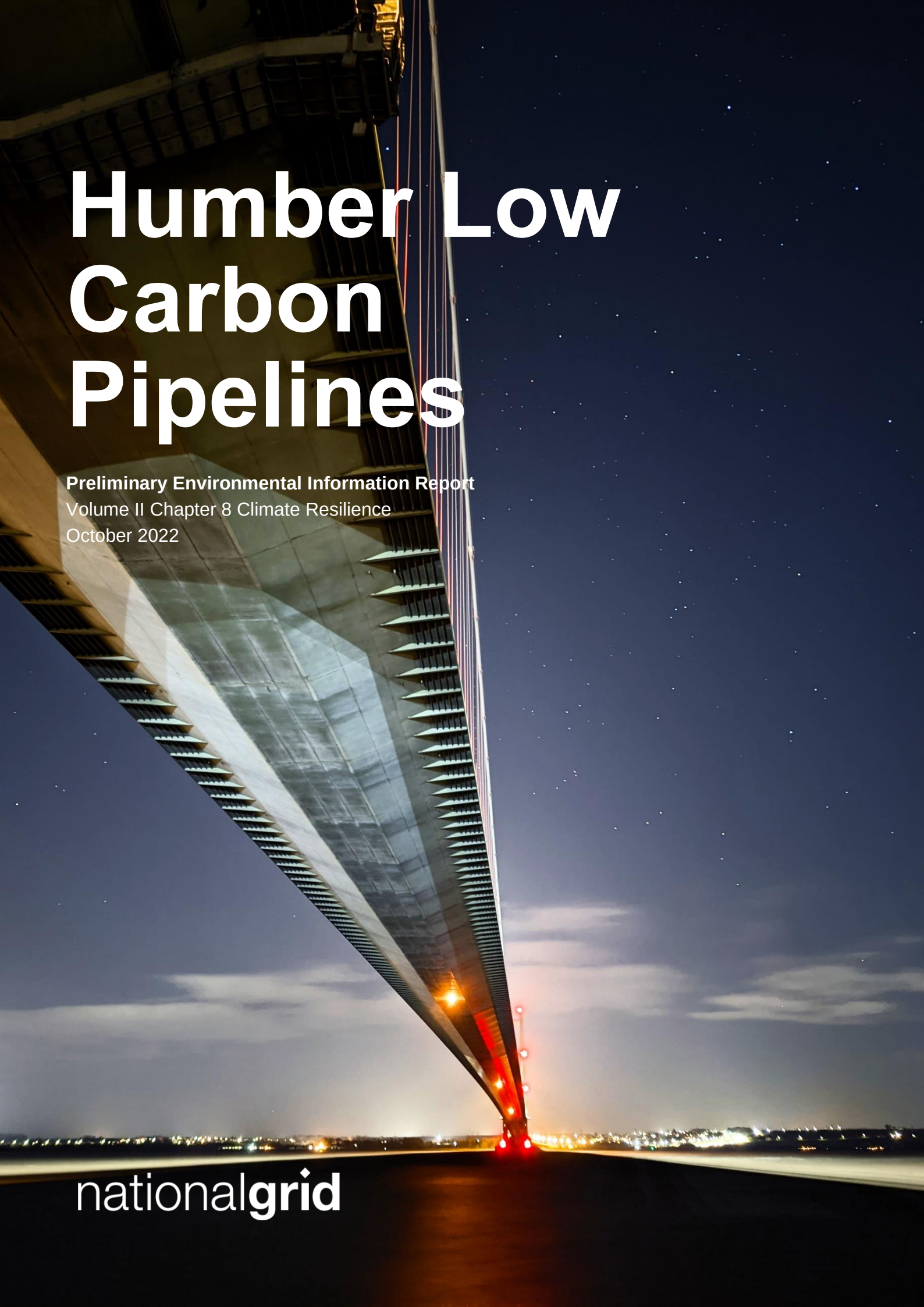


Humber Low Carbon Pipelines

Preliminary Environmental Information Report

Volume II Chapter 8 Climate Resilience

October 2022

nationalgrid

Contents

8. Climate Resilience

8.1 Introduction

8.1.1 This Chapter reports the results of the preliminary assessment of the potential impacts and effects of the Project on Climate Resilience and describes:

- Relevant, legislation, policy and guidance;
- Engagement undertaken to date;
- The proposed assessment methodology and associated significance criteria;
- Preliminary baseline conditions;
- Potential impacts of construction, operation, and decommissioning;
- Potential design, mitigation, and enhancement measures;
- Summary of the preliminary assessment of potential significant effects; and
- Next steps.

8.1.2 This assessment considers the simultaneous construction of a dual pipeline system (one for carbon dioxide and one for hydrogen), as well as the associated Above Ground Installations (AGIs). The majority of the carbon dioxide pipeline will be up to 600 mm (24”) nominal diameter and the hydrogen pipeline will be up to 900 mm (36”) nominal diameter. This is referred to as the Base Case in this Preliminary Environmental Information Report (PEIR). Also under consideration is the possibility of deploying a larger carbon dioxide pipeline, with a diameter up to 750 mm (30”) (with the hydrogen pipeline remaining the same diameter as within the Base Case). This is referred to in this PEIR as Sensitivity 1. Further details regarding the Base Case and Sensitivity 1, as well as the diameter and capacity of the pipelines are provided in Sections 2.3 and 2.4 of Chapter 2: Project Description (Volume II). This chapter assesses the impacts and effects associated with the Base Case. It is anticipated that the types of potential impacts for the Base Case and Sensitivity 1 will be the same, although the magnitude of impacts may differ. A full assessment of Sensitivity 1 will be undertaken and recorded within the Environmental Statement (ES) if the larger carbon dioxide pipeline diameter is taken forward into the Development Control Order (DCO) application.

8.1.3 This Chapter is intended to be read as part of the wider PEIR.

8.2 Legislation, policy and guidance

8.2.1 A summary of the international, national, and local legislation, planning policy and guidance relevant to the climate resilience assessment for the Project is set out below.

Legislation

The Climate Change Act 2008 (2019 Amendment) (Ref 8.1)

8.2.2 This Act sets up a framework for the UK to achieve its long-term goals of reducing Greenhouse Gas (GHG) emissions by 100% from 1990 baseline by 2050, with intermediate goals set by the UK Carbon Budgets, and to ensure steps are taken towards adapting to the impact of climate change. The Act introduces a requirement for the UK Government to develop an adaptation programme, and provides guidance on implementing mitigation measures.

8.2.3 The UK Government has published a list of those bodies that must report under the reporting power. This includes transport bodies, energy and water utilities, and environmental agencies, and therefore applies to this Project.

Policy

Overarching National Policy Statement for Energy (EN-1) (Ref 8.2)

8.2.4 This National Policy Statement (NPS) sets out national policy for energy infrastructure. It affects decisions made by the Secretary of State on applications for energy developments that are nationally significant under the Planning Act 2008. The NPS states that if new energy infrastructure is not sufficiently resilient against the impacts of climate change it will not be able to satisfactorily meet energy needs. A series of UK Climate Projects, and a statutory National Adaptation Programme, has been produced to assist in resilience-based planning decisions. The Planning Inspectorate should be satisfied that the Applicant has taken sufficient measures to reduce the impacts of climate change, to ensure the operation of the infrastructure over its expected lifetime.

Draft Overarching National Policy Statement for Energy (EN-1) (Ref 8.3)

8.2.5 This policy statement includes a requirement that all proposals for energy infrastructure projects should assess the impacts on and from their proposed energy project across a range of climate change scenarios, in line with appropriate expert advice and guidance available at the time. Applicants should be able to demonstrate that proposals have a high level of climate resilience built-in from the outset. They should also be able to demonstrate how proposals can be adapted over their predicted lifetimes to remain resilient to a credible maximum climate change scenario. These results should be considered alongside relevant research which is based on the climate change projections.

National Planning Policy Framework (NPPF) 2021 (Ref 8.4)

8.2.6 The NPPF sets out Government planning policy for England and describes ways in which the challenge of climate change can be met. Chapter 10 of the NPPF highlights that planning plays a key role in mitigation against climate change. The Policy also includes requirements that local authorities adopt proactive strategies to mitigate and adapt to climate change in line with the provisions and objectives of the Climate Change Act 2008 and co-operate to deliver strategic priorities which include climate change. The policy also states that local authorities should:

- Adopt proactive strategies to mitigate and adapt to climate change taking full account of flood risk, coastal change and water supply and demand considerations;

- Limit inappropriate development in areas at risk of flooding, but where development is necessary, making it safe without increasing flood risk elsewhere;
- Support the move to a low carbon future, by supporting energy efficient improvements to existing buildings and set out requirements consistent with zero carbon building policy; and
- Help to increase the use and supply of renewable and low carbon energy.

8.2.7 The policy also avails radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to impacts of climate change, and support the delivery of renewable and low carbon energy and associated infrastructure. It also puts emphasis on driving and supporting sustainable development and good design.

Guidance

Institute of Environmental Management Assessment (IEMA) Environmental Impact Assessment guide to Climate Change Resilience and Adaptation (2020) (Ref 8.5) –

8.2.8 This provides guidance on assessment of climate change resilience and adaptation within the context of Environmental Impact Assessment (EIA), and states that:

- Climate change must be integrated into the design process;
- The ES should document how consideration of climate change and extreme weather events has been integrated into the design for the benefit of stakeholders;
- Every ES should include a clear characterisation of the future climate and the developer should put forward a single, sensible and unambiguous climate scenario; and
- It should be acceptable to set out that there are no significant risks; if that can be supported by evidence.

Climate Change Committee Independent Assessment of UK Climate Risk (16 June 2021) (Ref 8.6)

8.2.9 Under the 2008 Climate Change Act, the UK Government is required to publish a UK-wide Climate Change Risk Assessment (CCRA) every 5 years. The CCRA sets out the main priorities for adaptation in the UK under five key themes (Agriculture and Forestry, Business, Industries and Services, Health and Wellbeing, Natural Environment, and Buildings and Infrastructure). The latest CCRA (CCRA3) released in 2021 identifies the following as the highest priorities for urgent action within the two years following its release:

- Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards;
- Risks to soil health from increased flooding and drought;
- Risks to natural carbon stores and sequestration from multiple hazards, leading to increased emissions;
- Risks to crops, livestock and commercial trees from multiple climate hazards;
- Risks to supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks;

- Risks to people and the economy from climate-related failure of the power system;
- Risks to human health, wellbeing and productivity from increased exposure to heat in homes and other buildings; and
- Multiple risks to the UK from climate change impacts overseas.

Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government Guidance on Climate Change (12 June 2014) (Ref 8.7)

8.2.10 The guidance on climate change by the Department for Levelling Up and Ministry of Housing advise how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change.

8.2.11 It helps local authorities to understand how can planning deal with the uncertainty of climate risks, how can local planning authorities identify appropriate mitigation measures in plan-making, support energy efficiency improvements, and align with the government's national target for sustainability and Net Zero.

8.3 EIA Scoping Opinion and engagement

8.3.1 A summary of the EIA Scoping Opinion received from the Planning Inspectorate (PINS) and responses to this EIA Scoping Opinion are outlined below. Furthermore, all relevant engagement undertaken to date is outlined in this Section.

Response to the EIA Scoping Opinion

8.3.2 An EIA Scoping Opinion (Appendix 1.2: EIA Scoping Opinion (Volume III)) was received by the Applicant from PINS on 20 May 2022. Table 8.1 lists the comments that PINS and consultation bodies made in relation to Climate Resilience and shows how the Applicant is responding to these.

Table 8.1 Summary of EIA Scoping Opinion in relation to Climate Resilience

Section reference	Applicant's proposed matter	Inspectorate's / consultation bodies comments	Response
3.4.1	All project elements other than Above Ground Infrastructure (AGIs) from operational phase climate change adaption and resilience assessment	*The Scoping Report states that as the proposed pipelines would be buried underground, they are not considered vulnerable to the climate during the operational phase.* *The Inspectorate is content that the buried pipelines can be scoped out of the operational phase climate change adaption and resilience assessment. In addition to AGIs, impacts on all above ground components, including block valves should be assessed in the operational phase climate change adaption and resilience assessment where significant effects are likely.*	The impacts of climate change on all AGIs, including block valves, during the operational phase will be considered. During the PEIR process, high-level assessment of the flood zones where the suggested route is passing through has been conducted. A distinction between inland and coastal areas has been made in regard to the three large climatic risks: heat, precipitation and sea level rise. A resilience assessment will be carried out during the ES on areas where climate impacts are most likely, and mitigation measures will be proposed.
3.4.2	Climate risks during the construction phase from climate change adaptation and resilience assessment	*The Scoping Report states that the construction period will not be susceptible to climatic changes due to its relatively short duration (up to 44 months). The Inspectorate does not consider sufficient evidence has been provided to scope this matter out of the assessment.* *The ES climate change adaptation and resilience assessment should assess climate risks during the construction phase (such as extreme temperatures, extreme precipitation or storm events) where significant effects are likely.*	Climate risks during the construction phase will be assessed, and a resilience assessment will be carried out where significant effects are likely.

Engagement undertaken to date

8.3.3 Engagement with officers from North Lincolnshire Council, West Lindsay District Council and Lincolnshire Council took place via a virtual stakeholder engagement meeting on 8 July 2022. No comments were made regarding the Climate Resilience Chapter.

8.3.4 Table 8.2 provides a summary of the engagement undertaken to inform the assessment to date.

Table 8.2 Summary of engagement undertaken

Consultee	Date and method of engagement	Summary of issues raised	Response
North Lincolnshire Council	Virtual stakeholder engagement meeting 08 July 2022	Meeting with stakeholders to summarise progress on the Climate Resilience and Greenhouse Gas chapters of the PEIR. Provided an update on the proposed route, infrastructure related to construction, the EIA Scoping Opinion, and updated pipeline specifications.	No comments regarding the Climate Resilience Chapter.
West Lindsay District Council	Virtual stakeholder engagement meeting 08 July 2022	Meeting with stakeholders to summarise progress on the Climate Resilience and Greenhouse Gas chapters of the PEIR. Provided an update on the proposed route, infrastructure related to construction, the EIA Scoping Opinion, and updated pipeline specifications.	No comments regarding the Climate Resilience Chapter.
Lincolnshire County Council	Virtual stakeholder engagement meeting 08 July 2022	Meeting with stakeholders to summarise progress on the Climate Resilience and Greenhouse Gas chapters of the PEIR. Provided an update on the route, infrastructure related to construction, the EIA Scoping Opinion, and updated pipeline specifications.	No comments regarding the Climate Resilience Chapter.

8.4 Assessment methodology and significance criteria

8.4.1 This preliminary climate resilience assessment in this PEIR is compliant with EN-1 section 4.8 'climate change adaptation' specifically paragraph 4.8.5 which outlines that "*new energy infrastructure will need to remain operational over many decades, in the face of a changing climate. Consequently, applicants must consider the impacts of climate change when planning the location, design, build, operation and, where appropriate, decommissioning of new energy infrastructure"*. In addition, the EIA Scoping Report and the PEIR have utilised the latest UK climate projections, and adaptation measures will be explored further at the ES stage following a detailed climate resilience assessment and a confirmed design for the DCO.

8.4.2 The preliminary climate resilience assessment in this PEIR is compliant with EN-4 (Ref 8.8) section 2.2 'climate change adaptation', specifically paragraph 2.2.2 which identifies risks to infrastructure as a result of climate change. These risks have been identified in the EIA Scoping Report, are set out in this PEIR, and will be explored further at the ES stage.

Study Area

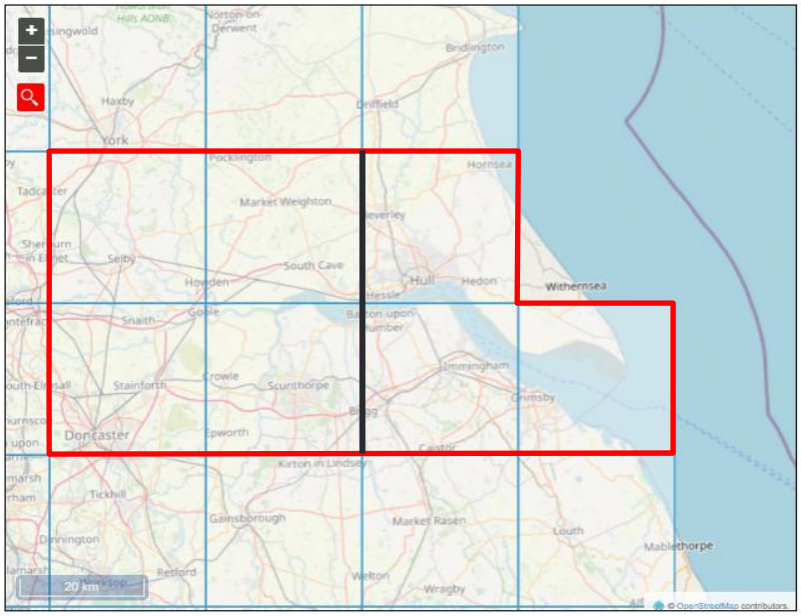
8.4.3 The climate resilience assessment will consider the impact of the climate on the Project as the receptor, rather than the impacts of the Project on the climate. Therefore, the Study Area for the climate resilience assessment is the Project. The climate resilience Study Area for each phase of the Project is set out below:

- Construction phase - the Project's construction footprint;
- Operational phase - the AGIs only. As the pipelines are buried underground, they are not considered vulnerable to the climate during the operational phase; and
- Decommissioning - the Project's decommissioning footprint.

8.4.4 The choice of climate projections to use in the assessment also informs the Study Area. The UK Climate Projections (UKCP18) provides probabilistic projections for the whole of the UK at 25 km^2 resolution. The Study Area of the assessment is limited to the seven 25 km^2 UKCP18 grid squares which encompass the Project, as shown in Insert 8.1.

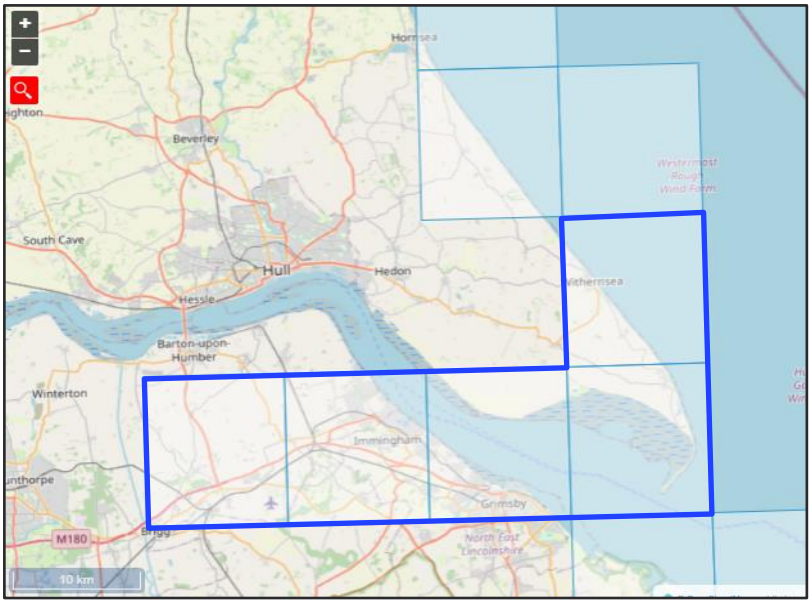
8.4.5 Due to variations in climate baseline conditions and future projections, the Study Area is separated into two sections representing inland and coastal climate. These sections are assessed independently of one another where necessary and can be seen separated by the black line in Insert 8.1.

Insert 8.1 Map of 25 km^2 UKCP18 grid squares used for assessment, outlined in red. 'Inland' and 'Coastal' areas are separated by a black line.



8.4.6 UKCP18 sea level anomalies for marine projections around the UK coastline are given at 12 km^2 resolution. Therefore, the Study Area also incorporates the five grid squares shown in Insert 8.2 below.

Insert 8.2 Map of 12 km^2 UKCP18 grid squares used for assessment of sea level rise.



Baseline data collection

Desk study

8.4.7 Existing and future baseline conditions of the Project were established during a desk study using the following sources:

- Met Office's UK regional climate summary for Eastern England (Ref 8.9).
- Average annual, summer, and winter rainfall data for the Hull climate station (1991-2020), the region, and the UK from the Met Office (Ref 8.10).
- UKCP18 data for the construction, operational and decommissioning phases for:
  - Summer maximum air temperature at 1.5 m (°C);
  - 1-day total precipitation (mm) for all seasons; and
  - Time-mean sea level anomaly (mm).

using the conservative, high-emissions scenario RCP8.5 at the 50th percentile.

Site visits and surveys

8.4.8 No Climate Resilience surveys have been or will be undertaken. Sea level rise will be available to the design team and will be taken under consideration in the detailed design stage.

8.4.9 Heat and drought related risks do not require a site visit.

Impact assessment methodology

8.4.10 A four-stage framework will be adopted for the assessment, which looks at the likelihood and consequence of the impact occurring to each receptor, leading to evaluation of the significance of the effect.

8.4.11 Stage 1 involves the assessment of climate effects on the Project using the lifespan of the Project (taken as 40 years) and the decommissioning lifecycle stage (2080s).

8.4.12 The UKCP programme provides probabilistic projections for the whole of the UK, at regional level and at local level. To identify the future changes to the climate baseline, the following factors have been identified and used in the assessment:

- The lifespan of the Project (including timescales for construction and operational life cycle stages, and decommission in the end of life); and
- In line with IEMA guidance on Climate Change Resilience and Adaptation, the conservative approach of using climate projections under the high-emission scenario RCP8.5 at the 50th percentile is taken.

8.4.13 For the purpose of the assessment, the 25 km^2 grid squares encompassing the area of the Proposed Order Limits have been separated to form an 'inland' area (four grid squares) and a 'coastal' area (three grid squares). The Sea Level Rise assessment is based on 12 km^2 squares. The UKCP18 data for the grid squares in each of these areas have been averaged to give overall values for each.

8.4.14 Stage 2 involves the identification of receptors which are vulnerable to climate change. These could be:

- Buildings and infrastructure receptors (including equipment and building operations);
- Human health receptors (e.g., construction workers);
- Environmental receptors (e.g., habitats and species); and
- Climatic systems.

8.4.15 Stage 3 will involve the identification of the impacts (hazards and opportunities) for each receptor using the UKCP18 data, including the vulnerability of the Project to both normal weather and extreme weather-related disaster scenarios.

8.4.16 Stage 4 of the framework will include an assessment of the identified impacts. The assessment will be undertaken using the categories in Stage 2. The sensitivity of receptors will be measured against these criteria:

- High Sensitivity – receptor is directly dependent on existing/prevailing climatic factors and reliant on these specific existing climate conditions continuing in future (e.g., river flows and groundwater level) or only able to tolerate a very limited variation in climate conditions;
- Medium sensitivity – receptor is dependent on some climatic factors but able to tolerate a range of conditions (e.g., drainage system is capable of tolerating higher volumes of flooding than current ones in the region);
- Low sensitivity – climatic factors have little influence on the receptors (e.g., buildings associated with the pipelines are not staffed, so staff will not be susceptible to heat-related issues on these sites); or
- Negligible – Climatic factors have no influence on the receptors.

8.4.17 Magnitude of change/impact will be assessed under these criteria:

- High Impact – With high probability, the receptor will not be able to function properly under the impact and/or loss of life and/or heavy financial loss are highly likely;
- Medium impact – The receptor may not be able to function properly under the impact/receptors has some limited ability to withstand/not be altered by the projected changes to the existing/prevailing climatic conditions; or
- Low impact – receptor has the ability to withstand/not be altered much by the projected changes to the existing/prevailing climatic factors.

Significance criteria

8.4.18 The likelihood and consequence of a hazard occurring are combined to assess the significance of the effects on receptors, as shown in Table 8.3. The various levels of likelihood and consequence are described in Tables 8.4 and 8.5, respectively.

Table 8.3 Significance rating matrix. (Source: IEMA Guidance (Ref 8.5))

Measure of consequence of hazard occurring	Measure of likelihood				
	Very low	Low	Medium	High	Very High
Very large	Not Significant	Significant	Significant	Significant	Significant
Large	Not Significant	Not Significant	Significant	Significant	Significant
Moderate	Not Significant	Not Significant	Significant	Significant	Significant
Minor	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
Negligible	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant

Table 8.4 Descriptions of levels of likelihood of hazard occurring. (Source: IEMA Guidance Ref 8.5)

Measure of likelihood of hazard occurring	Description
Very High	The event occurs multiple times/is certain to occur during the lifetime of the Proposed Development. For example, approximately annually.
High	The event occurs several times/is almost certain to occur during the lifetime of the Proposed Development. For example, it occurs approximately once every 5 years.
Medium	The event occurs limited times during the lifetime of the Proposed Development. For example, approximately once every 20 years.
Low	The event occurs occasionally during the lifetime of the Proposed Development. For example, once in 40 years.
Very low	The event may occur once or not at all during the lifetime of the Proposed Development.

Table 8.5 Descriptions of levels of consequence of hazard occurring. (Source: IEMA Guidance Ref 8.5)

Consequence of impact	Description
Very large adverse	Permanent damage. Disruption lasting more than ten days. Early renewal of infrastructure >90%. Severe health effects and/or fatalities. Significant repair costs.
Large adverse	Extensive infrastructure damage. Disruption lasting more than three but less than ten days. Early renewal of 50-90% of infrastructure. Severe health effects and/or fatalities. Significant effect on the environment, requiring remediation. Significant repair costs.
Moderate adverse	Limited infrastructure damage with damage recoverable by maintenance or minor repair. Disruption lasting more than one but less than three days. Adverse effects on health and/or the environment. Moderate repair costs.
Minor adverse	Localised infrastructure disruption. No permanent damage, minor restoration work required: Disruption lasting less than one day. Slight adverse health or environmental effects. Minor repair costs.
Negligible	No infrastructure damage, minimal adverse effects on health, safety, and the environment. No disruption to infrastructure. No financial loss.

8.4.19 Table 8.5 categories are based on Environmental Impact Assessment Guide to: Climate Change Resilience & Adaptation (Ref. 8.5) Appendix 1, as well as professional judgement based on the proposed projects character and intent of operation.

Assumptions and limitations

8.4.20 To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- The climate resilience assessment is inherently uncertain in relation to climate change projections and the variation of information available in relation to different climate hazards. To mitigate the inherent uncertainty, the climatic model chosen is RCP8.5, considered to represent a worst-cast scenario climate change.
- Climate projections are not predictions or forecasts but simulations of potential scenarios of future climate, under a range of hypothetical emissions scenarios and assumptions. Therefore, the UKCP18 presented cannot be treated as exact or factual, but different scenarios. They represent internally consistent representations of how the climate may evolve in response to a range of potential scenarios, and their reliability varies between climate variables. Furthermore, the projections do not

go beyond 2100 and so weather extremes cannot be extrapolated beyond this period.

- Climate resilience for below ground infrastructure during the operational phase has been scoped out. During the operational phase, only the resilience of AGIs is considered.

8.4.21 Due to the preliminary nature of this assessment, at the time of writing, some of the primary mitigation measures outlining how the Project will incorporate climate resilience into the design are not available. As such the significance of the effects are based upon what is currently agreed and are therefore expected to be an overestimate of impacts.

8.5 Existing baseline

8.5.1 The Proposed Order Limits are located within the Met Office profile (Ref 8.9) of Eastern England ('the region'). Within this profile lies the Hull climate station, the closest climate station to the Proposed Order Limits. Data from the Hull climate station (53.7492, -0.3471) have been used here as a representation for the Proposed Order Limits.

Rainfall

8.5.2 The region includes some of the driest areas, with much of the region receiving less than 700 mm of rain per year. Relative to most other parts of the UK, rainfall in the region shows an even distribution throughout the year.

8.5.3 The region experiences generally low rainfall relative to the UK. On average, there are around 30 rain days (more than 1 mm rainfall) in winter and fewer than 25 rain days in summer.

8.5.4 Average annual, summer and winter rainfall data for the Hull climate station, the region, and the UK for the period 1991-2020 are given in Table 8.6.

8.5.5 Table 8.6 shows that on average, the location of the Hull weather station receives less rain than the UK and regional averages.

Table 8.6 Mean annual rainfall and annual number of days of rainfall above 1 mm for Hull Climate Station, England East and Northeast, and the UK for the period 1991-2020.

Location	Annual rainfall (mm)	Annual days of rainfall ≥1 mm (days)
Hull Climate Station	693.45	124.75
England East and Northeast	1163.04	159.09
UK	793.06	133.8

Temperature

8.5.6 The region's mean annual temperature varies from around 9.5 °C to over 10.5 °C, dependent on proximity to the coast and altitude, with a decrease of around 0.5 C per 100 m increase in altitude.

8.5.7 The mean daily maximum temperature ranges from 6 °C to 8 °C and 20 °C to 23 °C in the winter and summer respectively. Many of the UK maximum temperature records are

held by stations in Eastern England with the highest known temperature recorded in the area being 40.3 °C at Coningsby, Lincolnshire in July 2022.

8.5.8 Table 8.7 shows the average mean monthly temperature for the Hull climate station, England East and Northeast (as defined by the Met Office) and for the UK.

Table 8.7 Monthly average maximum and minimum temperature for Hull Climate Station, England East and Northeast (as defined by the Met Office), and the UK for the period 1991-2020.

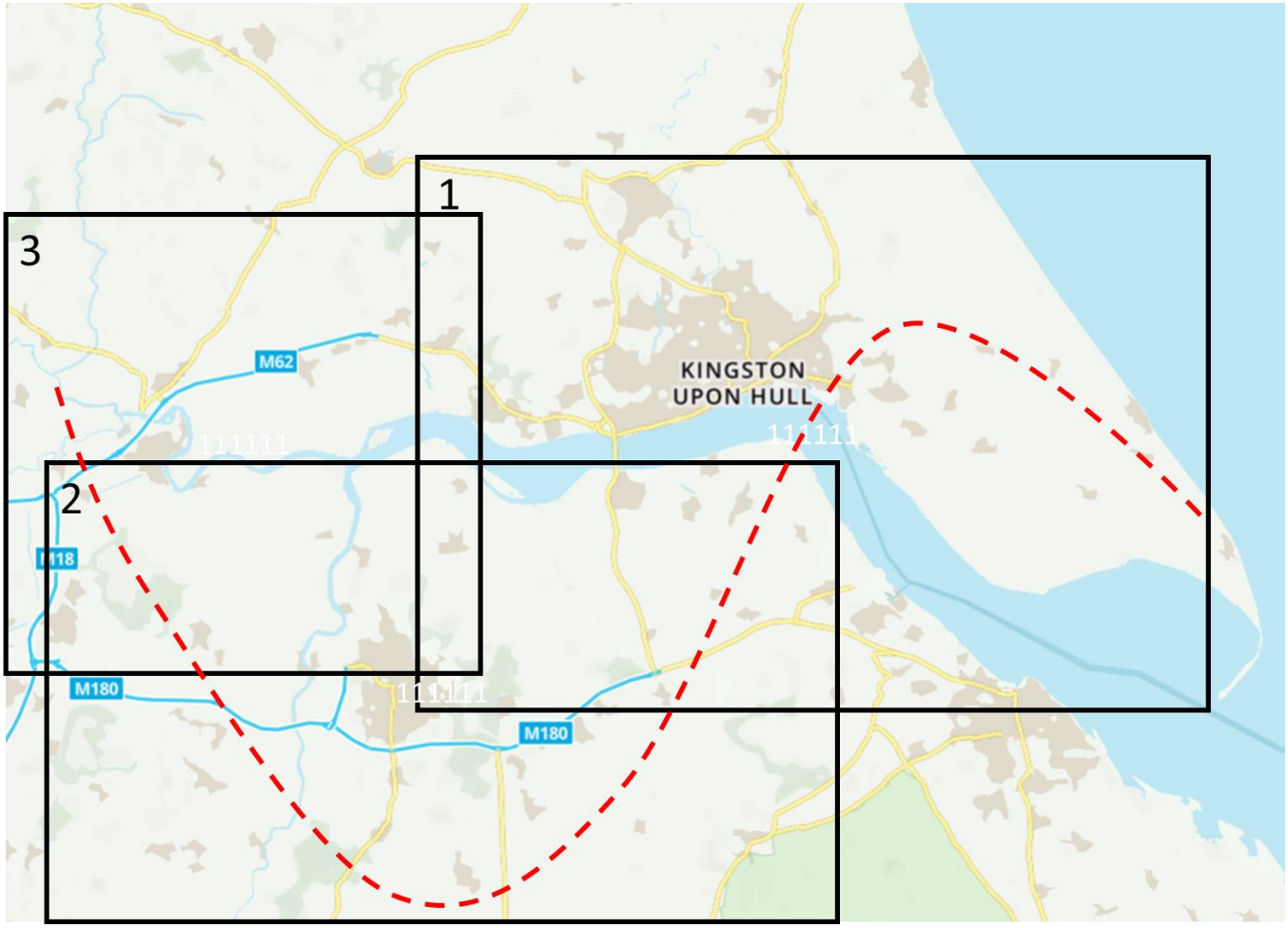
Month	Maximum Temperature (°C)			Minimum Temperature (°C)		
	Hull	UK	England E and NE	Hull	UK	England E and NE
January	7.74	6.66	7.20	2.16	1.21	1.06
February	8.55	7.16	9.43	2.21	1.13	2.12
March	10.88	9.22	12.15	3.41	2.19	3.68
April	13.66	12.03	15.21	5.12	3.75	6.25
May	16.60	15.13	17.97	7.74	6.25	9.07
June	19.55	17.68	20.32	10.54	9.08	11.10
July	22.02	19.62	19.99	12.76	11.02	11.10
August	21.83	19.30	17.26	12.57	10.97	9.13
September	18.91	16.85	13.34	10.53	9.04	6.46
October	14.76	13.08	9.36	7.83	6.42	3.42
November	10.66	9.41	6.78	4.64	3.56	1.14
December	7.92	7.02	6.48	2.42	1.42	1.00

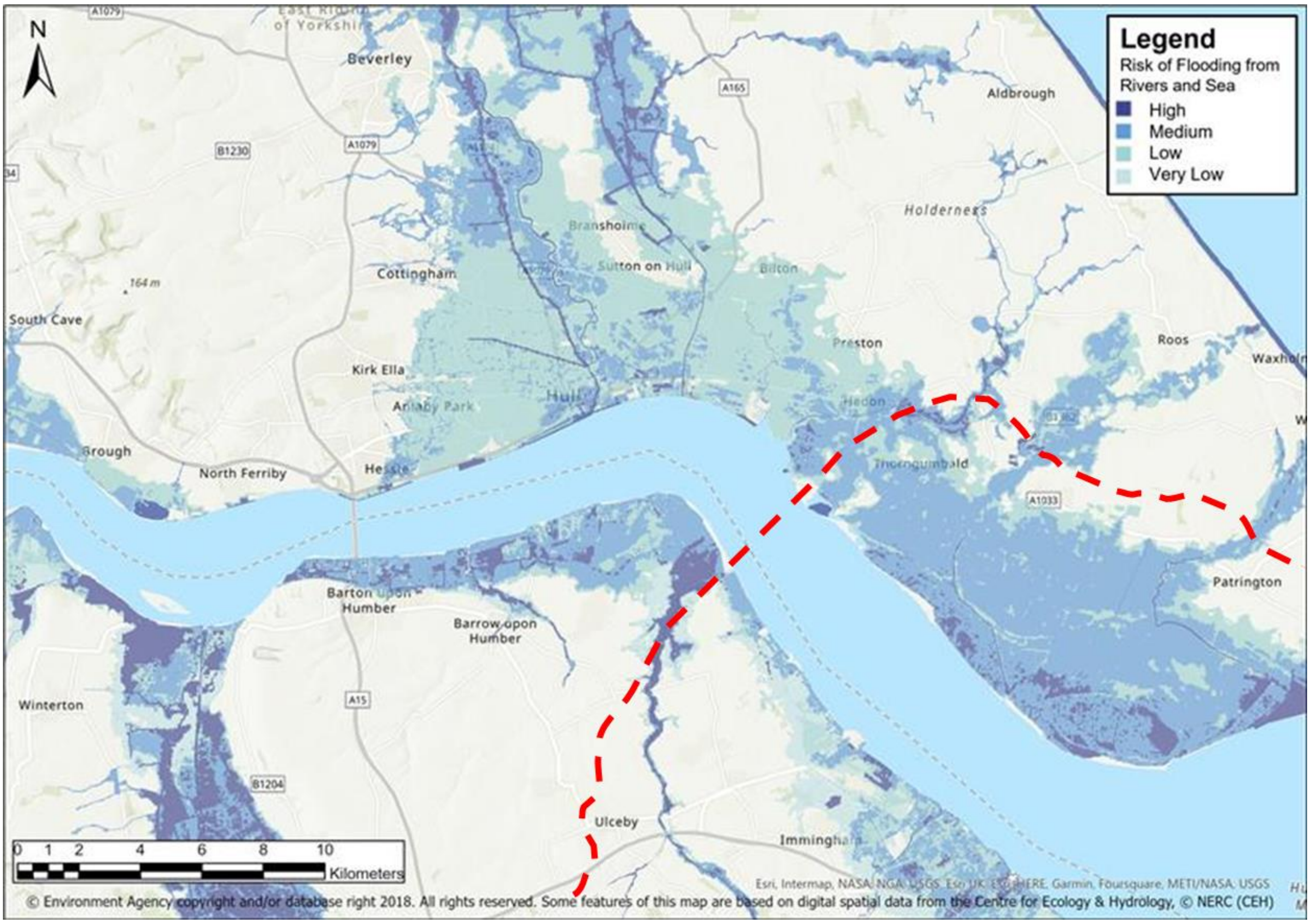
Sea level rise

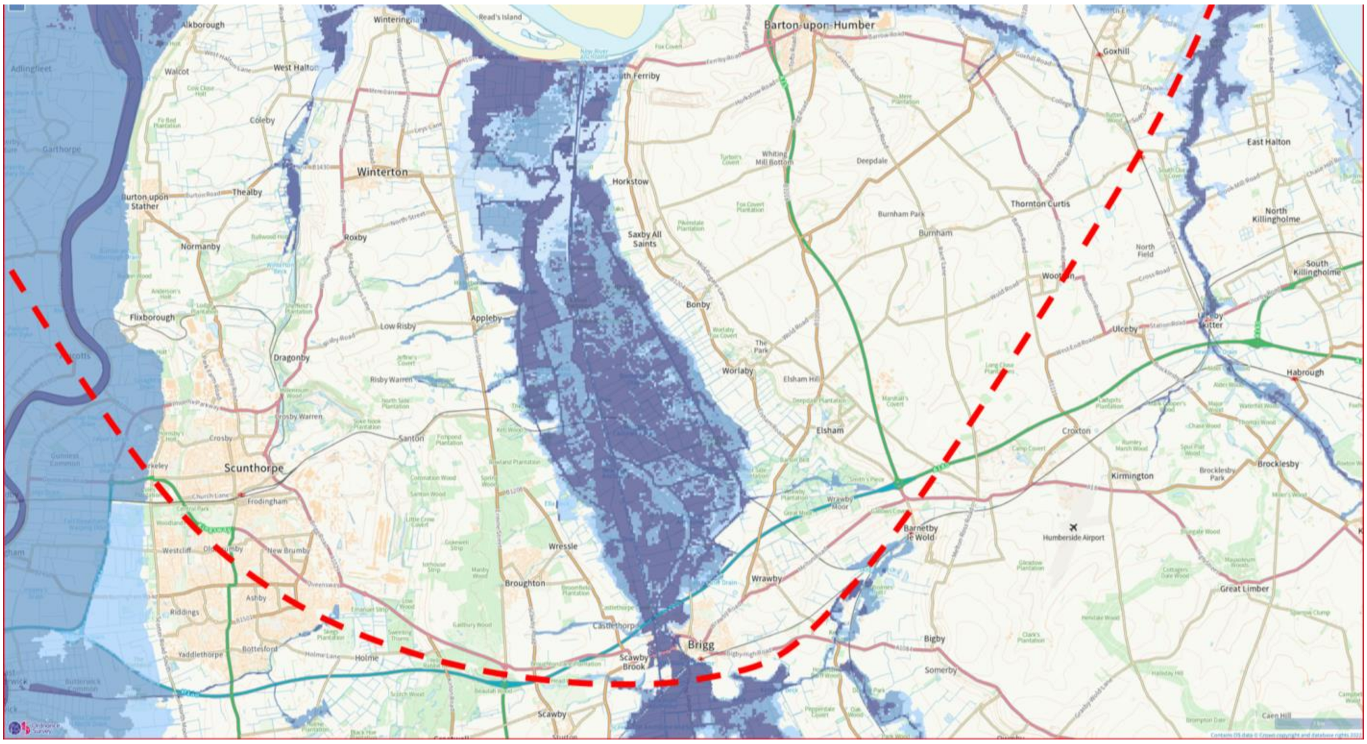
8.5.9 The Project runs along the length of the Humber estuary and up to the North Sea. Therefore, the Project is vulnerable to sea level rise. Large parts of the Project are within areas of flood risk. The entirety of the Project between Drax and the River Trent is within areas of high flood risk in addition to a roughly 5 km wide area associated with the New River Ancholme and large areas of land adjacent to the River Humber.

8.5.10 According to the Environment Agency's data set, Risk of Flooding from Rivers and Seas, a significant area of the land surrounding the Humber Estuary is vulnerable to flooding from rivers and seas, with large areas of High risk, representing a chance of flooding of greater than 1 in 10 (3.3%). Insert 8.3 shows the Environment Agency's Risk of Flooding from Rivers and Seas along a stretch of the estuary.

Insert 8.3 Map of an area of the Humber Estuary with Environment Agency's Risk of Flooding from Rivers and Seas. (indicative route of the Project is in dashed red).




Legend
Risk of Flooding from Rivers and Sea
High
Medium
Low
Very Low
N
Beverley
Aldbrough
Holderness
Bransholme
Sutton on Hull
Bilton
Cottingham
South Cave
Preston
Roos
Kirk Ella
Anlaby Park
Hull
Hedon
Brough
North Ferriby
Hessle
Thorngumbald
Patrington
Barton upon Humber
Barrow upon Humber
Winterton
Ulceby
Immingham
A1079
B1230
A165
A1033
A15
B1204
0 1 2 4 6 8 10
Kilometers
Esri, Intermap, NASA, NGA, USGS, Esri UK, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS
© Environment Agency copyright and/or database right 2018. All rights reserved. Some features of this map are based on digital spatial data from the Centre for Ecology & Hydrology, © NERC (CEH)


Barton upon Humber
Winterton
Scunthorpe
Brigg
Barnetby le Wold
Thornton Curtis
Ulceby
Elsham
Worlaby
Bonby
Wrawby
Broughton
Humberside Airport
East Halton
Goxhill
Kirmington
Great Limber
Brocklesby

8.5.11 According to the latest State of the UK Climate report (Ref 8.11), mean sea level around the UK has risen by around 1.5 mm per year on average from the start of the 20th century to 2020, with an overall rise of 16.5 cm over that period. The rate of sea level rise has increased in recent years, with an increase of more than 3 mm per year for the period 1993 – 2019.

Future baseline

8.5.12 It is predicted that climate change will increase the frequency and severity of some types of extreme weather events in England. UKCP18 Projections generally show that warmer, drier summers are more likely along with warmer, wetter winters.

8.5.13 Presented below is the future baseline for temperature, rainfall and sea level rise for the Project area , including inland and coastal areas, for the high emissions scenario, RCP8.5 at the 50th percentile.

Temperature

8.5.14 UKCP18 predicts that climate change will lead to hotter summers and warmer winters. Table 8.8 provides the projected summer maximum air temperature at 1.5 m (°C) for 2020, 2050 and 2080, representing the construction, operational and decommissioning phases, respectively. The values presented are averages of the 25 km^2 grid squares comprising the ‘inland’ area and the ‘coastal’ area.

8.5.15 The central estimate (50th percentile) projects maximum temperatures of 33.8 °C for the summer of 2020, 35.4 °C for 2050 and 37.7 °C for 2080. These increase further inland, with temperatures of 34.3 °C, 35.8 °C and 38.1 °C for 2020, 2050 and 2080, respectively. It is worth noting that the values represent average maximum temperature extremes, therefore individual days may exceed these values.

Table 8.8 UKCP18 projections of summer maximum air temperature at 1.5 m (RCP8.5 50th percentile) for 2020, 2050 and 2080.

Year	Summer maximum air temperature at 1.5 m (°C) (RCP8.5 50th Percentile)	
	Inland	Coastal
2020	34.27	33.81
2050	35.82	35.36
2080	38.13	37.67

Rainfall

8.5.16 Table 8.9 shows the projected 1-day total precipitation for coastal and inland regions for all seasons in 2020, 2050 and 2080 at the 50th percentile. Throughout the construction phase (2020), the inland area is predicted to see 1-day total precipitation of 69.8 mm in summer and 36.3 mm in winter. The coastal area will see 73.5 mm in summer compared to 37.2 mm in winter. In the decommissioning phase (2080), this will increase to 70.2 mm in summer and 42.3 mm in winter in the inland area, and 73.8 mm in summer and 42.9 mm in winter in the coastal area.

Table 8.9 Average UKCP18 projections for 1-day total precipitation (RCP8.5 50th percentile) by season for 2020, 2050 and 2080.

Area	Season	1-day total precipitation (mm) (RCP8.5 50th Percentile)				
		2020	2050	% Increase from 2020	2080	% Increase from 2020
Inland	Winter	36.34	38.82	6.81%	42.31	16.40%
	Spring	42.92	44.94	4.72%	47.77	11.31%
	Summer	69.76	70.15	0.57%	70.22	0.67%
	Autumn	52.23	56.59	8.33%	62.85	20.33%
Coastal	Winter	37.15	39.55	6.47%	42.89	15.45%
	Spring	44.65	46.68	4.55%	49.47	10.80%
	Summer	73.46	73.76	0.41%	73.76	0.41%
	Autumn	53.46	58.03	8.55%	64.37	20.40%

Sea level rise

8.5.17 Average UKCP18 marine projections are given for the four 12 km^2 grid squares closest to the Proposed Order Limits in Table 8.10. This shows that under RCP8.5 at the 50th

percentile, by 2050, sea level rise is predicted to reach 28.3 cm relative to a 1981-2000 baseline. By 2080, this will have increased to 54.9 cm.

Table 8.10 UKCP18 projections of time-mean sea level anomalies (RCP8.5 50th percentile) for 2020, 2050 and 2080 in cm.

Year	Time-mean sea level anomaly (cm)(RCP8.5 50th Percentile)
2020	9.63
2050	28.29
2080	54.86

8.6 Design development, impact avoidance and embedded mitigation

8.6.1 Primary climate mitigation measures – those which are an inherent part of the Project's design – include the following:

- The pipelines and associated AGIs would be regularly maintained to ensure their continued reliability using trained and competent personnel and all work would be strictly controlled. Where issues are found, these would be corrected by appropriate remedial works. Periodically the pipelines would be internally inspected to check for corrosion and any damage present, including potential damage caused by climate-related hazards, as detailed below in Tables 8.11-13.
- During construction, the pipe trenches would be left open for the minimum length of time as is practicable. Where necessary, outfall drains would be re-connected across the trench as part of the backfill operation.
- Where necessary, additional post construction drainage would be installed within the construction working width to ensure that the integrity of the drainage infrastructure affected by construction is adequately maintained. Detailed drainage designs would have regard to soil type, existing drainage systems and land levels.
- Making allowances in structural designs to accommodate for changes in climate, such as measures taken to manage increased surface runoff.
- Maximise structural stability in the operational phase, ensuring sufficient inspections are carried out to identify any structural maintenance requirements.
- Materials chosen for construction should consider durability to withstand likely future climate scenarios and associated impacts (e.g., water accumulation).
- Accounting for increased rates of material deterioration.
- Minimising working in adverse conditions, construction efforts should be weighted towards low-risk seasons.

8.6.2 Tertiary climate mitigation measures include compliance with the UK Building Regulations and British Standard (BS).

8.6.3 A decommissioning plan would account for 2060's UKCP18 projected weather under RCP8.5 (worst-case) model.

8.6.4 A contractor work plan would be produced and would address identified climate change risks.

8.6.5 Confirmed embedded mitigation will be presented within the ES and will align with other technical topics, most notably, surface and flood water consideration which will be considered as part of the Flood Risk Assessment (FRA).

8.7 Preliminary assessment of potential impacts

8.7.1 This Section details the preliminary assessment of impacts for the Project during construction, operation and decommissioning phases.

Construction

8.7.2 The potential impacts for Climate Resilience associated with the construction phase are provided in Table 8.11.

Table 8.11: Construction phase – preliminary assessment of potential impacts

Climate Hazard	Associated Hazard	Resource/receptor	Description of potential impact/change
Precipitation	Changes in annual average precipitation. Extreme precipitation events (flooding)	Construction staff. Construction compounds. Construction plant and machinery.	• Increased surface water flooding resulting in flooding of the temporary construction compounds and machinery causing damage. • Drainage infrastructure overwhelmed. • Loss of working hours. • Risk to human health and wellbeing of construction workers, such as increased risk of slips, trips and falls to construction workers. • Site roads may become impassable through flooding. • An increase in extreme precipitation has the potential to lead to the requirement for additional drainage, larger components, and more extensive works. • Increased risk to the earthworks stability resulting in a requirement for fill materials that are less susceptible to moisture such as Pulverised Fuel Ash and aggregate and/or increased stabilisation techniques (such as lime stabilisation).
Temperature	Extreme temperature events. Changes in annual average temperature	Construction staff. Construction compounds. Construction plant and machinery.	• Overheating of construction machinery. • Under extreme temperatures, certain construction activities may be required to be reprogrammed to keep the Project build to schedule. • Risk of loss of working hours due to extreme temperatures. • Risk to human health and wellbeing of construction workers.

Climate Hazard	Associated Hazard	Resource/receptor	Description of potential impact/change
			• An increase in extreme temperatures may require the use of more expensive components like joints, bearings, paint systems etc. Greater care would be required to set the gaps and the expansion joints, allowing for more movement with higher future temperature, to ensure that movement does not cause a problem. • An increase in mean temperatures and extreme temperatures has the potential to lead to the requirement for stronger fill material and therefore increasing the quantities of excavated material becoming waste. • Risk from a greater degree of surface failure or deterioration. For example, for concrete pavements, thermal gradients have the potential to create uneven internal stresses which can then give rise to curling or warping of slabs. Loading stress from vehicles can expose these weaknesses and further degrade the integrity of surfaces. • Large changes in temperature have the potential to generate thermal contraction and expansion of the concrete slabs which, if not taken into consideration at the design stage, can generate unacceptably large longitudinal internal stresses and excessive movements at joints.

Climate Hazard	Associated Hazard	Resource/receptor	Description of potential impact/change
Drought	Prolonged periods of high temperatures combined with low levels of precipitation	Construction compounds. Construction plant and machinery.	• An increase in extreme temperature and a decrease in summer precipitation has the potential to lead to increased risk of ground movement and slope instability. • An increase in extreme temperature and a decrease in summer precipitation has the potential to lead to a reduction in soil moisture requiring greater compaction. • Changes to ground water levels and soil moisture content. A wider range in precipitation also has the potential to generate larger ground movement dependent on underlying geology.
Sea level	Flooding and coastal erosion	Construction staff. Construction compounds. Construction plant and machinery.	• Overwhelmed drainage infrastructure. • Site roads may also become impassable through flooding. • Increased risk to the earthworks stability resulting in the requirement of fill materials that are less susceptible to moisture such as Pulverised Fuel Ash and aggregate and/or increased stabilisation techniques (such as lime stabilisation).

Operation

8.7.3 The potential impacts for Climate Resilience associated with the operational phase are provided in Table 8.12.

Table 8.12: Operational phase – preliminary assessment of potential impacts

Climate Hazard	Associated Hazard	Resource/receptor	Description of potential impact/change
Precipitation	Changes in annual average precipitation. Extreme precipitation events (flooding).	AGIs (including buildings and structures, drainage systems). Operational maintenance workers.	• Flooding causing damage to AGIs. • Drainage infrastructure overwhelmed. • Flooding causing risk to maintenance crews. • Changes in groundwater levels as a result of an increase in precipitation rates could lead to ground movements and soil settlement. • Increases in precipitation rates could lead to premature deterioration rates for joints, bearings, surfaces and external fabric of buildings. • The increased prevalence of drought conditions may decrease the permeability of the ground that forms part of sustainable urban drainage (SuDS) and if followed by heavy rainfall events may result in surface water flooding.
Temperature	Extreme temperature events. Changes in annual average temperature.	AGIs (including buildings and structures, drainage systems). Operational maintenance workers.	• Overheating of machinery and AGIs. • Loss of working hours. • Risk to human health and wellbeing of construction workers. • Change in climate conditions could include the occurrence of severe cold spells, this has a potential to cause mortality and morbidity. • Increases in temperature have the potential risk of thermal actions (loads) applied to buildings (e.g., leading to joint and bearing failure). Some buildings have the potential to fail to operate within original design parameters. This could induce failures meaning

Climate Hazard	Associated Hazard	Resource/receptor	Description of potential impact/change
			additional works would then be required to strengthen them. • An increase in extreme temperatures may require the use of more expensive components like joints, bearings, paint systems etc. Also, greater care would be required to set the gaps, to ensure that movement does not cause a problem. • An increase in mean temperatures and extreme temperatures has the potential to lead to the requirement for stronger fill material and therefore increasing the quantities of excavated material becoming waste. • An increase in mean temperatures and increased humidity levels has the potential to lead an increased need for maintenance of the AGIs.
Drought	Prolonged periods of high temperatures combined with low levels of precipitation.	AGIs (including buildings and structures, drainage systems). Operational maintenance workers.	• Ground/soil movement due to drought conditions. • An increase in extreme temperature and a decrease in summer precipitation has the potential to lead to increased risk of ground movement and slope instability. • An increase in extreme temperature and a decrease in summer precipitation has the potential to lead to a reduction in soil moisture requiring greater compaction. • Changes to ground water levels and soil moisture content. A wider range in precipitation also has the potential to generate larger ground movement dependent on underlying geology.

Climate Hazard	Associated Hazard	Resource/receptor	Description of potential impact/change
Sea level rise	Flooding and coastal erosion.	AGIs (including buildings and structures, drainage systems). Operational maintenance workers.	• Overwhelmed drainage infrastructure. • Access roads may also become impassable through flooding. • Increased slope instability. • Increase in deterioration of structures. • Increased drought could lead to the subsidence in the buildings.

Decommissioning

8.7.4 The potential impacts for Climate Resilience associated with the decommissioning phase are provided in Table 8.13.

Table 8.13: Decommissioning phase –preliminary assessment of potential impacts

Climate Hazard	Associated Hazard	Resource/receptor	Description of potential impact/change
Precipitation	Changes in annual average precipitation. Extreme precipitation events (flooding). Drought.	Staff involved with decommissioning activities. Decommissioning compounds. Decommissioning plant and machinery.	• Ground/soil movement due to drought conditions. • Loss of working hours. • Risk to human health and wellbeing of decommissioning workers, such as increased risk of slips, trips and falls. • Site roads may also become impassable through flooding.
Temperature	Extreme temperature events. Changes in annual average temperature. Drought.	Staff involved with decommissioning activities. Decommissioning compounds. Decommissioning plant and machinery.	• Overheating of machinery. • Under extreme temperatures, certain decommissioning activities may be required to be reprogrammed to keep schedule. • Risk of loss of working hours due to extreme temperatures. • Risk to human health and wellbeing of decommissioning workers.
Drought	Prolonged periods of high temperatures combined with low levels of precipitation.	Decommissioning compounds. Decommissioning plant and machinery.	• An increase in extreme temperature and a decrease in summer precipitation has the potential to lead to increased risk of ground movement and slope instability. • Changes to ground water levels and soil moisture content. A wider range in precipitation also has the potential to

Climate Hazard	Associated Hazard	Resource/receptor	Description of potential impact/change
			generate larger ground movement dependent on underlying geology.
Sea level rise	Flooding and coastal erosion.	Staff involved with decommissioning activities. Decommissioning compounds. Decommissioning plant and machinery.	• Site roads may also become impassable through flooding. • Flooding causing disruption to decommissioning activities.

8.8 Design, mitigation and enhancement measures

8.8.1 No secondary mitigation measures for climate resilience have been identified at this stage.

8.9 Summary of the preliminary assessment of potential significant effects

8.9.1 Table 8.14 below summarises the preliminary assessment of potential effects associated with the Project.

Table 8.14 Summary of the preliminary assessment of potential significant effects

Resource/ receptor	Stage	Sensitivity of resource/receptor	Description of potential impact/change	Mitigation	Potential significant effects
Workforce Construction compounds Construction plant and machinery	Construction	Very High	Heat related issues may hinder workforce ability to complete work on schedule, heatwave conditions may require a halt of works for several days. Flooding may endanger workforce, cause damage to construction compounds, plant and machinery.	The contractor work plan would include heat and flood related risks and their responses. Further mitigation will be assessed in next steps.	Not significant
AGIs	Operation	Very High	AGIs may be affected by heat related issues, flooding of pluvial, fluvial or sea level rise cause.	Provisions for heat and flood related issues will be incorporated into design and engineering plans of all AGIs.	Not significant
Workforce Construction compounds Construction plant and machinery	Decommissioning	Very high	Heat and flood related issues may hinder future decommissioning works and endanger workforce, construction compounds and regular operation of plant and machinery	A design-for-deconstruction approach in the contractor work plan and assembly methods to allow for easy decommissioning. Decommissioning plan will account for 2060's UKCP18 projected weather under RCP8.5 (worst-case) model.	Not significant

8.10 Next steps

8.10.1 A further assessment of the significant effects will be undertaken and reported in the assessment set out in the ES. If required further primary and secondary mitigation and enhancement measures will be recommended in order to reduce and remove any outstanding significant effects. This will be done in consultation with the design team.

8.11 References

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