Keuper Gas Storage Project

Preliminary Environmental Information Report – Climate Change and Greenhouse Gas Emissions

PREPARED FOR
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ACRONYMS AND ABBREVIATIONS

Acronym	Description
CCRA	Climate Change Risk Assessment
CCRR	Climate Change Resilience Review
DCO	Development Consent Order
DESNZ	Department for Energy Security and Net Zero
EA	Environment Agency (UK)
EIA	Environmental Impact Assessment
ERM	Environmental Resources Management
ES	Environmental Statement
FEED	Front End Engineering Design
FFDI	Forest Fire Danger Index
GCD	Global Climate Database
GHG	Greenhouse Gas
HVAC	Heating, ventilation and air conditioning
ICCI	In-combination climate impacts

Acronym	Description
IPCC	Intergovernmental Panel on Climate Change
KGSL	Keuper Gas Storage Limited
KGSP	Keuper Gas Storage Project
MC	Material Change
NPS	National Planning Statement
PEIR	Preliminary Environmental Information Report
SME	Subject matter expert
SSP	Shared socioeconomic pathway

17. CLIMATE CHANGE AND GREENHOUSE GASES

17.1 INTRODUCTION

17.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) sets out the scope and methodology for assessing the impact of climate change on the Proposed Development (the 'GHG Assessment') and the impact of the Proposed Development on climate change (the 'Climate Change Resilience Assessment' (CCRA)).

17.1.1.2 The chapter also sets out the approach to the 'In-Combination Climate Change Impact Assessment (ICCI)'.

17.1.1.3 The Proposed Development is a critical element of the HyNet consortium of hydrogen generation and supply in the North-West and North Wales. The Proposed Development aims to support regional and national net zero commitments by providing hydrogen storage as an alternative to gas storage.

17.2 LEGISLATION, POLICY AND GUIDANCE

17.2.1.1 The legislation, policy and guidance relevant to this chapter supports developments that rapidly increase electricity generation from low carbon and renewable sources. The relevant legislation, policy and guidance to climate change and greenhouse gas emissions are detailed below.

17.2.2 LEGISLATION

17.2.2.1 The Climate Change Act 2008[1] ('the Act') is the UK Government's legislation for addressing climate change. In relation to climate change mitigation, the Act commits the UK to GHG emissions reductions and reporting. The Climate Change Act 2008 (2050 Target Amendment) Order 2019 sets the UK's net zero target by 2050.

17.2.3 NATIONAL POLICY

17.2.3.1 Schedule 4 of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 ('the EIA Regulations')[2] sets out the requirement to consider climate change within EIA assessment and decision-making processes: *"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 the vulnerability of the project to climate change".*

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[1] UK Government. (2008). Climate Change Act. (Online). Available at: Climate Change Act 2008 [Accessed August 2025].

[2] UK Government. (2017). The Town and Country Planning (Environmental Impact Assessment) Regulations 2017. (Online). Available at: https://www.legislation.gov.uk/id/uksi/2017/571 [Accessed August 2025].

17.2.3.2 Section 5.3 of the National Planning Statement (NPS) for Energy (EN-1)[3] sets out the requirements for a GHG assessment of the whole life GHG impacts from construction, operation and decommissioning of a Proposed Development. This includes an explanation of how these impacts have been mitigated at every stage.

17.2.4 LOCAL PLANNING POLICY

17.2.4.1 Cheshire West and Chester Local Plan 2015[4] supports the creation of infrastructure that promotes 'green infrastructure' that addresses climate change by designing and constructing infrastructure that mitigates and adapts to climate change.

17.2.5 GUIDANCE

17.2.5.1 The methodology used in the GHG assessment will be developed in line with the Institute of Sustainability and Environmental Professional's (ISEP) Guide: Assessing Greenhouse Gas Emissions and Evaluating the Significance[5].

17.2.5.2 EIA Guide to: Climate Change Resilience and Adaptation 2020, herein referred to throughout as "ISEP Climate Guidance"[6]

17.2.5.3 The methodology used in the climate change resilience review will be guided by ISEP's EIA Guide to: Climate Change Resilience & Adaptation[7].

17.3 CONSULTATION

17.3.1.1 This section provides a summary of the consultation undertaken to date on the Proposed Development.

17.3.2 EIA SCOPING

17.3.2.1 A Scoping Opinion was received from the Planning Inspectorate in June 2025.**Table 17.1** summarises how this chapter of the PEIR addresses the Scoping Opinion comments in relation to climate change.

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[3] UK Government. (2024). Overarching National Policy Statement for Energy (EN-1). (Online). Available at: https://www.gov.uk/government/publications/overarching-national-policy-statement-for-energy-en-1 [Accessed August 2025].

[4] Cheshire West and Chester Council. (2015). Chester West and Chester Local Plan. (Online). Available at: Local Plan - Part One | Cheshire West and Chester Council [Accessed August 2025].

[5] Institute of Sustainability and Environmental Professionals. (2022). Assessing Greenhouse Gas Emissions and Evaluating the Significance. (Online). Available at: 2022_iema_greenhouse_gas_guidance_eia.pdf [Accessed August 2025].

[6] Institute of Environmental Management and Assessment (2020) Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation. Available at: https://www.iema.net/media/mabhqino/iema-eia-climate-change-resilience-june-2020.pdf [accessed June 2025]

[7] ISEP. (2022) Climate Change Resilience and Adaptation. (Online). Available at: https://www.iema.net/resources/blogs/2022/11/11/iema-publishes-guidance-on-climate-change-adaptation [Accessed August 2025].

TABLE 17.1 – PLANNING INSPECTORATE'S SCOPING OPINION RESPONSES

Consultee	Reference	Issue	Summary of Comment	How is this addressed in the PEIR?
The Planning Inspectorate	3.13.1	Water-related climate hazards: ocean acidification, saline intrusion, sea level rise and glacial outbursts	This matter is proposed to be scoped out on the basis that the Proposed Development is not located in an area that is susceptible to these climate hazards. The Inspectorate is content to scope this matter out of further assessment.	N/A – Scoped Out for further assessment.
The Planning Inspectorate	3.13.2	Wind-related climate hazards: cyclones, hurricanes, typhoon and tornados	This matter is proposed to be scoped out on the basis that the Proposed Development is not located in an area that is susceptible to these climate hazards. The Inspectorate is content to scope this matter out of further assessment.	N/A – Scoped Out for further assessment.
The Planning Inspectorate	3.13.3	Solid mass-related climate hazards: coastal erosion, soil degradation, soil erosion, solifluction, avalanche, landslide and subsidence	This matter is proposed to be scoped out on the basis that the Proposed Development is not located in an area that is susceptible to these climate hazards. The Inspectorate is content to scope this matter out of further assessment.	N/A – Scoped Out for further assessment.

Consultee	Reference	Issue	Summary of Comment	How is this addressed in the PEIR?
The Planning Inspectorate	3.13.4	Approach to assessment	The proposed approach to assessment provided in the Scoping Report is high level and does not describe a specific assessment methodology to be followed, nor does it describe what would be considered a significant effect in EIA terms. The ES should make clear how any likely significant effects have been determined for climate change aspects of the Proposed Development and clearly describe the methodology adopted for the assessment.	Noted. The approach to the assessment for GHG is outlined in Section 17.4.2 and Section 17.8.5 for Climate Change. The expected significance of effect will be determined for both for the ES.

17.3.3 OTHER CONSULTATION

17.3.3.1 At the time of writing no other consultation has been undertaken outside of the EIA Scoping Opinion in relation to climate change and GHG emissions.

17.4 GHG BASIS OF THE ASSESSMENT

17.4.1.1 The GHG assessment will be prepared in accordance with the UK Government's Environmental Reporting Guidelines[8]; the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (revised edition)[9] developed by the World Resources Institute and the World Business Council for Sustainable Development (2004); and ISO14064-1:2018 Specification with Guidance at the Organisation Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals .

17.4.1.2 The GHG assessment will also use the most up-to-date conversion factors as detailed by non-financial reporting guidance and specifically the UK Government Department for Energy Security and Net Zero (DESNZ) conversion factors for company reporting and the UK Government's electricity emission factors to 2100 which are part of its Green Book and supplementary guidance[10].

17.4.1.3 The methodology used in the GHG assessment will be guided by the EIA Guide to: Assessing Greenhouse Gas Emissions and Evaluating the Significance[5].

17.4.2 GHG ASSESSMENT METHODOLOGY

17.4.2.1 The GHG assessment will identify and calculate the GHG emissions associated with the construction, operation and decommissioning of the Proposed Development.

17.4.2.2 The GHG emissions will be classified in accordance with best practice GHG reporting into the following categories:

- Scope 1 GHG emissions (direct): GHG emissions that arise from sources that are owned or controlled by the Proposed Development such as consumption of oil, gas and biomass to generate electricity, for use in vehicles, plant or machinery and the venting of hydrogen or other fugitive emissions (for example sulphur hexafluoride (SF6)) from equipment;

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[8] UK Government. (2019). Environmental Reporting Guidelines. (Online). Available at: The GHG assessment will be prepared in accordance with the UK Government's environment reporting guidelines [Accessed August 2025].

[9] Greenhouse Gas Protocol. (2015). A Corporate Accounting and Reporting Standard. (Online). Available at: https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf [Accessed August 2025].

[10] DESNZ. (2023). Green Book Supplementary Guidance: Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal. (Online). Available at: Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK [Accessed August 2025].

- Scope 2 GHG emissions (indirect): GHG emissions from the generation of purchased electricity, heat and steam. This can involve electricity consumed in buildings, plant and machinery; and
- Scope 3 GHG emissions (indirect): GHG emissions that occur as a consequence of the activities of the Proposed Development but occur from sources not owned or controlled by the Proposed Development. For instance, the fuel used in third party vehicles and for business travel; and the hydrogen fuel sold to customers.

17.4.2.3 The GHG assessment will report the GHG emissions in tonnes of carbon dioxide equivalent (tCO2e). To calculate the tCO2e the following methodology will be used:

Activity data x GHG emissions factor = GHG emissions (tCO2e)

17.4.2.4 Where feasible, activity data will be gathered from primary sources such as the quantity of materials used, wastes generated, or distances travelled. The activity data will then be multiplied by the most appropriate conversion factor.

17.4.2.5 The individual quantification calculations are then summed to form a total GHG emission inventory for the project and its activities. The GHG calculations and inventory will be presented as a Technical Appendix to the ES.

17.4.2.6 Where data is not available, alternative approaches would be taken using generic or publicly available information that best represents the projects and its activities.

17.4.2.7 The emissions associated with the Proposed Development will be assessed against a suitable baseline to provide a comparison of the impact of the Proposed Development on the climate.

17.4.2.8 In some cases, there will be exceptions to the stated boundaries and methods detailed above. Any activities representing under 1% of the total GHG assessment emissions will be considered de-minimis.

17.4.3 SCOPE OF ASSESSMENT

17.4.3.1 For the GHG assessment it is considered that any change in GHG emissions has the potential to impact climate change.

17.4.3.2 The Proposed Development will support the generation and transmission of low carbon electricity as part of the HyNet consortium and therefore, will provide a benefit assuming that it will reduce GHG emissions from fossil fuels. This is described in detail in **Chapter 5, Planning and Policy Context**.

17.4.3.3 The Proposed Development is at an early stage in its design and as a result activity data was not available to inform the GHG assessment. As a result, a full GHG assessment will be completed and presented in the final ES as described in the following paragraphs **17.4.3.4 to 17.4.3.6.**

17.4.3.4 The GHG assessment for the ES will identify and calculate the GHG emissions associated with the construction, operation and decommissioning of the Proposed Development.

17.4.3.5 The key activities of the Proposed Development that will generate GHG emissions are likely to include:

- Construction (proposed to be undertaken over an 13-year period from 2028-2040): This includes the extraction, manufacture and transport of materials to the Proposed Development; as well as the emissions associated with the construction processes on site (including fuel consumption of construction and installation equipment and vehicles; electrical pumps used for sub-surface work during construction; and construction waste management).
- Operation and Maintenance (proposed to commence in 2032): The GHG emissions associated with the operation of the Proposed Development will involve fuel consumption related to the maintenance equipment and vehicles used; the electrical supply during operations as well as the vented hydrogen and other fugitive emissions.
- Decommissioning (50 years after Operation): This will involve the GHG emissions associated with the fuel consumption of plant, machinery and vehicles during the decommissioning phase.

17.4.3.6 To conduct the GHG assessment, activity data such as the quantity of materials used, fuel consumed, waste generated, hydrogen vented, other fugitive emissions or distances travelled will be gathered. The availability of activity data will determine the sources of, and categories of GHG emissions reported in the GHG assessment that is presented in the final ES.

17.4.3.7 The GHG assessment will be based on the data that is available at the design stage, the assumptions that are used within the assessment and the limitations of the assessment. The GHG assessment will therefore, present an estimate of the GHG emissions associated with the Proposed Development.

17.4.4 ELEMENTS SCOPED OUT OF ASSESSMENT

17.4.4.1 Due to the potential for GHG emissions to be associated with the construction, operation and decommissioning of the Proposed Development there have been no specific impacts scoped out.

17.4.5 STUDY AREA

17.4.5.1 The Proposed Development is located in the open countryside which is predominantly arable. The Proposed Development is located in the Chester West and Chester region of in the North-West of England and is shown on **Figure 2.1**

17.4.5.2 A description of the Proposed Development is provided in **Chapter 2, Proposed Development Description.**

17.4.5.3 GHG emissions will be considered throughout the construction, operation and decommissioning stages of the Proposed Development. The ES will additionally review the change in emissions as a result of operating a hydrogen storage facility for the Proposed Development and not gas storage as per the Consented Development.

17.4.6 METHODOLOGY FOR THE ASSESSMENT OF EFFECTS

17.4.6.1 Any GHG emissions released to the atmosphere is classified as an impact to climate change due to the importance of limiting GHG emissions to the atmosphere as set out by the Paris Agreement and the UK Government's net zero ambitions.

17.4.6.2 To understand the significance of the Proposed Development on the climate the net GHG emissions impact of the Proposed Development will be evaluated against the ISEP significance criteria detailed in **Table 17.2,** below.

TABLE 17.2 – SIGNIFICANCE CRITERIA RELEVANT TO THE GHG ASSESSMENT

Significance	Significance Criteria
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.
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.

Significance	Significance Criteria
Minor Adverse:	The project's 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.
Negligible:	The project's 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 is 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.
Beneficial:	The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG 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.

17.4.7 ADDRESSING UNCERTAINTY

17.4.7.1 For the purposes of the PEIR, at this stage, activity data including a detailed inventory of components and materials required to construct the Proposed Development is not available to inform the GHG assessment at this stage. Therefore, a full GHG assessment will be completed and presented in the final ES.

17.4.7.2 The GHG assessment when completed for the ES will use activity data provided by the design team. Where data is not available, reasonable assumptions will be made based on professional judgement and analysis using methods and data sources as detailed in section **17.4.2.**

17.5 GHG BASELINE

17.5.1.1 The baseline is the reference against which the GHG emissions associated with the Proposed Development will be compared and assessed in the ES.

17.5.1.2 A suitable baseline will be identified in the ES to understand the scale of the impact of the GHG emissions associated with the Proposed Development.

17.5.1.3 The ES will consider two baselines, the existing baseline and a future baseline for the Proposed Development.

17.6 GHG MITIGATION

17.6.1.1 The mitigation of GHG emissions for the construction, operation and maintenance, and decommissioning stages of the Proposed Development will be detailed in the ES.

17.6.2 ASSESSMENT OF GHG EFFECTS

17.6.2.1 The assessment of GHG effects for the construction, operation and maintenance, and decommissioning phases of the Proposed Development will be detailed in the ES.

17.6.2.2 The results of the GHG assessment will be compared to the relevant UK Carbon Budget time period based on the timeframe that the GHG emissions are expected to occur.

17.6.2.3 For the GHG emissions that are saved as a result of the Proposed Development these will be compared with the equivalent natural gas GHG emissions that would have occurred if the Proposed Development did not go ahead.

17.7 CLIMATE CHANGE RESILIENCE REVIEW

17.7.1 INTRODUCTION

17.7.1.1 This section sets out the approach for assessing the impact of climate change on the Proposed Development. There are two assessments associated with a Climate Change Resilience Review (CCRR), required as per the ISEP Climate Guidance[67]:

i. **Climate Change Risk Assessment (CCRA)**: assesses the potential effects of climate change on the Proposed Development, in terms of resilience and adaptation to future climatic conditions; and

ii. The **In-Combination Climate Impacts (ICCI) Assessment** which assesses how future climate changes could potentially exacerbate likely significant effects identified from other relevant chapters in this PEIR from the Proposed Development.

17.7.1.2 The Proposed Development (described in detail in **Chapter 2: Proposed Development Description**), is located in Holford Brinefields, Cheshire, and is characterised as open countryside supporting mainly dairy farming. The Proposed Development is in the sub-catchment of Puddinglake Brook which runs through the Site and is a tributary of the River Dane to the west of the site. The topography is very low gradient and supports numerous ponds. The Proposed Development is located in a Temperate oceanic climate (Cfb) region. The area experiences mild, wet winters and cold mild summers, with rainfall spread evenly throughout the year, due to proximity to the Atlantic Oceans and Gulf Stream[11].

17.7.2 ELEMENTS SCOPED OUT OF THE ASSESSMENT

17.7.2.1 As detailed in **Table 17.1** and in line with the comments in EIA Scoping Opinion, the following issues have been scoped out of the assessment as the Proposed Development is not located in an area susceptible to these climate hazards:

- Water-related climate hazards involving ocean acidification, saline intrusion, sea level rise and glacial outbursts;
- Wind-related climate hazards involving cyclones, hurricanes, typhoons and tornados; and
- Solid-mass related climate hazards involved coastal erosion, soil degradation, soil erosion, solifluction, avalanche, landslide and subsidence.

17.7.3 STUDY AREA

17.7.3.1 The CCRA assesses the potential effects of climate change on the Proposed Development. Therefore, the Study Area is considered to include all assets and land on and within the Site Boundary. This will include all elements of the Proposed Development described in **Chapter 2, Proposed Development Description** and the below ground assets / other elements included as part of the Consented Development ES.

17.7.3.2 The ICCI Study Area considers receptors that have been identified in relevant technical chapters which may be impacted by the Proposed Development in combination with future climatic conditions.

17.7.3.3 The study area of both assessment is in line with the ISEP (formally IEMA) Climate Guidance[6] and reflects the Scoping Opinion (see Table 17.1 – Planning Inspectorate's Scoping Opinion Responses**Table 17.1**).

17.7.4 ASSESSMENT SCOPE

HAZARDS

17.7.4.2 The Planning Inspectorate has confirmed the hazards which they are content to scope out (refer to **Table 17.1**). The hazards which have been scoped into further assessment are outlined below:

- Increasing Mean Temperatures;
- Extreme Heat;
- Extreme cold;

[11] Met Office. (n.d.). Climate zones. (Online). Available at: https://weather.metoffice.gov.uk/climate/climate-explained/climate-zones [Accessed August 2025].

- Extreme Rainfall;
- Flooding (Pluvial);
- Water Stress and Drought; and
- Wildfires.

ASSETS

Above Ground

- Gas Processing Plant (GPP) Building and Associated Equipment;
- Nitrogen Package Plant;
- Compressed Air Package Plant;
- Wellheads;
- Electrical Substation; and
- Flare Technology.

Below Ground

- Salt Caverns;
- Wellhead Piping Components; and
- Monitoring Systems.

CLIMATE DATA

17.7.4.3 The Proposed Development's total design life is anticipated to be 50 years. This assessment has selected three time horizons: 2030, 2050, 2080, to accurately assess climate hazards across the entire life of the Proposed Development.

17.7.4.4 To represent a variety of future climate scenarios, Shared Socioeconomic Pathways (SSPs) 1-2.6 and 5-8.5 were selected (refer to Section 17.8.7.2 and 17.8.7.3 for more information on the SSPs).

17.7.5 METHODOLOGY FOR THE ASSESSMENT OF THE AFFECTS

17.7.5.1 The assessment of climate-related risks to the Proposed Development follows a structured methodology comprising two complementary components: the **Climate Change Risk Assessment (CCRA)** and the **In-Combination Climate Impact (ICCI) assessment**.

17.7.5.2 The **CCRA** evaluates direct climate risks to the Proposed Development by identifying relevant hazards, assessing their likelihood and magnitude, and determining both initial and residual risk levels. It uses future climate projections and proposes mitigation actions to enhance climate resilience.

17.7.5.3 The **ICCI** assesses how projected climate conditions may amplify environmental effects identified in other technical chapters. It evaluates the likelihood and consequence of climate impacts on receptors and recommends additional mitigation only where effects are deemed significant.

17.7.5.4 This integrated methodology ensures that both direct climate risks and in-combination effects are systematically assessed, enabling a robust understanding of climate resilience and adaptation needs for the Proposed Development.

CCRA

17.7.5.5 A CCRA is a systematic approach that utilises risk assessment methodologies to identify potential climate impacts and evaluate their significance.

17.7.5.6 At the simplest level, the CCRA will be conducted for the Proposed Development through the following steps:

- Gather baseline and future climate data for the Proposed Development's location. Future climate data is collected for future time horizons (2030, 2050, 2080) and climate scenarios (SSP1-2.6 and SSP5-8.5);
- Identify potential climate change risks to a scheme or project. Climate risks are defined in this assessment as per the Intergovernmental Panel on Climate Change (IPCC) Annual Report 6 (IPCC AR6) equation[12]: **Climate risk = Hazard * Vulnerability * Exposure.** This means that the overall risk for climate hazards considered in this assessment is based upon three key factors.
    a. Hazard – This is the climate related event or trend itself, such as extreme heat, flooding, or wildfires.
    b. Vulnerability – This refers to how sensitive the receptors (environmental, human health, infrastructure) of the Proposed Development is to that hazard.
    c. Exposure – This is about how much of the system is exposed to the hazard, for example, above ground or below ground infrastructure.
- Assess the inherent initial risk, where no mitigation measures considered;
- Mitigation measures are outlined to manage identified inherent risks;

[12] IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. (Online). Available at: Climate Change 2022: Impacts, Adaptation and Vulnerability | Climate Change 2022: Impacts, Adaptation and Vulnerability [Accessed August 2025].

- Assess the residual risk, where embedded mitigation measures are considered; and
- A final determination of risk is outlined, concluding whether or not the risk is a likely significant effect to the Proposed Development.

17.7.5.7 The likelihood (or probability) and magnitude (or impact) for each risk will be determined. Definitions of likelihood and magnitude have been defined specifically for the Proposed Development[6]. **Table 17.3** below outlines the data sources accessed to inform the CCRA.

17.7.5.8 Mitigation measures are yet to be determined, therefore, the residual risk and resulting likely significant effect will be outlined in the ES.

TABLE 17.3 – CLIMATE DATA SOURCES UTILISED TO INFORM THE CCRA

Source	Summary
Inter-Sectoral Impact Model Intercomparison Project Phase 3b (ISMIP3b) downscaled CMIP6 models	This is a global model that ERM queries to provides baseline and future climate data specific to the Proposed Development location. Climate indicators used to assess heatwaves, extreme cold, extreme rainfall and water stress & drought. Accessed from ERM's proprietary Global Climate Database (GCD).
Fathom 3.0 Flood Inundation Depth	Provides baseline and future climate data specific to the Proposed Development location. Climate indicators used to assess pluvial and fluvial flooding. Accessed from ERM's proprietary Global Climate Database (GCD).
ISEP, 2020. EIA Guide to: Climate Change Resilience and Adaptation[7].	Provided the risk assessment methodology to develop this CCRA.

ICCI

17.7.5.9 The aim of the ICCI assessment is to assess whether the impacts of the Proposed Development on environmental receptors are likely to be significantly different under projected future climate conditions compared with those under existing baseline conditions.

17.7.5.10 The ICCI assessment methodology has been developed in line with the ISEP Climate Guidance[6]. The guidance defines an ICCI effect as: *"When a projected future climate impact (e.g. increase in temperatures) interacts with an effect identified by another topic and exacerbates its impact".*

17.7.5.11 The ICCI assessment methodology is outlined below:

- identity climate change hazards;
- identify likelihood of climate change hazards occurring;
- identify likelihood of climate impact occurring to environmental receptor (taking into account embedded and good practice mitigation measures);
- identify level of consequence of climate impact;
- determine level of significance of a climate change impact on environmental receptors; and
- identify potential additional mitigation / adaptation measures (only for ICCIs assessed as Significant).

17.7.5.12 The ICCI will be based upon the likely significant effects identified in **Chapters 6-16**.

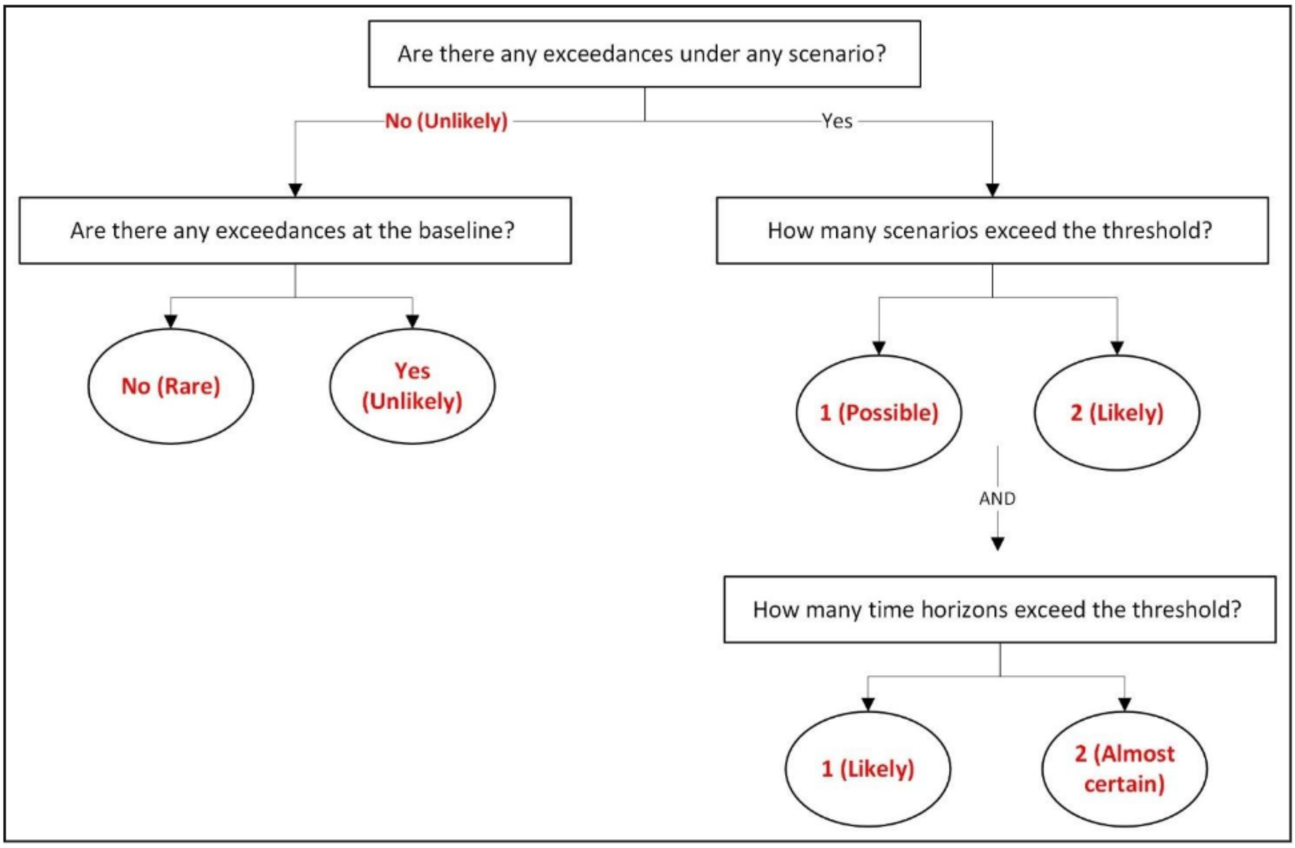
17.7.6 RISK FRAMEWORK

17.7.6.1 The risk framework for this PEIR has been developed based on industry guidance, professional judgement and our understanding of the Proposed Development's design. The assessment of likelihood for each hazard uses a likelihood decision tree which has been developed according to hazard-specific thresholds and considering the location of the Proposed Development.

17.7.6.2 The hazard-specific thresholds have been determined based on desktop research of hazard historical events in the area, hydrogen storage assets and their ability to withstand hazards, and climate risk professional judgement. These thresholds are designed to indicate at what point the specific risk will become material to the Proposed Development.

17.7.6.3 The likelihood is then determined according to how many time horizons and scenarios a hazard exceeds the defined hazard-specific thresholds, which is deemed to be significant for the location of the Proposed Development. Please see **Table 17.4** for further detail.

TABLE 17.4 – LIKELIHOOD DECISION TREE - AS DEFINED FOR THIS PROJECT



To note, where there is only 1 scenario exceeding the threshold, but threshold is exceeded across both the 2030 and 2050 time horizons, the likelihood will be categorised as 'likely'. Whereas, if there are 2 scenarios exceeding the threshold and threshold is exceeded across both time horizon, a conservative approach is taken and the likelihood will be categorised as 'almost certain'.

TABLE 17.5 – MEASURE OF LIKELIHOOD

Consequence of Impact	Description
Almost Certain	The climate hazard is expected to exceed a critical threshold under both scenarios, and across all future time horizons.
Likely	The climate hazard is expected to exceed a critical threshold under both scenarios, but only under a specific time horizon.

Consequence of Impact	Description
Possible	The climate hazard may exceed a critical threshold in future, but only under a specific climate scenario and time horizon.
Unlikely	The climate hazard may occur under current conditions but is not projected to exceed a critical threshold in future under all scenarios and time horizons.
Rare	The climate hazard is not currently observed and is not projected to exceed a critical threshold in future under all scenarios and time horizons.

17.7.6.4 Consequences were assessed using standardized criteria to determine the sensitivity of receptors across infrastructure, human health, environmental and financial dimensions. These definitions are tailored to be relevant to the types of risks being assessed for the Proposed Development. **Table 17.6** below shows the standardised criteria used.

TABLE 17.6 – CONSEQUENCE CRITERIA TO ASSESS IMPACT OF SENSITIVE RECEPTORS

Consequence of Impact	Description
Very Large	Infrastructure; Significant permanent damage and/or complete loss of the infrastructure and infrastructure services. Extreme delays to / cancellation of the construction. Human health; Event leading to 1 or more fatalities on site Environmental; Devastating environmental implications and regulatory non-compliance due to protected species/habitat change Financial: Extreme financial loss and operation is unviable.
Large	Infrastructure; Extensive infrastructure damage and/or major loss of the infrastructure and infrastructure services. Major delays to the construction Human health; Event leading to long term health issues / disabilities (over 14 days lost work).

Consequence of Impact	Description
	Environmental; Severe environmental implications and potential new environmental compliance obligations Financial: Major financial loss and additional operating costs.
Moderate	Infrastructure; Limited infrastructure damage and loss of service, damage recoverable by early maintenance and minor repair. Substantial construction interruption (5 days or more). Human health; Event leading to short term stress, medical treatment required (under 14 days lost work). Environmental; Moderate environmental implications and potential for additional mitigation and/or maintenance needs Financial: Moderate financial loss and additional operating cost.
Minor	Infrastructure; Localised infrastructure service disruptions, no permanent damage, some minor repair work required. Minor construction interruption (5 days or less). Human health; Event leading to minor discomfort and/or first aid treatment Environmental; Minor environmental implications on landscaping or buffer vegetation and no impacts on protected species/habitats Financial; Slight financial loss and additional operating costs.
Negligible	Infrastructure; No damage, construction delays or additional operational costs Human health; No injuries or illness Environmental; No disturbance or disturbance is already within degraded or non-sensitive area Financial; No financial loss or costs

17.7.6.5 As shown in **Table 17.7** –, the likelihood is then assessed against the consequence to determine the level of risk.

TABLE 17.7 – SIGNIFICANCE MATRIX

Measure of Consequence	**Measure of Likelihood**				
	Rare	Unlikely	Possible	Likely	Almost Certain
Negligible	Very Low	Very Low	Low	Medium	Medium
Minor	Very Low	Low	Low	Medium	High
Moderate	Low	Low	Medium	High	High
Large	Medium	Medium	High	High	Very High
Very Large	Medium	High	High	Very High	Very High

17.7.6.6 The risk statement and corresponding rating is based on climate data, published guidance and desktop research for risk profiles of hydrogen storage infrastructure at this PEIR stage. These risk statements and ratings have not yet been validated with engineering or design teams. Final confirmation, detailed design considerations, and any necessary mitigation measures will be addressed as part of the ES process for the Proposed Development. Consequently, the findings presented in this chapter should be treated as preliminary and indicative and may be subject to refinement following consultation with relevant technical specialists.

17.7.7 EXISTING AND FUTURE BASELINE

17.7.7.1 This section details the existing baseline and future climate projections across a comprehensive range of climate hazards applicable, as per the Scoping Report, to the location of the Proposed Development. The time horizons of 2030, 2050 and 2080 were selected for the future baseline scenario as these represent the operational life of the Proposed Development (50 years).

17.7.7.2 The IPCC released a key review of climate change science, referred to as 'Assessment Report 6', in 2021. The report considers climate change trends provided by approximately 100 leading climate models. Projections trends are grouped into five Shared Socioeconomic Pathways (SSPs). These reflect potential changes in net CO_2 emissions, by combining qualitative storylines of societal features and quantified measures of development alongside climate data to create plausible scenarios for how quickly humans can curb emissions.

17.7.7.3 To represent a variety of future climate scenarios, Shared Socioeconomic Pathways (SSPs) 1-2.6 and 5-8.5 were selected. SSP1-2.6 represents a future with strong mitigation effects and a focus on sustainability, resulting in a low emissions scenario and low levels of global warming. SSP5-8.5 represents a high-emissions scenario with continued reliance on fossil fuels, leading to significant warming[13].

17.7.7.4 The existing and future baseline conditions that may be expected to occur in the locality of the Proposed Development is outlined in **Table 17.8**. The data is sourced from ERM's Global Climate Database (GCD), which is ERM's in-house tool for sourcing climate projections.

[13] Zeke Hausfather, Carbon Brief, 2021. Explainer: How Shared Socioeconomic Pathways Explore Future Climate Change. Available online at: https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change/ [Accessed July 2025].

TABLE 17.8 – BASELINE AND FUTURE CLIMATE DATA

Indicator	Definition	Unit	Critical Threshold	Rationale	Existing Baseline	2030		2050		2080	
						SSP1 -2.6	SSP5 -8.5	SSP1 -2.6	SS-5-8.5	SSP1 -2.6	SSP5 -8.5
Maximum daily temperature	The maximum daily maximum temperature	Celsius	Greater than 26 degrees	In Middlewich, Cheshire, a heatwave is considered when temperatures exceed 26°C[14]. At this threshold, above-ground infrastructure may approach poor performance, e.g., thermal shutdowns or active cooling.	31.2	32.4	32.3	33.6	34.7	32.7	35.2
Mean daily temperature	The mean daily mean temperature	Celsius	+2 degrees	A 2°C increase from baseline conditions is generally considered a critical threshold for changes in infrastructure aging for above-ground infrastructure[15]. This temperature rise is expected to accelerate the degradation processes of materials and systems, leading to increased maintenance requirements and potential for earlier-than-expected failures. While 2 degrees seems minimal, the impacts on infrastructure when accounted for across the lifetime of the Proposed Development.	9.6	10.2	10.3	10.3	10.8	10.3	11.8
Minimum daily temperature	The minimum daily temperature	Celsius	Less than 0 degrees	This facility uses salt brine caverns, with associated infrastructure such as wellheads and compressors, which are susceptible to frost and ice. A minimum daily temperature threshold of 0°C has therefore been established. Temperatures at or below freezing can cause brine in the caverns to freeze, reducing storage capacity and affecting pressure control. Wellhead valves and fittings may ice over, obstructing flow, and compressors, particularly those handling condensates, could experience mechanical stress or efficiency loss. In support of this threshold, the Met Office issues cold-weather alerts when average temperatures are expected to be below	-11.2	-10.8	-9.3	-8.9	-7.9	-8.9	-5.9

[14] Met Office (n.d.) What is a heatwave? Available at: https://weather.metoffice.gov.uk/learn-about/weather/types-of-weather/temperature/heatwave [accessed August 2025].
[15] OECD (2024) Infrastructure for a Climate-Resilient Future. OECD Publishing, 9 April 2024. Available at: https://www.oecd.org/en/publications/infrastructure-for-a-climate-resilient-future_a74a45b0-en.html?utm_source=chatgpt.com [accessed August 2025].

Indicator	Definition	Unit	Critical Threshold	Rationale	Existing Baseline	2030		2050		2080	
						SSP1 -2.6	SSP5 -8.5	SSP1 -2.6	SS-5-8.5	SSP1 -2.6	SSP5 -8.5
				0°C for 48 hours or more, indicating a high potential for severe impacts on both health and infrastructure[16].							
Max 1-day rainfall	The maximum amount of precipitation to fall across a 1-day period.	mm	An increase of more than 50mm	The maximum one-day rainfall threshold for the facility has been set to account for rainfall-induced flooding risks to above-ground infrastructure, including wellheads, compressors, and associated equipment. According to Environment Agency (EA) guidance[17], by the 2070s the upper-end allowance for climate change impacts on rainfall is 45%, with 40% by the 2050s. These values incorporate fluvial data; however, as the facility is primarily at risk from localized surface-water flooding, adopting the central allowance is proportionate to the actual exposure. For this threshold, the central allowance uplift for the 2070s of 30% has been applied, which corresponds to an increase of approximately 50 mm above baseline rainfall. This threshold ensures that above-ground infrastructure is resilient to extreme rainfall events while accounting for projected climate change.	38.01	38.6	36.2	39.6	39.5	39.4	43.2
Pluvial 1 in 100-year flood inundation depth	The maximum inundation depth experienced within an area that is associated with a 1 in-100-year pluvial flooding event.	metres (m)	Greater than 0.3	The pluvial flooding threshold of >0.3 m has been established to reflect exposure of above-ground infrastructure, including wellheads and compressors, to surface-water inundation. It is generally accepted that flood depths exceeding 30 cm represent a medium to high hazard to infrastructure, buildings, and personnel. In line with UK EA guidance[18], any depth above 30 cm is considered a medium risk, and floor levels should be designed with a 60 cm freeboard above	0.38	0.4	0.4	0.4	0.4	0.4	0.4

[16] UK Health Security Agency and Met Office (2025) Weather-health alerting system: User guide. Available at: https://assets.publishing.service.gov.uk/media/67f3aeaed3f1efd2ce2ab897/WHA_User_Guide.pdf [accessed August 2025].
[17] Environment Agency (2022) Climate change allowances – peak rainfall by management catchment. Available at: https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3111 [accessed August 2025].
[18] Environment Agency. (2025). Preparing a Flood Risk Assessment: Standing Advice. (Online). Available at: https://www.gov.uk/guidance/flood-risk-assessment-standing-advice [Accessed August 2025].

Indicator	**Definition**	**Unit**	**Critical Threshold**	**Rationale**	**Existing Baseline**	**2030**		**2050**		**2080**	
						SSP1 -2.6	SSP5 -8.5	SSP1 -2.6	SS-5-8.5	SSP1 -2.6	SSP5 -8.5
				projected flood levels to ensure safety and resilience.							
Forest Fire Danger Index (FFDI)	The annual number of days with wildfire enhancing climatic conditions. This index is based on the McArthur Forest Fire Danger Index (FFDI; widely used in Australia for several decades) and combines a record of dryness, based on rainfall and evapotranspiration rate, with meteorological variables for wind speed, temperature, and humidity.	Days	Greater than 5 days	This indicator measures fire weather occurrence, rather than fire activity. In Australia, the number of FFDI days of 0-11 is considered a low to moderate risk[19]. Given that even one FFDI in the region would be considered usually dry for the area, threshold has been set conservatively to 5 FFDI days or more[20].	0	0.5	0	0	0	0	0.5
Consecutive dry days	Maximum annual number of consecutive dry days when precipitation is less than 1 mm.	Days	Greater than 15 days	The UK Met Office defines drought across numerous dimensions (meteorological, agricultural, ecological, hydrological). However, the broadly accepted definition for drought in the UK is: A dry spell as ≥ 15 consecutive days with < 1 mm/day rainfall; or An absolute drought as ≥ 15 days with < 0.2 mm/day[21]. As some assets are underground, it will be vital to ensure soil cracking and moisture depletion does not significantly impact the assets. Additionally, as water supply is vital to the operation of the asset, extended dry periods can reduce operational resilience. Therefore, a conservative threshold of >15 consecutive dry days has been adopted to ensure asset integrity and operational continuity.	21.9	21.3	22	23.1	24.7	21.3	23.8

[19] Met Office. (2020). Causes of extreme fire weather in Australia. (Online). Available at: https://www.metoffice.gov.uk/research/news/2020/causes-of-extreme-fire-weather-in-australia [Accessed August 2025].
[20] Arnell, N.W., Freeman, A. & Gazzard, R. (2021). The effect of climate change on indicators of fire danger in the UK. (Online). Available at: https://iopscience.iop.org/article/10.1088/1748-9326/abd9f2 [Accessed August 2025].
[21] WeatherOnline (n.d.) Drought. Available at: https://www.weatheronline.co.uk/reports/wxfacts/Drought.htm [accessed August 2025].

17.7.7.5 The CCRA and ICCI assessments involve the attribution of climate indicator data to each climate hazard. A qualitative description of the future baseline conditions per hazard is outlined below.

Increasing Mean Temperatures

17.7.7.6 Mean temperatures are expected to rise steadily in North-West of England. The climate indicator used to project future changes in mean temperature in this assessment is mean daily temperature. Mean temperatures are projected to increase across both scenarios and time horizons.

17.7.7.7 As outlined in **Table 17.8**, the baseline mean daily temperature at the Proposed Development location is 9.6°C, already reflecting typical UK temperate conditions[22]. Above-ground infrastructure within the GPP area such as the compressors may be particularly vulnerable to temperature related impacts as a result of their temperature sensitivity. Potential temperature impacts include thermal expansion, material fatigue, and general degradation over time.

17.7.7.8 By 2030, mean temperatures increase to 10.19°C (SSP1-2.6) and10.26°C (SSP5-8.5). By 2050, the increase continues to 10.27°C (SSP1-2.6) and 10.83°C (SSP5-8.5), and by 2080, mean temperatures increase are expected to have increased by 0.7°C (SSP1-2.6) and 1.51°C (SSP5-8.5) from the existing baseline. This trend demonstrates a gradual but sustained rise in mean temperature, exceeding the +2°C threshold from baseline by the later time horizons under a high-emissions 2030 and 2050 scenario.

17.7.7.9 For above-ground infrastructure, the key risks associated with gradual warming include accelerated thermal expansion, material fatigue, and degradation of components such as the compressors. Over the facility’s lifetime, these effects may increase maintenance requirements and reduce operational reliability, potentially leading to earlier-than-expected equipment failure. While below-ground infrastructure, including salt brine caverns, is buffered from these slow changes, increased heat loading at the surface could indirectly affect operational equipment and monitoring systems. Collectively, these changes highlight the ongoing need to account for thermal aging and material stress in long-term operational planning.

Extreme Heat

17.7.7.10 Extreme heat events are expected to increase in intensity and frequency in the North-West of England. The climate indicator used to project future heat conditions in this assessment is maximum

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[22] Met Office (2025) Mean Central England Temperature. Available at: https://www.metoffice.gov.uk/hadobs/hadcet/cet_info_mean.html [last updated 18 August 2025; accessed August 2025].

daily temperature. Maximum temperatures are projected to increase across both scenarios and time horizons.

17.7.7.11 As outlined in **Table 17.8**, the baseline maximum daily temperature at the Proposed Development location is 31.2°C, already exceeding the 26°C threshold used to define heatwaves in Middlewich, Cheshire[14]. This demonstrates existing pressure placed on the Proposed Development's above-ground infrastructure, particularly wellheads, compressors, and associated equipment, which may approach poor performance or require active cooling to maintain safe operation.

17.7.7.12 By 2030, maximum temperatures increase slightly under both pathways: 32.37°C (SSP1-2.6) and 32.34°C (SSP5-8.5). By 2050, heat intensifies further, reaching 33.56°C (SSP1-2.6) and 34.69°C (SSP5-8.5), and by 2080, temperatures rise to 32.72°C (SSP1-2.6) and 35.17°C (SSP5-8.5). This trend indicates a clear escalation in the frequency and severity of extreme heat events, even under the lower emissions scenario.

17.7.7.13 For above-ground infrastructure, extreme heat can cause thermal stress, reduce compressor efficiency, and necessitate active cooling or operational curtailment to avoid overheating. While below-ground infrastructure, particularly salt brine caverns, is buffered from short-term temperature fluctuations, prolonged periods of elevated surface temperatures could increase heat loading on wellheads and associated mechanical equipment, potentially affecting operational efficiency and maintenance schedules. In addition, larger fluctuations in temperature during extreme heat events may increase the risk of thermo-mechanical challenges when carrying out withdrawals which may reduce the effectiveness of storage. Together, these conditions indicate that the facility remains vulnerable to impacts from extreme heat, with implications for operational expenditure, longevity, safety and performance.

Extreme Rainfall

17.7.7.14 Extreme rainfall at the Proposed Development location is assessed using the maximum 1-day rainfall indicator. As outlined in **Table 17.8**, the baseline maximum 1-day rainfall is 38.01 mm, which is below the threshold of 50 mm, indicating that the facility is currently within acceptable risk levels for rainfall-induced flooding of above-ground infrastructure such as the compressors.

17.7.7.15 Across future climate scenarios, maximum 1-day rainfall shows a gradual increase, with values ranging from 36.24 mm to 43.18 mm under SSP1-2.6 and SSP5-8.5 by 2080. This trend indicates that the location of the Proposed Development is projected to see rising severity of intense rainfall events under SSP5-8.5. The severity of extreme rainfall will depend on the outcome of this assessment. The 1-day rainfall extremes could result in increased vulnerability of the Site to infrastructure damage and exceedance of capacity in existing drainage systems.

Flooding (Pluvial)

17.7.7.16 Pluvial flooding at the Proposed Development Site is primarily driven by extreme localised rainfall and surface-water accumulation. The climate indicator used to assess this risk is the 1-in-100-year pluvial flood inundation depth. As outlined in **Table 17.8**, the baseline inundation depth at the Proposed Development is 0.38 m, which already exceeds the threshold of 0.3 m, indicating a medium to high hazard for above-ground infrastructure such as wellheads and compressors. Flood depths above this threshold can obstruct access, damage equipment, and compromise operational functionality.

17.7.7.17 Across future climate scenarios, the pluvial flood risk remains relatively stable, with projected depths ranging between 0.38 m and 0.39 m under both SSP1-2.6 and SSP5-8.5 by 2080, respectively. However, this still exceeds the threshold.

17.7.7.18 For above-ground hydrogen storage infrastructure, these conditions suggest that surface-water inundation could impede operations, damage GPP equipment, and increase maintenance requirements.

17.7.7.19 The Flood Risk Assessment which will determine the flood extents due to the fluvial risk from the Puddinglake Brook will be submitted alongside the ES as **Appendix 7.1, Flood Risk Assessment**.

Water Stress and Drought

17.7.7.20 Dry periods are expected to increase in intensity and occurrence Northwest England[23]. The climate indicator used to project future drought in this assessment is consecutive dry days. Consecutive dry days are expected to increase across both scenarios and all time horizons. As outlined in **Table 17.8**, the baseline consecutive dry days at the Proposed Development location is 21.9 days per year. This number of days at the 2020 baseline already exceeds the dry spell definition of >15 days with less than 1 mm of precipitation per day. This demonstrates existing pressure placed on the Proposed Development's water-dependent infrastructure, especially for cooling during peak dry periods.

17.7.7.21 By 2030, the number of consecutive dry days remains relatively stable under both scenarios: 21.3 days (SSP1-2.6) and 22 days (SSP5-8.5). However, by 2050, the risk intensifies, particularly under the high-emissions scenario, reaching 23.1 days (SSP1-2.6)

[23] Reyniers, N., Osborn, T., Addor, N., Darch, G. (2023). Projected Changes in Droughts and Extreme Droughts in Great Britain Strongly Influenced by the Choice of Drought Index. (Online). Available at: HESS - Peer review - Projected changes in droughts and extreme droughts in Great Britain strongly influenced by the choice of drought index [Accessed August 2025].

and 24.7 days (SSP5-8.5). This indicates a gradual but significant increase in dry spell duration, even under lower emissions scenario.

17.7.7.22 This trend could indicate that under future climate conditions, longer dry spells could lead to reduced water availability at the Proposed Development. For above-ground infrastructure, the key risk associated with water stress and drought is the ability to secure a consistent water supply for operational processes, cooling, dust suppression and fire safety systems[24]. For below-ground infrastructure, particularly brine caverns, climate-induced soil dryness may exacerbate risks of soil shrinkage and subsidence, especially where soil handling and reinstatement has already altered physical properties such as compaction and drainage. While the deeper geology of the caverns is buffered from short-term hydrological change, long-term ground movement in surface and near-surface materials could affect local stability. Together, these changes may result in leakage from wellheads or pipelines are soil movement could place stress on casing, seals or joints which may impact operational efficiency[25].

Wildfires

17.7.7.23 Wildfire projections in the UK are inherently uncertain due to the highly localised nature of the hazard and the limited applicability of commonly used indices such as the Forest Fire Danger Index (FFDI). For the purposes of this PEIR, wildfire risk will therefore draw primarily on qualitative data, supported by historical burned-area records and FFDI projections. While historical fire data that has been obtained from the ERM GCD provides useful local context, it is not sufficient on its own to assess future risk to the Proposed Development. Therefore, a combined approach of qualitative desktop research and regional climate modelling outputs has been applied to determine likelihood.

17.7.7.24 In the UK context, wildfire events have increased in frequency in recent decades, predominantly affecting vegetated land proximal to built infrastructure. Over a 12-year period, the North-West region had the highest area burned per square kilometre in England (3.2 ha/km²) compared to other regions such as Yorkshire & Humber (0.7 ha/km²) and London (0.4 ha/km²)[26]. The historical area burned within 30km^2 of the Proposed Development location is 1.58km^2. This is only approximately 5% of the area.

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[24] Kumar, P., Date, A., Mahmood, N., Kumar Das, R., Shabani, B. (2024). Freshwater Supply for Hydrogen Production: An Underestimated Challenge. (Online). Available at: Freshwater supply for hydrogen production: An underestimated challenge - ScienceDirect [Accessed August 2025].

[25] David Royle. (2022). Soil Resource Assessment, Land Drainage Consultancy.

[26] Forestry Commission (2023) Forestry Commission Wildfire statistics for England: Report to 2020-21 – Summary. Available at: https://www.gov.uk/government/publications/forestry-commission-wildfire-statistics-for-england-report-to-2020-21/forestry-commission-wildfire-statistics-for-england-report-to-2020-21-summary [accessed August 2025].

17.7.7.25 As outlined in **Table 17.8**, the baseline number of FFDI days at the Proposed Development location is 0 days per year. This is projected to continue until 2080 under SSP5-8.5 scenarios, where it is projected that there will 0.5 FFDI days. This is below the threshold of 5 days, and therefore wildfire enhanced climate conditions alone is unlikely impact the Proposed Development. However, actual fire occurrence depends on ignition, so this indicator needs to be coupled with analysis of historical fire events in the area.

17.7.7.26 A recent significant event was the 2018 Saddleworth Moor fire that occurred in Greater Manchester. This persisted for three weeks, burned extensive moorland, and caused measurable deterioration in regional air quality, thereby demonstrating the potential for wildfire to affect both environmental receptors and human populations[27]. Projections for England regionally suggests that at +2 °C global warming relative to pre-industrial conditions, the frequency of days with "very high" fire danger could double, with up to a fivefold increase under +4 °C warming[28]. These trends are strongly correlated with projected increases in extreme heat and prolonged dry periods. For the Proposed Development, this indicates a potential future elevation in wildfire hazard exposure, with implications due to potential restrictions on emergency access to the site, elevated occupational health risks to employees from smoke and particulates, and secondary operational vulnerabilities linked to fire-adjacent land use.

17.7.8 EMBEDDED MITIGATION MEASURES

17.7.8.1 .At this stage, the mitigation measures have not yet been validated with the relevant engineering and design teams. Therefore, mitigation measures will remain unconfirmed until the ES is developed.

17.7.9 ASSUMPTIONS

17.7.9.1 Assumptions around climate projections reflect currently available data and guidance. The assumptions made for this assessment are:

- there is inherent uncertainty in future emissions pathways, which can influence the range and severity of projected climate impacts;
- some climate hazards are assessed using data with coarse spatial resolution, due to limitations in data availability or model accuracy at finer scales;

[27] Taylor, M. (2018) More Saddleworth-style fires likely as climate changes, scientists warn. The Guardian, 29 June 2018. Available at: https://www.theguardian.com/world/2018/jun/29/more-saddleworth-style-fires-likely-as-climate-changes-scientists-warn [Accessed August 2025].

[28] Natural Hazards and Earth System Sciences. (2022). Past and Future Trends in Fire Weather for the UK. (Online). Available at: NHESS - Past and future trends in fire weather for the UK [Accessed August 2025].

- where data gaps exist, professional judgement has been applied to interpret results and inform the assessment of significance;
- the methodology does not apply probabilistic weighting to different climate scenarios, and all scenarios are treated equally;
- the definition of impact thresholds can influence assessment outcomes and is partly based on expert judgement, particularly where regulatory benchmarks are absent; and
- future time horizons and socio-economic pathways have been treated interchangeably to simplify the analysis, which may not fully reflect nuanced differences between scenarios.

17.7.10 LIKELY SIGNIFICANT EFFECTS

CCRA

17.7.10.2 Risks to the construction, operation and maintenance and decommissioning phases due to climate change are outlined in **Table 17.9** below.

TABLE 17.9 – PRELIMINARY CLIMATE CHANGE RISK ASSESSMENT AND DETERMINATION OF LIKELY SIGNIFICANCE

Climate Hazard	Risk No	Risk Statement	Indicator	Sensitive Receptor	Phase	Initial Likelihood	Initial Consequence	Initial Significance Rating	Embedded Mitigation Measure
Increasing mean temperature	1	Increasing mean temperature may accelerate thermal expansion, material fatigue, and degradation of above ground infrastructure associated with the GPP extension. This could lead to increased maintenance requirements and reduce operational reliability over the facility's lifespan.	Mean daily mean temperature	Infrastructure	Operation and Maintenance	**Almost Certain**	**Minor**	**Medium**	Embedded mitigation measures will be detailed in the ES.
Extreme heat	2	Increasing average temperatures may reduce the efficiency of hydrogen compression and handling systems, as warmer intake air can lower compression efficiency and raise cooling loads. This could lead to increased operational energy demand and cost and affect throughput capacity during peak temperature periods.	Mean daily temperature	Infrastructure	Operation and Maintenance	**Almost Certain**	**Moderate**	**High**	Embedded mitigation measures will be detailed in the ES.
	3	Increased extreme heat days negatively impacting above-ground and below-ground hydrogen infrastructure (e.g., overheating, increased stress, and material degradation), leading to increased maintenance costs.	Maximum daily temperature	Infrastructure	Operation and Maintenance	**Almost Certain**	**Moderate**	**High**	Embedded mitigation will be detailed in the ES.
	4	Increased extreme heat days causing health and safety hazards for construction and operational staff, maintenance crews, and visitors, leading to work stoppages, construction delays, and reduced productivity.	Maximum daily temperature	Human health	All phases	**Almost Certain**	**Minor**	**Medium**	Embedded mitigation will be detailed in the ES.

Climate Hazard	Risk No	Risk Statement	Indicator	Sensitive Receptor	Phase	Initial Likelihood	Initial Consequence	Initial Significance Rating	Embedded Mitigation Measure
Extreme cold	5	Increased extreme cold days causing material degradation to internal site roads, control building, and main operational buildings, leading to increased maintenance costs.	Minimum daily temperature	Infrastructure	Operation and Maintenance	**Almost Certain**	**Minor**	**Medium**	Operational limits for extreme cold developed on baseline temperatures. The data demonstrates a decreasing trend over time and therefore the risk of frost impacts on hydrogen storage infrastructure will reduce over the lifetime of the Proposed Development. Embedded mitigation measures to manage frost days and impacts on infrastructure during operation will be confirmed prior to the ES.
	6	Increased extreme cold days causing icing in above-ground pipework, valves, and dehydration units, leading to reduced equipment efficiency, potential blockages, and increased operational costs.	Minimum daily temperature	Infrastructure	Operation and Maintenance	**Almost Certain**	**Minor**	**Medium**	
	7	Increased extreme cold days causing frost and ice accumulation on HVAC intakes and process instrumentation, leading to reduced operational function, measurement errors, and increased maintenance requirements.	Minimum daily temperature	Infrastructure	Operation and Maintenance	**Almost Certain**	**Minor**	**Medium**	
Flooding	8	Pluvial flooding causing internal damage to process plant, electrical substation, and control building, leading to disruption of service, early maintenance, additional mitigations, and increased operational costs.	1 in 100-year Pluvial Flood Inundation Depth	Infrastructure	Operation and Maintenance	**Almost Certain**	**Moderate**	**High**	The inherent risk of surface water flooding is mitigated, as the **Appendix 7A, Flood Risk Assessment** will be supplied as part of the ES will assess the operational flood risk in the Study Area which will inform the detailed design. In addition, the Proposed Development will be designed in accordance with best practice guidance to attenuate surface water runoff from hardstanding surfaces, and control runoff from the Proposed Development so that there is not an increase in runoff rates compared to the existing greenfield runoff.

Climate Hazard	Risk No	Risk Statement	Indicator	Sensitive Receptor	Phase	Initial Likelihood	Initial Consequence	Initial Significance Rating	Embedded Mitigation Measure
	9	Pluvial flooding causing blockage of worker access routes and site roads within the GPP area leading to health and safety risks and restricted operational access.	1 in 100 year Pluvial Flood Inundation Depth	Human health	All phases	**Almost Certain**	**Moderate**	**High**	The inherent risk of surface water flooding is mitigated, as the **Appendix 7A, Flood Risk Assessment** will be supplied as part of the ES will assess the operational flood risk in the Study Area which will inform the detailed design. In addition, the Proposed Development will be designed in accordance with best practice guidance to attenuate surface water runoff from hardstanding surfaces, and control runoff from the Proposed Development so that there is not an increase in runoff rates compared to the existing greenfield runoff.
	10	Pluvial flooding causing internal damage to control and maintenance buildings, leading to potential health and safety risks to workers and additional repair and maintenance costs.	1 in 100-year Pluvial Flood Inundation Depth	Human Health; Infrastructure	Operation and Maintenance	**Almost Certain**	**Minor**	**Medium**	The inherent risk of surface water flooding is mitigated, as the **Appendix 7A, Flood Risk Assessment** will be supplied as part of the ES will assess the operational flood risk in the Study Area which will inform the detailed design. In addition, the Proposed Development will be designed in accordance with best practice guidance to attenuate surface water runoff from hardstanding surfaces, and control runoff from the Proposed Development so that there is not an increase in runoff rates compared to the existing greenfield runoff.

Climate Hazard	Risk No	Risk Statement	Indicator	Sensitive Receptor	Phase	Initial Likelihood	Initial Consequence	Initial Significance Rating	Embedded Mitigation Measure
Extreme rainfall	11	Extreme rainfall causing temporary or prolonged flooding of areas containing sensitive electrical equipment within the GPP area leading to infrastructure damage, operational disruption, and increased operational costs.	Max 1-day rainfall	Infrastructure	Operation and Maintenance	**Unlikely**	**Moderate**	**Low**	The embedded mitigation measures relating to extreme flooding will be detailed **Technical Appendix 7A: Flood Risk Assessment** which will be supplied as part of the ES.
Water stress and drought	12	Increased water stress durations and drought events causing water deficits for operation of process cooling systems, condensers, and water storage facilities, leading to reduced asset lifespan, early maintenance costs, and intermittent system shutdowns.	Consecutive dry days	Infrastructure	Operation and Maintenance	**Almost Certain**	**Moderate**	**High**	Embedded mitigation measures will be detailed in the ES.
	13	Increased drought durations causing significant soil moisture loss, leading to ground shrinkage and subsidence that may damage underground hydrogen pipelines, GPP foundation footings and buried utility services, resulting in potential structural instability, increased maintenance costs, and operational disruption.	Consecutive dry days	Infrastructure	Operation and Maintenance	**Almost Certain**	**Minor**	**Medium**	
	14	Increased water stress durations and drought events causing increased water demand in the local area, leading to impacts on surrounding properties' water availability and potential regulatory constraints on operations.	Consecutive dry days	Environmental	Operation and Maintenance	**Almost Certain**	**Minor**	**Medium**	

Climate Hazard	Risk No	Risk Statement	Indicator	Sensitive Receptor	Phase	Initial Likelihood	Initial Consequence	Initial Significance Rating	Embedded Mitigation Measure
Wildfires	15	Increased wildfire events in the area causing regional impacts to air quality, leading to health and safety risks to workers, employees and visitors to the site.	Forest Fire Danger Index (FFDI)	Human health	Operation and Maintenance	**Rare**	**Moderate**	**Medium**	Embedded mitigation measures will be detailed in the ES.
	16	Increased fire danger days causing wildfire events in the area of the Proposed Development, could expose above ground infrastructure within the GPP (tanks, pipelines, values, vent stacks and ancillary control systems to direct flame contact and/or smoke contamination, leading to damage to above ground hydrogen infrastructure on site.	Forest Fire Danger Index (FFDI)	Environmental	Operation and Maintenance	**Rare**	**Moderate**	**Medium**	

Construction

17.7.10.3 Likely significant effects due to future climate changes associated with construction phase will be determined in the ES.

Operation and Maintenance

17.7.10.4 Likely significant effects due to future climate changes associated with operations and maintenance phase will be determined in the ES.

Decommissioning

17.7.10.5 Likely significant effects due to future climate changes associated with decommissioning phase will be determined in the ES.

ICCI

17.7.10.6 All environmental topics assessed within the PEIR and ES have the potential to be impacted by climate change. The impact of climate change on these other environmental topics will be reviewed and assessed by the subject-matter experts (SMEs). Mitigation measures will additionally be identified as part of this process.

17.7.10.7 At the time of writing, the Proposed Development is at pre-FEED stage, and as result, the ICCI will be assessed and presented in the ES.

17.7.11 SUMMARY OF INDIRECT EFFECTS

17.7.11.1 The indirect effects will be assessed and summarised in the ES.

17.8 SUMMARY OF CUMULATIVE EFFECTS

17.8.1.1 The summary of cumulative effects have been presented in **Table 17.9** and Chapter 18, Cumulative Effects Assessment.

17.9 SUMMARY AND CONCLUSIONS

CCRA

17.9.1.2 As embedded mitigation measures will be finalised during the ES stage, the CCRA is currently unable to determine the likely significance of climate-related hazards during the construction, operation, and maintenance phases of the Proposed Development.

ICCI

17.9.1.3 The embedded mitigation measures for this chapter and other relevant technical chapters outlined in **Table 17.9** will be finalised during the ES stage. Therefore, the ICCI is currently unable to determine the likely significance of all in-combination climate-related effects during the construction, operation, and maintenance phases of the Proposed Development.

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