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Appendix 19A: Climate Change Resilience Assessment

Appendix 19B: In-Combination Climate Change Impact Assessment

Rev: 0

19.0 CLIMATE CHANGE

19.1 Introduction

19.1.1 This chapter of the Environmental Statement (ES) identifies the potential impacts and effects of the Proposed Development on the climate as well as the impacts and effects of climate change on the Proposed Development that are to be considered as part of the Environmental Impact Assessment (EIA) of the Proposed Development. The assessment has been undertaken in accordance with best practice guidance from the Institute of Environmental Management and Assessment (IEMA) for Assessing Greenhouse Gas (GHG) Emissions and Evaluating their Significance (IEMA, 2022) and Climate Change Resilience and Adaptation (IEMA, 2020). This chapter undertakes and presents three separate assessments:

- Lifecycle Greenhouse Gas impact assessment – the potential effects on the climate from GHG emissions arising from the Proposed Development, including how the Proposed Development would affect the ability of the UK Government to meet its carbon reduction targets;
- Climate Change Resilience (CCR) assessment – the resilience of the Proposed Development to the projected impacts of climate change, including how the Proposed Development design will be adapted to take account of the projected impacts of climate change; and
- In-combination climate change impacts (ICCI) assessment – the in-combination effects of a changing climate and the Proposed Development on receptors in the surrounding environment.

19.2 Legislation, Planning Policy Context and Other Guidance

19.2.1 This section identifies and describes legislation, planning policy and guidance that is of relevance to the assessment of climate change effects.

Legislative Background

International

Paris Agreement (2015)

19.2.2 The Paris Agreement (UNFCCC, 2016) is an agreement under the United Nations Framework Convention on Climate Change (UNFCCC) dealing with GHG emissions mitigation, adaptation and finance starting in the year 2020. It requires all signatories to strengthen their climate change mitigation efforts to keep the increase in global average temperatures to well below 2°C this century above pre-industrial levels and to pursue efforts to limit the increase to 1.5°C (UNFCCC, 2016). This ambition is addressed in Section 19.5.

Kyoto Protocol (2005)

19.2.3 The Kyoto Protocol, entered into force in 2005 (UNFCCC, 2005), was the first international treaty ratifying commitments to reduce GHG emissions in accordance with individual targets. The Kyoto Protocol also defined the seven greenhouse gases

that are considered in carbon budgets. This agreement has since been superseded by the 2015 Paris Agreement.

National Legislation

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

19.2.4 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (hereafter referred to as the EIA Regulations) (HM Government, 2017) state that an EIA (where relevant):

"must include a description of the likely significant effects of the development on the environment resulting from … the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and vulnerability of the project to climate change."

19.2.5 This requirement is addressed in Sections 19.5, 19.6 and 19.7.

Climate Change Act 2008/ Climate Change Act (2050 Target Amendment) Order 2019

19.2.6 The Climate Change Act 2008 (HM Government, 2008) set a legally binding target for the UK to reduce its GHG emissions from 1990 levels by at least 80% by 2050. This target is supported by a system of legally binding five-year 'carbon budgets' and an independent body to monitor progress, the Climate Change Committee (CCC). The UK carbon budgets restrict the amount of GHG emissions the UK can legally emit in a defined five-year period.

19.2.7 The Act was amended in 2019 (HM Government, 2019) to revise the existing 80% reduction target and legislate for net zero emissions by 2050 (through the Climate Change Act 2008 (2050 Target Amendment) Order 2019).

19.2.8 In 2020, the Sixth Carbon Budget (HM Government, 2021a) was published by the CCC for consideration by government and is the first budget to reflect the amended trajectory to net zero by 2050.

19.2.9 The Carbon Budget Delivery Plan sets out the proposals and policies to achieve the Carbon Budgets 4, 5 and 6 (HM Government, 2023a) and projections of what the policies could achieve in carbon savings, as a follow on to the Net Zero Strategy, referenced below.

19.2.10 The existing UK carbon budgets are used to determine significance of GHG emissions from the Proposed Development, as described in Section 19.5.

UK Nationally Determined Contribution (2020)

19.2.11 Under Article 4 of the Paris Agreement (UNFCCC, 2016), parties are required to communicate their intended domestic GHG mitigation targets. In 2020 (updated in 2022), the UK communicated its new Nationally Determined Contribution to the UNFCCC. Within this, the UK has set a target of reducing its GHG emissions by at least 68% by 2030 compared to 1990 levels (HM Government, 2022a).

Planning Policy Context

National Planning Policy

National Policy Statement for Energy (EN-1) (2023)

19.2.12 The National Policy Statement (NPS) for Energy EN-1 describes the national policy for energy infrastructure. It sets out how the energy sector can help deliver Government objectives in relation to climate change.

19.2.13 NPS EN-1 sets out that energy transformation is needed including renewables and:

"*hydrogen manufactured using low carbon processes (low carbon hydrogen) and, where we still emit carbon, developing the industry and infrastructure to capture transport and store it.*"

19.2.14 Paragraphs 3.4.12 to 3.4.22 of the NPS discuss the need for hydrogen (H_2) as part of a decarbonised energy system (DESNZ, 2023a).

19.2.15 Section 4.10 sets out the requirement for an assessment of climate change adaptation and resilience, for how energy infrastructure will be able to meet energy needs of the UK in a changing climate. Section 5.3 sets out the requirements for a GHG assessment of the whole life GHG impacts from construction, operation and decommissioning, and an explanation of how these have been mitigated at every stage.

National Policy Statement for Natural Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (2023)

19.2.16 An updated version of NPS EN-4 was published in December 2023, and was designated on 17 January 2024. Section 2.3 of the NPS sets out the requirements for climate change adaptation which is expanded to say that any assessment should consider any other increased risks as well as the identified risks of flooding, sea level rise, higher temperatures and earth movements (DESNZ, 2023b).

19.2.17 The NPS is in respect of, and only has effect for natural gas infrastructure, but may be considered where relevant for hydrogen infrastructure as detailed in paragraph 1.6.4 to 1.6.7.

19.2.18 Guidance for including emissions from storage and supply infrastructure are expected to be accounted for as detailed in paragraph 2.9.21 to 2.9.24.

Draft National Policy Statement for Electricity Networks Infrastructure (EN-5) (2023)

19.2.19 An update to NPS EN-5 was published in December 2023 and was designated on 17 January 2024, setting the policy for transmission and distribution systems in electrical networks. Section 2.3 of the NPS sets out the requirements for climate change adaptation which is expanded to say that any assessment should consider any other increased risks as well as the identified risks of flooding, sea level rise, higher temperatures and earth movements (DESNZ, 2023c).

The National Planning Policy Framework (2023)

19.2.20 The Ministry of Housing, Communities and Local Government (MHCLG) (now called the Department for Levelling Up, Housing and Communities (DLUHC)) drafted the revised National Planning Policy Framework (NPPF) (DLUHC, 2023) which sets out the Government's planning policies for England. While the NPPF does not set specific policies for NSIPs, its policies may be of relevance to decision making.

19.2.21 Policies of relevance to climate change include those meeting the challenge of moving to a low carbon economy, climate change, flooding and coastal change (Section 14 of the framework). The NPPF states that the planning system should support this transition by supporting low carbon energy and associated infrastructure.

National Planning Policy Guidance on Climate Change (2019)

19.2.22 National Planning Policy Guidance (NPPG) (DLUHC, 2019) describes how to identify suitable mitigation and climate adaptation measures to incorporate into the planning process. It states that:

19.2.23 "*effective spatial planning is an important part of a successful response to climate change as it can influence the emission of greenhouse gases… Planning can also help increase resilience to climate change impact through the location, mix and design of development*."

Biodiversity Strategy 2020 (2011)

19.2.24 The Department for Environment, Food and Rural Affairs (Defra) Biodiversity 2020: a strategy for England's wildlife and ecosystem services (Defra, 2011) establishes principles for considering biodiversity and the potential effects of climate change. This assessment will reflect these principles and identify how the effects of the Proposed Development on the natural environment will be influenced by climate change, and how ecological networks will be maintained.

Local Planning Policy

North and South Tees Industrial Development Framework (2009)

19.2.25 This framework discusses the need to promote carbon capture and storage networks as an important opportunity for both the North and South Tees, and for the UK to meet its climate change reduction targets (Parsons Brinckerhoff Ltd and Genecon, 2009).

Tees Valley Climate Change Partnership Climate Change Strategy (2010)

19.2.26 This Partnership (made up of the five Tees Valley Local Authorities, the Environment Agency, Renew@CPI, Tees and Durham Energy Advice Centre and the Energy Savings Trust) published the Tees Valley Climate Change Strategy (Tees Valley Unlimited, 2010). The Partnership represents five local neighbouring local authorities and details its strategy for emissions reductions, climate change adaptation and resilience communities.

19.2.27 The combined Tees Valley GHG baseline was calculated as 7,125,000 tonnes of carbon dioxide (CO_2) equivalents (CO_2e) in 2005 as shown below in Plate 19-1.

19.2.28 Plate 19-1 also illustrates the Partnership's total emission reductions that would be needed to meet the previous UK Government target of an 80% reduction in emissions by 2050 compared to that in 1990. Tees Valley calculated that their emissions would need to be under 2,000,000 tonnes of CO_2e by 2050 to meet the previous UK target. As set out above, the Climate Change Act (2050 Target Amendment) Order 2019 revised that 80% reduction target to a net zero target (HM Government, 2019). The Tees Valley Climate Change Partnership has yet to recalculate their emissions reduction target in light of the revised net zero target, though it would need to align with the national net zero target.

19.2.29 Redcar and Cleveland Borough Council (RCBC) and Stockton-on-Tees Borough Council (STBC) have adopted the Tees Valley Climate Change Strategy (Tees Valley Unlimited, 2010). The Council is also a member of UK100, a network of community leaders committed to *"100% clean energy production by 2050".* This enhances the need and commitment for developments that lead to clean energy.

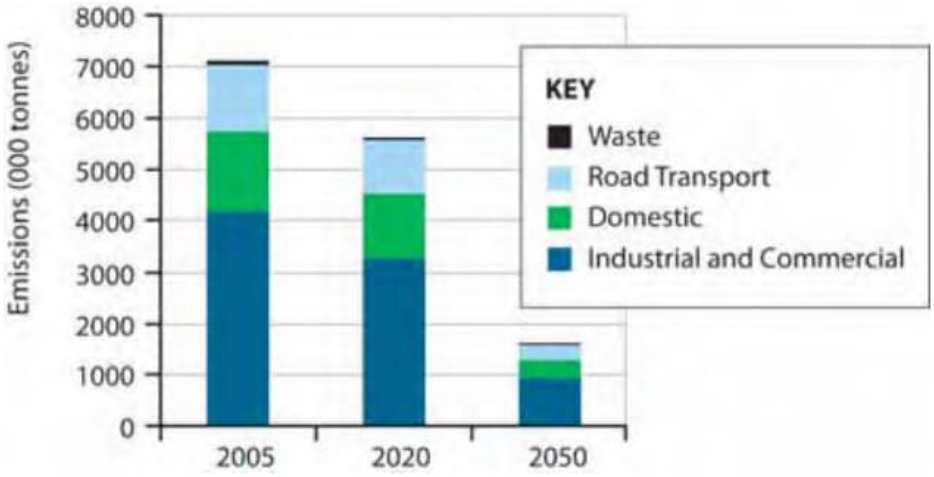

Plate 19-1: Tees Valley GHG Emissions Baseline and Reduction Targets (Tees Valley Unlimited, 2010)

Redcar and Cleveland Borough Council

Redcar and Cleveland Borough Council Carbon Neutral Declaration (2019)

19.2.30 RCBC declared a climate emergency in March 2019 and have declared an intent to be carbon neutral by 2030 (Redcar and Cleveland Borough, 2019a). This notably includes the support of a carbon capture and storage (CCS) network for industry stating:

"[to achieve carbon neutrality by 2030] This must include protecting our manufacturing industry and associated jobs by facilitating an industrial Carbon Capture Storage and Utilisation (CCSU) network in our Borough".

Redcar and Cleveland Borough Council Strategic Flood Risk Assessment (2016)

19.2.31 RCBC's Strategic Flood Risk Assessment (JBA Consulting, 2016) is used as guidance for new developments to help avoid increased flooding risks from projections for sea level rise and increased rainfall as a result of climate change. As the council is defined as the Lead Local Flood Authority (LLFA) and a Local Planning Authority, Strategic Flood Risk Assessments must be developed as a base for new Local Plans and Sustainability Appraisals. This is described in more detail in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2).

Redcar and Cleveland Borough Council Local Plan (2019)

19.2.32 RCBC's Local Plan (Redcar and Cleveland Borough Council, 2019b) describes the need for new developments to be *"sustainable in design and construction, incorporating best practice in resource management, energy efficiency and climate change adaptation"* (Redcar and Cleveland Borough Council, 2018) with particular climate change adaptation measures to be incorporated in flood and water management design.

Stockton-on-Tees Borough Council

Stockton-on-Tees Borough Council Climate Strategy and Action Plan (2022)

19.2.33 In 2022, STBC adopted and published its Climate Change Strategy and Action Plan, active until 2032 (Stockton-on-Tees Borough Council, 2022). The strategy details its low carbon vision for the area and the industrial sector being a priority area for emission reductions.

Stockton-on-Tees Borough Council Strategic Flood Risk Assessment (2018)

19.2.34 In 2018, STBC completed a Level 1 Strategic Flood Risk Assessment (JBA consulting, 2018), which is used as guidance for new developments in understanding the flood risks of rainfall and sea level rise. More detail can be found in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2).

Stockton on Tees Borough Council Local Plan (2019)

19.2.35 STBC adopted their Local Plan in 2019 with a commitment to contribute towards the national targets on CO_2 reductions by 2050 (Stockton-on-Tees Borough Council, 2019). As part of this plan paragraph 8.5 identifies opportunities in H_2 and CCS to achieve economic growth and decarbonisation.

Hartlepool Borough Council

Hartlepool Local Plan (2019)

19.2.36 Hartlepool Borough Council's (HBC) local plan, published in 2018, sets the planning framework for HBC for the next 15 years (Hartlepool Borough Council, 2018). Chapter 7 of the Plan commits to a range of policies related to minimising and adapting to climate change. Policy CC3 encourages the development of renewable and low carbon energy. The local infrastructure plan also commits to ensuring that the replacement of pipelines across Tees Valley will be able to accommodate H_2.

Other Guidance

Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (2013)

19.2.37 This guidance aims to help European Union (EU) Member States improve the way in which climate change and biodiversity are integrated in EIAs undertaken across the EU (EU Commission, 2013). Although the UK is no longer a Member State of the EU, this guidance is still considered relevant in the context of EIAs undertaken in respect of developments in the UK.

EC Non-paper Guidelines for Project Managers: Making Vulnerable Investments Climate Resilient (2011)

19.2.38 These guidelines aim to help developers of physical assets and infrastructure incorporate resilience to current climate variability and future climate change within their projects (EU Commission, 2011). Although the UK is no longer a Member State of the EU, this guidance is still considered relevant in the context of EIAs undertaken in respect of developments in the UK.

Guidance for the Calculation of Land Carbon Stocks (2010)

19.2.39 The EU Commission provides a calculation methodology for calculating carbon stocks (i.e., CO_2 stored in land or soil habitats), from land use (EU Commission, 2010). This guidance is applied in Section 19.5.

British Standards (2019)

19.2.40 The British Standards Institution (BSI) BS EN ISO 14064-1:2019 and 14064-2:2019 (BSI, 2019a; BSI, 2019b) provides specifications for organisational-level and project-level guidance for the quantification and reporting of GHG emissions and removals. These are used within the GHG emissions calculation methodology, as described in Section 19.5.

IEMA Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022)

19.2.41 To assess GHG emissions, guidance published by IEMA (IEMA, 2022) has been followed. This provides a framework for the consideration of GHG in the EIA process, in line with the 2014 European Union (EU) Directive (EU Directive 2014/52/EU) (EU, 2014). The guidance sets out how to:

- identify the GHG emission baseline in terms of GHG current and future emissions;
- identify key contributing GHG sources and establish the scope and methodology of the assessment;
- assess the impact of potential GHG emissions and evaluate their significance; and
- consider mitigation in accordance with the hierarchy for managing project related GHG emissions (avoid, reduce, substitute and compensate).

19.2.42 This guidance is used within the GHG emissions calculation methodology, as described in Section 19.5.

IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation (2020)

19.2.43 The IEMA Guidance for assessing climate change resilience and adaptation in EIA (IEMA, 2020) has been followed in the production of this chapter. It provides guidance for consideration of the impacts of climate change within project design. The guidance sets out how to:

- define potential climate change concerns and environmental receptors vulnerable to climate factors;
- define the environmental baseline with projections for changing future climate parameters; and
- determine the resilience of project design and define appropriate mitigation measures to increase resilience to climate change.

19.2.44 This guidance is used within the climate change resilience and ICCI methodology, as described in Sections 19.6 and Section 19.7.

GHG Protocol (2004)

19.2.45 The World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) GHG Protocol provides overarching guidance on developing GHG inventories and reporting standards (World Resource Institute and World Business Council for Sustainable Development, 2004). This guidance is used within the GHG emissions calculation methodology, as described in Section 19.5.

PAS 2080: 2023

19.2.46 Publicly Available Specification (PAS) 2080 specifies whole life carbon management for both buildings and infrastructure. PAS 2080:2023 is an updated revision from the previous issue in 2016 and brings an increased emphasis on whole life carbon (BSI, 2023). PAS 2080 is used as a guidance for the methodology around scoping assessment and inclusion of different GHG sources.

2020 UK Greenhouse Gas Emissions, Final Figures (2022)

19.2.47 The 2020 UK Greenhouse Gas Emission, Final Figures (HM Government, 2022b) provides the latest estimates of 1990 to 2015 UK GHG emissions by source and by end user sector.

19.2.48 In 2020, UK emissions of the seven GHGs covered by the Kyoto Protocol were estimated to be 406 million tonnes CO_2 equivalent ($MtCO_2e$). This was 9.5% lower than the 2019 figure.

19.2.49 CO_2 is the main GHG, accounting for 79% of total UK GHG emissions in 2020. The drivers for the decrease in emissions were in the energy supply sector (down 12%), the business sector (4.8%) and the waste management sector (6.7%). The decrease in the energy supply sector is due to the change in the fuel mix for electricity generation, with less use of coal and greater use of nuclear and renewables.

UK Low Carbon Hydrogen Standard (2023)

19.2.50 The UK Low Carbon H_2 Standard (DESNZ, 2023d) provides standards to define what constitutes low carbon H_2 at the point of the production, setting a threshold of 20 gCO_2e/MJ_{LHV} to be considered low carbon. This is to ensure that low carbon H_2 supported by government makes a direct contribution to the GHG emissions set out in the Climate Change Act (2050 Target Amendment) Order 2019 (HM Government, 2019).

19.2.51 The methodology sets out the boundaries of calculations e.g., up to the point of production, to be considered when calculating GHG emission from H_2.

19.2.52 The requirements around fugitive H_2 emissions are set in the policy including producing a plan for how H_2 emissions will be minimised, expected rates of emissions and monitoring plans.

19.2.53 The third version of the Low Carbon H_2 Standard was published in December 2023 and has been used as a guide for assessing the emissions of the hydrogen produced against the threshold in this chapter.

Carbon Capture, Usage and Storage: A Vision to Establish a Competitive Market (2023)

19.2.54 This policy paper sets out the UK governments vision for the CCS sector in the 2030s (DESNZ, 2023e). One of the key sectors it focuses on is the growth of the low carbon hydrogen economy by providing storage and enablement for captured carbon. The policy sets out the phases of market creation, transition and self-sustaining market phase from 2035 onwards.

UK Hydrogen Strategy

19.2.55 The UK Hydrogen Strategy (DESNZ, 2021), sets out the case for the role of low carbon hydrogen in the UK, setting a framework for a hydrogen economy by 2030 in line with UK's net zero ambitions. The roadmap for the 2020s looks to have large-scale CCS-enabled production in several locations by the late 2020s, with wide use in industry.

Hydrogen Strategy: Update to the Market

19.2.56 In an update to the market in 2023 (DESNZ, 2023f), DESNZ provide an update on the governments progress on hydrogen, with supporting policy for bringing forward demand and support for hydrogen in power.

Net Zero Strategy: Build Back Greener

19.2.57 The UK's Net Zero Strategy (HM Government, 2021b) sets out the strategy and trajectory for decarbonising the UK economy in line with its net zero targets. It sets out a range of policies and the importance of scaling up new hydrogen and carbon capture business models in order to achieve the UK's goals.

19.3 Rochdale Envelope

19.3.1 In order to ensure a robust assessment of the likely significance of the environmental effects of the Proposed Development, the EIA is being undertaken

adopting the principles of the 'Rochdale Envelope' approach where appropriate in line with the Planning Inspectorate's ('the Inspectorate's') Advice Note 9 (The Inspectorate, 2018). This involves assessing the maximum (or where relevant, minimum)/ realistic worst-case parameters for the elements where flexibility needs to be retained (building dimensions or operational modes for example). The Rochdale Envelope approach has specifically been used to estimate likely emissions from construction, upstream operational emissions and operational chemicals used.

19.3.2 Due to construction phasing there will be a period following opening of Phase 1 where Phase 1 will be operational and Phase 2 in construction. The assessment methodology for all assessments considers a scenario independent of the overlap of phases, where all construction is completed within a four-year period. This has no impact on the quantification of emissions associated with the Proposed Development.

19.4 Consultation

Scoping Opinion

19.4.1 An EIA Scoping Opinion was requested from the Inspectorate on 6 April 2023. A response was received on 17 May 2023. For the Scoping Opinion and the Applicant's responses to them, refer to Appendix 1B (ES Volume III, EN070009/APP/6.4).

Statutory Consultation

19.4.2 The PEI Report was published for statutory consultation on 14 September 2023 and the consultation period ended on 26 October 2023. A second statutory consultation was held between 13 December 2023 and 23 January 2024, and additional targeted consultation was held between 9 February 2024 and 10 March 2024. The matters raised have been reviewed and an explanation of how the Applicant has had regard to them is set out in the Consultation Report (EN070009/APP/5.1).

19.5 Greenhouse Gas Impact Assessment

Methodology

Study Area

19.5.1 The Study Area for the lifecycle GHG impact assessment considers direct GHG emissions arising from activities within the Proposed Development Site and indirect emissions from activities outside of the Proposed Development Site but related to the construction, operation and decommissioning of the Proposed Development (for example, the transportation of materials and embodied carbon within construction materials). As it is not known where construction materials will be sourced from at this stage, the Study Area for indirect emissions was assumed to be global.

Sensitive Receptors

19.5.2 The identified receptor for GHG emissions is the global climate as effects are not geographically constrained which means that all development has the potential to

result in a cumulative effect on GHG emissions. Therefore, for the purpose of the GHG emissions impact assessment, the global climate was used as the sensitive receptor. The UK's relevant five-year carbon budgets will be used as a proxy for the global climate. The emissions from the Proposed Development will be considered against these budgets, as a way of assessing whether they are in line with the UK's commitments and trajectory to net-zero by 2050.

Cumulative Assessment Approach

19.5.3 The current IEMA guidance states that:

"All global cumulative GHG sources are relevant to the effect on climate change, and this should be taken into account in defining the receptor (the atmospheric concentration of GHGs) as being of 'high' sensitivity to further emissions."

"Effects of GHG emissions from specific cumulative projects therefore should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has GHG emissions for assessment over any other."

19.5.4 In essence, there is no difference in the impact on the global climate of a tonne of carbon dioxide equivalent emitted at one location compared to the same mass of CO_2e (CO_2 equivalents) emitted anywhere else on the planet. So, it is not meaningful to carry out a cumulative assessment of the Proposed Development alongside other developments in a geographical area, nor is such an exercise reasonably practicable due to the difficulties in accessing reliable future emissions data for other developments.

19.5.5 As such, the assessment against the carbon budgets, which considers all the UK's emissions in reaching a budget, is an appropriate approach to considering cumulative impacts. Such an approach is supported by recent Court of Appeal case law (Boswell v Secretary of State for Transport) and the recent DCO decisions for the Net Zero Teesside and Drax Bioenergy Carbon Capture and Storage projects.

19.5.6 Notwithstanding this, although not a 'cumulative' effect of the project, in this chapter, consideration has been given to the emissions from the construction and operation of the NEP infrastructure in Section 19.5 as it recognised that this transport and storage network forms the full chain process of the carbon capture and storage process (although, importantly, does not itself form part of the Proposed Development that is being consented).

Impact Assessment Methodology

19.5.7 The assessment has adopted a project lifecycle approach to identify hot spots of GHG emissions (i.e., the project stage(s) likely to generate the largest amount of GHG emissions) and enable priority areas for mitigation to be identified. This approach is consistent with the principles set out in IEMA guidance (IEMA, 2022) and PAS 2080 (BSI, 2023).

19.5.8 In line with the WRI and WBCSD (World Resource Institute and World Business Council for Sustainable Development, 2004) GHG Protocol guidelines, the lifecycle GHG impact assessment has been reported as tonnes of CO_2 equivalent (tCO_2e) and has considered the seven Kyoto Protocol gases:

- CO_2;
- methane (CH_4);
- nitrous oxide (N_2O);
- sulphur hexafluoride (SF_6);
- hydrofluorocarbons (HFCs);
- perfluorocarbons (PFCs); and
- nitrogen Trifluoride (NF_3).

19.5.9 Where data is available, GHG emissions arising from construction activities, embodied carbon in materials and operational direct and indirect emissions of the Proposed Development have been quantified using a calculation-based methodology as per the following equation and aligned with the GHG Protocol (World Resource Institute and World Business Council for Sustainable Development, 2004):

Activity data x GHG emissions factor = GHG emissions

19.5.10 A set of standard data quality principles have been applied so that the results from the GHG assessment are as accurate and representative as possible. This has included the selection of emission factors that are representative of the UK construction industry.

19.5.11 DESNZ 2023 emissions factors (DESNZ, 2023g) and embodied carbon data from the Inventory of Carbon and Energy V3.0 (Inventory of Carbon and Energy, 2019) have been used as the main sources of emissions factors for calculating GHG emissions. The resulting carbon footprint has been compared to the existing baseline condition to identify the impact of the Proposed Development.

Determining Construction Effects

19.5.12 Construction emissions for the Proposed Development have been assessed in a lifecycle approach to evaluating GHG emissions. This approach is consistent with the principles set out by IEMA (IEMA, 2022) and PAS 2080 (BSI, 2023). Emissions were calculated using a construction Bill of Quantities and details on predicted vehicle movements. The included emissions are summarised in Table 19-1.

19.5.13 There is the potential that landfill sites may be affected or disturbed by underground construction, with one of the options for river crossings including a pipeline through a historic landfill area. This adds an additional risk of landfill gas and contaminated leachate exposure. It is not currently possible to quantify the potential additional emissions from this pipeline route, though they can be avoided through the mitigation actions set out in Chapter 10: Geology and Soils . It is therefore expected that any emissions that may occur would be minimal and not significant at this stage and are not quantified.

19.5.14 As detailed in Chapter 5: Construction Programme and Management (ES Volume I, EN070009/APP/6.2), site preparation and remedial works at the Main Site would be completed by STDC prior to the commencement of construction of the Proposed

Development. STDC would be required to obtain the necessary consents and permits to do this work. However, there is a scenario where STDC may not complete the works and the Applicant may be required to do so. Furthermore, even if STDC does so, the proposed remediation works will be subject to further review by the Applicant and following the assessment of ground condition information. further remedial measures may be required during the construction phase of the Proposed Development. These would be localised, targeted remediation works. As such, all scenarios are considered and assessed, along with site construction activities including management and movement of previously remediated material, as detailed in Table 19-1 below.

Table 19-1: Scope of Potential GHG Emission Sources from the Construction Stage

LIFECYCLE STAGE	ACTIVITY	PRIMARY EMISSION SOURCES	SCOPED IN/ OUT
Permitted Preliminary Works	Permitted Preliminary Works	GHG emissions from any activities required onsite prior to construction including excavation and remediation activities for the purpose of the installation of the foundations.	In
	Land clearance	Loss of carbon sink.	In
Production Stage	Raw material extraction and manufacturing of products/materials. Transport of products/materials to site.	Embodied GHG emissions. GHG emissions from fuel consumption for transportation of materials.	In
Construction process stage	On-site construction activity Transport of construction workers	Energy (electricity, fuel etc.) consumption from plant and vehicles, generators on site and construction workers commuting. GHG emissions from fuel consumption for transportation of construction workers. Targeted Remediation Activities to enable construction platform	In
	Transportation and disposal of construction waste	GHG emissions from energy use and from fuel consumption for transportation of waste.	In
	Provision and treatment of water	GHG emissions from the supply of potable water, and the	In

LIFECYCLE STAGE	ACTIVITY	PRIMARY EMISSION SOURCES	SCOPED IN/ OUT
		disposal and treatment of wastewater.	

Determining Operational Effects

19.5.15 The methodology for determining Proposed Development operational GHG emissions was the same as that for the permitted preliminary works, production stage and construction process stage emissions. Table 19-2 summarises the key anticipated GHG emissions sources and whether they have been scoped in or out of the assessment. Consideration is also given to the GHG savings that the Proposed Development would enable by providing Low Carbon Hydrogen to displace other activity, the scope of which is explained further below. There are a range of uncertainties associated with fugitive H_2, carbon capture, and Global Warming Potential (GWP) values which are discussed in the Uncertainty in Impact Analysis section below.

19.5.16 Whole Life Carbon assessment methodology often recommends setting usage and maintenance emissions at 1% of the embodied construction emissions for the building and this assumption was used when calculating the maintenance footprint (Greater London Authority, 2022).

19.5.17 There is currently no information available for the quantities of amines and other chemicals required for the carbon capture process, but this is expected to be immaterial to the overall footprint and less than 1% of total emissions as it is a closed loop system for amines so raw material procurement should be minimal.

Table 19-2: Scope of Potential GHG Emission Sources from the Operational Stage

LIFECYCLE STAGE	ACTIVITY	PRIMARY EMISSION SOURCES	SCOPED IN/ OUT
Operation	Operation of the Proposed Development	GHG emissions from flare, methane extraction and well to tank, electricity for plant, CO_2 atmospheric emission not captured, and any other materials required for operation of plant. More detail on these can be found in Section 19.5: Construction; Operation; and Decommissioning.	In
	Use of vehicles i.e., cars and motorcycles	GHG emissions from vehicle use from worker journeys to and from the site.	In
	Disposal and transportation of operational waste	GHG emissions from recycling/ disposal of process waste and domestic waste.	In

LIFECYCLE STAGE	ACTIVITY	PRIMARY EMISSION SOURCES	SCOPED IN/ OUT
		GHG emissions from fuel consumption for transportation of raw materials and waste.	
	Provision and treatment of water	GHG emissions from the supply of potable water, and the disposal and treatment of wastewater.	In
	Combustion of H_2 Product	GHG emissions from combustion of residual methane in H_2 Stream	In
	Building / infrastructure maintenance	GHG emissions from maintenance of buildings and infrastructure/assets in the operational stage.	Out

Determining Decommissioning Effects

19.5.18 The methodology for determining Proposed Development decommissioning GHG emissions is the same as for that for the enabling works, production stage, construction process stage and operational emissions. Table 19-3 summarises the key anticipated emissions sources and whether they were scoped in or out of the assessment.

19.5.19 Due to the high uncertainty around decommissioning emissions, resulting from the life-cycle of the Proposed Development and the anticipated decarbonisation of technologies associated with decommissioning, it was not possible to do a quantitative assessment.

Table 19-3: Scope of Potential GHG Emissions Sources from the Decommissioning Stage

LIFECYCLE STAGE	ACTIVITY	PRIMARY EMISSION SOURCES	SCOPED IN/OUT
Decommissioning	Raw material extraction and manufacturing of products/materials. Transport of products/materials to site.	Embodied GHG emissions. GHG emissions from fuel consumption for transportation of materials.	In
	On-site decommissioning activity. Transport of decommissioning workers	Energy (electricity, fuel etc.) consumption from plant and vehicles, generators on site, and workers commuting. GHG emissions from fuel consumption for transportation of workers.	In

LIFECYCLE STAGE	ACTIVITY	PRIMARY EMISSION SOURCES	SCOPED IN/OUT
	Transportation, recycling and disposal of waste	GHG emissions from energy use and from fuel consumption for transportation of waste.	In
	Provision and treatment of water	GHG emissions from the supply of potable water, and the disposal and treatment of wastewater.	In

Classification and Significance of Effects

Significance Criteria

19.5.20 IEMA (IEMA, 2022) guidance states that there are currently no agreed methods to evaluate levels of GHG significance and that professional judgement is required to contextualise a proposed development's emission impacts.

19.5.21 In GHG accounting, it is considered good practice to contextualise emissions against pre-determined carbon budgets (IEMA, 2022). The Tees Valley targets noted in Plate 19-1 do not have a statutory or policy requirement to be considered so the UK Carbon Budgets are used to contextualise the level of significance.

19.5.22 There is currently no published standard definition for receptor sensitivity of GHG emissions. As per IEMA (IEMA, 2022) guidance, all GHG emissions were classed as having the potential to be significant as all emissions contribute to climate change. The global climate has been identified as the receptor for the purposes of the GHG assessment. The sensitivity of the climate to GHG emissions was considered to be 'High'. The rationale supporting this includes:

- Any additional GHG impacts could compromise the UK's ability to reduce its GHG emissions and therefore the ability to meet its future carbon budgets.
- The importance of meeting the Paris Agreement (UNFCCC, 2016) goal of limiting global average temperature increase to well below 2°C above pre-industrial levels. Additionally, a recent report by the Intergovernmental Panel on Climate Change (IPCC) highlighted the importance of limiting global warming below 1.5°C (IPCC, 2023a).

19.5.23 Table 19-4 summarises IEMA guidance (IEMA, 2022) on how to apply significance criteria for GHG impact of projects.

Table 19-4: IEMA Significance Criteria

LEVEL OF EFFECT	SIGNIFICANCE CRITERIA	SIGNIFICANCE
Major Adverse	The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with Major Adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.	Significant
Moderate Adverse	The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with Moderate Adverse effects falls short of fully contributing to the UK's trajectory towards net zero.	Significant
Minor Adverse	The projects GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with Minor Adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.	Not Significant
Negligible	The projects GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero achieved well before 2050. A project with Negligible Effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.	Not Significant
Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmospheric concentration, whether directly or indirectly compared to the without project baseline. A project with Beneficial Effects substantially exceeds net zero requirements with a positive climate impact.	Significant

19.5.24 To comply with the UK Government's Low Carbon H_2 standard, H_2 must be able to be produced at an intensity of $20gCO_2e/MJ_{LHV}$ or less (DESNZ, 2023d). The accounting boundary for this does not include construction, combustion of residual CH_4 in the H_2 stream emissions, accounting for any unavailability periods in transport and storage infrastructure, or decommissioning.

19.5.25 The accounting boundary for Low Carbon H_2 standard does include any emissions associated with exploration, extraction, flaring/venting, pre-processing, compression, storage and transport (including any leakage), plus any liquefaction and regasification of fossil gas feedstock, methane in this case, to the plant. As such, the GHG assessment has been carried out both as a whole-life assessment, and compared against the boundary of the UK Low Carbon H_2 standard.

19.5.26 Where the overall emissions of the development are compared against the $20gCO_2e/MJ_{LHV}$ standard the boundaries align with the scope of the standard. Elsewhere total emissions were calculated across a whole life carbon scope (incorporating all the matters covered by the standard and those not included referenced above in Section 19.5).

19.5.27 The significance criteria compare emissions from the Proposed Development against the baseline within the Proposed Development Site i.e. no operational activity. In this context the Proposed Development will have GHG emissions.

19.5.28 When viewed in a wider context the fuel from the Proposed Development will have a role in displacing different fuel and energy sources. Therefore, a broader approach to significance has been taken, looking at the reductions and mitigations associated with introducing H_2 into the UK fuel supply over time.

UK Carbon Budgets

19.5.29 The UK carbon budgets are in place to restrict the volume of GHG emissions the UK can legally emit in a five-year period (HM Government, 2021a). The UK is currently in the 4th carbon budget period which runs from 2023 to 2027. The 3rd to the 5th carbon budgets reflect the earlier UK target (80% reduction target by 2050). The Sixth Carbon Budget, (HM Government, 2021a), is the first budget to reflect the amended net zero target. As the Proposed Development will be active past 2050, the assessment also compared the emissions against the net zero by 2050 target. The current and projected future carbon budgets are presented in Table 19-5 below.

Table 19-5: Current UK Carbon Budgets

UK CARBON BUDGET (PERIOD)	TOTAL BUDGET ($MtCO_2e$)	INDICATIVE CARBON BUDGETS BASED ON CCC'S NET-ZERO PATHWAY ($MtCO_2e$)
4th (2023 to 2027)	1,950	-
5th (2028 to 2032)	1,725	-
6th (2033 to 2037)	965	-

UK CARBON BUDGET (PERIOD)	TOTAL BUDGET ($MtCO_2e$)	INDICATIVE CARBON BUDGETS BASED ON CCC'S NET-ZERO PATHWAY ($MtCO_2e$)
7th (2038 to 2042)	-	526
8th (2043 to 2047)	-	195
9th (2048 to 2050)	-	17

Sources of Information / Data

19.5.30 The assessment was carried out using design data from the Applicant for construction and operational impacts. For further details refer to Table 19-7, Table 19-8 and Table 19-9.

Baseline

Baseline Environment

19.5.31 The baseline environment for the GHG assessment is a "Do Nothing" scenario where the Proposed Development is not undertaken. The baseline comprises existing carbon stock and sources of GHG emissions within the Order limits of the Proposed Development Site. The Proposed Development Site covers an area of approximately 507 ha.

19.5.32 For the purposes of determining net changes in GHG emissions as a consequence of the Proposed Development, it is assumed that there are no activities on the Proposed Development Site currently and that the area is fully under hardstanding. The baseline emissions are therefore considered to be zero and all emissions from the Proposed Development are considered as additional. This is considered a conservative worst-case-scenario as approximately 30% of the Proposed Development Site does not currently consist of hardstanding.

19.5.33 The methodology for calculating GHG emissions and removals has been consistently used across the baseline, construction and operational phases of the Proposed Development, as described below.

19.5.34 The GHG baseline also considers the impact of ongoing gas, coal and diesel energy generation (i.e. the existing supplies to industry and transport) where the Proposed Development is not built.

19.5.35 Emissions from the ongoing consumption of these fossil fuels have been estimated by applying the relevant emissions factor, taken from the UK Government's Conversion Factors for Company Reporting 2023 (DESNZ, 2023g), in terms of mass of CO_2e per unit of energy demand. Natural gas is considered the most likely fuel to be displaced by the hydrogen to be generated by the Proposed Development, but the displacement of industrial coal and diesel for mobility are also considered to provide additional context.

19.5.36 The use of hydrogen to address otherwise hard to decarbonise sectors is a key policy measure as laid out in the UK Government's Carbon Budget Delivery Plan (HM Government, 2023a), and it is reasonable to assume that without a reliable supply of hydrogen, emissions from these sectors are likely to continue.

Proposed Design Development and Impact Avoidance

19.5.37 The alternative environment to the Do Nothing scenario in which the Proposed Development is not undertaken is a "Do Something" scenario with the delivery of the Proposed Development, which includes its construction, operation and decommissioning.

19.5.38 The EIA process aims to avoid, prevent, reduce or offset potential environmental effects through design and/or management measures. These are measures that are inherent in the design and construction of the Proposed Development (also known as embedded measures).

Construction

19.5.39 The Final Construction Environmental Management Plan (CEMP) which is to be produced prior to construction, in accordance with the Framework CEMP (EN070009/APP/5.12) by the Engineering Procurement and Construction (EPC) Contractor(s), which has not yet been appointed, will control construction activities to minimise any impact on the environment through relevant regulations, industry good practice and specific measures, including those described in this ES.

19.5.40 The Framework CEMP also contains an Outline Site Waste Management Plan which will be finalised in the Final CEMP(s), specifying the waste streams and goals for minimising waste arisings through the waste management hierarchy to minimise landfill, off-site disposal and maximise reuse of materials on site, when suitable.

19.5.41 Examples of actions that could be taken during construction set out in the Framework CEMP include:

- fuel consumption on site in vehicles, equipment and plant through minimisation of idling, and switching off when not being used;
- reduction in water consumption in the on-site amenity blocks and construction activities (including dampening down as part of dust mitigation);
- minimisation of transportation of materials to the site, by implementing measures set out in the Framework Construction Workers Management Plan (EN070009/APP/5.15) and the Framework Construction Traffic Management Plan (EN070009/APP/5.16);
- minimisation of emissions through worker commuting by encouraging group transport by the provision of minibuses;
- minimising import of infill materials through recovery of existing materials on site (e.g. slag) when suitable;
- provision of facilities for cyclists;
- provision of information on public transport links; and

- setting minimum rates for material recycling and re-use.

Operation

19.5.42 The proposed design's operation is intended to contribute to avoidance of GHG impact by contributing to decarbonisation and the UK's net zero goals by providing low carbon hydrogen.

19.5.43 The main mitigation strategy is carbon capture which is designed to capture in excess of 95% of the emissions resulting from the Proposed Development operation. The capture rate will be addressed in the permit. It is a key assumption that carbon capture is part of the Proposed Development and transported and stored using NEP infrastructure.

19.5.44 Process emissions, mainly CO_2, H_2 and CH_4, would be managed and regulated through an Environmental Permit issued by the Environment Agency in accordance with the Environmental Permitting (England and Wales) Regulations (HM Government, 2016).

19.5.45 The permit application will present a number of measures that the Proposed Development will include in order to improve energy efficiency and to reduce overall GHG emissions.

19.5.46 In addition, the Proposed Development will be operated in line with appropriate standards, whilst the operator will implement and maintain an Environment Management System (EMS) which will be attested to International Standards Organisation (ISO) 14001 (International Organisation for Standardization, 2015). The EMS will outline requirements and procedures required to ensure that the Proposed Development Site is operating to the appropriate standard. Mitigation actions will also be taken in line with government best practice for blue hydrogen (HM Government, 2023b). Monitoring and reporting will also be taken in line with the low carbon hydrogen standard section 8 which requires monitoring and reporting of GHG intensity of Hydrogen to DESNZ, which will form part of the requirements of any funding support received (DESNZ, 2023d).

19.5.47 Additional maintenance and mitigation measures will include the following appropriate measures, which will be secured in permitting:

- minimising flaring and venting of gases in operation;
- minimising leakage and fugitive emissions of H_2 and using trace processes;
- minimising of H_2, CO_2 and CH_4 leakage in the Connection Corridors;
- use of energy efficient lighting;
- optimisation of overall auto thermal reforming process;
- regular maintenance every four years;
- flaring rather than venting, where emissions cannot be eliminated and where practicable;
- plant design to maximise equipment availability and reliability;

- avoiding routine flaring for waste gas destruction;
- managing production of off-gas and balancing against requirements for fuel gas;
- using procedures to define operations, including start-up and shutdown, maintenance work and cleaning;
- using commissioning and handover procedures to ensure that the plant is installed in line with the design requirements;
- using return-to-service procedures to ensure that the plant is recommissioned and handed over in line with the operational requirements;
- designing flaring devices to enable smokeless and reliable operations, and to ensure an efficient combustion of excess gases when flaring under other than normal operations; and
- monitoring and reporting of gas sent to flaring and associated parameters of combustion.

Decommissioning

19.5.48 At this stage, limited specific additional mitigation measures have been identified for the Proposed Development decommissioning phase due to uncertainties in the activities that will be undertaken, future emission factors and technologies available.

19.5.49 A Decommissioning Environmental Management Plan (DEMP) will be produced pursuant to a Requirement within the Draft DCO (EN070009/APP/4.1). The DEMP will consider in detail all potential environmental risks (including those that relate to climate change) on the Proposed Development Site and contain guidance on how risks can be removed or mitigated. The DEMP will be produced in accordance with guidance and legislation at the time and would likely include measures to reduce GHG emissions (for example encouraging the contractors to recycle the bulk of the plant, equipment and materials).

Likely Impacts and Effects

Description of Potential Effects

19.5.50 This section presents the findings of the GHG impact assessment for the construction (including commissioning), operation (including maintenance) and decommissioning of the Proposed Development. It identifies any likely significant effects that are predicted to occur and then highlights the mitigation and enhancement measures that are proposed to minimise any potential Significant Adverse effects.

Construction

19.5.51 Construction emissions were calculated using data about vehicle movements and quantities of key construction materials required for the Proposed Development. Total construction emissions are summarised in Table 19-6.

19.5.52 The main materials are aggregates for earthworks and backfill, concrete for foundations and piles, steel for structural reinforcement, pipework and asphalt for roads. Total quantities were multiplied by emission factors from the Inventory of Carbon and Energy (Inventory of Carbon and Energy, 2019).

19.5.53 For the transport of materials a standard assumption of a 50 km return trip by Heavy Goods Vehicle (HGV) was considered, using the DESNZ emission factor for an average laden HGV journey of 0.8539 $kgCO_2e/km$ (DESNZ, 2023g). There are expected to be approximately 50,550 HGV journeys associated with the Proposed Development.

19.5.54 Transport of workers is assumed based on a weighted average of 19.2 km based upon distribution of workers detailed in Chapter 15: Traffic and Transport (ES Volume I, EN070009/APP/6.2). A return journey is calculated using the DESNZ emission factor for an average unknown car journey of 0.20874 $kgCO_2e/km$. There are 259,020 journeys during construction associated with the Proposed Development.

19.5.55 5% of construction materials are assumed to go to waste and emissions are calculated using the landfill-based emission factors from DESNZ (DESNZ, 2023g).

19.5.56 Detailed data is not currently available for plant operation energy and fuel consumption. To estimate the GHG impact of plant operation, the Royal Institute of Chartered Engineers (RICS) WLC guidance figure of 1,400 $kgCO_2e$/£100k of the construction cost was used (RICS, 2023). This is a worst-case estimate as the benchmarked emissions factor relates to standard construction projects. The cost of the project was uplifted by 1.32 to represent inflation since 2015, the original date of spend factor issuing, as calculated from the UK Central Bank (Bank of England, 2023). As the Proposed Development consists of many bespoke and advanced technologies the overall cost of development is likely to be more expensive than standard construction projects that this figure is based upon, meaning the 1,400 $kgCO_2e$/£100k is likely an overestimate.

19.5.57 As outlined in Chapter 5: Construction and Programme Management (ES Volume I, EN070009/APP/6.2) construction of Phase 1 is due to be completed in 2028, with Phase 2 commencing in 2028 for a further 3 years, with construction to be completed by late 2030.

Table 19-6: Construction Emissions

LIFECYCLE STAGE	ACTIVITY/EMISSION SOURCE	EMISSIONS (tCO_2e)
Raw Materials	Concrete, aggregate, steel and asphalt for construction	59,217
Transport of Materials	50 km return HGV trip transport for construction materials	4,317
Transport of workers	Return trip via car for workers	2,074

LIFECYCLE STAGE	ACTIVITY/EMISSION SOURCE	EMISSIONS (tCO_2e)
Waste	Disposal of 5% of raw materials at landfill, disposal of hazardous and non-hazardous waste from site preparation	291
Construction Activities	Emissions resulting from plant operation and fuel use	24,320
TOTAL	90,220	
Annual emissions over 4-year Period (2026-2030)[1]	22,555	

Operation

19.5.58 There are a range of uncertainties with future operation that are discussed in the Decommissioning Section Summary of GHG Impact Assessment. To assess the magnitude of climate change impacts associated with operating the Proposed Development, the GHG emissions that are associated with relevant activities were calculated based on the assumptions listed below:

- the Proposed Development is expected to be available and manned 24 hours a day, 7 days per week for 28 years (25 years from completion of Phase 2). With regard to maintenance schedules, it is assumed that any outages are brief, so a fully operational plant is assumed at 8,760 hours per year as a worst-case;
- the majority of the emissions arise from a scenario of 5% unabated CO_2 from the Hydrogen Production Facility, upstream 'well to tank' CH_4 emissions and imported electricity. Minor contributions come from flare pilots, flue gas, vent and seal leakage, worker transport and downstream combustion of residual CH_4 in the H_2 stream;
- quantities of amines and other chemicals required for the carbon capture process are still to be determined, but this is expected to be immaterial to the overall footprint and there are no emissions associated with the amines as it is a closed loop system;
- all residual CH_4 in the H_2 exported product is combusted by the users and converted to CO_2 and water;
- natural gas and carbon emissions emitted during start-up processes are not quantified in this assessment due to the extremely short timeframe in which they occur, compared to continuous normal operations. From a whole-life carbon perspective, start-up emissions are expected to have a negligible effect on overall emissions and are therefore are considered immaterial to this assessment;

[1] Four years used as worst case to give highest annual emissions.

- staff levels are expected to be the same, 130 as a worst case, in Phases 1 and 2;
- electricity demand, H_2 output, CO_2 streams and upstream emissions (well-to tank methane extraction) and downstream emissions (combustion of methane in hydrogen product) doubles in scale after Phase 2;
- the Proposed Development is designed to capture in excess of 95% of the carbon, as required by UK government for H_2. The carbon capture rate will be addressed by the Environmental Permit for the Proposed Development;
- electricity-related emissions have been calculated using DESNZ projections for grid intensity to 2100 (DESNZ, 2023g); and
- natural gas leakage on site is relatively low due to the first process of the Auto Thermal Reformer (ATR) splitting natural gas. Therefore, natural gas leakages are only accounted for in upstream emissions calculations.

19.5.59 The key activity data for the emissions assessment is provided in Table 19-7. The resulting calculated emissions based on the data presented in Table 19-7 are shown in Table 19-8 and Table 19-9. These emissions were categorised as Scopes 1, 2 or 3 in line with the GHG protocol. Scope 1 covers direct emissions from controlled sources such as on-site combustion, whilst Scope 2 covers indirect emissions from purchase of electricity, steam, heating and cooling. Scope 3 emissions are a consequence of activities of the company from sources not owned or controlled by the company.

19.5.60 The unabated CO_2 emissions in Table 19-8 were back-calculated based upon the quantity of CO_2 captured in the process.

19.5.61 Downstream CH_4 combustion emissions arise from the anticipated residual CH_4 in the H_2 export steam. This emerges from unreacted CH_4 in the output stream which hasn't been converted into H_2 and CO_2. When combusted (by offtakers) this residual methane is assumed to convert to CO_2.

Table 19-7: Activity Data from Phase 1 Operating Independently (items not applicable under low carbon hydrogen standard in italics)

ITEM	ACTIVITY	VALUE
Scope 1	Flare pilots, flue gas, vent and seal leakage	497 $kgCO_2e$/hour
	Uncaptured CO_2 emissions (5% that is not captured at 95% capture rate)	7,755 $kgCO_2e$/hour
Scope 2	Electricity demand	70,000 kW
Scope 3	Natural Gas demand	60,500 kg/hour
	Downstream residual methane combustion emissions	15 $kgCO_2e$/hour
	Regular workers	130 Staff

ITEM	ACTIVITY	VALUE
	Irregular maintenance workers	400 people over a 28 day period every 4 years.
	Uncaptured CO_2 from transport and storage unavailability	9,577 $kgCO_2e$/hour (see explanation below).

19.5.62 The flare gas, flue vent and seal leakages, unabated CO_2 emissions and downstream CH_4 combustion emissions are already in $kgCO_2e$/year, so were multiplied by the operational hours per year to calculate emissions in Table 19-8 and Table 19-9.

19.5.63 Imported electricity from the grid will decarbonise throughout the life of the project, and this is calculated using projections from DESNZ projections (DESNZ, 2023g). The figures in Table 19-8 and Table 19-9 represent the average grid emissions per year across the different phase timescales.

19.5.64 Upstream CH_4 emissions were calculated using the DESNZ well-to-tank factor of 0.423 $kgCO_2e/kg$ for natural gas which represents the upstream emissions from sourcing and extracting natural gas (Exergia, 2015; DESNZ, 2023g). This emission factor also accounts for leakage in the upstream natural gas sourcing (Exergia, 2015). This is an approach that was accepted in Net Zero Teesside decision (DESNZ, 2024).

19.5.65 Worker transport was calculated using the same assumptions and emission factors as construction emissions, detailed in the list of assumptions above.

19.5.66 Uncaptured CO_2 arising from the unavailability of the NEP pipeline and storage facility are not accounted for in the Low Carbon Hydrogen Standard boundary, but are included in the calculations for the separate whole life carbon assessment here. Transport and Storage unavailability is assessed here at an assumed rate of 6.5% of operating time. This is a worst case scenario as in cases of unavailability the facility will shut down after 24 hours.

Table 19-8: Average Annual GHG Emissions from Phase 1 Operating Independently (items not applicable under low carbon hydrogen standard in italics)

ITEM	ACTIVITY/EMISSION SOURCE	EMISSIONS (tCO_2e/YEAR)
Scope 1	Flare pilots, flue gas, vent and seal leakage	4,357
	Uncaptured CO_2 emissions (5% that is not captured at 95% capture rate)	67,980
Scope 2	Imported electricity (average of 2028 to 2029)	64,223

ITEM	ACTIVITY/EMISSION SOURCE	EMISSIONS (tCO_2e/YEAR)
Scope 3	Upstream emissions (well to tank methane extraction)	224,422
	Downstream emissions (combustion of methane in output H_2 product)	132
	Worker transport	412
	Maintenance	36
	Uncaptured CO_2 during transport and storage unavailability	83,956
TOTAL		445,518

Table 19-9: Average Annual GHG Emissions from Phase 1 + Phase 2 (items not applicable under low carbon hydrogen standard in italics)

ITEM	ACTIVITY/EMISSION SOURCE	EMISSIONS (tCO_2e/YEAR)
Scope 1	Flare pilots, flue gas, vent and seal leakage	8,713
	Uncaptured CO_2 emissions (5% that is not captured at 95% capture rate)	135,960
Scope 2	Imported electricity (average of 2030 to 2055)	31,006
Scope 3	Upstream emissions (well to tank methane extraction)	448,843
	Downstream emissions (combustion of methane in output H_2 product)	263
	Worker transport	412
	Maintenance	36
	Uncaptured CO_2 during transport and storage unavailability	167,911
TOTAL		793,147

19.5.67 Over 25 years (from completion of Phase 1) the estimated operational GHG emissions from Proposed Development operation add up to 19,133,421 tCO_2e. The

emissions above do not consider the savings associated with displacement of natural gas from H_2 by users, discussed below.

19.5.68 The output stream has an energy content of 600 MWth LHV in Phase 1 only, and 1200 MWth LHV for Phases 1+2 combined. This gives an energy output of 252,461 GWh over 25 years (from completion of Phase 1).

19.5.69 Dividing the estimated emissions in scope of the Low Carbon H_2 standard, not including downstream combustion of residual CH_4 in the H_2 stream, T&S unavailability, decommissioning and construction emissions, by the energy produced gives an emission factor of 16.62 gCO_2e/MJ_{LHV} compared to the low carbon standard of 20 gCO_2e/MJ_{LHV} (DESNZ, 2023d).

19.5.70 If combustion of residual CH_4 in the H_2 stream, construction, decommissioning, and T&S unavailability are included in the whole life carbon assessment, the emission factor increases to 21.64 gCO_2e/MJ_{LHV} on average over the life cycle of the plant.

19.5.71 If the DCO were to seek powers for generating H_2 independently of carbon capture, effectively a carbon capture rate of 0%, the life cycle emissions would add up to 77,094,718 tCO_2e, equivalent to 84 gCO_2e/MJ compared to the low carbon standard of 20 gCO_2e/MJ. The overall emission factor of 305 gCO_2e/kWh represents a 29% increase against the emissions associated with natural gas. However, in the case of the Proposed Development it is assumed that a 95% carbon capture will be achieved so this figure is not taken forward further in this assessment. The capture rate will be addressed by Environmental Permit. .

Decommissioning

19.5.72 In order to assess the magnitude of the climate change impacts through GHG emissions associated with Proposed Development decommissioning, the GHG emissions that would be associated with decommissioning activities include those associated with:

- demolition and excavation of all buildings and infrastructure, as required;
- blowdown/venting of natural gas lines;
- disposal and treatment of wastes; and
- return of the Proposed Development Site to an industrial brownfield use (i.e. no change in land use).

19.5.73 It is not considered possible to reliably forecast decommissioning requirements of infrastructure far in the future due to uncertainty surrounding the decarbonisation of associated sectors and the change deconstruction techniques and technologies. The decommissioning phase is anticipated to involve the removal of all above surface structures. It is assumed that all redundant underground infrastructure would remain in-situ; however, all connection and access points would be sealed or grouted to ensure disconnection.

19.5.74 It is assumed that decommissioning emissions would be on a similar scale to construction emissions. It is likely that some of the associated activities will be decarbonised by the time the Proposed Development is being decommissioned,

however it is assumed that decommissioning emissions are equal to construction of 90,479tCO_2e as a worst case scenario.

Essential Mitigation and Enhancement Measures

19.5.75 Due to the beneficial nature of the operation of the Proposed Development, no further mitigation or enhancement measures are beyond those presented above.

Uncertainty in Impact Analysis

Hydrogen Fugitive Emission

19.5.76 H_2 is not a recognised GHG but has an indirect effect on the climate due to its effect on hydroxyl radicals leading to lengthening the atmospheric lifetime of CH_4 (Warwick, et al., 2022). The global warming effect of H_2 is still uncertain (Warwick, et al., 2022), and it is not recognised in the Kyoto Protocol gases therefore it has not been accounted for in the GHG assessment. There is a potential that fugitive emissions of H_2 (including from the Hydrogen Distribution Network) could contribute to the impact of the Proposed Development though; so, in line with the Low Carbon H_2 standard, the operation of the Proposed Development will minimise cold venting and fugitive emissions of H_2 throughout the operation.

Short Lived GHG Gases

19.5.77 CH_4 and H_2 are both gases that break down relatively quickly in the atmosphere, compared to the 100-year timespan used for global warming analyses. GWP is a measure used to compare non-CO_2 gases that have a global warming effect to CO_2. In this, CO_2 has a GWP of 1, so if a theoretical gas has a GWP of 2 then it has twice the warming effect over the selected timespan. This means that the effect of fugitive emissions is far higher if considered on a shorter time horizon such as 20 years. When using the 100-year timespan, as used in this assessment, CH_4 has a GWP of 27.9. The IPCC estimates CH_4 to have a GWP of 81.2 when using a 20-year timespan (IPCC, 2023b), while a UK Government study suggests H_2 would have a GWP of 33 in a 20-year timespan instead of 11 (Warwick, et al., 2022). This suggests that the risks of large increases in H_2 emissions, from factory leakage, and CH_4 leakage from upstream extraction, may be far higher when considered in the 20-year time horizon to 2050. A 100-year timespan has been used in this assessment as it is the timeframe used in the low carbon hydrogen standard (DESNZ, 2023d). A 100 year timespan is also used in the pathways used to inform the sixth carbon budget (CCC, 2023). Therefore the use of 100-year timespan for GWP values is considered best practice in terms of identifying significance and alignment with the UK's Net Zero goals.

Effects from GHG Transport and Storage Network

19.5.78 As the carbon capture depends on a transport and storage network from the Northern Endurance Partnership (NEP) development, consideration has been given to construction and operational (including leakage) emissions from that network. The construction, operation and decommissioning emissions from the network combine to 357,408 tCO_2e (DWD, 2023). However, it should be noted that this network will provide CO_2 transport and storage capacity for multiple industrial

emitters in the cluster, including NZT power station and the Proposed Development. It is considered that these emissions are minor, in the context of the overall construction emissions and long-term operational emissions of the Proposed Development, and the savings discussed in the next section.

Natural Gas Leakage and Decarbonisation

19.5.79 A 65% proportion of the assessed operational emissions are driven from upstream well-to-tank emissions of natural gas that already exist irrespective of the Proposed Development. This is driven by CH_4 leakage in the supply chain (Bauer, et al., 2022). There is a degree of uncertainty in how much leakage of natural gas is likely in any given supply chain, and whether it can be reduced. Whilst studies suggest it is possible that this leakage may be reduced, in turn reducing the carbon footprint of blue H_2 (Bauer, et al., 2022), there are no reliable projections to base this on currently, so the current well-to-tank emissions of CH_4 extraction, detailed in Section 19.5 and Table 19-8 and Table 19-9, are extrapolated over the lifetime of the Proposed Development from current Government conversion factors which account for leakage (DESNZ, 2023g). This approach is supported by the recent Net Zero Teesside decision. Whilst the upstream well-to-tank emissions are a major contributor to the GHG assessment, this should be seen in the context that the H_2 produced will likely be used by industrial users who currently rely on unabated natural gas or fossil fuel consumption.

Contextualisation Against Carbon Budget Delivery Plan (CBDP)

19.5.80 The CBDP was issued by the UK Government on 30 March 2023 (DESNZ, 2023h) and sets out the Government's detailed proposals and policies to enable the delivery of the 4th, 5th and 6th Carbon Budgets in accordance with the Climate Change Act (HM Government, 2019). In particular it sets out emissions savings projections (importantly, not targets) for various business sectors across the UK (Table below) based on the Government's policies such as supporting hydrogen production.

19.5.81 Table 5 within the CBDP provides a detailed list of proposals and policies to decarbonise various sectors. The production of low-carbon hydrogen, both blue and green, is specifically included in the list of policies to deliver decarbonisation of the fuel supply sector for the 4th, 5th and 6th Carbon Budgets.

Table 19-10: Sectoral Carbon Budgets as defined in the CBDP ($MtCO_2e$) (Sectors in italics are relevant for this assessment)

SECTOR	4th CARBON BUDGET (2023-2027)	5th CARBON BUDGET (2028-2032)	6th CARBON BUDGET (2033-2037)
Agriculture and Land Use	231	207	187
Buildings	350	320	217
Domestic Transport	546	422	254
Fuel Supply	93	69	48

SECTOR	4th CARBON BUDGET (2023-2027)	5th CARBON BUDGET (2028-2032)	6th CARBON BUDGET (2033-2037)
Industry	340	207	111
Power	143	63	42
Waste and F-Gases	125	96	75
GHG Removals	0	-32	-117
Intl. Aviation and Shipping (IAS)	217	210	184
Total excluding IAS	1829	1353	813
Total including IAS	2046	1563	997

19.5.82 To assist in contextualising the potential emissions of the Proposed Development, projected emissions from the Proposed Development have been compared to the relevant sectoral carbon budget for the fuel supply, power, and domestic transport sectors, up to the end of the 6th Carbon Budget It is noted that these sectoral budgets are only projections and should not be interpreted as hard sectoral policy targets. This comparison is presented in table 19-11.

Table 19-11: Residual Operational Emissions, Compared to Relevant CBDP Sectoral Carbon Budget Projections

SECTOR	ESTIMATED RESIDUAL GHG EMISSIONS PER SECTOR (tCO_2e) – 25 YEAR OPERATION	ESTIMATED ANNUALISED RESIDUAL GHG EMISSIONS PER SECTOR (tCO_2e/YR)	RELEVANT % OF CARBON BUDGET PROJECTION	
			5th CARBON BUDGET (2027-2032)	6th CARBON BUDGET (2032-2037)
Fuel Supply	10,778,563	449,107	3%	5%
Power	8,511,563	388,176 (5th Budget) 354,929 (6th Budget)	3%	4%
Domestic Transport	10,305	412	<0.01%	<0.01%

Summary of GHG Impact

19.5.83 Overall, the GHG emissions from the Proposed Development construction are Minor Adverse and Not Significant, whilst the operational emissions are also Minor Adverse and Not Significant when viewing the Proposed Development Order limits in isolation.

19.5.84 However, when looking at the H_2 product and its ability to help enable a transition to a lower carbon economy, the Proposed Development is considered Beneficial and Significant due to its reduced footprint vs natural gas or other fuels such as diesel or coal, as set out below. The overall quantitative benefit depends on the end-use of H_2.

19.5.85 The estimated whole life carbon emissions of the Proposed Development, including downstream and construction emissions, have an emission factor of 77.9 gCO_2e/kWh which represents a 75% reduction against the emissions associated with the whole life carbon emissions of natural gas (236.14 gCO_2e/kWh including combustion and well to tank) (DESNZ, 2023g).

19.5.86 This would add to an abatement of 39.9 $MtCO_2e$ over the life cycle of the project, as a result of replacing natural gas with H_2 on a per kWh basis. This means that the benefits of the H_2 product differ if used to displace other fuels such as coal, gas or diesel. Its benefit would be maximised in 'hard-to-electrify' sectors.

19.5.87 Overall, the Proposed Development could lead to a saving of up to 39.9 $MtCO_2e$, 60 $MtCO_2e$ or 81 $MtCO_2e$ over the lifetime of the Proposed Development if the hydrogen produced displaces natural gas, diesel (vehicle usage scenario) or industrial coal (steel plant scenario) respectively - these savings are shown in Plate 19-2.

19.5.88 These emissions savings will assist the UK government in achieving the required emissions reductions required from the power sector to meet Net Zero and meet carbon budgets. Taking the projections (but note, these are not legally binding targets, or commitments) from the Carbon Budget Delivery Plan, these savings would make up 8% of the projected savings hoped to be achieved from the Government's initiatives in the power sector (such as supporting blue hydrogen projects).

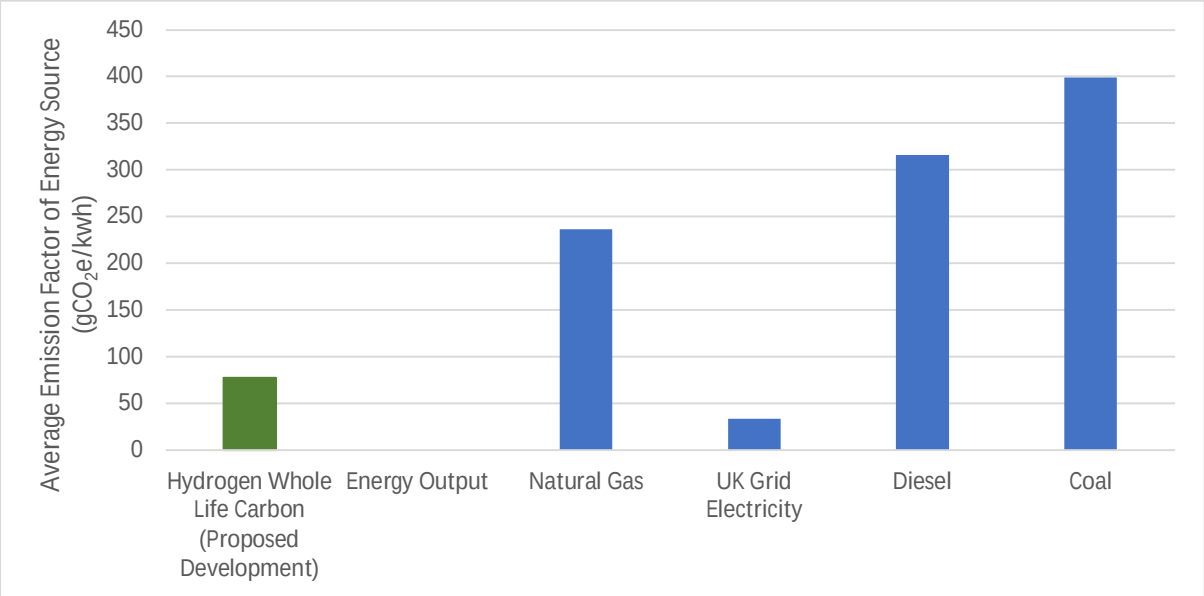

Plate 19-2: Projected Emission Factor of Hydrogen from the Proposed Development, Contrasted with Natural Gas, Diesel and Coal and the UK Grid Carbon Intensity

19.6 Climate Change Resilience Assessment

Methodology

Study Area

19.6.1 The Study Area for the Climate Change Resilience Assessment (CCRA) is the Proposed Development Site itself, including staff and visitors.

Proposed Development Environment

19.6.2 The CCRA considers a '*do something*' scenario with the delivery of the Proposed Development, including its construction, operation and decommissioning.

Sensitive Receptors

19.6.3 Sensitive receptors include workers, occupiers, users, equipment, utilities and associated infrastructure. Sensitive receptors affected by specific climate impacts are detailed in Appendix 19A: Climate Change Resilience Assessment (ES Volume III, EN070009/APP/6.4).

Climate Variables and Parameters

19.6.4 Climate parameters considered in the CCRA during the construction, operation and decommissioning of the Proposed Development include the following:

- extreme weather events;
- flood risk;
- sea level rise;
- temperature change; and
- rainfall change.

19.6.5 The CCRA includes a qualitative review of the Proposed Development's resilience to climate change considering the UK Climate Projections 2018 (UKCP18) (Met Office, 2018) for the geographical location and timeframe of the Proposed Development (including its construction, operation and decommissioning). A detailed assessment of flood risks from climate change and associated mitigation is provided in detailed in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2).

19.6.6 The CCRA has been undertaken for the Proposed Development to identify potential climate change impacts on the Proposed Development and associated receptors, and to consider their potential consequence and likelihood of occurrence, taking account of the mitigation measures incorporated into the Proposed Development design.

19.6.7 Climate change projections for the Proposed Development Site during the construction phase have been examined against receptors applicable to this stage, namely the construction workforce, plant, machinery, and materials.

Determining Construction Effects

19.6.8 As the construction phase of the Proposed Development is relatively short from a climatic perspective (5 years) and is expected to occur in the immediate future, it is not anticipated that there will be any significant changes to climate conditions. Accordingly, the CCRA for the construction phase uses a qualitative descriptive approach.

Determining Operational Effects

19.6.9 For the Proposed Development operational phase, potential climate change impacts have been identified using relevant projections from UKCP18 (Met Office, 2018). The CCRA considers potential consequence to receptors and the likelihood of occurrence, taking account of the measures incorporated into the Proposed Development design. Receptors when the Proposed Development is complete include the Proposed Development's assets and their operation, maintenance and refurbishment.

19.6.10 The CCRA considers the strategic aims and objectives encompassed within national and local planning policy (Section 19.2), such as the NPS EN-1 (DESNZ, 2023a), the NPPF (DLUHC, 2023), the National Planning Policy Guidance on Climate Change (DLUHC, 2019), the Tees Valley Climate Change Strategy (Tees Valley Unlimited, 2010) and the RCBC Local Plan (Redcar and Cleveland Borough, 2019b). These documents detail the broader aims of minimising the adverse impacts of climate change, whilst requiring new developments to take climate change considerations into account within their designs. Ways in which resilience of the Proposed Development to climate change can be enhanced have been assessed and mitigation measures identified where necessary.

19.6.11 The CCRA considers resilience against both gradual climate change and the risks associated with an increased frequency of extreme weather events as per the UKCP18 (Met Office, 2018).

19.6.12 The identification and assessment of climate change resilience within EIA is an area of emerging practice. There is no single prescribed format for undertaking such assessments; therefore, the approach adopted to undertaking and reporting the assessment has drawn on good practice from other similar developments and studies and is aligned with existing guidance such as that of IEMA (IEMA, 2020).

19.6.13 The types of receptors considered vulnerable to climate change include:

- construction phase receptors;
- the Proposed Development assets and their operation, maintenance and refurbishment (e.g. pavements, structures, earthworks and drainage, technology assets, etc.); and
- end users (e.g. staff and commercial operators, etc.).

19.6.14 The potential climate change impacts identified in the CCRA are determined based on the UKCP18 projections (Met Office, 2018). Further data has been obtained as

described in the Future Baseline section, where available, for other climate variables and types of extreme acute weather events, namely:

- heavy rainfall events;
- droughts (extended periods of low precipitation);
- heat waves (high temperatures);
- frosts/freezes (low temperatures);
- humidity;
- wind speed;
- storm surges;
- lightning; and
- fog.

Determining Decommissioning Effects

19.6.15 Although the impacts of climate change are likely to be more acute during the Proposed Development decommissioning phase, this phase is expected to be shorter in duration than construction. Accordingly, the CCRA for the decommissioning phase follows a descriptive based approach.

Scope of CCRA

19.6.16 The scope of the CCRA is set out in Table 19-12.

Table 19-12: CCRA Climate Variable Scope

CLIMATE PARAMETER	CONSIDERED IN CCRA	RATIONAL
Extreme weather events	In	The Proposed Development may be vulnerable to extreme weather events such as extreme heat, droughts, frosts/freezes, storm damage, coastal erosion and storm surge damage to structures and assets.
Precipitation	In	The Proposed Development may be vulnerable to changes in precipitation, for example, pressure on water supply during periods of reduced rainfall, and damage to structures and drainage systems during periods of heavy precipitation and resultant flooding.
Temperature	In	Increased temperatures may increase cooling requirements of the Proposed Development and could impact on structural integrity of buildings and materials

CLIMATE PARAMETER	CONSIDERED IN CCRA	RATIONAL
Sea level rise	In	The Proposed Development Site is located in an area that is susceptible to sea level rise.
Sea temperature	Out	The Proposed Development is not likely to be affected by the small increase in sea temperature during its operational life.
Wind	Out	The impacts of wind on receptors in the surrounding environment and the Proposed Development assets are likely to be no worse relative to baseline conditions. The State of the UK Climate Report (Kendon et al., 2022) states there are *"no compelling trends in storminess when considering maximum gust speeds over the last five decades."*

19.6.17 The CCRA identifies potential climate change impacts and consider their potential consequence and likelihood of occurrence. The following key terms and definitions relating to the CCRA are used:

- climate hazard – a weather or climate related event which has the potential to do harm to environmental or community receptors or assets, for example, increased winter precipitation;
- climate change impact – an impact from a climate hazard which affects the ability of the receptor or asset to maintain its function or purpose; and
- consequence – any effect on the receptor or asset resulting from the climate hazard having an impact.

19.6.18 A stepped approach has been used to assess the impacts of climate change on the Proposed Development as follows:

- identify climate hazard;
- identify likelihood of climate change impact occurring;
- identify consequence of climate change impact on the Proposed Development; and
- identify significance of effect (*likelihood of impact occurring x consequence of impact*).

19.6.19 Potential climate hazards are identified based on data extracted from UKCP18 (Met Office, 2018) for the climate parameters identified above in the Climate Variables and Parameters sub-section.

Classification and Significance of Effects

19.6.20 For the Proposed Development operational phase, once potential impacts have been identified, the likelihood and consequence of each impact occurring to each receptor (where relevant) have been assessed for the selected future time frame for operation.

19.6.21 The criteria which have been used to determine the likelihood of a climate change impact occurring is detailed in Table 19-13.

Table 19-13: Description of Climate Impact Likelihood

LIKELIHOOD OF CLIMATE IMPACT OCCURRING	DESCRIPTION (PROBABILITY OF OCCURRENCE)
Very Likely	90 to 100% probability that the hazard will occur
Likely	66 to 90% probability that the hazard will occur
Possible, about as likely as not	33 to 66% probability that the hazard will occur
Unlikely	10 to 33% probability that the hazard will occur
Very Unlikely	0 to 10% probability that the hazard will occur

19.6.22 Following identification of the likelihood of the climate impact occurring, the consequences of the impact have been assessed according to Table 19-14. The categories and descriptions provided are based on the IEMA climate change resilience and adaptation guidance (IEMA, 2020).

Table 19-14: Climate Risk Consequence Criteria

CONSEQUENCE OF IMPACT	DESCRIPTION
Very High	• permanent damage to structures/assets; • complete loss of operation/service; • complete/partial renewal of infrastructure; • serious health consequences, possible loss of life; • extreme financial impact; and • exceptional environmental damage.
High	• extensive infrastructure damage and complete loss of service; • some infrastructure renewal; • major health impacts; • major financial loss; and • considerable environmental impacts.
Medium	• partial infrastructure damage and some loss of service;

CONSEQUENCE OF IMPACT	DESCRIPTION
	• moderate financial impact; • adverse health consequences; and • adverse impact on the environment.
Low	• localised infrastructure disruption and minor loss of service; • no permanent damage, minor restoration work required; and • small financial losses and/or slight adverse health or environmental consequences.
Very Low	• no damage to infrastructure; • no impacts on health or the environment; and • no adverse financial impact.

19.6.23 Engagement has been undertaken with relevant environmental disciplines as included within this ES and the engineering design team to discuss the CCRA and identify mitigation measures for incorporation into the Proposed Development design. Measures to adapt the Proposed Development are identified where potential climate change consequences are identified as being potentially significant.

19.6.24 The significance of a climate impact is determined by:

Likelihood of climate hazard occurring x Consequence to receptor if climate hazard occurs

19.6.25 The significance level of the identified climate hazard is determined through a combination of the likelihood of the hazard occurring and the severity of the potential consequence, as outlined in Table . Any risk considered to be negligible or minor are considered not significant, whilst moderate or major would be considered significant.

Table 19-15: Climate Risk Significance Matrix

		LIKELIHOOD OF CLIMATE CHANGE HAZARD OCCURING				
		VERY UNLIKELY	UNLIKELY	POSSIBLE	LIKELY	VERY LIKELY
CONSEQUENCE	VERY LOW	Negligible	Negligible	Negligible	Negligible	Negligible
	LOW	Negligible	Minor	Minor	Minor	Minor
	MEDIUM	Negligible	Minor	Moderate	Moderate	Moderate
	HIGH	Negligible	Minor	Moderate	Major	Major
	VERY HIGH	Negligible	Minor	Moderate	Major	Major

19.6.26 The overall methodology for the CCRA is in line with IEMA guidance (IEMA, 2020) and is illustrated in in Plate 19-3.

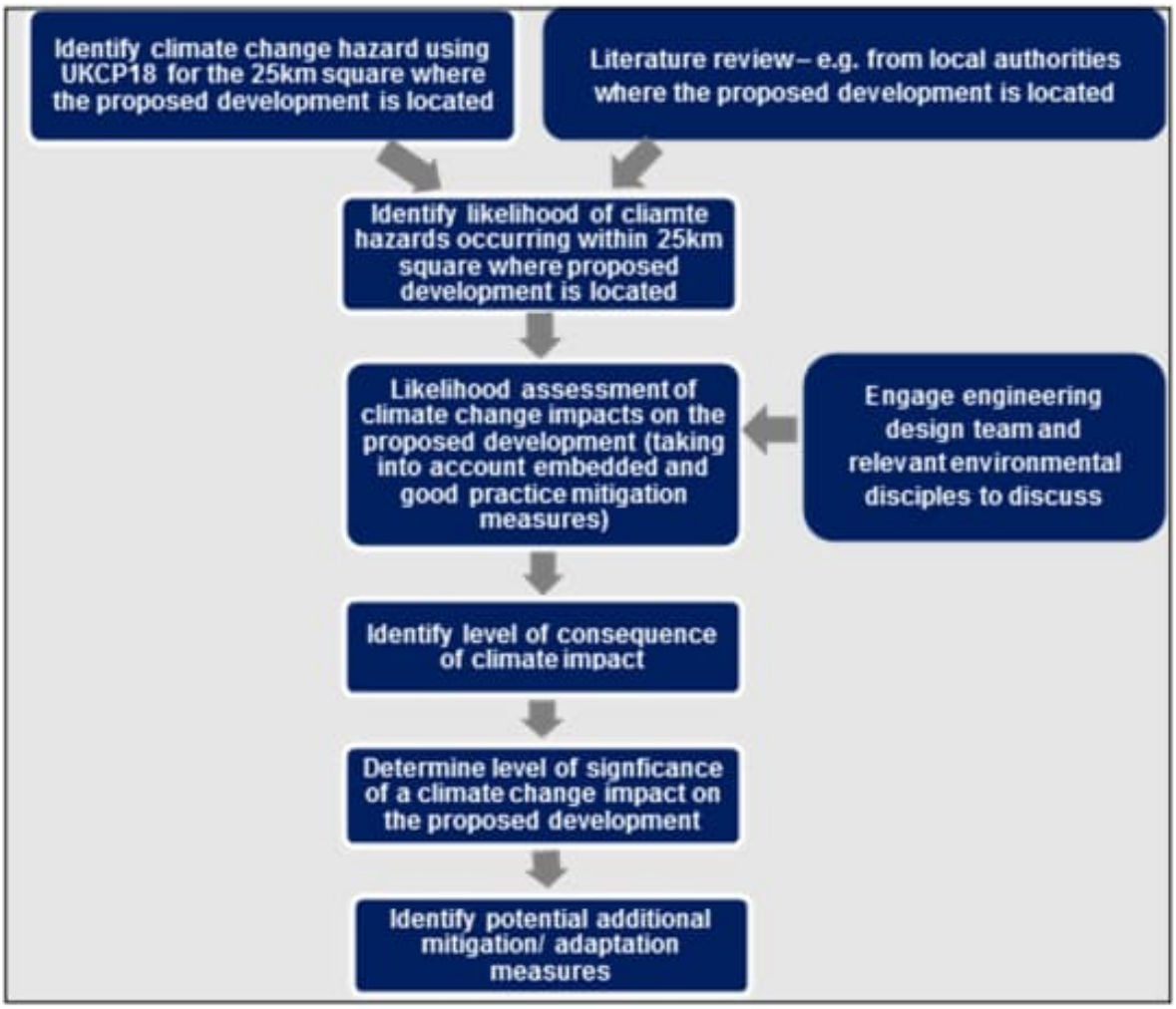

Plate 19-3: CCRA Methodology

Source of Information

19.6.27 The potential climate change impacts identified in the CCRA are determined based on the UKCP18 projections (Met Office, 2018). Further data has been obtained as described in the Future Baseline section, where available, for other climate variables and types of extreme acute weather events as defined in Determining Operational Effects Section above. Details on changes to the water environment as a result of climate change and the associated flood defence strategy refer to Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2).

Limitations

19.6.28 The CCRA assumes that the defined mitigation measures (Proposed Development and Impact Avoidance Section below) will be incorporated into the Proposed Development design. No additional mitigation has been identified as necessary for any stage of the Proposed Development on this basis.

19.6.29 While modelled climate change projections represent anticipated average weather conditions, they do not capture the full range of possible future severe weather events (e.g. droughts, heatwaves and prolonged heavy rainfall).

19.6.30 The CCRA is limited by the availability of data and Proposed Development design information at the date this assessment was prepared.

Baseline

Existing Baseline

19.6.31 The current baseline for the CCRA is based on historic climate data obtained from the Met Office (Met Office, 2023) recorded by the closest meteorological station to the Proposed Development Site (Stockton-on-Tees located approximately 11 km from the Proposed Development Site) for the period 1981 to 2010 (Table 19-16). This baseline considers how resilient the Proposed Development is to current and projected future climates.

Table 19-16: Historic Climate Data

CLIMATIC VARIABLE	MONTH	VALUE
Average annual maximum daily temperature (°C)	-	13.1
Warmest month on average (°C)	July	20.4
Coldest month on average (°C)	December and January	0.7
Mean annual rainfall levels (mm)	-	574.2
Wettest month on average (mm)	August	60.6
Driest month on average (mm)	February	32.9

19.6.32 The Met Office historic 10-year averages for the 'East and North East England' region identify gradual warming (although not uniformly so) between 1970 and 2019, with increased rainfall. Information on mean maximum annual temperatures and mean annual rainfall is summarised in Table .

19.6.33 In comparison to the historic climate data, Stockton-on-Tees appears somewhat drier than the average for the region. As described by the Met Office (Met Office, 2016), rainfall is greater across the Pennines and:

19.6.34 "*decreases as land falls eastwards, such that the east coast is one of the driest parts of the UK with less than 600 mm in places such as Tees-side and the Northumbrian coast.*"

Table 19-17: Historic 10-year Averages for Temperature and Rainfall for the East and North East England

CLIMATE PERIOD	CLIMATE VARIABLE	
	MEAN MAXIMUM ANNUAL TEMPERATURES (^{O}C)	MEAN ANNUAL RAINFALL (MM)
1970 to 1979	12.0	698.2
1980 to 1989	12.0	748.2
1990 to 1999	12.7	720.2
2000 to 2009	13.2	824.9
2010 to 2019	13.1	796.2

Future Baseline

19.6.35 The future baseline for the CCRA is based on future UKCP18 data from the Met Office for the Stockton-on-Tees area (Met Office, 2018). This projection data provides probabilistic indications of how global climate change is likely to affect areas of the UK using pre-defined climate variables and time periods.

19.6.36 For the purpose of the assessment, UKCP18 (Met Office, 2018) probabilistic projections for pre-defined 20-year periods for the following average climate variables have been obtained and analysed:

- mean annual temperature;
- mean summer temperature;
- mean winter temperature;
- maximum summer temperature;
- minimum winter temperature;
- mean annual precipitation;
- mean summer precipitation;
- mean winter precipitation; and
- sea level rise.

19.6.37 Projected variables are presented in Table 19-18 and Table 19-19. UKCP18 (Met Office, 2018) probabilistic projections have been analysed for the 25 km grid square in which the Proposed Development Site is located. These figures are expressed as temperature / precipitation anomalies in relation to the 1981 to 2000 baseline. This baseline was selected as it provides projections for 20-year time periods (e.g. 2020 to 2039) for the parameters analysed within the assessment compared to the 30-year land-based projections that would be generated from the 1981 to 2010 baseline.

19.6.38 UKCP18 (Met Office, 2018) uses a range of possible scenarios, classified as Representative Concentration Pathways (RCPs), to inform differing future emission trends. These RCPs *"... specify the concentrations of greenhouse gases that will result in total radiative forcing increasing by a target amount by 2100, relative to preindustrial levels."* RCP 8.5 is considered to be the worst-case global scenario with the greatest concentration of GHGs in the atmosphere and has been used for the purposes of this assessment as a worst-case scenario.

19.6.39 As the design life of the Proposed Development is relatively short (25 years from completion of Phase 2) and does not extend far beyond the point where the emissions scenarios begin to differ considerably (2040), only the RCP 8.5 emissions scenario has been selected for analysis. The time period up to 2069 is considered for the future baseline to allow for flexibility in the design life of the Proposed Development.

19.6.40 Construction of the Proposed Development is expected to take approximately five years. Construction of Phase 1 is likely to last approximately three years. Phase 2 works will commence thereafter (2028) and last a further two years, with construction expected to be completed by the end of 2030. Please refer to Chapter 5: Construction Programme and Management (ES Volume I, EN070009/APP/6.2) for further detail.

19.6.41 Power generation and carbon capture are expected from 2028 for up to 28 years (25 years from completion of Phase 2). Therefore, the CCRA has considered a scenario that reflects a high level of GHG at the 10%, 50% and 90% probability levels up to the 2069 projection to assess the impact of climate change over as much of the lifetime of the Proposed Development as possible.

Table 19-18: Projected Changes in Temperature Variables (°C), 50% Probability (10% and 90% Probability in Parenthesis)

CLIMATE VARIABLE	TIME PERIOD		
	2020 TO 2039	2030 TO 2049	2050 TO 2069
Mean annual air temperature anomaly at 1.5 m (°C)	+1.0 (+0.4 to +1.6)	+1.3 (+0.6 to +2.1)	+2.1 (+1.0 to +3.2)
Mean summer air temperature anomaly at 1.5 m (°C)	+1.0 (+0.2 to +1.8)	+1.3 (+0.3 to +2.3)	+2.4 (+0.7 to +4.2)
Mean winter air temperature anomaly at 1.5 m (°C)	+1.0 (0.0 to +1.9)	+1.3 (+0.1 to +2.5)	+1.9 (+0.5 to +3.5)
Maximum summer air temperature anomaly at 1.5 m (°C)	+1.1 (+0.2 to +2.1)	+1.5 (+0.3 to +2.7)	+2.6 (+0.8 to +4.6)

CLIMATE VARIABLE	TIME PERIOD		
	2020 TO 2039	2030 TO 2049	2050 TO 2069
Minimum winter air temperature anomaly at 1.5 m (°C)	+1.0 (+0.0 to +2.0)	+1.3 (+0.2 to +2.4)	+1.9 (+0.5 to +3.3)

Table 19-19: Projected Changes in Precipitation Variables (%), 50% Probability (10% and 90% Probability in Parenthesis)

CLIMATE VARIABLE	TIME PERIOD		
	2020 TO 2039	2030 TO 2049	2050 TO 2069
Annual precipitation rate anomaly (%)	+4.5 (-1.5 to +11.2)	+1.5 (-3.5 to +6.9)	+0.8 (-6.0 to +8.3)
Summer precipitation rate anomaly (%)	-2.0 (-16.8 to +14.7)	-5.1 (-19.9 to +11.3)	-16.4 (-36.6 to +5.5)
Winter precipitation rate anomaly (%)	+9.5 (-3.0 to +22.8)	+12.0 (-1.2 to +26.3)	+14.6 (-4.3 to +35.7)

19.6.42 Sea level rise may increase up to 14 cm when Proposed Development operations start (approximately 2028 and up to 33 cm when operations are completed, decommissioning starts (from 2056). The ranges of projected sea level rise from the 1981 to 2000 baseline are detailed in Table 19-20.

Table 19-20: Sea Level Rise Projections

	YEAR			
	2022	2028	2056	2071
Sea level anomaly (m)	+0.08 (+0.06 to +0.11)	+0.11 (+0.08 to +0.14)	+0.26 (+0.19 to +0.33)	+0.39 (+0.29 to +0.53)

19.6.43 Sea temperature change projections are more variable, but under RCP 8.5 a rise in global sea surface temperature of 1.5°C by 2050 is predicted, and 3.2°C by 2100, relative to 1870 to 1899 temperatures. In UK waters, mean annual sea temperatures have risen by 0.8°C since 1870, and have shown a consistent warming trend from the 1970s onwards (Genner et al., 2017). According to Lowe et al., (2009), the seas around the UK are projected to be 1.5 to 4°C warmer by 2100.

19.6.44 Using the climate variable likelihood data for future baselines and the definitions for likelihood, the likelihood of occurrence of potential climate hazards is detailed in Table 19-21.

Table 19-21: Potential Climate Hazards and Likelihood of Occurrence (from UKCP18 Projections)

CLIMATE VARIABLE	POTENTIAL HAZARD	2020 TO 2039 LIKELIHOOD	2030 TO 2049 LIKELIHOOD	2050 TO 2069 LIKELIHOOD
Mean annual air temperature anomaly at 1.5 m (°C)	Increase in mean annual air temperature	Very likely	Very likely	Very likely
Mean summer air temperature anomaly at 1.5 m (°C)	Increase in mean summer air temperature	Very likely	Very likely	Very likely
Mean winter air temperature anomaly at 1.5 m (°C)	Increase in mean winter air temperature	Very likely	Very likely	Very likely
Maximum summer air temperature anomaly at 1.5 m (°C)	Increase in maximum summer air temperature	Very likely	Very likely	Very likely
Minimum winter air temperature anomaly at 1.5 m (°C)	Increase in minimum winter air temperatures	Very likely	Very likely	Very likely
Annual precipitation rate anomaly (%)	Decrease in annual precipitation rate	Unlikely	Unlikely	Possible
Summer precipitation rate anomaly (%)	Decrease in summer precipitation rate	Possible	Likely	Likely
Winter precipitation rate anomaly (%)	Increase in winter precipitation rate	Very likely	Very likely	Very likely
Sea level rise (m)	Increase in sea level	Very likely	Very likely	Very likely

CLIMATE VARIABLE	POTENTIAL HAZARD	2020 TO 2039 LIKELIHOOD	2030 TO 2049 LIKELIHOOD	2050 TO 2069 LIKELIHOOD
Sea temperature rise (°C)	Increase in sea surface temperature	Very likely	Very likely	Very likely

19.6.45 The 2019 State of the UK Climate Report (Kendon et al., 2020) states that there are *"no compelling trends in storminess when considering maximum gust speeds over the last five decades"*, therefore an increase in storm intensity is currently considered unlikely.

19.6.46 Kendon et al., (2020) states that there has been a decline in the longest sequence of consecutive dry days. However, projected drier summers are suggestive of a drying trend. Therefore, an increase in droughts is currently considered possible.

19.6.47 Research by Sanderson et al., (2017) into the historical trends of heatwave frequency in the UK found variable results, with some weather stations recording a decline in very long heatwaves and others an increase in short heatwaves. Accordingly, the likelihood of an increase in heatwaves is considered possible.

Proposed Development Design and Impact Avoidance

19.6.48 The EIA process aims to avoid, prevent, reduce or offset potential environmental effects through design and/or management measures. These are measures that are inherent in the design and construction of the Proposed Development (also known as embedded measures).

19.6.49 The following impact avoidance measures have either been incorporated into the design or are standard construction or operational practices. These measures have, therefore, been taken into account during the impact assessment and will be secured pursuant to Requirement through the Draft DCO (EN070009/APP/4.1).

Construction

19.6.50 A Framework Construction Environmental Management Plan (CEMP) (EN070009/APP/5.12) sets out the key measures to be employed during the construction of the Proposed Development, to control and minimise the impacts on the environment. The Framework CEMP will set out how impacts upon the surrounding environment will be managed during construction. The Framework CEMP will also address how climate impacts to construction will be managed and mitigated. The Final CEMP(s) will be prepared by the EPC Contractor(s) in accordance with the Framework CEMP prior to construction. The submission, approval, and implementation of the Final CEMP(s) will be secured by a Requirement of the Draft DCO (EN070009/APP/4.1).

19.6.51 Full details of design measures embedded in the Proposed Development design that reduce its vulnerability to climate change are detailed in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2) and

Chapter 10: Geology, Hydrogeology and Contaminated Land (ES Volume I, EN070009/APP/6.2). Examples of these measures include:

- storage of topsoil and other construction materials stored outside of the 1 in 100-year floodplain to protect materials from high rainfall and flooding events or sea level rise;
- suitable storage and bunding of pollutants to protect from high rainfall events or sea level rise. This will be further supported by a Surface Water Maintenance and Management Plan and a Emergency Response Plan, as part of the Final CEMP(s);
- temporary construction compounds will be laid with permeable membranes to protect the Proposed Development Site from high rainfall and flooding events; and
- the Contractor will monitor weather forecasts and receive Environment Agency flood alerts and plan works accordingly, protecting workers and resources from any extreme weather conditions such as storms, flooding or heatwaves. The Emergency Response Plan, forming an annex to the Final CEMP(s), will contain further information on the management of working conditions during construction.

Operation

19.6.52 Full details of embedded design measures that reduce the vulnerability of the Proposed Development are contained within other technical disciplines within this ES, such as Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2). Examples of such measures include:

- Suitable storage and bunding of pollutants to protect from high rainfall events or sea level rise. This will be supported by a Emergency Response Plan.
- Cabling will be buried underground, insulating against overheating during heatwaves.
- Installation of a suitable surface water drainage network and management system through the Surface Water Drainage Strategy, Sustainable drainage systems (SuDS), to protect the Proposed Development Site from high rainfall events. This will be supported by a Surface Water Maintenance and Management Plan.
- To mitigate flood risk associated with increased rainfall and storm surges, a raised development platform will be provided for the Proposed Development to ensure the Finished Floor Levels will be above 7.4m AOD, allowing for continued operation in the occurrence of a flood event. This raised platform will also allow for additional below ground attenuation and gravity discharge to support the proposed drainage system. Further details on the flood defence strategy for the Proposed Development can be found in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2).

Decommissioning

19.6.53 A Decommissioning Plan (including DEMP) would be prepared at the time of decommissioning which will consider potential environmental risks on the Proposed Development Site and contain guidance on how these risks can be removed or mitigated. The DEMP would be secured by a Requirement in the Draft DCO (EN070009/APP/4.1). The Decommissioning Plan would also include an outline programme of works.

19.6.54 At this stage, limited specific mitigation measures have been identified for the decommissioning phase of the Proposed Development. A DEMP would be produced to appropriate guidance and legislation at the time and is likely be similar to that of the construction phase but reflect future climatic conditions at that point in time.

Likely Impacts and Effects Summary

19.6.55 A summary of the findings of the CCRA for the construction, operation and decommissioning of the Proposed Development can be found in Appendix 19A: Climate Change Resilience Assessment (ES Volume III, EN070009/APP/6.4).

19.6.56 Components of the Proposed Development that have been considered include all infrastructure, plant and machinery, all workers, staff or visitors on-site and materials. Potential climate change impacts, the likelihood and consequences to the construction, operation and decommissioning of the Proposed Development, together with the adaptation methods to increase the resilience of the Proposed Development are detailed in Appendix 19A: Climate Change Resilience Assessment (ES Volume III, EN070009/APP/6.4).

Essential Mitigation and Enhancement Measures

19.6.57 No additional mitigation measures are recommended for the Proposed Development due to the lack of significant climate change resilience risks.

Summary of CCRA Assessment

19.6.58 A range of climate change hazards and their potential impact upon the Proposed Development have been identified. The measures embedded within the Proposed Development design as detailed herein and discussed in Appendix 19A are deemed sufficient to reduce the likelihood or consequence of an impact occurring as a result of these projected climate hazards. As such, no significant resilience risks have been identified.

19.7 In-Combination Climate Change Impact Assessment

19.7.1 This ICCI assessment aims to identify any impact to receptors in the surrounding environment or communities that occur due to the combined impacts of climate change and the construction and operation of the Proposed Development.

Methodology

Study Area

19.7.2 The study areas used for the ICCI assessment comprises the study areas defined in each of the relevant topic Chapters (8 to 22) (ES Volume I, EN070009/APP/6.2) in

this ES. This assessment aims to determine the influence of climate change and related impacts to the identified receptors in each of the assessments in those chapters.

19.7.3 The ICCI assessment considers the ways in which projected climate change will influence the significance of the effects of the Proposed Development on receptors in the surrounding environment.

Proposed Development Environment

19.7.4 The ICCI considers a 'do something' scenario with the delivery of the Proposed Development, including its construction, operation and decommissioning.

Sensitive Receptors

19.7.5 The ICCI assessment considers the sensitive receptors as identified by each technical discipline in Chapters 8 to 22 of this ES (ES Volume I, EN070009/APP/6.2). The ICCI assessment is undertaken by individual technical disciplines in regard to the identified sensitive receptors in each assessment.

Determining Effects

19.7.6 The methodology for determining ICCI effects can be considered the same as the CCRA, though focuses on receptors as identified by the relevant topics as opposed to the Proposed Development itself. The determination of effects is undertaken by technical specialists responsible for their applicable chapter.

Scope

19.7.7 The scope of the ICCI is considered the same as that of the CCRA, as presented in (Table 19-12).

Classification and Significance of Effects

19.7.8 Once climate hazards are identified for the receptors associated with the Proposed Development, the likelihood of their occurrence and the sensitivity of the receptor is considered in order to determine the likelihood of a climate impact occurring during the Proposed Development's lifespan is categorised as per Table 19-22.

Table 19-22: ICCI Climate Impact Likelihood Descriptions

LEVEL OF LIKELIHOOD OF CLIMATE IMPACT OCCURING	QUALITATIVE DESCRIPTION	QUANTITATIVE DESCRIPTION
Very likely	Likely that the impact will occur many times (reoccurs frequently).	90 to 100% probability that the impact will occur during the life of the Proposed Development.
Likely	Likely that the impact will occur sometimes (reoccurs infrequently).	66 to 90% probability that the impact will occur during the life of the Proposed Development.

LEVEL OF LIKELIHOOD OF CLIMATE IMPACT OCCURING	QUALITATIVE DESCRIPTION	QUANTITATIVE DESCRIPTION
Possible, about as likely as not	Possible that the impact will occur (has occurred rarely)	33 to 66% probability that the impact will occur during the life of the Proposed Development.
Unlikely	Unlikely that the impact will occur (not known to have occurred)	10 to 33% probability that the impact will occur during the life of the Proposed Development.
Very unlikely	Almost inconceivable that the impact will occur.	0 to 10% probability that the impact will occur during the life of the Proposed Development.

19.7.9 The likelihood of a climate hazard occurring and the likelihood of an impact of a receptor is then combined to determine the likelihood of an ICCI occurring. This criterion is illustrated in Table 19-23.

Table 19-23: Definition of Likelihood of ICCI Occurring

LEVEL OF LIKELIHOOD OF CLIMATE IMPACT OCCURING	DEFINITION OF LIKELIHOOD
High	Likelihood of climate hazard occurring is high and impact is always/almost always going to occur.
Moderate	Likelihood of climate hazard occurring high and impact occurs often or the likelihood of climate hazard occurring is Moderate and impact is likely to occur always/almost always.
Low	Likelihood of climate hazard occurring is high, but impact rarely occurs or the likelihood of climate hazard occurring is Moderate and impact sometimes occurs or the likelihood of climate hazard occurring is low and impact is likely to occur always/almost always.
Negligible	All other eventualities – highly unlikely but theoretically possible.

19.7.10 Once the likelihood of an ICCI has been identified, the assessment then considers how this will affect the significance of the identified effects.

19.7.11 The ICCI consequence criteria are defined in Table 19-24 and are based on the change to the significance of the effect already identified by the applicable environmental discipline. To assess the consequence of an ICCI each discipline has

assigned a level of consequence to an impact based on the criteria description and their discipline assessment methodology.

Table 19-24: ICCI Consequence Criteria

CONSEQUENCE	CONSEQUENCE CRITERIA
High	The climate change parameter in-combination with the effect of the Proposed Development causes the significance of the effect of the Proposed Development on the resource/receptor, as defined by the topic, to increase from negligible, low, or Moderate to High.
Moderate	The climate change parameter in-combination with the effect of the Proposed Development, causes the significance of effect defined by the topic, to increase from negligible or low, to Moderate.
Low	The climate change parameter in-combination with the effect of the Proposed Development, causes the significance of effect defined by the topic, to increase from negligible to low.
Negligible	The climate change parameter in-combination with the effect of the Proposed Development does not alter the significance of the effect defined by the topic.

19.7.12 The significance of potential effects is determined using the matrix in Table 19-25. Where an effect has been identified as Moderate or high is classed as a significant ICCI effect. If significant ICCI effects are assessed, then appropriate additional mitigation measures are identified.

Table 19-25: ICCI Significance Matrix

CONSEQUENCE	LIKELIHOOD			
	NEGLIGIBLE	LOW	MODERATE	HIGH
NEGLIGIBLE	Not Significant	Not Significant	Not Significant	Not Significant
LOW	Not Significant	Not Significant	Not Significant	Significant
MODERATE	Not Significant	Not Significant	Significant	Significant
HIGH	Not Significant	Significant	Significant	Significant

Source of Information

19.7.13 The assessment is carried out in combination with the other environmental disciplines to identify receptors and risks within their associated chapters that may be influenced by climate change. The current and future baseline climate data is derived from the same sources as described in the CCRA methodology.

Limitations

19.7.14 While modelled climate change projections represent anticipated average weather conditions, they do not capture the full range of possible future severe weather events (e.g. droughts, heatwaves and prolonged heavy rainfall).

19.7.15 The ICCI is limited by the availability of data and Proposed Development design information at the date this assessment was prepared.

Baseline Conditions

19.7.16 The existing and future baseline conditions for the ICCI are the same as those described for the CCRA (Section 19.6).

Proposed Development and Impact Avoidance

19.7.17 Multiple embedded mitigation measures have been incorporated into the Proposed Development design to mitigate the in-combination climate change impacts on nearby receptors.

19.7.18 Examples of these mitigation measures are summarised below. Further detail on the ICCI embedded mitigation measures can be found in Appendix 19B: In Combination Climate Change Impact Assessment (ES Volume III, EN070009/APP/6.4)

- reinstating of any habitat lost during construction;
- development of dewatering strategy;
- 30% climate change allowance when developing drainage strategy;
- Minimum ground level of 6.83 AOD to reduce flood risk;
- Any contamination of groundwater during construction will be removed, remediated or mitigated; and
- Suppression of dust/particulate production during construction through the use of water bowsers.

Likely Impacts and Effects Summary

19.7.19 Refer to Appendix 19B: In Combination Climate Change Impact Assessment (ES Volume III, EN070009/APP/6.4) for a complete assessment of potential ICCI risks.

Mitigation and Enhancement Measures

19.7.20 Due to a lack of significant ICCI risks, no further mitigation measures beyond those presented above in Proposed Development and Impact Avoidance Section and Appendix 19B: In Combination Climate Change Impact Assessment (ES Volume III, EN070009/APP/6.4).

Assumptions and Limitations

19.7.21 While modelled climate change projections represent anticipated changes to average weather conditions, they cannot predict the frequency and severity of acute events such as droughts, heatwaves and prolonged heavy rainfall. Therefore, the ICCI assessment is based upon UKCP18 (Met Office, 2018) predictions for

general changes in climate conditions, and only a high-level assessment of acute events will be included in this assessment.

Summary of ICCI Assessment

19.7.22 A range of climate change hazards and their potential impact upon the Proposed Development and surrounding receptors have been identified. The measures embedded within the Proposed Development design as detailed in Appendix 19B are deemed sufficient to reduce the likelihood or consequence of an impact occurring as a result of these projected climate hazards. As such, no significant resilience risks have been identified.

19.8 Summary of Residual Effects

19.8.1 No residual significant effects for the construction, operation or decommissioning of the Proposed Development are anticipated following GHG Impact Assessment, CCRA and ICCI. A summary of the GHG assessment is given below in Table 19-26, whilst the CCRA and ICCI impacts are presented in Appendix 19A and 19B (ES Volume III, EN070009/APP/6.4) respectively.

Table 19-26: Summary of Residual Effects from GHG Assessment

RECEPTOR/ RECOURCE	IMPORTANCE AND VALUE/ SENSITIVITY	MAGNITUDE OF IMPACTS	LIKELY SIGNIFICANT EFFECTS	PROPOSED MITIGATION / ENHANCEMENT	RESIDUAL EFFECTS
Construction					
Global Climate	High	Minor adverse	Not significant	GHG emissions will be managed through a Final Construction Environmental Management Plan (CEMP) and related plans including a Final Site Waste Management Plan (SWMP). The overall project is considered beneficial due to the operational impact.	N/A
Operation					
Global Climate	High	Beneficial	Significant	None required	N/A

19.9 References

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