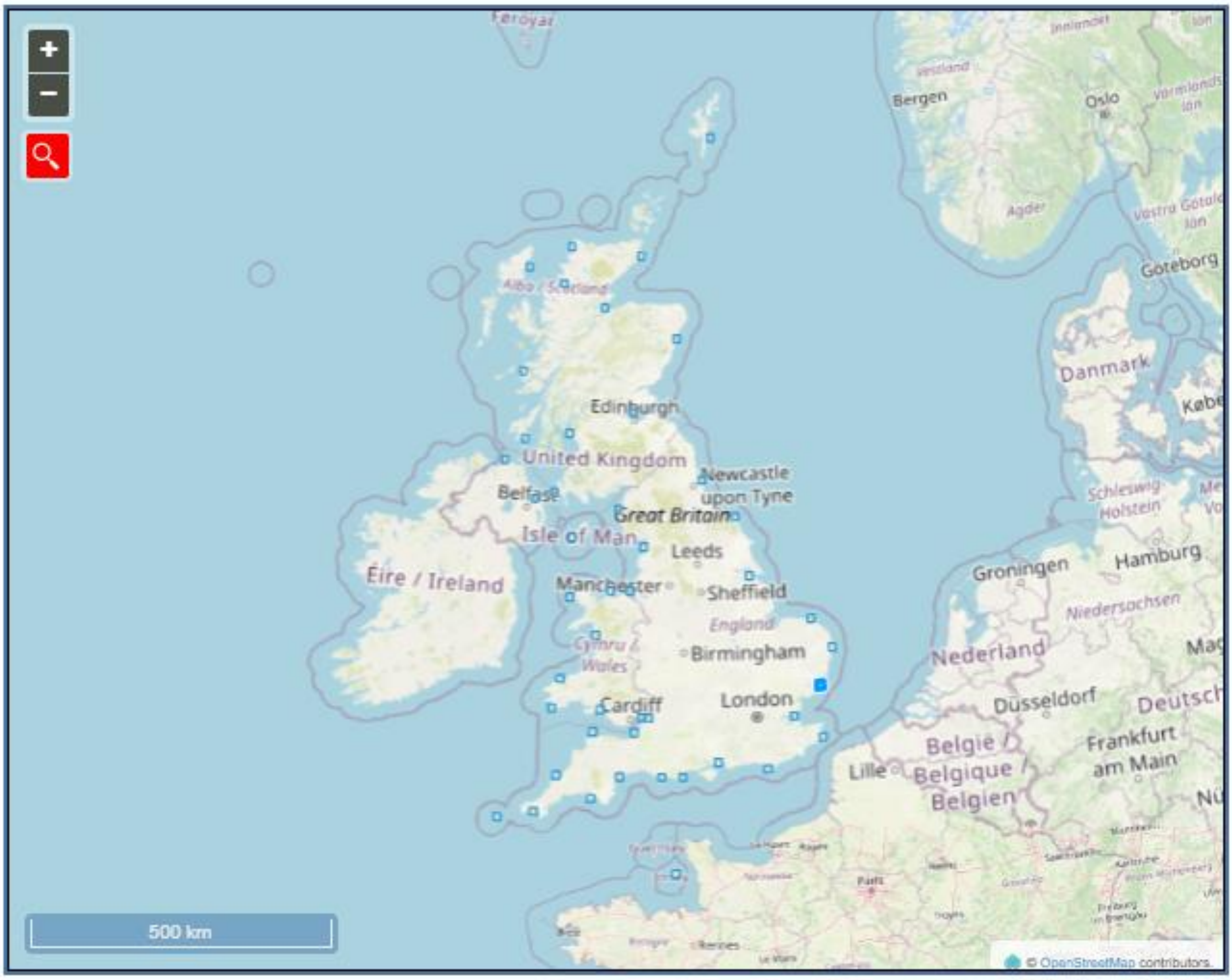

Figure 1.2: UKCP18 21st Century Projections Marine Assessment Area

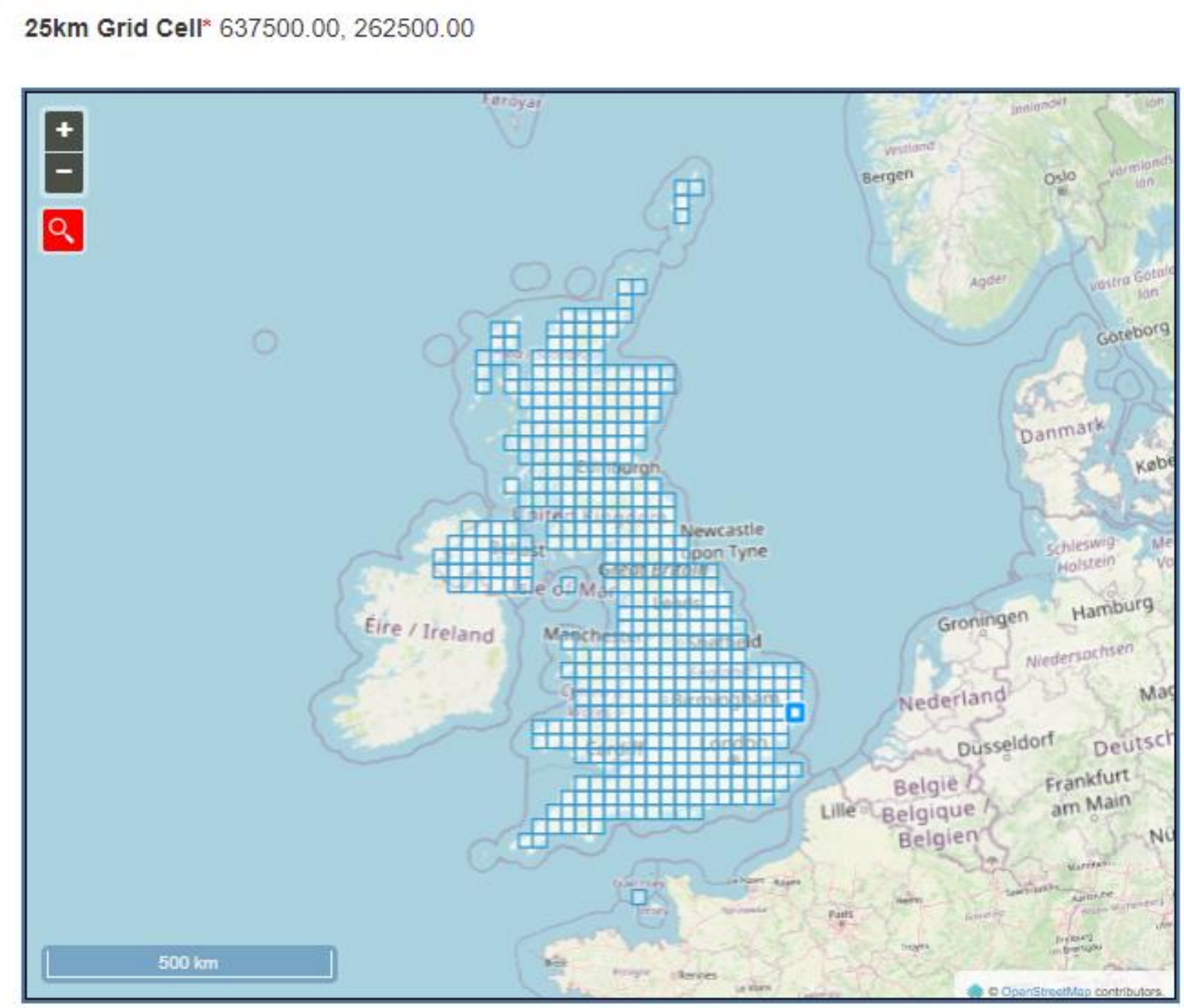

Figure 1.3: UKCP18 Probabilistic Projections of Climate Extremes (25 km) Assessment Area

GHG IMPACT ASSESSMENT

1.3.14 The study area for the GHG impact assessment is defined by the characterisation factors of the IPCC AR5, the University of Bath's Inventory of Carbon and Energy (2019) and the econinvent database 2023. Details of the characterisation factors are explained in Volume 6, Part 4, Annex 1.1.

DATA SOURCES

1.3.15 A summary of the data sources used to inform both the CCR assessment and the GHG impact assessment is provided in Table 1.7.

Table 1.7: Summary of Data Sources

Data type	Data source	Details of the information
UKCP18	Met Office	UK climate projections for specified baseline years, as well as 2040 and 2070 have been obtained for the location of VE. RCP8, the highest-impact scenario, is used in all cases.
AR5	IPCC	Conversion factors for company reporting of greenhouse gas emissions.
Inventory of Carbon and Energy.	University of Bath	Embodied carbon footprints.
Characterisation factors	Ecoinvent	Embodied and activity carbon footprints.

ASSESSMENT METHODOLOGY

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.3.16 The CCR assessment considers the likely effects of climate change impacts across the construction, operation, and decommissioning phases of VE. The assessment methodology has been developed in line with the IEMA EIA Guide to: Climate Change Resilience and Adaptation (IEMA, 2020).

1.3.17 To assess the resilience of VE to projected changes in the climate, the CCR assessment considers the project itself as the receptor. To facilitate a detailed assessment of each potential impact and effect, the project receptors have been separated into four categories: offshore built assets and infrastructure; onshore built assets and infrastructure; construction workers and site users; and drainage systems. Examples of each category are provided in Section 1.3under Scope of the Assessment.

1.3.18 For each potential impact, the sensitivity of the receptor and the magnitude of the impact was assessed according to the criteria outlined in Section 1.4. Informed by the UKCP18 projections data, as presented in Section 1.6under Future Baseline, expert judgment informed the determination of the level of sensitivity and magnitude attributable to each receptor and impact across the lifetime of VE. Given the maximum 40-year operational lifetime of VE, 2040 data is used to inform the CCR assessment of climate change impacts affecting the operational stage, and 2070 data is used to inform the assessment of decommissioning stage impacts.

1.3.19 The sensitivity and magnitude outcomes are used to determine the significance of the effect using a significance matrix, as shown in Table 1.8.. The matrix is used to categorise the significance of the effect as negligible, minor, or moderate; as well as showing whether the outcome was of an adverse or beneficial nature. Any effect that is concluded to be of moderate or major significance is deemed to be significant. Effects concluded to be of negligible or minor significance are deemed to be insignificant in EIA terms.

1.3.20 The outcomes of the CCR assessment are presented in Section 1.9, Section 1.10 and Section 1.11.

1.3.21 As part of the climate vulnerability and resilience assessment, potential In-Combination Climate Impact (ICCI) effects were 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 ES. Further details of this assessment and its outcomes can be found in Section 1.13.

Table 1.8: Significance Matrix

			Sensitivity			
			High	**Medium**	**Low**	**Negligible**
Magnitude	**Adverse**	**High**	Major	Major	Moderate	Minor
		Medium	Major	Moderate	Minor	Negligible
		Low	Moderate	Minor	Minor	Negligible
	Neutral	**Negligible**	Minor	Minor	Negligible	Negligible
	Beneficial	**Low**	Moderate	Minor	Minor	Negligible
		Medium	Major	Moderate	Minor	Negligible
		High	Major	Major	Moderate	Minor

GREENHOUSE GAS ASSESSMENT

1.3.22 The significance of VE in relation to GHG emissions, determined aligned with the Significance Matrix depicted above in Table 1.8Table 1.8, is dependent on the net GHG impacts compared to the without project baseline scenario impacts and overall net zero aspirations.

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

1.3.24 The complete methodology applied for the Greenhouse Gas Assessment can be found in Volume 6, Part 4, Chapter 1, Annex 1.1.

1.4 ASSESSMENT CRITERIA AND ASSIGNMENT OF SIGNIFICANCE

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.4.1 To determine the significance of likely effects arising from projected changes in the climate, the following criteria was applied.

1.4.2 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 Project dependencies associated with the receptor.

1.4.3 The susceptibility of the receptor was scored using the following three-point scale:

- **High susceptibility:** 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).
- **Moderate susceptibility:** 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).
- **Low susceptibility:** 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).

1.4.4 The vulnerability of the receptor was scored using the following three-point scale:

- **High vulnerability:** 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.
- **Moderate vulnerability:** the receptor is dependent on some climatic factors but able to tolerate a range of conditions.
- **Low vulnerability:** climatic factors have little influence on the receptor.

1.4.5 The importance of the receptor was assessed across the following three scales:

- **High importance:** High economic value, large number of dependencies that are important to the functioning of the project.
- **Moderate importance:** Moderate economic value, moderate number of dependencies that are important to the functioning of the project.
- **Low importance:** Low economic value, low number of dependencies that are important to the functioning of the project.

1.4.6 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.

1.4.7 Separately, the magnitude of the impact experienced by the receptor was scored by evaluating the probability of the impact and consequence of the effect. 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.

1.4.8 The probability of the impact was scored across the following five-point scale:

> **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.

> **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.

> **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, or about as likely as not to occur.

> **Low probability:** Equivalent to a 0-33% probability of occurring during the lifetime of the project. This can otherwise be thought of as ‘unlikely’ to occur.

> **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.

1.4.9 The consequence of the impact was scored across the following five-point scale:

> **Very high impact:** The scale of impact has the potential to be existentially material for the project.

> **High impact:** The scale of impact has the potential to be significant and material for the project.

> **Medium impact:** The scale of impact has the potential to be material for the project.

> **Low impact:** The scale of impact is expected to be minor and not considered material for the project.

> **Negligible impact:** The scale of impact is expected to be immaterial for the project.

1.4.10 Each receptor was given a separate score of between 1 and 5 for its probability of impact and consequence of the effect. These scores were multiplied together and then normalised to give a combined overall magnitude score from 1 to 100.

1.4.11 The magnitude of the impact was then also assigned a direction: adverse or beneficial. All impacts identified in the CCR were defined as adverse.

1.4.12 As described in Section 1.3, Paragraph 19, significance is determined according to the combined sensitivity and magnitude matrix presented in Table 1.8.

GREENHOUSE GAS ASSESSMENT

1.4.13 The effects of VE are deemed to be of beneficial significance regarding the reduction of GHG emissions in reference to Table 1.8, 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 6, Part 4, Chapter 1, Annex 1.1.

1.5 UNCERTAINTY AND TECHNICAL DIFFICULTIES ENCOUNTERED

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.5.1 UKCP18 Marine projections are currently limited to projections on sea levels. Sea level projections are used by the Met Office to inform conclusions on 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 for both onshore and offshore components are land-based projections. It is noted that conditions offshore at the proposed OWF site are likely to vary from land-based projections, however, they serve as a good proxy from which a climate risk assessment can be made.

1.5.2 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;
- 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 1.9).

GREENHOUSE GAS ASSESSMENT

1.5.3 Assumptions have been made for the GHG assessment, for further details see Volume 6, Part 4, Chapter 1, Annex 1.1.

1.6 EXISTING ENVIRONMENT

CURRENT BASELINE

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.6.1 Historic climate data from the Met Office for the period 1981-2001 has been used to determine the current baseline. The current baseline climate data for 1981-2001 is presented in the following tables: Table 1.10, Table 1.11, and Table 1.12. This enables a comparison of the future changes against this current baseline.

1.6.2 For each of the variables from local projections (2.2 km), the East of England administrative region was selected. For the 21st century projections (Marine), Felixstowe pier was selected as the location. For the variables from probabilistic projections of climate extremes (25 km), the coordinates closest to the offshore location (637500.0, 262500.0) was used.

1.6.3 To provide a broad overview of the baseline climate for the East of England the Met Office Eastern England report is summarised below (which was last updated 11 October 2016):

1.6.4 **Temperature:**

> The mean annual temperature over the region varies from around 9.5 °C to just over 10.5 °C. January and February are the coldest months with mean daily minimum temperatures across the region close to 1 °C.

> Mean daily maximum temperatures range from just over 6 °C to 8 °C during the winter months and from 20 °C to 23 °C in the summer.

> Sea temperatures off the coast of eastern England vary from 5-6 °C in February and early March to 15-16 °C in August.

1.6.5 **Rainfall:**

> Across most of the region there are, on average, about 30 rain days (rainfall greater than 1 mm) in winter (December to February) and less than 25 days in summer (June to August).

> Although rainfall is generally low, there have been some noteworthy severe storms. These include 25 to 26 August 1912 when over 100 mm was recorded in Norfolk causing damage to roads and bridges, with a maximum of 205 mm at Brundall, east of Norwich. On 1 September 1994, 147 mm was recorded in only a few hours at Ditchingham near Bungay in Suffolk, causing transport disruption and significant flooding.

1.6.6 For more location-specific data, the current baseline climate data for 1981-2001 is presented in the following tables: Table 1.10, Table 1.11, and Table 1.12**.**

FUTURE BASELINE

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.6.7 Predicted baseline changes as per the UKCP18 projections of climatic variables are presented in the following tables: Table 1.10, Table 1.11, and Table 1.12**.** This enables a comparison of the future changes against this current baseline.

1.6.8 Please see the following table for further information concerning the data presented in Table 1.10, Table 1.11, and Table 1.12.

Table 1.9: Data Specification for Future Baseline 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 dataset. This dataset covers 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 UK coastline, 2007-2100. This dataset provides the sea-level anomaly. 3) The variables from probabilistic projections of climate extremes (25 km) over 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 of England administrative region was selected. For the 21st century projections (Marine), Felixstowe pier was selected as the location. For the variables from probabilistic projections of climate extremes (25 km), the coordinates closest to the offshore location (637500.0, 262500.0) was used.
Return Period	The return period is only relevant for Variables from probabilistic projections of climate extremes (25 km) over UK, 1961-2100 where a 1 in 50-year return period event has been provided.
Baseline	For the local projections (2.2 km) and 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	RCP 8.5 Scenario was used across all indicators.
Climate Change Type	Met Office defines the climate change type of a value as anomaly or absolute. Anomaly values represent the change in the climate variable compared to the baseline period.

Parameter	Notes:
	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 2070. 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.

1.6.1 Three datasets were used:

> The variables from local projections (2.2 km) regridded to 5 km over UK for monthly, seasonal, or annual dataset. This dataset covers all basic climate variables that can be used for an assessment of how climate may impact aspects of the proposed development.

> The 21st century projections (Marine) dataset which provides the sea-level anomaly.

> The variables from probabilistic projections of climate extremes (25 km) over 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.

Table 1.10: Variables from local projections (2.2 km)

Climate variable	1981-2000 Absolute	2040 Anomaly	2070 Anomaly
Annual precipitation rate (%)	1.91 (mm/day)*	-0.23	-4.67
Annual mean air temp at 1.5m (°C)	9.64	2.14	3.82
Summer max air temp at 1.5m (°C)	20.42 **1991 values	23.10 **2031 values	26.41 **2071 values
Winter minimum air temp at 1.5m (°C)	1.42 **1990 values	2.87 **2030 values	4.72 **2070 values
Annual northward wind at 10m (m s-1)	0.56	-0.02	-0.06
Annual eastward wind at 10m (m s-1)	1.26	-0.02	-0.06
Annual wind speed at 10m (m s-1)	4.5	-0.34	-0.36

Climate variable	1981-2000 Absolute	2040 Anomaly	2070 Anomaly
Annual wind speed gust maximum at 10m (m s-1)	7.09	-0.53	-0.62
Annual sea level pressure (hPa)	1016.34	0.26	1.11
Annual net surface long wave flux (W m-2)	-48.05	-3.10	-5.15
Annual net surface short wave flux (W m-2)	100.53	12.72	16.67
Annual relative humidity at 1.5m (%)	79.19	-2.75	-4.67
Annual specific humidity at 1.5m (%)	0.01 (1)***	11.06	20.74
Annual snowfall flux at surface (%)	0.10 (mm/day)*	-59.61	-89.90
Winter surface snow amount (mm)	0.81	-0.25	-0.81
Annual total cloud (%)	66.22	-4.99	-11.11

*Values for these variables only available in UOM (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 UOM (1) for absolute values.

Table 1.11: Variables from 21st century marine projections

Climate variable	2007* Anomaly	2040 Anomaly	2070 Anomaly
Annual time-mean sea level anomaly (m)	0.05	0.23	0.49

*Values only available from 2007 onwards for this dataset

Table 1.12: Variables from probabilistic projections of climate extremes (25 km)

Climate variable	1981-2000 Absolute	2040 Absolute	2070 Absolute
Spring 1-day total precipitation (mm)	38.95	41.48	44.18
Summer 1-day total precipitation (mm)	48.96	49.73	50.47
Autumn 1-day total precipitation (mm)	52.15	57.78	63.81
Winter 1-day total precipitation (mm)	29.94	32.77	35.79
Seasonal average 1-day total precipitation (mm)	42.50	45.44	48.56
Spring 5-day total precipitation (mm)	83.78	89.31	95.19
Summer 5-day total precipitation (mm)	84.04	85.04	86.14
Autumn 5-day total precipitation (mm)	83.48	89.58	96.06
Winter 5-day total precipitation (mm)	58.43	63.18	68.3
Seasonal average 5-day total precipitation (mm)	77.43	81.78	86.43
Annual net surface short wave flux (W m-2)	100.53	12.72	16.67
Summer max air temp at 1.5m (°C)	33.12	35.08	37.21

1.7 KEY PARAMETERS FOR ASSESSMENT

1.7.1 Design proposals will be subject to refinement within the detailed design stage phase, post-consent. Consequently, the effects identified and assessed within Section 1.8-1.10 represent a worst-case scenario for each receptor or group of receptors. It is not likely, and in some cases not possible, for the scenario to occur to all receptors in any case. The maximum design scenarios (MDS) identified in Table 1.13 have been selected as those having the potential to be most affected by climate change. The scenarios have been selected using information provided in the following documents:

- Volume 6, Part 3, Chapter 1: Onshore Project Description.

> Volume 6, Part 2, Chapter 1: Offshore Project Description.

1.7.2 For the purposes of this assessment, it is assumed that all options for the onshore infrastructure (ECC, TCC, TJBs, landfall infrastructure, OnSS and site access routes), Scenario 1 will be used to present a worst-case scenario.

1.7.3 The following section identifies the MDS in environmental terms, defined by the project design envelope. This is to establish the maximum potential impact on the project whilst considering any designed-in mitigation. Effects of greater significance are not predicted to arise should any other development scenario to that assessed here, based on details within the project design envelope, be taken forward in the final design scheme.

Table 1.13: Key parameters for assessment

Potential effect	Maximum Design Scenario Assessed	Justification
Construction		
Onshore Export Corridor Cable (ECC) Increase in flood risk.	Based on Scenario 1 for onshore delivery with NF. Onshore ECC design: Number of onshore export cable circuits: up to 2 (with ducting for additional 2 circuits) Maximum Onshore ECC width: 90m. Onshore ECC length: 22 km. Maximum cable length: 24.5 km. Onshore cable installation: Trenches per circuit: 1. Maximum number of trenches for all cables / ducts: 4	The MDS includes the maximum number of cables anticipated and assumes disturbance throughout the onshore ECC area, therefore the greatest area of land disturbance.

Potential effect	Maximum Design Scenario Assessed	Justification
	Trench excavation: up to 4. Maximum trench width: 3.5 m at surface. Maximum trench depth: 2 m. <u>TCCs:</u> Number of TCC locations along the onshore ECC: 12. Number of main TCCs: 7. Number of minor TCCs: 5. Maximum cable construction compound TCC area: 45,000 m^2.	
TJBs Increase in flood risk and / or erosion risk.	<u>Based on Scenario 1 for onshore delivery with NF:</u> Maximum number of TJBs: 2 TJBs at landfall, 1 per export. TJB length: 20 m. TJB width: 5 m. Total construction landtake for TJBs: 150 x 75 m.	The MDS includes the maximum number of joint bays and total construction landtake is aligned with North Falls OWF construction metrics.

Potential effect	Maximum Design Scenario Assessed	Justification
Landfall Increase in risk of erosion.	Based on Scenario 1 for onshore delivery with NF: HDD compound dimensions: typically, 150 m x 75 m. Maximum depth of HDDs: 20 m. Maximum length of intertidal HDD: 750 m. Maximum length of subtidal HDD: 1,500 m.	The MDS includes the maximum number of cables anticipated at landfall and therefore, the maximum working corridor required. A number of access options for landfall are included in the MDS. A number of HDD lengths are included in the MDS.
Site access routes Increase in flood risk.	Based on Scenario 1 for onshore delivery with NF: Temporary access roads: Maximum construction landtake: 20 m in width.	The MDS includes the maximum anticipated landtake for construction and therefore the greatest area of disturbance to permanent and temporary access roads.
OnSS Increase in flood risk.	Based on Scenario 1 for onshore delivery with NF: Permanent area of the OnSS footprint (assumes an Air Insulated Switchgear (AIS) substation: 280 m x 210 m.	The MDS for flood risk at the OnSS requires the largest footprint for design resulting in the largest possible area of disturbance and largest potential for impermeable ground cover.

Potential effect	Maximum Design Scenario Assessed	Justification
Construction workers Increased safety risk due to changes in climate variables.	Offshore Construction safety zone radius: 500 m. Onshore Core construction working hours: 07:00 – 19:00 Monday to Saturday. Anticipated construction period: 18–27-month period.	500 m is the standard approach and judged to be a sensible precaution.
Project vessels Increase in risk of high winds, waves and storms.	Maximum number of construction vessels: Foundations vessels: 38. Export cable vessels: 12. Inter-array cable vessels: 12. WTG installation vessels: 10. Other installation vessels: 24. Maximum offshore vessels: 96.	The MDS includes the maximum total vessel offshore. It is unlikely that each of the packages 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 scenario.
Operation		
OnSS Increase of flood risk.	Based on Scenario 1 for onshore delivery with NF: Permanent area of the OnSS footprint (assumes an Air Insulated Switchgear (AIS) substation: 280 m x 210 m.	The MDS for flood risk at the OnSS requires the largest footprint for design resulting in the largest possible area of disturbance and largest potential for impermeable ground cover.

Potential effect	Maximum Design Scenario Assessed	Justification
Grid connection Risk of increased temperatures and transmission losses.	Based on Scenario 1 for onshore delivery with NF: Maximum installed WTGs: 79. Maximum project area: 128 km^2. Transmission voltage: Upto 275kV / 400 kV. HVAC cable technology: XLPE insultation.	The MDS includes all buildings and main earthworks at the new NG substation.
Onshore ECC Increase in flood risk and / or erosion risk.	Based on Scenario 1 for onshore delivery with NF: Onshore ECC design: Number of onshore export cable circuits: up to 2 (with ducting for additional 2 circuits) Onshore ECC width: 90m. Onshore ECC length: 22 km. Maximum cable length: 24.5 km.	The MDS includes the maximum number of cables anticipated and assumes disturbance throughout the onshore ECC area, therefore the greatest area of land disturbance.

Potential effect	Maximum Design Scenario Assessed	Justification
WTGs and OSPs and foundations in the array areas Risk of scouring or structural damage.	Maximum scour protection, including WTGs, OSPs and Met mast: 2,257,300 m^3. 79 WTG Gravity Based Monopile Structures: 1,209,300 m^3. OSP Gravity Based Monopile Structures: 148,100 m^3. Scour protection replenishment allowance: 20% (451,480m^3). T	The MDS includes materials in line with conventional scour protection that can be seen as the worst case scenario. Gravity base monopiles are included in the MDS as the worst case for scour protection.
WTGs Risk of changes in wind activity affecting power output.	Maximum number of large WTGs: 41 Maximum blade tip height above LAT (m): 399 m (395 m above MHWS) Maximum rotor diameter: 360 m. WTG type: horizontal axis. Number of rotor blades: 3. Minimum turbine spacing (centre to centre) (m): 830 m.	Wind turbine design may impact cut in and cut out thresholds. A number of options for wind turbine design are included in the MDS.
Maintenance workers	Typical number of expected additional direct full-time employees (FTEs): 16 core O&M team members, 14 technicians and 4 vessel crew.	Safe operating procedures apply to all employees involved in O&M phase, including direct FTEs and

Potential effect	Maximum Design Scenario Assessed	Justification
Increased safety risk due to changes in climate variables.	(will vary dependent on final WTG numbers / O&M strategy) Core onshore working hours: 07:00 – 19:00 Monday to Saturday.	indirect workers in the local area.
Project vessels Increase in risk of high winds, waves and storms.	Maximum peak number of operation vessels: peak 27 and annual round trips 1,776. Indicative peak vessels on-site simultaneously: peak 27. Lift vessels: Annual trips for small Jack Up Vessel: 9. Annual trips for large Jack Up Vessel: 8.	Peak number of O&M vessels operating on site at any given time. Represents a worse case with maximum vessel numbers for each vessel class.
Decommissioning		
OnSS Increase in flood risk.	Removal of the OnSS including any areas of hardstanding. No decision has yet been made regarding the final approach to decommissioning for landfall infrastructure (buried cables, TJB's, etc.) as it is recognised that industry best practice, rules and legislation change over time.	The MDS for flood risk on the surrounding environment during decommissioning is the removal of the OnSS. The change in surfacing and removal of attenuation storage associated with the OnSS could affect flood risk as it would take the natural environment a period of time to re-establish itself to provide natural attenuation.

1.8 MITIGATION

1.8.1 Various mitigation measures are embedded into the project design to minimise the impacts of GHG emissions as well as strengthen the resilience of VE to changes in the climate.

1.8.2 Climate change resilience measures embedded within VE been considered within the CCR assessment when determining the significance of potential effects. Where mitigation measures are in place, this has been noted in the mitigation column of Table 1.15, Table 1.16, and Table 1.17.

1.8.3 Further climate change resilience measures include the flood mitigation measures outlined in Volume 6, Part 3, Chapter 6: Hydrology and Flood Risk**.** Measures specifically relevant to climate change are outlined below:

> The proposed development incorporates a new surface water drainage system. The design of the drainage system incorporates an allowance for climate change to rainfall patterns over the lifespan of the development and will ensure that there is no change to the local hydrology or flood risk.

> Construction will be managed through principles set out in Volume 9, Chapter 21: CoCP. These measures include management of soil and earthwork activities, management of rainfall runoff in construction areas and principles for reinstatement. The outlined construction principles will be key to ensuring that the land remains resilient to future changes in rainfall runoff from climate change.

1.8.4 The mitigations contained in Table 1.14 are mitigation measures or commitments that have been identified and adopted as part of the evolution of the project design of relevance to the topic, these include project design measures, compliance with elements of good practice and use of standard protocols.

Table 1.14: Mitigation relating to Climate Change.

Project phase and parameter	Mitigation measures
General	
Project design	The development boundary selection was made following a series of constraints analyses, with the Array Area, offshore ECC, landfall zone, onshore ECC and onshore infrastructure including substation selected to ensure the impacts on the environment and climate are minimised as far as reasonably practical.
Project design and Route Selection	Design of key crossing points onshore (sea defence structures, main rivers, non-main and ordinary watercourses, roads, utilities etc.), include commitment to use trenchless techniques (such as HDD) to minimise the impact to key areas of sensitivity.
Site Selection	Avoidance of flood risk and interaction with aquifers including Flood Zones 2 and 3 and Source Protection Zones was considered as part of site selection process. Particularly the location of the onshore substation.

Cable Specification and Installation Plan (CSIP)	Development of, and adherence to, a Cable Specification and Installation Plan (CSIP), relating to the offshore ECC, post consent. The CSIP will set out appropriate cable burial depth in accordance with industry good practice, minimising the risk of cable exposure. The CSIP will also ensure that cable crossings are appropriately designed to mitigate environmental effects, these crossings will be agreed with relevant parties in advance of CSIP submission. The CSIP will be conditioned in the deemed Marine Licence. An Outline CSIP has been provided as part of this DCO Application (Volume 9, Report 12).
Cable Burial Risk Assessment (CBRA)	A detailed CBRA to enable informed judgements regarding burial depth to optimise the chance of cables remaining buried whilst seeking to limit the amount of sediment disturbance to that which is necessary. A preliminary CBRA is provided within Volume 9, Report 9).
Marine coordination for project vessels	Marine coordination will be implemented to manage project vessels and proximity to wildlife, as per the principles set out in the Navigation and Installation Plan (NIP) (Volume 9, Report 20: NIP) and Volume 9, Report 18.1: Working in Proximity to Wildlife. Advance warning and accurate location details of construction, maintenance and decommissioning operations, associated Safety Zones and advisory passing distances will be given via Notices to Mariners (NtM) and Kingfisher Bulletins and supplemented with VHF (very high frequency) radio broadcasts agreed with the Maritime & Coastguard Agency (MCA) in accordance with the construction and monitoring programme approved under deemed marine licence condition.
Construction	
Code of Construction Practice (CoCP)	The CoCP (Volume 9, Report 21: CoCP) is included as part of the DCO application. The CoCP includes measures covering: > Principles to minimise water within the trench and ensure ongoing drainage of surrounding land. > Management of soil and earthwork activities, management of rainfall runoff in construction areas and principles for reinstatement. > Safe storage and handling of fuel and other flammable liquids in accordance with applicable regulations. > Construction will be managed through principles set out in Volume 9, Report 21: CoCP. These measures include management of soil and earthwork activities, management of rainfall runoff in construction areas and principles for reinstatement. The outlined construction principles will be key to ensuring that the land remains resilient to future changes in rainfall runoff from climate change.

OnSS Surface Water Drainage	The design of the OnSS may result in the construction of low permeability surfacing, increasing the rate of surface water runoff from the site. A surface water drainage scheme is required to ensure the existing runoff rates to the surrounding water environment are maintained at pre-development rates. An outline surface water drainage scheme is provided as part of the OnSS FRA (Volume 5, Report 3.2).
Application for Safety Zones	The Applicant will apply for safety zones around the foundations and WTGs post consent including up to 500 m around ongoing activities during construction and up to 50 m for installed structures pre commissioning. Where appropriate, guard vessels will also be used 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. The avoidance areas around the ECC will be agreed with the relevant Shipping and Navigation stakeholders via the Navigation and Installation Plan (Volume 9, Chapter 20).
Operation	
General	Design parameters for project components are designed to accommodate maximum temperature scenarios
Scour Protection Plan	Development of a Scour Protection Plan (SPP) post consent, will consider the need for scour protection where there is the potential for scour to develop around wind farm infrastructure, including turbine and substation/ platform foundations and cables. The plan will be secured via a condition in the deemed Marine Licence.
Application for Safety Zones	An application will be made for safety zones post consent including up to 500 m around activities during major maintenance where necessary. Where appropriate, guard vessels will also be used 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.
Decommissioning	
Decommissioning Programme	A Decommissioning Programme will be developed to cover the decommissioning phase as required under Chapter 3 of the Energy Act 2004. As the decommissioning phase will be a similar process to the construction phase but in reverse (i.e., increased project vessels on-site, partially deconstructed structures) the mitigation measure will be similar to those for the construction phase. The Decommissioning Programme will be secured as a condition in the deemed Marine Licence.

1.8.5 Decommissioning practices will incorporate measures similar to the construction phase to minimise GHG emissions and improve climate resilience. Good practice measures would be employed during decommissioning and would be agreed with statutory authorities at the time of decommissioning through a decommissioning plan. The final approach to decommissioning has not yet been confirmed in recognition of the likelihood of changes to best-practice, rules, and legislation between now and the projected decommissioning phase of the project. Therefore, definite mitigation measures for this phase cannot be specified at this stage. However, a decommissioning plan, including a revised Code of Construction Practice (CoCP) would be required to be submitted prior to decommissioning and is secured in the Development Consent Order (DCO.). This will include mitigation measures designed to encourage lower-carbon and more climate resilient methods.

1.9 ENVIRONMENTAL ASSESSMENT: CONSTRUCTION PHASE

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.9.1 The construction phase is planned to take place over a three-year period between 2027 and 2030. The differences between the baseline conditions from 1981-2001 and the projected conditions for 2040 demonstrate that VE 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 VE 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.

1.9.2 The results of the CCR assessment for the construction phase are presented in Table 1.15. All identified effects were deemed to be of negligible significance for this phase of VE.

Table 1.15: CCR of VE during construction

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Onshore built assets and infrastructure.	Increased precipitation and frequency of heavy rainfall events.	Flooding of construction sites impacting excavation sites where trenching is used for ducts and cables.	Drainage measures with suitable allowance for predicted climate change will be incorporated into the works design, the CoCP sets out the principles to minimise water within the trench and ensure ongoing drainage of surrounding land. Where water enters the trenches during installation, this will be treated and discharged into local ditches or drains.	Low.	Negligible.	**Negligible.**
Onshore built assets and infrastructure.	Increased precipitation and frequency of heavy rainfall events.	Disruption to construction due to flooding of access routes restricting access for workers, machinery, and materials.	Sequencing of works will consider seasons where possible with ground works being targeted in summer months when precipitation levels are lower.	Low.	Negligible.	**Negligible.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Onshore built assets and infrastructure.	Sea level rise, wave height and storm surges.	Increased coastal erosion could impact construction works on landfall infrastructure such as the landfall HDDs , transition joint bays or onshore export cables.	Potential coastal erosion will be considered when selecting length of HDD and burial depths.	Low.	Negligible.	**Negligible.**
Onshore built assets and infrastructure.	Increased precipitation and increased temperatures.	Risk of land subsidence due to flooding or drought causing damage to onshore export cables.	Management of soil and earthwork activities, management of rainfall runoff in construction areas and principles for reinstatement are outlined in Volume 9, Chapter 22: Outline Landscape and Ecological Management Plan to ensure that the land remains resilient to future changes in rainfall. Specific mitigation measures, beyond good appropriate design for foundations and drainage, not in place due to how unlikely subsidence is to occur.	Low.	Negligible.	**Negligible.**
Drainage systems.	Increased precipitation	Overwhelming site and/or local drainage	Local agricultural irrigation systems reduce	Low.	Negligible.	**Negligible.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
	and frequency of heavy rainfall events.	systems leading to flooding of the OnSS and other onshore built assets.	the risk of flooding in the area. The OnSS design includes a surface water drainage system to manage rainfall runoff from the proposed OnSS. The design of the drainage system incorporates an allowance for climate change to rainfall patterns over the lifespan of the development and will ensure that there is no change to the local hydrology or flood risk.			
Drainage systems.	Increased precipitation and frequency of heavy rainfall events.	Risk of construction and excavation sites flooding due to overwhelmed drainage systems.	If and where excavation is needed, drainage measures will be incorporated into the works design, the principles of these are set out in Volume 9, Chapter 21: CoCP (secured by the DCO).	Low.	Negligible.	**Negligible.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Construction workers and site users.	Increased wind speed.	Increased safety risk during construction due to high winds.	Safe working practices will be employed for all construction activities.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased wave height.	Increased safety risk during construction due to high waves.	Safe working practices will be employed for all construction activities.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased temperatures and frequency of heat waves.	Heat exhaustion for construction workers.	Safe working practices will be employed for all construction activities.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased temperatures and frequency of heat waves.	Health and Safety risk due to increased possibility of fire e.g., due to overheating of fuel canisters.	Appropriate measures for safe storage and handling of fuel and other flammable liquids in accordance with applicable regulations are outlined in the Volume 9, Document 21: CoCP.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased precipitation, especially in winter months.	Increased risk of slips, trips, and falls.	Safe working practices will be employed for all construction activities.	Low.	Negligible.	**Negligible.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Construction workers and site users.	Increased precipitation, sea level rise, wave height and storm surges.	Risk of land subsidence due to increased precipitation and erosion of coastline posing health and safety risk to workers.	Safe working practices will be employed for all construction activities.	Low.	Negligible.	**Negligible.**

GREENHOUSE GAS ASSESSMENT

1.9.3 The construction phase of VE is broken down into life cycle stages for quantifying the carbon impacts, these are Raw Materials, Manufacturing, Transport and Installation. Further detail of the activities and materials included and the resultant impacts can be found in Volume 6, Part 4, Chapter 1, Annex 1.1, Section 1.3 and Section 1.4 respectively.

1.10 ENVIRONMENTAL ASSESSMENT: OPERATIONAL PHASE

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.10.1 The operational phase is planned to take place over a maximum 40-year period between 2030 and 2070. 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.

1.10.2 The results of the CCR assessment for the operation phase are presented in Table 1.16. One potential effect was deemed to be of moderate or major significance, therefore qualifying as ‘significant’. A summary of this effect and suggested mitigation measures, is provided in Section 1.14.

GREENHOUSE GAS ASSESSMENT

1.10.3 During the operation of VE, routine maintenance will be required, including trips to the OSP in order to keep VE in good working order throughout the lifetime. These transportation movements are summarised in Volume 6, Part 4, Chapter 1, Annex 1.1 Section 1.3.

1.10.4 It is anticipated VE will consume a relatively low level of grid electricity throughout operation across the lifetime and require routine replacement components and materials. Assumptions have been made regarding the level of consumption and hence carbon impacts. Further detail can be found in Volume 6, Part 4, Chapter 1, Annex 1.1, Section 1.3.

Table 1.16: CCR of VE during operation

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Onshore built assets and infrastructure.	Sea level rise, wave height and storm surges.	Coastal erosion from sea level rise could impact the integrity of landfall infrastructure such as the ducts installed using trenchless techniques (e.g. HDDs) and transition joint bays.	Potential coastal erosion will be considered when selecting length of HDD and burial depths.	Low.	Medium.	**Minor.**
Onshore built assets and infrastructure.	Sea level rise and increased precipitation.	Flooding could restrict access to landfall infrastructure and onshore export cables via jointing pits or cable-testing pits if maintenance such as fault testing is required.	Local agricultural irrigation systems reduce the risk of flooding in the area. Landfall HDD entry and exit points will have appropriate sealing flanges.	Medium.	Low.	**Minor.**
Onshore built assets and infrastructure.	Sea level rise.	If Essex County Council adopts a policy of managed realignment from 2055, tidal flooding may result in inundation of onshore infrastructure such as onshore export	As outlined in Volume 6, Part 3, Chapter 6: Hydrology & Flood Risk, Section 6.7, VE will ensure design of the cable route from landfall inland is cognisant of the	Low.	Low.	**Minor.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		cables and transition joint bays.	potential for managed realignment towards the end of the design life of the onshore cable. The cables and TJBs will take into account the potential for increased flood risk towards the end of the design life of the structure. If cables and TJBs were to become permanently submerged adjustments could be made to make them suitable for a submerged under water environment.			
Onshore built assets and infrastructure.	Sea level rise.	Saltwater intrusion due to sea level rise may damage onshore infrastructure such as the foundations of the OnSS.	Avoidance of flood risk and interaction with aquifers including Flood Zones 2 and 3 and Source Protection Zones was considered as part of site selection	Low.	Negligible.	**Minor.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
			process, reducing need for mitigation. Below ground infrastructure will be watertight and corrosion resistant by design.			
Onshore built assets and infrastructure.	Increased temperatures and frequency of heat waves.	Potential for some structures to fail to operate within original design parameters due to increased heat e.g., cables overheating which could increase transmission losses.	The design process considers the impact of climate change on maximum temperature capacity and ensures that appropriate parameters are in the design. It is also noted that times of peak energy production are likely to be correlated with periods of lower temperatures.	Low.	Low.	**Minor.**
Onshore built assets and infrastructure.	Increased temperatures.	Increased temperature of energy storage units requiring ventilation and cooling.	Large scale battery storage has been discounted from the OnSS design. Ongoing design planning will consider the impact of climate	Low.	Low.	**Minor.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
			change on maximum temperature capacity and ensure that appropriate parameters are in the design.			
Onshore built assets and infrastructure.	Increased temperatures and humidity.	Reducing the lifetime and performance of onshore infrastructure such as substation assets and onshore export cables.	The design process considers the impact of climate change on maximum temperature capacity and ensures that appropriate parameters are in the design.	Low.	Low.	**Minor.**
Onshore built assets and infrastructure.	Increased precipitation and increased temperatures.	Risk of land subsidence due to flooding or drought causing damage to onshore export cables.	Specific mitigation measures, beyond good appropriate design for foundations and drainage as outlined in Volume 9, Chapter 21: CoCP, are not in place due to how unlikely subsidence is to occur.	Low.	Negligible.	**Negligible.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Offshore built assets and infrastructure.	Increased wind speed.	Disruption to energy production due to high wind speed above the cut-out wind speed (Table 1.10 shows a projected decrease in annual wind speed at 10m to an average of 4.16 (m s-1) in 2040 (equivalent to9.30 mph) and 4.14 (m s-1) in 2070 (equivalent to 9.26 mph).	Wind turbine power curves and rotor diameter can be varied to suit different wind regimes. Project design has not yet been finalised so that final wind turbine choice can consider predicted changes in windspeeds and take advantage of expected technology developments.	Low.	Negligible.	**Negligible.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Offshore built assets and infrastructure.	Decreased wind speed.	Disruption to energy production due to low wind speed below the cut-in wind speed (Table 1.10shows a projected decrease in annual wind speed at 10m to an average of 4.16 (m s-1) in 2040 (equivalent to 9.30 mph) and 4.14 (m s-1) in 2070 (equivalent to 9.26 mph).	Wind turbine power curves and rotor diameter can be varied to suit different wind regimes. Project design has not yet been finalised so that final wind turbine choice can consider likely decreases in future wind speeds and take advantage of expected technology developments.	Low	Medium.	**Minor.**
Offshore built assets and infrastructure.	Increased humidity.	Increased humidity combined with saltwater in the offshore environment could accelerate corrosion, formation of condensation, and mould/microbial contamination, damaging the WTGs.	The WTGs and Foundations will have corrosion protection and cathodic protection systems to control and limit corrosion. In addition, WTGs typically have internally dehumidification systems.	Low.	Medium.	**Minor.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Offshore built assets and infrastructure.	Increased wind speed and wave height.	Fatigue damage from loading may result in structural failure due to the propagation of small cracks over the design life of an WTG or Foundation, 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. Overall average wind speeds are predicted to decrease so while higher extremes may need considered in fatigue the impact is likely to be low.	Low.	Negligible.	**Negligible.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Offshore built assets and infrastructure.	Increased wave height and tidal variability.	Exacerbation of scouring on offshore foundations.	Scour around foundations to be mitigated by the use of scour protection measures where assessed as required during design. Routine inspections will be carried out and repair / replenishment of scour protection has been considered in the MDS.	Low.	Low.	**Minor.**
Offshore built assets and infrastructure	Sea level rise and increased wave height	Greater environmental loads due to the increased heights at which tidal and wave loads act on the structures.	Predicted sea level rise across the lifetime of VE is accounted for in the design process.	Negligible	Low	**Negligible**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Drainage systems.	Increased precipitation and frequency of heavy rainfall events.	Overwhelming site and / or local drainage systems leading to flooding of the OnSS and other onshore built assets.	The drainage system included in the OnSS Mitigation zone is designed to mitigate flooding, and the design of this will consider likely changes in values due to climate change. Local agricultural irrigation systems also reduce the risk of flooding in the area.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased wind speed.	Increased safety risk during O&M due to high winds.	Safe working practices will be employed for all O&M activities.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased wave height.	Increased safety risk in relation to O&M procedures due to high waves.	Safe working practices will be employed for all O&M activities.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased temperatures and frequency of heat waves.	Increased risk of heat exhaustion for workforce, including regular site users and construction workers involved in O&M.	Safe working practices will be employed for all O&M activities.	Low.	Low.	**Minor.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Construction workers and site users.	Increased precipitation, especially in winter months.	Increased risk of slips, trips, and falls.	Safe working practices will be employed for all O&M activities.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased temperatures and frequency of heat waves.	Health and Safety risk due to increased possibility of fire e.g., due to overheating of fuel canisters.	Appropriate measures for safe storage and handling of fuel and other flammable liquids in accordance with applicable regulations are outlined in Volume 9, Document 21: CoCP.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased precipitation, sea level rise, wave height and storm surges.	Risk of land subsidence due to increased precipitation and erosion of coastline posing health and safety risk to workers undertaking maintenance work.	Safe working practices will be employed for all O&M activities.	Low.	Low.	**Minor.**

1.11 ENVIRONMENTAL ASSESSMENT: DECOMMISSIONING PHASE

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.11.1 The decommissioning phase is planned to take place over a one-year period. For the purposes of the CCR assessment, this is assumed to be between 2070 and 2071. 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 VE.

1.11.2 The results of the CCR assessment for the decommissioning phase are presented in Table 1.17. The identified effects were deemed to be of negligible to minor significance for this phase of VE.

GREENHOUSE GAS ASSESSMENT

1.11.3 It is anticipated that the wind turbine infrastructure will require transportation at the end of life, to the location of recycling or disposal. 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 6, Part 4, Chapter 1, Annex 1.1, Section 1.3.

Table 1.17: CCR of VE during decommissioning

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Onshore built assets and infrastructure.	Sea level rise, wave height and storm surges.	Coastal erosion from sea level rise could impact the integrity of landfall infrastructure such as the ducts installed using trenchless techniques (e.g. HDDs) and transition joint bays, potentially disrupting decommissioning works.	Potential coastal erosion will be considered when selecting length of HDD and burial depths.	Low.	Medium.	**Minor.**
Onshore built assets and infrastructure.	Sea level rise and increased precipitation.	Flooding could restrict access to landfall infrastructure and onshore export cables during decommissioning works.	Local agricultural irrigation systems reduce the risk of flooding in the area. Decommissioning will be undertaken in accordance with best practice guidelines at the time and will include appropriate drainage measures.	Medium.	Low.	**Minor.**
Onshore built assets and infrastructure.	Increased precipitation and increased temperatures.	Risk of land subsidence due to flooding or drought causing damage to onshore export cables	Specific mitigation measures beyond good appropriate design for foundations and drainage not in place due to	Low.	Negligible.	**Negligible.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		and disrupting decommissioning works.	how unlikely subsidence is to occur. Decommissioning will be undertaken in accordance with best practice guidelines at the time and will include appropriate measures to manage soil and earthwork activities, rainfall runoff and reinstatement			
Offshore built assets and infrastructure.	Increased humidity.	Increased humidity combined with saltwater in the offshore environment could accelerate corrosion, formation of condensation, and mould/microbial contamination, damaging the WTGs. If WTGs are eroded or damaged, ease of removal may be impacted.	The WTGs and foundations will have corrosion protection and cathodic protection systems to control and limit corrosion. In addition, WTGs typically have internally dehumidification systems.	Low.	Medium.	**Minor.**
Offshore built assets and infrastructure.	Increased wave height and tidal variability.	Exacerbation of scouring on offshore foundations may weaken stability of	Scour around foundations to be mitigated by the use of scour protection measures, where assessed as required	Low.	Low.	**Minor.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
		foundations impacting ease and safety of removal.	during design. Routine inspections will be carried out and repair / replenishment of scour protection has been considered in the MDS. Decommissioning will be undertaken in accordance with best practice guidelines at the time and will take into consideration updated climate projections when considering appropriate scour decommissioning options.			
Drainage systems.	Increased precipitation and frequency of heavy rainfall events.	Risk of decommissioning and excavation sites flooding due to overwhelmed drainage systems.	As with construction, if and where excavation is needed, drainage measures will be incorporated into the works design, the principles of these are set out in Volume 9, Report 21: CoCP (secured by the DCO).	Low.	Negligible.	**Negligible.**
Construction workers and site users.	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.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
Construction workers and site users.	Increased wave height.	Increased safety risk in relation to decommissioning procedures due to high waves.	Safe working practices will be employed for all decommissioning activities.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased temperatures and frequency of heat waves.	Increased risk of heat exhaustion for workforce, including regular site users and construction workers involved in decommissioning.	Safe working practices will be employed for all decommissioning activities.	Low.	Low.	**Minor.**
Construction workers and site users.	Increased precipitation, especially in winter months.	Increased risk of slips, trips, and falls.	Safe working practices will be employed for all decommissioning activities.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased temperatures and frequency of heat waves.	Health and Safety risk due to increased possibility of fire e.g., due to overheating of fuel canisters.	Appropriate measures for safe storage and handling of fuel and other flammable liquids will be undertaken in accordance with applicable regulations and best practice guidelines at the time.	Low.	Negligible.	**Negligible.**
Construction workers and site users.	Increased precipitation, sea level rise,	Risk of land subsidence due to increased precipitation	Safe working practices will be employed for all decommissioning activities.	Low.	Low.	**Minor.**

Receptor	Climate variable(s)	Potential Impact	Mitigation	Sensitivity	Magnitude	Significance
	wave height and storm surges.	and erosion of coastline posing health and safety risk to workers undertaking decommissioning work.				

1.12 ENVIRONMENTAL ASSESSMENT: CUMULATIVE EFFECTS

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.12.1 It is recognised that, when considered in conjunction with neighbouring renewable energy projects, such as the North Falls OWF, VE 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 VE 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

1.12.2 Cumulative Effects in relation to GHGs do not require an assessment.

1.13 INTER-RELATIONSHIPS

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

1.13.1 Interrelated effects refer to the potential interaction between multiple impacts on one receptor. 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.

1.13.2 As noted in Section 1.3under 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).

GREENHOUSE GAS ASSESSMENT

1.13.3 The Inter-relationships in relation to GHGs do not require an assessment.

1.13.4 Initial research for the assessment included a series of consultations held with experts from topic areas included elsewhere in the ES to confirm the likely environmental effects already identified throughout the EIA process. In addition to considering effects already identified, topic leads were encouraged to consider whether future climate conditions could result in completely new effects arising during construction, operation, and decommissioning phases. UKCP18 projections on future baseline conditions, as presented in Section 1.6, 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.

1.13.5 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 6, Part 2, Chapter 9: Shipping and Navigation.
- Volume 6, Part 2, Chapter 12: Other Marine Users and Activities.
- Volume 6, Part 2, Chapter 13: Military and Civil Aviation.
- Volume 6, Part 3, Chapter 3: Socioeconomics, Tourism and Recreation.
- Volume 6, Part 3, Chapter 8: Traffic and Transport.
- Volume 6, Part 3, Chapter 9: Airborne Noise and Vibration.
- Volume 6, Part 3, Chapter 10: Air Quality.

1.13.6 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 6, Part 2, Chapter 2: Physical Processes.
- Volume 6, Part 2, Chapter 3: Marine Water and Sediment Quality.
- Volume 6, Part 2, Chapter 4: Offshore Ornithology.
- Volume 6, Part 2, Chapter 5: Benthic Ecology.
- Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.
- Volume 6, Part 2, Chapter 7: Marine Mammals.
- Volume 6, Part 2, Chapter 8: Commercial Fisheries.
- Volume 6, Part 2, Chapter 10: Seascape, Landscape and Visual Impact Assessment.
- Volume 6, Part 2, Chapter 11: Offshore Archaeology and Cultural Heritage.
- Volume 6, Part 3, Chapter 2: Landscape and Visual Impact Assessment.
- Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation.
- Volume 6, Part 3, Chapter 5: Ground Conditions and Land Use.
- Volume 6, Part 3, Chapter 6: Hydrology and Flood Risk
- Volume 6, Part 3, Chapter 7: Onshore Archaeology and Cultural Heritage.

1.13.7 As explained in Section 1.8, mitigation measures are considered when assigning the significance of an effect. The relevant mitigation measures for each topic area are outlined in the correlating topic chapter.

1.13.8 The outcomes of the ICCI assessment are presented in Table 1.18. 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 1.6indicate 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 1.18: ICCI Assessment of VE across its lifetime

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes.	Coast Annex I offshore sandbanks. Seabed areas contained within nationally or internationally important sites.	Sea level rise, storm surges, & wave height.	Changes in sand bank morphology, combined with coastal defences, may result in loss of inter-tidal habitats.	No changes limited changes to physical processes indicated, therefore no higher level of significance associated with effects on habitat availability.
Volume 6, Part 2, Chapter 3: Marine Water and Sediment Quality.	Water and sediment quality. Bathing waters.	Increased temperatures. Increased precipitation. Increased wind speeds.	Increase of contaminant concentrations in the water column. Affecting freshwater inputs to the marine environment. Affecting water clarity through changes in suspended particulate matter.	No change as limited changes to physical processes indicated, 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.

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 2, Chapter 4: Offshore Ornithology.	Terrestrial sea birds. Marine sea birds.	Increased temperatures. Increased wind speed.	Affecting hatching success, chick growth and chick survival. Affecting ability of adult birds to forage successfully.	No change, VE 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 breeding success are likely to be relatively minor, with no higher level of significance expected.
Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology.	Sub-tidal and inter-tidal receptors. Ecological receptors e.g., sediment type. Designated site features e.g., sandbanks.	Increased temperatures. Sea level rise, storm surges & wave height.	Increased temperatures combined with decreases in PH levels may result in loss of habitat and place negative pressure on native species. Changes to sea levels and wave climate may increase pressures on intertidal habitats and native species through long term changes to habitat morphology.	No change as habitat cycles are shorter than long-term climate change effects.

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.	Valued ecological fish and shellfish. Designated site features (e.g., native oyster).	Increased temperatures. Sea level rise, storm surges & 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 rely on brackish water for survival.	No change as 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 temperature ranges and shifts in food availability therefore there is no change in significance.

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 2, Chapter 7: Marine Mammals.	Harbour porpoise. Grey seal. Harbour seal.	Increased temperatures. Sea level rise, storm surges & wave height.	Temperature increases may lead to geographic range shifts resulting in increased predation and competition risks and impacting prey availability. Changes in sea levels, storminess and wave height may limit haul-out sites for seals and pups.	No change as species range shifts over 10 to 25 years so it is not anticipated that there would be any change in marine mammal distribution during construction or operation and maintenance.
Volume 6, Part 2, Chapter 8: 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. Increased storminess could impact fishing activity in the study area e.g., by changing seasonal fishing patterns.	No change as habitat cycles and seasonal fishing patterns are shorter than long-term climate change effects.

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 2, Chapter 10: Seascape, Landscape and Visual Impact Assessment.	Seascape, landscape and visual receptors.	Increase in winter precipitation and decrease in summer precipitation. Increased temperatures and heat wave frequency. Sea level rise and heavy rainfall events.	Frequency of visibility of the VE array at distance offshore may decrease during periods with increased precipitation and/or storm intensity. The effects of VE are assessed in optimum visibility conditions to ensure the worst-case is assessed. Flooding could impact the character of the coast and seascape.	No change as projected climate impacts are considered unlikely to exacerbate or reduce the visual effects of the VE to any notable degree.

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 2, Chapter 11: Offshore Archaeology and Cultural Heritage.	Marine heritage receptors e.g., shipwrecks, historic seascape characterisation, palaeolandscapes.	Sea level rise. Temperature increase. Storm surges & wave height.	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 project.

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 3, Chapter 2: Landscape and Visual Impact Assessment.	Vegetation e.g., hedgerows or trees. Landscape character. People / visual amenity e.g., settlements, roads, rights of way.	Increased winter precipitation and decreased summer precipitation. Increased temperatures.	Changes in winter and summer precipitation levels may affect vegetation cover that contributes to the landscape character and provides visual screening of the VE array. Potential impact to growth and survival rates of vegetation used as part of the mitigation planting.	No change as flooding and drought events are mitigated by artificial irrigation of agricultural landscape and a mitigation planting management plan.

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation.	Coastal plants and wildlife.	Increased winter precipitation and decreased summer precipitation. Increased temperatures. Increased wind speed. Sea level rise, storm surges & wave height.	Warmer, wetter winters and hotter, drier summers could result in loss of species on the southern edge of their range and gain of more southern species expanding their range northwards. Waterbodies and habitats could be impacted by drought in summer periods. Increased wind speeds and storm events could cause damage to woodland habitats or mature trees. Sea level rise and coastal erosion could impact coastal plants and wildlife if their ability to move inland is prevented by urban land or flood defences.	No change as any negative impacts will likely take place during construction and therefore the medium- to longer-term climate effects are unlikely to result in measurable biodiversity changes locally.

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 3, Chapter 5: Ground Conditions and Land Use.	Soils. Humans.	Increased precipitation. Increased wind speeds. Increased temperatures. Sea level rise.	Heavy precipitation may result in waterlogging and soil compaction affecting soil health and exacerbating the mobilisation of contaminants. The combination of increased temperatures and wind speeds could exacerbate the generation of dust, mobilising contaminants. Impacts of higher temperatures on vegetation cover could result in a reduction of soil carbon stocks, resulting in emissions.	No change due to very managed landscape and farming processes moderating climate impacts such as soil quality and resource**.**

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 3, Chapter 6: Hydrology and Flood Risk.	Agricultural land. Coastal area.	Increased precipitation. Sea level rise, storm surges & wave height.	Increased rainfall and flooding may result in changes to the landscape character, e.g. changes to fluvial systems or local geomorphology. Sea level rise combined with increases in storminess and wave height may place additional pressure on coastal defences, putting inland areas at increased risk of flooding during extreme tidal events.	No change due to a well-managed landscape and existing irrigation systems. Additional mitigation measures will further moderate climate impacts such as increased drought and flood risks.

EIA Topic	Receptor(s)	Climate variable(s)	Potential Impact	Change in Significance
Volume 6, Part 3, Chapter 7: Onshore Archaeology and Cultural Heritage.	Foreshore assets. Built heritage. Buried archaeological remains.	Sea level rise & storm surges. Increased temperatures.	Coastal erosion could result in built heritage assets falling into the sea or affect estuaries and rivers where buried remains could be located. Changes in tidal activities could expose buried foreshore assets, leading to drying out of assets. Temperature rise could increase the risk of fire affecting built heritage assets onshore.	No change, any medium- and long-term climate impacts to cultural assets are unlikely to be realised during the lifetime of the project.

1.14 SUMMARY OF EFFECTS

CLIMATE VULNERABILITY AND RESILIENCE ASSESSMENT

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

1.14.2 The approach taken was based upon the Institute of Environmental Management and Assessment (IEMA) EIA Guide to Climate Change Resilience and Adaptation (IEMA, 2020), and the requirements of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (DCLG, 2017),

1.14.3 A summary of the assessment outcomes is provided in Table 1.19 below. As concluded in the table, when considering the mitigation outlined in Table 1.14the assessed significance of the identified effects varies from minor adverse to negligible. Overall, all identified effects across construction, operation, and decommissioning, are considered to be **not significant** in terms of the EIA regulations.

1.14.4 Furthermore, the outcomes of the ICCI assessment, as summarised in Section 1.13, conclude that climate change is not likely to affect the conclusions made by other chapters contained within this ES.

Table 1.19: Summary of effects for climate change

Description of impact	Effect	Additional mitigation measures	Residual effect
Construction			
Impact 1: Potential flooding of construction sites impacting excavation sites where trenching is used forducts and cables.	Negligible (adverse)	Not Applicable – no additional mitigation identified.	No significant adverse residual effects
Impact 2: Potential disruption to construction due to flooding of access routes restricting access for workers, machinery, and materials.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 3: Increased coastal erosion could impact construction works on landfall infrastructure such as the landfall HDDs, transition joint bays or onshore export cables.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 4: Risk of land subsidence due to flooding or drought causing damage to onshore export cables.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 5: Risk of overwhelming site and/or local drainage systems leading to flooding of the OnSS and other onshore built assets.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 6: Risk of construction and excavation sites flooding due to overwhelmed drainage systems.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 7-9: Increased safety risk during construction due to high winds/high waves/heat exhaustion	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 10: Health and Safety risk due to increased possibility of fire e.g., due to overheating of fuel canisters.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 11: Increased risk of slips, trips, and falls.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 12: Risk of land subsidence due to increased precipitation and erosion of coastline posing health and safety risk to workers.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Operation			
Impact 13: Coastal erosion from sea level rise could impact the integrity of landfall infrastructure such as the landfall HDDs and transition joint bays.	Minor (adverse)	Not Applicable – no additional mitigation identified.	No significant adverse residual effects
Impact 14: Flooding could restrict access to landfall infrastructure and onshore export cables via jointing pits or cable-testing pits if maintenance such as fault testing is required.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 15: If Essex County Council adopts a policy of managed realignment from 2055, tidal flooding may result in inundation of onshore infrastructure such as onshore export cables and transition joint bays.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 16: Saltwater intrusion due to sea level rise may damage onshore infrastructure such as the foundations of the OnSS.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 17: Potential for some structures to fail to operate within original design parameters due to increased heat e.g., cables overheating which could increase transmission losses.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 18: Potential for increased temperature of energy storage units to require additional ventilation and cooling.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 19: Potential to reduce the lifetime and performance of onshore infrastructure such as substation assets and onshore export cables due to increased temperatures and humidity.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 20: Risk of land subsidence due to flooding or drought causing damage to onshore export cables.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 21: Disruption to energy production due to high wind speed above the cut-out wind speed.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 21: Disruption to energy production due to decrease in wind speed below the cut-in wind speed.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 22: Increased humidity combined with saltwater in the offshore environment could accelerate corrosion, formation of condensation, and mould/microbial contamination, damaging the WTGs.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 23: Fatigue damage from loading may result in structural failure due to the propagation of small cracks over the design life of an WTG or Foundation, which could grow to a critical size, threatening the integrity of the structure.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 24: Potential exacerbation of scouring on offshore foundations due to increased wave height.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 25: Greater environmental loads due to the increased heights at which tidal and wave loads act on the structures.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 26: Potential for increased precipitation and frequency of heavy rainfall events to Overwhelm site and / or local drainage systems leading to flooding of the OnSS and other onshore built assets.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 27-30: Increased health and safety risk due to high winds/high waves/heat waves/increased precipitation	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 31: Increased health and safety because of increased temperatures and frequency of heatwaves due to increased possibility of fire e.g., due to overheating of fuel canisters.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 32: Risk of land subsidence due to increased precipitation and erosion of coastline	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
posing health and safety risk to workers undertaking maintenance work.			
Decommissioning			
Impact 33:Coastal erosion from sea level rise could impact the integrity of landfall infrastructure such as the HDDsand transition joint bays, potentially disrupting decommissioning works.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 34: Flooding because of sea level rise could restrict access to landfall infrastructure and onshore export cables during decommissioning works.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 35: Risk of land subsidence due to flooding or drought causing damage to onshore export cables and disrupting decommissioning works.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 36: Increased humidity combined with saltwater in the offshore environment could accelerate corrosion, formation of condensation, and mould/microbial contamination, damaging the WTGs. If WTGs are eroded or damaged, ease of removal may be impacted.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 37: Risk of decommissioning and excavation sites flooding due to overwhelmed drainage systems.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 38-40: Increased safety risk during decommissioning due to high winds/high waves/heatwaves.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 41: Increased risk of slips, trips, and falls due to increased precipitation, especially in winter months.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 42: Increased health and safety risk due to higher temperatures increasing the possibility of fire e.g., due to overheating of fuel canisters.	Negligible (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 42: Risk of land subsidence due to increased precipitation and erosion of coastline posing health and safety risk to workers undertaking decommissioning work.	Minor (adverse)	Not Applicable – no additional mitigation identified	No significant adverse residual effects
In-Combination Climate Impacts			
Impact 42: Changes in sand bank morphology, combined with coastal defences, may result in loss of inter-tidal habitats.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 43: Increase of contaminant concentrations in the water column. Affecting freshwater inputs to the marine environment. Affecting water clarity through changes in suspended particulate matter.	No change.	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 44: Increase of contaminant concentrations in the water column. Affecting freshwater inputs to the marine environment. Affecting water clarity through changes in suspended particulate matter.	No change.	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 45: Affecting hatching success, chick growth and chick survival. Affecting ability of adult birds to forage successfully. Increased temperatures combined with decreases in PH levels may result in loss of habitat and place negative pressure on native species. Changes to sea levels and wave climate may increase pressures on intertidal habitats and native species through long term changes to habitat morphology.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 46: Increased temperatures combined with decreases in PH levels may result in loss of habitat and place negative pressure on native species. Changes to sea levels and wave climate may increase pressures on intertidal habitats and native species through long term changes to habitat morphology.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 47: 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 rely on brackish water for survival.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 48: Temperature increases may lead to geographic range shifts resulting in increased predation and competition risks and impacting prey availability. Changes in sea levels, storminess and wave height may limit haul-out sites for seals and pups. Frequency of visibility of the VE array at distance offshore may decrease during periods with increased precipitation and/or storm intensity. The effects of VE are assessed in optimum visibility conditions to ensure the worst-case is assessed. Flooding could impact the character of the coast and seascape.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 49: 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	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 50: Changes in winter and summer precipitation levels may affect vegetation cover that contributes to the landscape character and provides visual screening of the VE array. Potential impact to growth and survival rates of vegetation used as part of the mitigation planting.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 51: Warmer, wetter winters and hotter, drier summers could result in loss of species on the southern edge of their range and gain of more southern species expanding their range northwards. Waterbodies and habitats could be impacted by drought in summer periods.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Increased wind speeds and storm events could cause damage to woodland habitats or mature trees. Sea level rise and coastal erosion could impact coastal plants and wildlife if their ability to move inland is prevented by urban land or flood defences.			
Impact 52: Heavy precipitation may result in waterlogging and soil compaction affecting soil health and exacerbating the mobilisation of contaminants. The combination of increased temperatures and wind speeds could exacerbate the generation of dust, mobilising contaminants. Impacts of higher temperatures on vegetation cover could result in a reduction of soil carbon stocks, resulting in emissions.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Impact 53: Increased rainfall and flooding may result in changes to the landscape character, e.g. changes to fluvial systems or local geomorphology. Sea level rise combined with increases in storminess and wave height may place additional pressure on coastal defences, putting inland areas at increased risk of flooding during extreme tidal events.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects

Description of impact	Effect	Additional mitigation measures	Residual effect
Impact 54: Coastal erosion could result in built heritage assets falling into the sea or affect estuaries and rivers where buried remains could be located. Changes in tidal activities could expose buried foreshore assets, leading to drying out of assets. Temperature rise could increase the risk of fire affecting built heritage assets onshore.	No change	Not Applicable – no additional mitigation identified	No significant adverse residual effects
Construction, operation and decommissioning			
GHG Emissions during construction, O&M and decommissioning	Beneficial	Not Applicable - effect is beneficial	Not Applicable

GREENHOUSE GAS ASSESSMENT

1.14.5 VE is anticipated to generate electricity with a carbon intensity of 18.6g/kWh for the best case and 32.8g/kWh for the worst case, compared to the current marginal mix in the UK of Gas derived electricity with a carbon intensity of 371g/kWh. Overall, for both the Best- and Worst-Case scenarios VE is deemed to be of beneficial significance regarding reduction of emissions compared to the baseline scenarios of Gas (Combined Cycle Gas Turbine) (CCGT) and non-renewable derived electricity.

1.14.6 As detailed in Volume 6, Part 4, Chapter 1, Annex 1.1, Section 1.4, VE Best Case scenario would result in net emission reductions compared to the project baseline scenarios of 71MTCO_2e (Gas CCGT) or 82MTCO_2e (all non-renewables). VE Worst Case scenario would result in net emission reductions compared to the project baseline scenarios of 41MTCO_2e (Gas CCGT) and 48MTCO_2e (all non-renewables). VE will provide a renewable source of electricity which will beneficially contribute to the UK's goal of achieving net zero carbon emissions by 2050. Consequently, the effects of VE are deemed to be of beneficial significance regarding the reduction of GHG emissions, when compared to the above described baseline scenarios, as shown in Table 1.19 above, in accordance with the IEMA guidance (2022) significance matrix detailed by Table 1.8. This is considered to be significant in EIA terms.

1.14.7 The complete GHG assessment of VE can be found in Volume 6 Part 4, Chapter 1, Annex 1.1.

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