



LIGHTHOUSE GREEN FUELS PROJECT

Preliminary Environmental Information Report

Chapter 12: Climate Resilience

The Inspectorate Reference: **EN010150**

May 2024

Volume 1



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12. CLIMATE RESILIENCE

12.1. INTRODUCTION

- 12.1.1. This Chapter reports the preliminary assessment of the likely significant effects of climate change on the Proposed Scheme (rather than the impact of the Proposed Scheme on climate) and describes:
- Relevant policy, legislation and guidance;
 - Methodology for climate resilience assessment;
 - Current and future climate baseline conditions;
 - Potential significant effects of climate change on the Proposed Scheme; and
 - Additional mitigation and enhancement measures.
- 12.1.2. The construction phase, decommissioning phase and some elements from the operation phase of the Proposed Scheme were deemed as insignificant at the scoping stage and hence, were scoped out from further assessment. The justification for scoping these elements out is provided below and confirmation from the Planning Inspectorate ('the Inspectorate') is provided in **Table 12-1**.

MATTERS SCOPED OUT

- 12.1.3. The following elements have been scoped out from further assessment at the ES stage:
- The construction phase is determined to have low vulnerability to climate change and has been scoped out of further assessment. As per **Chapter 2: Site and Proposed Scheme Description (Volume 1)**, the Construction Phase will last approximately three years (from Q4 2025 to Q3 2028). The relatively short construction phase in the context of climate trends combined with the management of weather-related risks in the Outline Code of Construction Practice (OCoCP), will result in no potential for significant effects.
 - Impacts of annual temperature change have been scoped out for the SAF plant and components, feedstock storage and pre-processing area, and cable connections (import and export) and utility corridors, flares, internal conveying equipment corridor, drainage, marine transport infrastructure, and operational staff and maintenance.
 - Impacts of annual precipitation changes have been scoped out for the SAF plant and components, feedstock storage and pre-processing area, pipeline and cable connections (import and export) and utility corridors, flares, bulk liquid storage, hard landscaping (including roads, pavements, parking, temporary and permanent laydown areas), internal conveying equipment corridor, rail terminal, drainage, marine transport infrastructure and operational staff and maintenance.
 - Impacts of drought have been scoped out for feedstock storage and pre-processing area, pipeline and cable connections (import and export) and utility corridors, flares, internal conveying equipment corridor, drainage and operational staff and maintenance.
 - Impacts of extreme temperature events have been scoped out for drainage.

- Impacts of relative humidity have been scoped out for hard landscaping (including roads, pavements, parking, temporary and permanent laydown areas), internal conveying equipment corridor, rail terminal, drainage and operational staff and maintenance.
- Impacts of wind have been scoped out for internal conveying equipment corridor.
- The decommissioning phase has been determined to have low vulnerability to climate change and has been scoped out of further assessment. As detailed in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**, decommissioning is anticipated to last 15-18 months following a 50-year operational lifespan. It is considered that the potential effects of decommissioning of the Proposed Scheme would be similar or less than those of the construction phase. The measures adopted from the OCoCP with regards to climate change impacts would be considered within the Decommissioning Plan.

12.2. POLICY, LEGISLATION, AND GUIDANCE

12.2.1. The policy, legislation, and guidance relevant to the assessment of climate resilience for the Proposed Scheme is detailed in **Appendix 4A: Policy, Legislation and Guidance (Volume 3)**. The policy, legislation and guidance relevant to this Chapter is summarised below:

- Policy:
 - Overarching National Policy Statement for Energy (EN-1) 2023¹;
 - Climate Change Adaptation: Policy Information 2021²;
 - National Planning Policy Framework (NPPF) 2023³;
 - The National Adaptation Programme 2018⁴;
 - Stockton-on-Tees Borough Council Local Plan (2019)⁵;
 - Climate Change: Strategy for Stockton-on-Tees (2016-2021)⁶;
 - Redcar and Cleveland Local Plan⁷; and
 - North East England Climate Change Adaptation Study (2008)⁸.
- Legislation:
 - Climate Change Act 2008⁹.
- Guidance:
 - National Planning Practice Guidance (NPPG): Climate Change 2019¹⁰;
 - EIA Guide to: Climate Change Resilience and Adaptation 2020¹¹ (“the IEMA guidance”);
 - ISO 14091:2021 Adaptation to climate change – Guidelines on vulnerability, impacts and risk assessment¹²;
 - Safeguarding chemical businesses in a changing climate¹³;
 - Redcar and Cleveland Borough Council - Climate Change Strategy 2021-2030¹⁴; and

- Redcar and Cleveland Borough Council - Climate Change Action Plan 2021-2025¹⁵.

12.3. SCOPING OPINION AND CONSULTATION

- 12.3.1. An EIA Scoping Opinion¹⁶ was received by the Applicant from the Inspectorate on behalf of the Secretary of State on 01 September 2023. The responses from the Inspectorate in relation to climate resilience and how these requirements should be addressed by the Applicant are set out in **Table 12-1** below.

Table 12-1: Summary of the EIA Scoping Opinion in relation to Climate Resilience

Section ID	Applicant's Proposed Matters to Scope Out	Scoping Opinion Comments	Response
3.9.1	Construction and decommissioning phases	<i>"The Applicant proposes to scope out effects during the construction and decommissioning phases on the basis that the Proposed Development is predicted to have low vulnerability to all climate variables. Based on the vulnerability assessment, the Inspectorate is content that the construction and decommissioning phases can be scoped out of further assessment."</i>	No response required.
3.9.2	Changes in annual average precipitation and annual average temperature – SAF plant and components	<i>"The Applicant proposes to scope this matter out on the basis that vulnerability is considered to be low. It is stated that the SAF plant and components are less likely to be impacted by changes in annual average temperature and precipitation. The Inspectorate has considered the characteristics of the Proposed Development and is content that significant effects are unlikely to occur from changes in annual average precipitation and temperature. This matter can be scoped out of further assessment."</i>	No response required.
3.9.3	Changes in annual average precipitation,	<i>"The Applicant proposes to scope this matter out on the basis that vulnerability is considered to be</i>	No response required.

Section ID	Applicant's Proposed Matters to Scope Out	Scoping Opinion Comments	Response
	drought, annual average temperature – feedstock processing and storage area, pipeline and cable connections, and utility corridors	<i>low. The Inspectorate has considered the characteristics of these components of the Proposed Development and is content that significant effects from climate change are unlikely to occur and therefore this matter can be scoped out of further assessment."</i>	
3.9.4	Changes in annual average precipitation – bulk liquid storage	<i>"The Applicant proposes to scope this matter out on the basis that vulnerability is considered to be low. The Inspectorate has considered the characteristics of this component of the Proposed Development and is content that significant effects from climate change are unlikely to occur and therefore this matter can be scoped out."</i>	No response required.
3.9.5	Change in annual average precipitation and relative humidity – hard landscaping	<i>"The Applicant proposes to scope this matter out on the basis that vulnerability is considered to be low. The Inspectorate has considered the characteristics of this component of the Proposed Development (namely roads, walkways, pavements, and laydown areas) and is content that significant effects from climate change are unlikely to occur and therefore this matter can be scoped out of further assessment."</i>	No response required.

Section ID	Applicant's Proposed Matters to Scope Out	Scoping Opinion Comments	Response
3.9.6	Change in annual average precipitation, drought, change in annual average temperature, wind, relative humidity – internal conveying corridor	<i>“The Applicant proposes to scope this matter out on the basis that vulnerability is considered to be low. Paragraph 2.2.32 states that these conveying corridors are likely to be above ground and covered to protect materials from weather exposure. The Inspectorate has considered the characteristics of this component of the Proposed Development and is content that significant effects from climate change are unlikely to occur and therefore can be scoped out. However, the ES should describe how the conveying corridors have been designed to reduce the exposure from weather related events.”</i>	The ES will describe how the conveying corridors have been designed to reduce the exposure from weather related events. This will be included within the ES's Climate Resilience Chapter.
3.9.7	Changes in annual average precipitation, wind, relative humidity – rail terminal	<i>“The Applicant proposes to scope this matter out on the basis that vulnerability is considered to be low. The Inspectorate has considered the characteristics of the rail terminal and is content that significant effects from climate change are unlikely to arise from changes in annual average precipitation and relative humidity and agrees that these matters can therefore be scoped out of the ES. The rail terminal would be vulnerable to wind events and therefore the Inspectorate does not agree to scope out this climate</i>	Impact of wind events on the rail terminal has been scoped in for further assessment within this Chapter and the ES. An assessment of the vulnerability of the rail terminal component of the Proposed Scheme to strong winds will be included within this Chapter and in the ES Chapter on Climate Resilience.

Section ID	Applicant's Proposed Matters to Scope Out	Scoping Opinion Comments	Response
		<i>variable.” The ES should include an assessment of the vulnerability of the rail terminal component of the Proposed Development to strong winds.</i>	
3.9.8	Change in annual average precipitation, drought, temperature, relative humidity – drainage features	<i>“It is stated that drainage is unlikely to be impacted by changes in annual average rainfall, drought, temperature events, and relative humidity. No further explanation is provided. Subject to demonstration that drainage has been designed to take into account climate change, such as through a Flood Risk Assessment, and agreement from the relevant consultation bodies, the Inspectorate is content that this matter can be scoped out of further assessment.”</i>	Drainage will be designed to include a climate change allowance suitable for the Proposed Scheme in accordance with EA flood risk requirements. This will be informed by the Flood Risk Assessment (see Chapter 9: Water Environment and Flood Risk (Volume 1)). However, at the time of writing the design is not sufficiently progressed to have the details on the drainage design. This will be reviewed and updated at ES stage. An Outline Drainage Strategy (ODS) will be prepared to allow for this to be assessed within the ES (see Chapter 9: Water Environment and Flood Risk (Volume 1)).
3.9.9	Change in annual average precipitation, change in annual average temperature – marine transport infrastructure	<i>“The Inspectorate is content that marine transport infrastructure is unlikely to be impacted by changes in annual average precipitation or temperature and is therefore content that this matter can be scoped out of further assessment.”</i>	No response required.

Section ID	Applicant's Proposed Matters to Scope Out	Scoping Opinion Comments	Response
3.9.10	Changes in annual average precipitation, drought, change in annual average temperature, relative humidity – operational staff	<i>"It is stated that operational staff are less likely to be impacted by changes in annual average rainfall and temperature, drought, or relative humidity. The Inspectorate considers that any such changes would be unlikely to lead to significant effects and agree that this matter can be scoped out of further assessment. The Inspectorate agrees that extreme precipitation and temperature events, wind and sea level rise should be scoped in."</i>	No response required.
Environment Agency Response Page 7	Climate Change Adaptation Plan	<i>"We refer the applicant to the Chemical Industries Association guidance document 'Safeguarding Chemical Businesses in a Changing Climate – How to prepare a Climate Change Adaption Plan.'"</i>	The Applicant is aware of this document and will act in accordance with this guidance. This guidance has been included in Appendix 4A: Policy, Legislation and Guidance (Volume 3) .

12.4. ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

SENSITIVE RECEPTORS

- 12.4.1. In the case of climate resilience, the sensitive receptors considered within the EIA are described below.

Operation Phase

- 12.4.2. The operational lifespan of the Proposed Scheme is estimated to be 50 years. The sensitive receptors during the operation phase include:
- Sustainable Aviation Fuel (SAF) Plant and components (as described in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**) (including the Gasification Plant, Fischer-Tropsch (FT) Reactor, Syngas Clean-up (including thermal oxidiser), Product Upgrading Unit, Miscellaneous Tankage, the Existing CCGT Power Plant, Air separation Unit, Feedstock Storage & Pre-Processing Area, Utilities, Wastewater treatment Plant (WWTP), General Administration Facilities and Process Waste Storage).
 - Bulk Liquid Storage (for SAF and naphtha).
 - Pipeline and Cable connections (import and export) and Utility corridors.
 - Flares.
 - Hard landscaping (including pavement, parking, temporary and permanent laydown areas).
 - Internal Conveying Corridors (above ground).
 - Rail Terminal.
 - Drainage (including cover ponds).
 - Marine transport infrastructure.
 - Operational Staff and maintenance.

BASELINE DATA COLLECTION

- 12.4.3. In line with best practice, the current baseline for the Climate Change Resilience Assessment is based on historic climate data (1991-2020) obtained from the Met Office records¹⁷ for the closest meteorological weather station to the Proposed Scheme (Stockton-on-Tees) and the Met Office Regional Climate Profile for East England. Key findings from the State of the UK Climate Report¹⁸ have also been included. This is detailed in **Section 12.6**.
- 12.4.4. In line with IEMA guidance¹¹, for future baseline, the UKCP18¹⁹ projections have been used to analyse future changes in a range of climate variables that may affect the resilience of the Proposed Scheme to climate change. The Climate Risk Indicators (CRI)²⁰, developed by Nigel Arnell et al. as part of the UK Climate Resilience Programme, have been used to inform this assessment. The CRI utilises the UKCP18 projections and allows for a range of climate related indicators to be assessed. The CRI data for the local authority of Stockton-on-Tees has been used to inform this assessment.

ASSESSMENT METHODOLOGY

- 12.4.5. The assessment of impacts will be undertaken using an approach based on the IEMA guidance¹¹, EU Climate Change and Major Projects²¹ and professional judgement.
- 12.4.6. The significance of effects of changes in (scoped in) climate variables on receptors will be identified for the operation phase. The scoped in climate variables are based on the findings of the vulnerability assessment at the scoping stage and also incorporate comments received from the Inspectorate and the consultation bodies in the Scoping Opinion¹⁶. The significance of effects will be determined by considering the consequence and the likelihood of potential impacts associated with changes in climate variables on Proposed Scheme components occurring. Consequence and likelihood will be qualitatively assessed using the descriptions in **Table 12-2** and **Table 12-3**. These descriptions have been developed using professional judgement, informed by relevant guidance. It should be noted that the IEMA guidance¹¹ definitions of consequence have been developed for large scale infrastructure specifically, and therefore, the description of the measure of consequence will have regard to the wider Proposed Scheme. This PEIR has completed a preliminary assessment of the climate change impacts based on the current level of design. This will be refined further at the ES stage.
- 12.4.7. The assessment of consequence and likelihood (and therefore significance) will take embedded mitigation into account as an assumed part of the design. Embedded mitigation will be identified through engagement with the design team and informed by ongoing consultation (for example with the Environment Agency) regarding the climate change allowances considered in relation to flood risk, as detailed in **Chapter 9: Water Environment and Flood Risk (Volume 1)** and best practice/guidance, where available.

Table 12-2: Consequences Definitions^a

Measure of consequence	Description
Very large adverse	Permanent damage. Disruption lasting more than ten days. Early renewal of facility / infrastructure >90%. Severe health effects and / or fatalities. Repairs cost 50% of facility reconstruction cost.
Large adverse	Extensive facility / infrastructure damage. Disruption lasting more than three but less than ten days. Early renewal of 50-90% of infrastructure. Severe health effects and / or fatalities. Significant effect on the environment, requiring remediation. Repairs cost 50% of facility reconstruction cost.
Moderate adverse	Limited facility / infrastructure damage with damage recoverable by maintenance or minor repair. Disruption lasting more than one but less than three days. Adverse effects on health and / or the environment. Repairs cost 25% of facility reconstruction cost.

^a Source: Adapted from key themes identified in the impact analysis EU Climate Change and Major Projects page 7²¹ and amended to suit applicability of the scheme.

Measure of consequence	Description
Minor adverse	Localised facility / infrastructure disruption. No permanent damage, minor restoration work required: Facility closure lasting less than one day. Slight adverse health or environmental effects. Repairs cost 2% of facility reconstruction cost.
Negligible	No facility / infrastructure damage, minimal adverse effects on health, safety and the environment. Facility doesn't shut down. No financial loss.

Table 12-3: Likelihood Definitions^b

Measure of likelihood	Description
Very High	The event occurs multiple times during the lifetime of the Proposed Scheme e.g., approximately annually.
High	The event occurs several times during the lifetime of the Proposed Scheme e.g., approximately once every five years.
Medium	The event occurs limited times during the lifetime of the Proposed Scheme e.g., approximately once every 15 years.
Low	The event occurs occasionally during the lifetime of the Proposed Scheme e.g., once in 60 years.
Very Low	The event may occur once during the lifetime of the Proposed Scheme.

SIGNIFICANCE CRITERIA

- 12.4.8. The likelihood and consequence are combined to assess the significance of effects on receptors, as shown in **Table 12-4**. The assessment is qualitative and based on professional judgment, engagement with the design team and a review of relevant literature.

^b Source: IEMA guidance¹¹, Appendix 1, Table 4

Table 12-4: Significance Rating Matrix^c

Likelihood	Consequence				
	Negligible	Minor adverse	Moderate adverse	Large adverse	Very large adverse
Very High	Not significant	Significant	Significant	Significant	Significant
High	Not significant	Significant	Significant	Significant	Significant
Medium	Not significant	Not significant	Significant	Significant	Significant
Low	Not significant	Not significant	Not significant	Significant	Significant
Very Low	Not significant	Not significant	Not significant	Not significant	Not significant

12.5. STUDY AREA

- 12.5.1. The scope for the climate resilience assessment relates to the impact of climate on the Proposed Scheme (rather than the impact of the Proposed Scheme on climate). As such, the Study Area for the Proposed Scheme is defined as the Site.
- 12.5.2. In the context of a climate resilience assessment, all elements of the Proposed Scheme are located within a relatively close proximity of each other. Therefore, the same baseline conditions and future baseline (projections) apply for all Proposed Scheme elements.
- 12.5.3. The Climate Resilience Assessment explores the potential impacts of changing climate on the Proposed Scheme, and therefore considers both current and future baseline conditions to account for the full extent of climate impacts on the Proposed Scheme. In line with IEMA guidance¹¹, this Climate Resilience Assessment examines the potential impacts of climate at various temporal scales for the operation phase of the Proposed Scheme, accounting for short, medium and long term changes in climate.

12.6. BASELINE CONDITIONS AND FUTURE BASELINE

- 12.6.1. The IEMA Guidance¹¹ identifies the need for the baseline to consider:
- The current climate baseline (defined by historic climate conditions) to provide an indication of past vulnerability; and
 - The future climate baseline (short term extremes and long term variation) to assess a project's vulnerability to climate change.

^c Source: IEMA guidance page 28¹¹

- 12.6.2. This section provides an overview of the current baseline conditions for the Site of the Proposed Scheme using weather station data, and the projected future changes in the climate for the Site.
- 12.6.3. The key data sources referred for current and future baseline include:
- Met Office records for UK Climate averages¹⁷
 - State of the UK Climate Report¹⁸
 - UKCP18 climate projections¹⁹
 - UK Climate Risk Indicators¹⁹.
- 12.6.4. An explanation of the approach to Cumulative Effects is outline in **Chapter 19: Cumulative Effects (Volume 1)**.

EXISTING BASELINE

- 12.6.5. This section provides an overview of the current baseline conditions for the Site of the Proposed Scheme using weather station data, and the projected future changes in the climate for the Site.
- 12.6.6. This section includes the climate trends over the past three decades (1991-2020) for temperature, precipitation (rain and snow), wind, humidity and solar radiation. This provides an understanding of how recent climate trends have impacted the Site. This is presented for both the UK context as well as the local climate, as represented by Stockton-on-Tees weather station¹⁷.

UK Context

- 12.6.7. According to the latest State of the UK Climate Report¹⁸, the UK's climate is changing, with recent decades warmer, wetter and sunnier than the 20th century. The Report highlights that the UK has warmed at a broadly consistent (but slightly higher) rate than the observed change in global mean temperature. The key findings from the latest 2022 report are:
- All the top ten warmest years for the UK in the series from 1884 have occurred this century.
 - The most recent decade (2013–2022) has been on average 0.3°C warmer than the 1991–2020 average and 1.1°C warmer than 1961–1990.
 - The most recent decade (2013–2022) had 4% and 7% fewer days of both air and ground frost, respectively, compared to the 1991–2020 average, and 15% and 18% fewer compared to 1961–1990.
 - The most recent decade (2013–2022) had 3% fewer heating degree days per year on average compared to 1991–2020, and 12% fewer compared to 1961–1990.
 - Five of the ten wettest years for the UK since 1836 have occurred this century.
 - For the most recent decade (2013–2022), UK winters have been on average 10% wetter than 1991–2020 and 25% wetter than 1961–1990.
 - Widespread and substantial snow events have occurred in 2021, 2018, 2013, 2010 and 2009, but their number and severity have generally declined since the 1960s.

- For the most recent decade (2013–2022) UK winters have been 3% sunnier than 1991–2020 and 14% sunnier than 1961–1990. UK springs have been 6% / 16% sunnier.
- The UK annual mean wind speed from 1969 to 2022 shows a downward trend, consistent with that observed globally. However, this series must be interpreted with some caution. Changes in instrument type, station network size, station exposure, and choice of metric used mean that interpreting trends in storminess from UK wind speed data is not straightforward due to the limitations of available data.

Local Climate

Precipitation – Rainfall

12.6.8. Average seasonal rainfall at Stockton-on-Tees weather station, England East and Northeast, and the UK - for the period 1991–2020 is presented in **Table 12-5**. It shows that the weather station is drier than both the region and the UK average year-round, particularly during winter.

Table 12-5: Long term average seasonal rainfall (mm) (1991–2020) for Stockton-on-Tees weather station, England East and North East, and the rest of the UK

Season	Long Term Average Season Rainfall (1991-2020) (mm)		
	Stockton-on-Tees	England East and North East	UK
Summer (June, July, August)	178 mm	208.5 mm	253.4 mm
Winter (December, January, February)	128.5 mm	205.4 mm	344.9 mm

Precipitation – Snow

12.6.9. Snowfall is closely linked with temperature, with falls rarely occurring if the temperature is higher than 4°C. In the local area, snowfall is normally confined to the months including and between November to April.

Temperature

12.6.10. **Table 12-6** shows the long term average seasonal mean temperature for Stockton-on-Tees weather station, England East and North East, and the UK between 1991-2020. It shows that the Site is warmer than both the region and the UK average.

Table 12-6: Long term average mean seasonal temperature (°C) (1991–2020) for Stockton-on-Tees weather station, England East and North East, and the UK

Season	Long Term Average Season Temperature (1991-2020) (°C)		
	Stockton-on-Tees	England East and North East	UK
Summer (June, July, August)	15 °C	14.9 °C	14.6 °C
Winter (December, January, February)	4.2 °C	3.9 °C	4.1 °C

Wind

12.6.11. The local area is one of the more sheltered parts of the UK. In general, the strongest winds are associated with the passage of deep depressions across or close to the UK. The frequency and strength of these depressions is greatest in the winter half of the year, especially from December to February, and this is when mean speeds and gusts (short duration peak values) are strongest.

Humidity

12.6.12. The annual average relative humidity for the Site is 78-80%, with a slightly higher humidity of 80-82% in the surrounding area.

Solar Radiation

12.6.13. Average seasonal sunshine hours at Stockton-on-Tees Weather station, England East and North East, and the UK for the period 1991–2020 is presented in **Table 12-7**. The table shows that the weather station receives slightly less sunshine than the region, but greater than the UK average.

Table 12-7: Long term average seasonal sunshine (hours) (1991–2020) for Stockton-on-Tees weather station, England East and North East, and the rest of the UK

Season	Long Term Average Seasonal Sunshine hours (1991-2020) (C)		
	Stockton-on-Tees Weather Station	England East and North East	UK
Summer (June, July, August)	507	534	507
Winter (December, January, February)	183	189	162

Sea Level Rise and Flood Risk

12.6.14. The Site is located along the tidal River Tees, flowing into the nearby North Sea. Large portions of the Site are within Flood Zone 2 and 3 associated with River Tees.



Figure 12-1: Extent of flooding from rivers or the sea at the Proposed Scheme

12.6.15. According to the EA flood risk summary²² for the Site, the Proposed Scheme is currently at high risk from tidal and fluvial flooding (greater than 3.3% chance of flooding per year), with other areas at low risk (between 0.1% and 1% chance of flooding per year), as shown in **Figure 12-1**. Flood Risk and its relation to the Proposed Scheme is shown in more detail on **Figure 9-4 (Volume 2)**.

Past Major Events

12.6.16. Some past major events which have affected the region of the Proposed Scheme are described below:

- In December 2013, Port Clarence was subject to severe tidal flooding. A high spring tide was forecast; the tide at Teesport was due to peak at 1704 hrs. At a height of 2.85m AOD (Above Ordnance Datum). The meteorological conditions on that day included strong offshore wind, with a deep area of low pressure forming in the North Sea causing the positive surge on top of the already high tide. The positive surge measured 1.24m above the spring tide, giving a total tide height of 4.09m AOD, which exceeded previous historical events. This event resulted in extensive damage and disruptions with internal flooding to properties and businesses in Port Clarence, Billingham Reach Industrial Estate and Seal Sands. In addition, there was severe transport disruption and evacuation protocols in place. The Environment Agency mobilised immediately and engaged the military, as there was no access to the breach due to the widespread flooding²³.
- In February to March 2018, the most significant spell of snow and low temperatures for the UK overall since December 2010. The snow and ice resulted

in road closures, people becoming stranded, trains cancelled and power cuts²⁴. The spell also led to many instances of broken heating or frozen pipes, which led to buildings flooding²⁵.

- In February 2022, Storm Eunice led to wind speeds reaching over 50mph in the area of the Proposed Scheme²⁶, causing road closures, flooding, and power loss²⁷.
- In July 2022, the UK experienced a brief but unprecedented extreme heatwave from 16 to 19 July 2022, as hot air moved north from the near continent, with extreme temperatures recorded on both 18 and 19 July. This heatwave marked a milestone in UK climate history, with 40°C being recorded for the first time in the UK, with a large part of England exceeding 37°C. Several fire services declared major incidents after multiple fires broke out²⁸.

FUTURE BASELINE

- 12.6.17. The future climate has been presented for the 2030s (2020-2049), the 2050s (2040-2069) and 2080s (2070-2099) to identify the anticipated climate conditions. These projections are provided against the baseline period of 1981-2010 (based on model data), and 1991-2020 (current climate) as an indication of change from the baseline period.
- 12.6.18. Although the assessment has been undertaken for the 50th percentile (i.e. the median, or central estimate) the 10th and the 90th percentiles are presented here to illustrate the full range of projected outcomes.
- 12.6.19. Climate change is projected to lead to warmer wetter winters and hotter drier summers, with an increase in the intensity and frequency of extreme events such as heatwaves, drought, extreme rainfall leading to flash flooding, storms and wind events. The information presented below illustrates how the climate may evolve at the Site of the Proposed Scheme by the end of the century.

Rainfall and Temperature

- 12.6.20. **Table 12-8** provides an overview of current and projected summer and winter temperature and rainfall for the location of the Proposed Scheme.

Table 12-8: Temperature and rainfall data for the Model Reference (1981-2010), current (1991-2020) and future climate (2030s, 2050s and 2080s) for RCP8.5 (anomalies), the table shows the 50th percentile (10th percentile to 90th percentile) values.

Climate variable	Model Reference (1981-2010)	Current Baseline (1991-2020)	RCP8.5		
			2030s	2050s	2080s
Average summer temperature	14.7°C	15°C	+1.0°C (0.3°C to 1.7°C)	+1.9°C (0.8°C to 3.2°C)	+3.9°C (1.8°C to 6.1°C)
Average winter temperature	3.9°C	4.2°C	+0.9°C (0.1°C to 1.8 °C)	+1.6°C (0.6°C to 2.8°C)	+3.0°C (1.3°C to 4.8°C)
Min winter temperature	0.8°C	1.1°C	+0.9°C (0°C to 1.9°C)	+1.6°C (0.4°C to 2.9°C)	+3.0°C (1.0°C to 5.2°C)
Max summer temperature	19.4°C	19.7°C	+1.0°C (0.2°C to 1.9°C)	+2.0°C (0.5°C to 3.6°C)	+4.0°C (1.4°C to 6.7°C)
Average summer Rainfall	166 mm	178 mm	-5.9% (-18.9% to +8.2%)	-13.7% (-30.4% to +4.6%)	-23.1% (-42.2% to -1.8%)
Average winter rainfall	122 mm	128.5mm	+6.9% (-0.9% to +14.9%)	+11.6% (+1.3% to +22.2%)	+20.9% (+6.3% to +35.7%)

12.6.21. Indicators of climate risk are shown in **Table 12-9**. These provide an indication of sector specific thresholds which are projected to change in the future. The indicators presented in **Table 12-9** are provided against the model reference period of 1981-2010. These indicators are unavailable for the current baseline period (1991-2020).

Table 12-9: Future projections (absolute) of climate risk indicators for the 2030s, 2050s and 2080s for RCP8.5, the table shows the 50th percentile (10th percentile to 90th percentile) values.

Climate variable	Model Reference (1981-2010)	RCP8.5		
		2030s	2050s	2080s
Met office heatwave ^d (events per year)	0.7	1.5 (1.0 to 2.2)	2.5 (1.3 to 4.1)	4.5 (2.5 to 6.1)
Road accident risk ^e (days per year)	46.4	34.0 (26.3 to 42.9)	26.8 (18.4 to 37.6)	16.9 (8.81 to 29.5)
Road melt risk (days per year) ^f	6.4	12.3 (8.7 to 17.4)	20.0 (10.7 to 35.3)	43.0 (19.7 to 72.9)
Heat stress ^g (days per year)	0	0.07 (0.01 to 0.14)	0.23 (0.03 to 1.50)	3.02 (0.30 to 10.93)
Wildfire events ^h (days per year)	21.7	30.3 (20.7 to 43.5)	40.3 (23.8 to 61.8)	60.1 (30.5 to 90.7)

Precipitation – Snow

12.6.22. With regards to future changes, rising winter temperatures are likely to reduce the amount of precipitation that falls as snow in winter. Snowfall data is unavailable for the probabilistic projections (25km) of UKCP18, however both the regional (12km) and the local (2.2km) of UKCP18 show a decrease in both falling and lying snow across the UK for the period of 2061-2080 relative to the 1981-2000 baseline. These findings are consistent with an increase in average and minimum winter temperatures and a decrease in road accidents risks (measures as days with minimum temperature below 0°C) outlined in **Table 12-8** and **Table 12-9**, respectively.

Humidity

12.6.23. Projections for humidity anticipate an average decrease of approximately 1.1% in the 2030s (-2.1% to -0.7%), and a decrease of 2% in the 2050s (-2.9% to – 1.5%).

^d A UK heatwave threshold is met when a location records a period of at least three consecutive days with daily maximum temperatures meeting or exceeding the heatwave temperature threshold. The threshold for the local area is 25 °C.

^e Days with minimum temperature below 0°C

^f Days with maximum temperature above 25 °C

^g Days with shade Wet Bulb Globe Temperature (WBGT) above 25°C

^h Days with Met Office Wildfire Index at the Very High Fire Severity level or above

Soil Moisture

12.6.24. **Table 12-10** indicates the projected changes in soil moisture, with a decrease in soil moisture for the 50th percentile, and a slight increase under the 90th percentile.

Table 12-10: Future projections of soil moisture (as % change) for the 2030s, 2050s and 2080s for RCP8.5, the table shows the 50th percentile (10th percentile to 90th percentile) values.

	2030s	2050s	2080s
Soil Moisture ⁱ (% change)	-1.2% (-5.7% to +0.8%)	-1.8% (-8.3% to +0.4%)	-2.7% (-11.7% to +0.6%)

Wind

12.6.25. UKCP18 depicts a wide spread of future changes in mean surface wind speed, however, there is large uncertainty in projected changes in circulation over the UK and natural climate variability contributes to much of this uncertainty. It is therefore difficult to represent regional extreme winds and gusts within regional climate models.

12.6.26. Central estimates of change in mean wind speed for the 2050s are small (<0.2ms⁻¹). A wind speed of 0.2ms⁻¹ (approximately 0.4 knots) is small compared with the typical magnitude of summer mean wind speed of about 3.6–5.1ms⁻¹ (7 – 10 knots) over much of England. Seasonal changes at individual locations across the UK lie within the range of –15% to +10%.

Sea Level Rise and Flood Risk

12.6.27. The Site is located along the tidal River Tees, flowing into the nearby North Sea. Therefore, it is exposed to future sea level rise. Sea level projections at the closest marine projections data point, adjacent east of the Proposed Scheme, range from 0.12m in the 2030s to 0.74m in the 2080s. **Table 12-11** below depicts the projected sea level rise for the 2030s, 2050s and 2080s using UKCP18 marine projections data.

Table 12-11: Sea level rise projections (m) presented as 50th percentile (10th percentile to 90th percentile) for the Development area.

	2030s	2050s	2080s
Sea level rise	0.16 (0.12 to 0.21)	0.29 (0.22 to 0.38)	0.55 (0.40 to 0.74)

ⁱ Potential soil moisture deficit measured by the maximum difference between accumulated rainfall and potential evaporation.

12.7. EMBEDDED DESIGN, MITIGATION AND ENHANCEMENT MEASURES

- 12.7.1. The assessment of effects takes into account confirmed measures and mitigation embedded in the Proposed Scheme's design, as provided by the design team and topic specialists. Although such measures are based on the preliminary design, it is assumed that these will be fully implemented as part of the detailed design. Specific climate resilience design information is relatively limited at this stage due to the early stages of the design and will be reevaluated and updated in the ES stage.
- 12.7.2. **Table 12-12** sets out the embedded mitigation measures^j that address potential impacts of climate change on the Proposed Scheme for the operation phase covering all the scoped in elements.

^j Confirmed by the Applicant (Alfanar) on September 11, 2023

Table 12-12: Embedded mitigation measures that address climate risks in the Proposed Scheme's design

Receptor	Climate variables	Confirmed measures / embedded mitigation
Site wide (including receptors: SAF Plant and components; Feedstock Processing and Storage area; Flares; Bulk Liquid Storage; Pipeline and cable connections (import and export); Hard landscaping (including pavement, parking, temporary and permanent laydown areas); Rail Terminal; Drainage; Marine transport	Precipitation: Drought; Extreme precipitation events Sea level rise	<ul style="list-style-type: none"> Drainage design will be informed by the Flood Risk Assessment (FRA). The FRA will assess flood risk from all sources of flooding and identify appropriate mitigation measures. Consultation with the Environment Agency will be ongoing throughout the assessment. This includes seeking agreement of the appropriate climate change allowances most applicable to the Proposed Scheme. An ODS will be prepared for the management of surface, foul and effluent drainage. An appropriate surface water drainage system, taking into account future climate projections, will be implemented that will incorporate appropriate pollution control and maintenance measures to mitigate the risk of pollution during operation. More information can be found in Chapter 9: Water Environment and Flood Risk (Volume 1). A Controlled Waters Risk Assessment will be undertaken as part of the additional ground investigation and risk assessments, which will be inherent to the progression of the Proposed Scheme, as a requirement of planning and detailed design. This will be secured as a requirement in the DCO. Hydraulic modelling will be undertaken as part of the FRA to inform the design of appropriate mitigation and ensure no unacceptable flood risk to the Proposed Scheme. All operational areas (where there are risks of spills) will be covered with hardstanding to prevent any mobilisation of pollutants and include interceptors and other measures to avoid pollution. The design will be in accordance with the UK Building Regulations and BE EN codes. Where no BS EN code exists the Eurocodes and ISO standards will be adopted (temperature, wind/storms, snow load). Structures have been designed to accommodate an increase in extreme wind and storm events,
	Temperature: Extreme temperature events	
	Wind: Gales and high winds; Storms and lightning	
	Relative humidity: Changes in annual average	

Receptor	Climate variables	Confirmed measures / embedded mitigation
infrastructure; Operational and maintenance staff		<p>including ensuring emergency access routes to critical parts of the infrastructure, even in the event of flooding.</p> <ul style="list-style-type: none"> ▪ The plant will be subject to a global conformity assessment by a third party to demonstrate the components meet the requirements of applicable design, manufacture and conformity Directives and Regulations^k ▪ Nature based solutions will be incorporated within the design where practicable. For example, Sustainable urban Drainage Systems (SuDS), etc. ▪ The Proposed Scheme design has considered Reliability, Availability and Maintenance (RAM) studies to ensure critical equipment has a back-up system in the event of maintenance or equipment failure. ▪ A site wide maintenance system will be in operation at the site which will incorporate regulatory and equipment manufactures inspection and maintenance requirements. The site will be subject to a defined maintenance regime in accordance with equipment manufacturers requirements. ▪ The engineering design will be developed by a Fire and Gas specialist and include detection and suppression systems. Fire and Emergency plans will be developed prior to operation. ▪ Back-up generators will be installed at the facility. Furthermore, the 49.9 MW TV1 power plant can be used to provide power when Grid power is unavailable. ▪ Geotechnical data from TV1 and TV2 sites will be used to inform the design, with further geotechnical investigations undertaken as required.

^k Directives and Regulations include, but not limited to, the Pressure Equipment Directive; Dangerous Substances and Explosive Atmospheres Regulations; Low Voltage Directive; Electromagnetic Compatibility Directive; Machinery directives.

Receptor	Climate variables	Confirmed measures / embedded mitigation
		<ul style="list-style-type: none"> The Proposed Scheme design has considered RAM studies to ensure critical equipment has a back-up system in the event of maintenance or equipment failure.
SAF Plant and components	Precipitation: Drought; Extreme precipitation events Sea level rise	<ul style="list-style-type: none"> Major electrical substations or cabins will be ventilated to manage overheating. The Thermal Oxidiser will be operating at >800°C during normal operation. High external temperatures will not markedly increase pressure within the unit.
	Temperature: Extreme temperature events	
	Wind: Gales and high winds; Storms and lightning	
	Relative humidity: Changes in annual average	
Feedstock Processing and Storage area	Precipitation: Extreme precipitation events Sea level rise	<ul style="list-style-type: none"> Maintenance schedule will be in operation such that the feedstock storage facility will allow the SAF Plant to build up suitable buffer capacity to maintain operations while the Feedstock Processing Facilities (FPFs) facilities are shut down for maintenance, and vice versa. The storage bunkers will be covered for inclement weather protection, or alternatively, constructed within a dedicated building. Alternatively, storage will be provided by enclosed silos.
	Temperature: Extreme temperature events	

Receptor	Climate variables	Confirmed measures / embedded mitigation
	Wind: Gales and high winds; Storms and lightning	<ul style="list-style-type: none"> Exposed machinery will be Ingress Protection Rated (IP-rated) and installed on plinths or raised foundations.
	Relative humidity: Changes in annual average	
Flares	Precipitation: Extreme precipitation events Sea level rise	<ul style="list-style-type: none"> Flare design inherently allows for wind and rain exposure. The flare design will include wind shields and methods for re-ignition.
	Wind: Gales and high winds; Storms and lightning	
Conveying Corridors	Precipitation: Extreme precipitation events Sea level rise	<ul style="list-style-type: none"> Conveying equipment will be elevated and enclosed, reducing impacts of any potential flooding. The conveying equipment will include belt tensioners to accommodate thermal variation and support steelwork will have sliding connections or air brakes to allow for thermal expansion. Pneumatic system accommodates expansion bellows or stress loops to allow for thermal stress.
	Temperature: Extreme temperature events	

Receptor	Climate variables	Confirmed measures / embedded mitigation
	Wind: Gales and high winds; Storms and lightning	
Rail Terminal	Precipitation: Drought; Extreme precipitation events Sea level rise	<ul style="list-style-type: none"> The existing rail terminal located in the southwest of the Site is operated by Navigator, the Applicant continues to liaise with Network Rail in relation to protective provisions and likely works required.
	Temperature: Change in annual average; Extreme temperature events	
	Wind Gales and high winds; Storms and lightning	

12.8. PRELIMINARY ASSESSMENT OF LIKELY IMPACTS AND EFFECTS

- 12.8.1. This Section details the preliminary assessment of impacts and effects for the Proposed Scheme during the operational phase, taking into account the embedded design, mitigation and enhancement measures detailed in **Section 12.7**. Due to the design being preliminary the confirmed embedded mitigation is likely to change as the design evolves, and the assessment of likelihood and consequence will therefore need to be re-assessed as part of the ES.

Table 12-13: Assessment of Significance of the effects to the Operational Phase as a Result of Climate Change

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
SAF Plant and components	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks	Medium	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric	Medium	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption of functioning of plant	Low	Moderate adverse	Not significant
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice	Medium	Minor adverse	Not significant
	Precipitation: Drought	Drying out and cracking of materials which has the	Medium	Moderate adverse	Significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
		potential to affect structural and foundation stability.			
	Precipitation: Drought	Low river flows, affecting the water that is available for cooling.	Low	Moderate adverse	Not significant
	Precipitation: Drought	Low river flows potentially leading to subsidence.	Low	Moderate adverse	Not significant
	Temperature: Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Temperature: Extreme temperature events	Overheating of infrastructure, leading to greater demand for cooling.	High	Negligible	Not significant
	Temperature: Extreme temperature events	Overheating of electronic equipment resulting in potential fire risks.	Low	Minor adverse	Not significant
	Temperature: Extreme temperature events	Increased temperature of cooling water and of river flows that are used for cooling, thereby reducing efficiency of this process.	Medium	Negligible	Not significant
	Temperature: Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness.	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Temperature: Extreme temperature events	Deterioration of material structure and fabric.	Medium	Minor adverse	Not significant
	Temperature: Extreme temperature events	Potential melting and deformation of materials.	Low	Moderate adverse	Not significant
	Temperature: Extreme temperature events	Security infrastructure and lighting may fail in heatwave conditions.	Medium	Minor adverse	Not significant
	Temperature: Extreme temperature events	Increased pressure on thermal oxidiser.	Low	Minor adverse	Not significant
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Medium	Moderate adverse	Significant
	Wind: Storms and lightning	Damage from wind-driven rain infiltration	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
		into building materials and surfaces.			
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Medium	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Low	Moderate adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Power loss.	Low	Minor adverse	Not significant
	Wind: Storms and lightning	Lightning strike can cause fire as well as power surges and shock waves which can destabilise	Very Low	Moderate adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
		energy systems, as well as cause damage to electronical equipment.			
	Relative humidity: Changes in annual average	Humidity affects both the performance of the plant and storage areas as well as the comfort of staff.	Medium	Minor adverse	Not significant
	Relative humidity: Changes in annual average	Increase condensation, mould growth, mildew, staining and the corrosion and decay of metal surfaces.	Medium	Minor adverse	Not significant
	Relative humidity: Changes in annual average	Poor insulation performance.	Medium	Minor adverse	Not significant
Feedstock Storage & Pre-Processing Area	Precipitation: Extreme precipitation events	Mobilisation of pollutants potentially affecting building	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
		materials and consequently the structural integrity.			
	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Medium	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Low	Moderate adverse	Not significant
	Precipitation: Extreme precipitation events	Power outages and disruption to functioning of machinery.	Low	Minor adverse	Not significant
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice.	Low	Minor adverse	Not significant
	Temperature:	It is anticipated that over time faults in	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Extreme temperature events	machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.			
	Temperature: Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Low	Minor adverse	Not significant
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Medium	Moderate adverse	Significant
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Wind: Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Low	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Low	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Power loss.	Medium	Minor adverse	Not significant
	Wind: Storms and lightning	Lightning strike can cause fire as well as power surges and shock waves which can destabilise energy systems, as well as cause	Very Low	Moderate adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
		damage to electronical equipment.			
	Relative humidity: Changes in annual average	Humidity affects both the performance of the plant and storage areas as well as the comfort of staff.	Medium	Minor adverse	Not significant
	Relative humidity: Changes in annual average	Increase condensation, mould growth, mildew, staining and the corrosion and decay of metal surfaces.	Medium	Minor adverse	Not significant
	Relative humidity: Changes in annual average	Poor insulation performance.	Medium	Minor adverse	Not significant
Bulk Liquid Storage	Precipitation: Drought; Extreme precipitation events	Reduction in ground stability and hastening the deterioration of materials.	Low	Moderate adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Sea level rise				
	Precipitation: Extreme precipitation events Sea level rise	Mobilisation of pollutants potentially affecting building materials and consequently the structural integrity.	Low	Negligible	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Medium	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Low	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption to business continuity.	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice.	Medium	Minor adverse	Not significant
	Precipitation: Drought	Drying out and cracking of materials which has the potential to affect structural and foundation stability.	Medium	Moderate adverse	Significant
	Precipitation: Drought	Cracking of surfaces (during dry spells).	Medium	Minor adverse	Not significant
	Temperature: Change in annual average; Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Temperature: Change in annual average; Extreme temperature events	Overheating of infrastructure	Medium	Negligible	Not significant
	Temperature: Change in annual average; Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Low	Minor adverse	Not significant
	Temperature: Change in annual average; Extreme temperature events	Deterioration of material structure and fabric.	Medium	Minor adverse	Not significant
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Medium	Minor adverse	Not significant
	Wind: Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Low	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Low	Minor adverse	Not significant
	Relative humidity: Changes in annual average	Humidity affects both the performance of the plant and storage areas.	Medium	Minor adverse	Not significant
	Relative humidity: Changes in annual average	Increase condensation, mould growth, mildew,	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
		staining and the corrosion and decay of metal surfaces.			
	Relative humidity: Changes in annual average	Poor insulation performance.	Medium	Minor adverse	Not significant
Pipeline and cable connections (import and export)	Precipitation: Extreme precipitation events Sea level rise	Reduction in ground stability and hastening the deterioration of materials.	Medium	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Medium	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption to business continuity.	Low	Moderate adverse	Not significant
	Temperature: Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Medium	Minor adverse	Not significant
	Temperature: Extreme temperature events	Overheating of electronic equipment resulting in potential fire risks.	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Temperature: Extreme temperature events	Deterioration of material structure and fabric.	Low	Minor adverse	Not significant
	Temperature: Extreme temperature events	Potential melting and deformation of materials.	Low	Moderate adverse	Not significant
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Low	Moderate adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Low	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Relative humidity: Changes in annual average	Corrosion and decay of metal surfaces.	Low	Minor adverse	Not significant
	Relative humidity: Changes in annual average	Poor insulation performance.	Low	Minor adverse	Not significant
Flares	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Low	Minor adverse	Not significant
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice.	Medium	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Medium	Minor adverse	Not significant
	Temperature:	Faster deterioration of materials from UV	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Extreme temperature events	radiation (e.g., fading and brittleness).			
	Temperature: Extreme temperature events	Deterioration of material structure and fabric.	Low	Minor adverse	Not significant
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Medium	Moderate adverse	Significant
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Low	Minor adverse	Not significant
	Wind: Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Medium	Minor adverse	Not significant
	Relative humidity: Changes in annual average	Increase condensation, mould growth, mildew, staining and the corrosion and decay of metal surfaces.	Low	Minor adverse	Not significant
	Relative humidity: Changes in annual average	Poor insulation performance.	Medium	Minor adverse	Not significant
Hard landscaping (including pavement, parking, temporary and permanent laydown areas)	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Medium	Minor adverse	Not significant
	Precipitation: Drought	Cracking of surfaces (during dry spells).	Medium	Minor adverse	Not significant
	Temperature: Change in annual average; Extreme temperature events	Deterioration of material structure and fabric.	Medium	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Medium	Minor adverse	Not significant
Conveying Corridors	Precipitation: Extreme precipitation events	Flooding of all assets resulting in loss or disruption of function and associated risks.	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Sea level rise				
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Low	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption to business continuity.	Low	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Damage to above ground infrastructure due to snow and ice.	Low	Minor adverse	Not significant
	Temperature: Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
		events have the potential to exacerbate the occurrence of these faults.			
	Temperature: Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Low	Negligible	Not significant
	Temperature: Extreme temperature events	Expansion and contraction of tracks and conveying equipment corridor.	Medium	Minor adverse	Not significant
	Temperature: Extreme temperature events	Potential melting and deformation of materials.	Low	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Potential impact to stability of above-ground infrastructure.	Medium	Moderate adverse	Significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Wind: Gales and high winds; Storms and lightning	Damage from wind-driven rain infiltration into conveying equipment structures.	Medium	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Medium	Minor adverse	Not significant
Rail Terminal	Precipitation: Extreme precipitation events Sea level rise	Reduction in ground stability and hastening the deterioration of materials.	Medium	Minor adverse	Not significant
	Precipitation: Extreme precipitation events	Mobilisation of pollutants potentially affecting building materials and consequently the structural integrity.	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Low	Minor adverse	Not significant
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption to business continuity.	Low	Minor adverse	Not significant
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice.	Medium	Minor adverse	Not significant
	Precipitation: Drought	Drying out and cracking of materials which has the potential to affect structural and foundation stability.	Medium	Minor adverse	Not significant
	Precipitation: Drought	Cracking of surfaces (during dry spells).	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Medium	Minor adverse	Not significant
	Temperature: Change in annual average; Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Low	Negligible	Not significant
	Temperature: Change in annual average; Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Low	Negligible	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Temperature: Change in annual average; Extreme temperature events	Expansion and contraction of tracks resulting in alternative transport forms being required.	High	Minor adverse	Significant
	Temperature: Change in annual average; Extreme temperature events	Potential melting and deformation of materials.	Medium	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Medium	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
Drainage	Precipitation: Extreme precipitation events Sea level rise	Drainage infrastructure overwhelmed leading to surface water flooding.	Low	Moderate adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Windborne dust and debris clogging drainage systems and requiring clearing	Medium	Minor adverse	Not significant
Marine transport infrastructure	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Medium	Minor adverse	Not significant
	Precipitation: Extreme precipitation events	Mobilisation of pollutants potentially affecting building materials and consequently the structural integrity.	Low	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Low	Minor adverse	Not significant
	Precipitation: Drought	Drying out and cracking of materials which has the potential to affect structural and foundation stability.	Low	Moderate adverse	Not significant
	Precipitation: Drought	Low river flows, affecting marine infrastructure and has the potential to lead to subsidence.	Low	Moderate adverse	Not significant
	Temperature: Extreme temperature events	Deterioration of material structure and fabric.	Medium	Minor adverse	Not significant
	Temperature:	Faster deterioration of materials from UV	Medium	Minor adverse	Not significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Extreme temperature events	radiation (e.g., fading and brittleness).			
	Temperature: Extreme temperature events	Potential melting and deformation of materials.	Low	Minor adverse	Not significant
	Wind: Gales and high winds; Storms and lightning	Marine infrastructure may be unsafe to operate in high wind speeds.	Medium	Minor adverse	Not significant
Operational staff and maintenance staff	Precipitation: Extreme precipitation events Sea level rise	Safety risks to operational staff.	Medium	Minor adverse	Not significant
	Temperature: Extreme temperature events	Increase risk of fire and associated safety risks (for staff working in non-air conditioning work spaces).	Medium	Large adverse	Significant

Receptor	Climate variables	Potential impacts	Likelihood	Consequence	Significance
	Wind: Gales and high winds; Storms and lightning	Potential safety risk should structures become weakened.	Medium	Large adverse	Significant

12.9. ADDITIONAL DESIGN, MITIGATION AND ENHANCEMENT MEASURES

- 12.9.1. For the Proposed Scheme, additional mitigation should be considered to reduce the potential effects from risks related to climate change that are found to be 'significant' in **Table 12-13**.
- 12.9.2. This Section sets out potential additional mitigation and compensation measures which are relevant for climate resilience assessment. The design is ongoing and the measures that would be included in the Proposed Scheme will be confirmed and reported in the ES. These measures are relevant to the operation phase of the Proposed Scheme and include:
- Regard to projections of extreme temperature when specifying materials. Re-consider choice of materials when repair or replacement is necessary as part of planned maintenance processes.
 - Ensure the site is designed to take into account an increase in extreme wind and storm events; this should include ensuring emergency access routes to critical parts of the infrastructure even in the event of flooding.
 - The drainage design will be further developed in the ES and the climate change allowance will be confirmed.
 - Regular inspection of drainage infrastructure, materials and structures to identify any deterioration/clogging. Additional inspection of ground conditions and structures to ensure structural stability following extreme weather events (e.g., floods, heatwaves, drought, storm). Bring forward repair/replacement if necessary.
 - Ensure Health and Safety workplace protocols mitigate impacts associated with extreme weather events (storm events, heatwaves and fire risks).
 - Ensure processes in place to safely shut down the facility in case of prolonged period of extreme weather events (storm events and heatwaves).
 - Use of heat resistant materials on the external surfaces to prevent impact from increasing temperatures.
 - Monitoring of weather forecasts for extreme events allowing them to implement plans (as necessary) to minimise the risk to the Proposed Scheme and operational staff from heatwaves, extreme rainfall, high winds.

12.10. MONITORING

- 12.10.1. A list of extreme weather-related incidents (for example, road surface deformations, flooding, snow and ice etc.) would be maintained to assist in identifying thresholds which, when exceeded, require maintenance. Inspections should be carried out following an intense rainfall event or heatwave to monitor any damage and implement appropriate mitigation as necessary.
- 12.10.2. Monitor weather forecasts for extreme events and implement plans (as necessary) to minimise the risk to the Proposed Scheme from heatwaves, extreme rainfall and high winds.

- 12.10.3. Given the uncertainties inherent in climate science and projections, the impacts and effects identified would be monitored as part of best practice throughout operational phases of the Proposed Scheme. The monitoring would be undertaken to assess the appropriateness of the mitigation measures. The assessment should be revisited when new and/or updated information becomes available, for example when further updates to climate projections are published.
- 12.10.4. Regular inspection of drainage infrastructure, materials and structures to identify any deterioration. Additional inspection of earthworks and structures following extreme weather events (e.g., floods, heatwaves, drought, storm). Repairs and replacements will be brought forward if necessary.
- 12.10.5. In line with standard practice, maintenance schedule should be in operation such that the feedstock storage facility will allow the SAF Plant to build up suitable buffer capacity to maintain operations while the FPFs are shut down for maintenance, and vice versa.
- 12.10.6. Any additional monitoring requirement will be considered and reported as part of the ES.

12.11. RESIDUAL EFFECTS

- 12.11.1. This PEIR Chapter does not consider the full extent of climate risk mitigation measures as these measures are yet to be developed. The residual effects are, therefore, yet to be determined and will be complete as part of the ES. On the basis of the additional mitigation measures being implemented, it is anticipated that there will be no remaining significant effects. **Table 12-12** to **Table 12-14** presents an initial assessment as of this PEIR. Any embedded and additional mitigation measures subsequent to this preliminary assessment will be considered as part of the ES.

Table 12-14: Summary of Residual Effects for Climate Resilience

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
Operation Phase					
SAF Plant and components	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption of functioning of plant	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Drought	Drying out and cracking of materials which has the potential to affect structural and foundation stability.	Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Drought	Low river flows, affecting the water that is available for cooling.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Drought	Low river flows potentially leading to subsidence	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Overheating of infrastructure, leading to greater demand for cooling.	Not Significant	Additional climate risk mitigation measures will be developed as the	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				Proposed Scheme design is progressed.	
	Temperature: Extreme temperature events	Overheating of electronic equipment resulting in potential fire risks.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Increased temperature of cooling water and of river flows that are used for cooling, thereby reducing efficiency of this process.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
	Temperature: Extreme temperature events	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Potential melting and deformation of materials.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Security infrastructure and lighting may fail in heatwave conditions.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Temperature: Extreme temperature events	Increased pressure on thermal oxidiser.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Not significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Power loss.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Wind: Storms and lightning	Lightning strike can cause fire as well as power surges and shock waves which can destabilise energy systems, as well as cause damage to electronical equipment.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Relative humidity: Changes in annual average	Humidity affects both the performance of the plant and storage areas as well as the comfort of staff.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Relative humidity: Changes in annual average	Increase condensation, mould growth, mildew, staining and the corrosion and decay of metal surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
	Relative humidity: Changes in annual average	Poor insulation performance.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
Feedstock Storage & Pre-Processing Area	Precipitation: Extreme precipitation events	Mobilisation of pollutants potentially affecting building materials and consequently the structural integrity.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events	Power outages and disruption to functioning of machinery.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Temperature: Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Significant	Additional climate risk mitigation measures will be developed as the	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				Proposed Scheme design is progressed.	
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
	Wind: Gales and high winds; Storms and lightning	Power loss.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Storms and lightning	Lightning strike can cause fire as well as power surges and shock waves which can destabilise energy systems, as well as cause damage to electronical equipment.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Relative humidity: Changes in annual average	Humidity affects both the performance of the plant and storage	Not Significant	Additional climate risk mitigation measures will be developed as the	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
		areas as well as the comfort of staff.		Proposed Scheme design is progressed.	
	Relative humidity: Changes in annual average	Increase condensation, mould growth, mildew, staining and the corrosion and decay of metal surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Relative humidity: Changes in annual average	Poor insulation performance.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
Bulk Liquid Storage	Precipitation: Drought; Extreme precipitation events Sea level rise	Reduction in ground stability and hastening the deterioration of materials.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
	Precipitation: Extreme precipitation events Sea level rise	Mobilisation of pollutants potentially affecting building materials and consequently the structural integrity.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption to business continuity.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Drought	Drying out and cracking of materials which has the potential to affect structural and foundation stability.	Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Drought	Cracking of surfaces (during dry spells).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Change in annual average; Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Change in annual average;	Overheating of infrastructure.	Not Significant	Additional climate risk mitigation measures will be developed as the	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Extreme temperature events			Proposed Scheme design is progressed.	
	Temperature: Change in annual average; Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Change in annual average; Extreme temperature events	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Relative humidity: Changes in annual average	Humidity affects both the performance of the plant and storage areas.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Relative humidity: Changes in annual average	Increase condensation, mould growth, mildew, staining and the corrosion and decay of metal surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Relative humidity: Changes in annual average	Poor insulation performance.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
Pipeline and cable connections (import and export)	Precipitation: Extreme precipitation events Sea level rise	Reduction in ground stability and hastening the deterioration of materials.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption to business continuity.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Overheating of electronic equipment resulting in potential fire risks.	Not Significant	Additional climate risk mitigation measures will be developed as the	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				Proposed Scheme design is progressed.	
	Temperature: Extreme temperature events	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Potential melting and deformation of materials.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Not Significant	Additional climate risk mitigation measures will be developed as the	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				Proposed Scheme design is progressed.	
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Relative humidity: Changes in annual average	Corrosion and decay of metal surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
	Relative humidity: Changes in annual average	Poor insulation performance.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
Flares	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Wind: Gales and high winds	Potential impact to stability of above-ground infrastructure.	Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Material degradation.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Relative humidity: Changes in annual average	Increase condensation, mould growth, mildew, staining and the corrosion and decay of metal surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Relative humidity: Changes in annual average	Poor insulation performance.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
Hard landscaping (including pavement, parking, temporary and permanent laydown areas)	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Drought	Cracking of surfaces (during dry spells).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Temperature: Change in annual average; Extreme temperature events	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
Conveying Corridors	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption to business continuity.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Damage to above ground infrastructure due to snow and ice.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Temperature: Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Expansion and contraction of tracks and conveying equipment corridor.	Not Significant	Additional climate risk mitigation measures will be developed as the	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				Proposed Scheme design is progressed.	
	Temperature: Extreme temperature events	Potential melting and deformation of materials.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Potential impact to stability of above-ground infrastructure.	Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Damage from wind-driven rain infiltration into conveyor structure.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
Rail Terminal	Precipitation: Extreme precipitation events Sea level rise	Reduction in earthwork stability and hastening the deterioration of materials.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events	Mobilisation of pollutants potentially affecting building materials and consequently the structural integrity.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Power outages and disruption to business continuity.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Snow/ice	Damage to above ground infrastructure due to snow and ice.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Drought	Drying out and cracking of materials which has the potential to affect structural and foundation stability.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Drought	Cracking of surfaces (during dry spells).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Temperature: Change in annual average; Extreme temperature events	It is anticipated that over time faults in machinery and equipment may occur (due to design life of equipment), extreme temperature events have the potential to exacerbate the occurrence of these faults.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Change in annual average; Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Change in annual average;	Expansion and contraction of tracks. Resulting in alternative transport	Significant	Additional climate risk mitigation measures will be developed as the	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Extreme temperature events	forms being required.		Proposed Scheme design is progressed.	
	Temperature: Change in annual average; Extreme temperature events	Potential melting and deformation of materials.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Damage from wind-driven rain infiltration into building materials and surfaces.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Increased operational disruption.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
				design is progressed.	
Drainage	Precipitation: Extreme precipitation events Sea level rise	Drainage infrastructure overwhelmed leading to surface water flooding.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Windborne dust and debris clogging drainage systems and requiring clearing	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
Marine transport infrastructure	Precipitation: Extreme precipitation events Sea level rise	Flooding of all assets resulting in loss or disruption of function and associated risks.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Extreme precipitation events	Mobilisation of pollutants potentially affecting building materials and consequently the structural integrity.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Extreme precipitation events Sea level rise	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Precipitation: Drought	Drying out and cracking of materials which has the potential to affect structural and foundation stability.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Precipitation: Drought	Low river flows, affecting marine infrastructure and has the potential to lead to subsidence.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Deterioration of material structure and fabric.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Temperature: Extreme temperature events	Faster deterioration of materials from UV radiation (e.g., fading and brittleness).	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Temperature: Extreme temperature events	Potential melting and deformation of materials.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Marine infrastructure may be unsafe to operate in high wind speeds.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
Operational staff and maintenance staff	Precipitation: Extreme precipitation events Sea level rise	Safety risks to operational staff.	Not Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

Receptor	Climate variables	Potential impacts	Significance (with embedded mitigation)	Additional mitigation and enhancement measures	Residual effect
	Temperature: Extreme temperature events	Increase risk of fire and associated safety risks (for staff working in non-air conditioning workspaces).	Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.
	Wind: Gales and high winds; Storms and lightning	Potential safety risk should structure become weakened.	Significant	Additional climate risk mitigation measures will be developed as the Proposed Scheme design is progressed.	The assessment of residual effects will be completed as part of the ES.

12.12. NEXT STEPS

12.12.1. Embedded design mitigation measures will be confirmed through discussion with the design team at the ES stage and will be used to inform and update the assessment of significant effects. In the event of any significant effects being identified, further secondary mitigation and enhancement measures will be detailed in order to reduce any outstanding significant effects. This will be done in consultation with the design team.

12.13. LIMITATIONS AND ASSUMPTIONS

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

- The in-combination climate impacts will be assessed at ES stage by each individual topic discipline with support from climate risk specialists.
- The UKCP18 projections have been used to infer future changes in a range of climate variables that may affect the vulnerability of the Proposed Scheme to climate change. At the time of writing, these represent the most up-to-date representation of future climate in the UK. The CRI has been developed using UKCP18 projections.
- There are inherited limitations and uncertainties within the CRI data. Further information on the methodology used to produce this data can be found in Changing climate risk in the UK: a multi-sectoral analysis using policy-relevant indicators²⁵.
- There are inherent uncertainties associated with climate projections and they are not predictions of the future. It is possible that future climate will differ from the future baseline climate against which the resilience of the Proposed Scheme has been assessed, depending on global emissions over the next century. A 'high' emissions scenario (RCP 8.5) using the 2080s time slice (2070-2099) has been used to develop the baseline against which resilience has been assessed, this incorporates the three year construction period and the 50 year design life.
- Any further research, analysis or decision-making should take account of the accuracies and uncertainties associated with climate projections. It is also important to note that the analysis is based on selected observational data, the results of climate model ensembles and a selected range of existing climate change research and literature available at the time of assessment. Any future decision-making based on this analysis should consider the range of literature, evidence and research available at that time and any changes to this.
- The embedded mitigation measures discussed are based on the design at this stage and will be updated at the ES stage.

12.14. REFERENCES

- ¹ Department for Energy Security & Net Zero. (2023). 'Overarching National Policy Statement for Energy (EN-1)'. Available at: <https://assets.publishing.service.gov.uk/media/65a7864e96a5ec0013731a93/overarching-nps-for-energy-en1.pdf>
- ² Department for Environment, Food and Rural Affairs. (2021). 'Climate Change Adaptation: Policy Information'. Available at: <https://www.gov.uk/government/publications/climate-change-adaptation-policy-information/climate-change-adaptation-policy-information>
- ³ Ministry of Housing Communities & Local Government (2023) National Planning Policy Framework. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1182995/NPPF_Sept_23.pdf
- ⁴ Department for Environment, Food and Rural Affairs. (2018). 'Climate Change: second national adaptation programme (2018 to 2023)'. Available at: <https://www.gov.uk/government/publications/climate-change-second-national-adaptation-programme-2018-to-2023>
- ⁵ Stockton-on-Tees Borough Council. (2019). 'Local Plan'. Available at: <https://www.stockton.gov.uk/local-plan>
- ⁶ Stockton-on-Tees Borough Council (2016-2021). 'Climate Change Strategy for Stockton-on-Tees 2016-2021'. 1 Available at: <https://cape.mysociety.org/media/data/plans/stockton-on-tees-borough-council-aee34a7.pdf>
- ⁷ Redcar & Cleveland Borough Council. (2018). 'Redcar & Cleveland Borough Council Local Plan, adopted May 2018'. Available at: <https://www.redcar-cleveland.gov.uk/sites/default/files/2022-04/Local%20Plan%20Adopted%20May%202018.pdf>
- ⁸ UK Climate Impacts Programme, Sustaine, Royal Haskoning. (2008). 'North East England Climate Change Adaptation Study'. Available at: https://www.hartlepool.gov.uk/download/downloads/id/3017/hlp05_6_climate_change_adaptation_study_2008pdf.pdf
- ⁹ UK Government. (2008). 'Climate Change Act'. Available at: <https://www.legislation.gov.uk/ukpga/2008/27/contents>
- ¹⁰ Department for Levelling Up, Housing & Communities and Ministry of Housing, Communities & Local Government. (2019). 'National Planning Practice Guidance (NPPG): Climate Change'. Available at: <https://www.gov.uk/guidance/climate-change>
- ¹¹ IEMA. (2020). 'EIA Guide to: Climate Change Resilience and Adaptation'. Available at: <https://www.iema.net/resources/reading-room/2020/06/26/iema-eia-guide-to-climate-change-resilience-and-adaptation-2020>
- ¹² ISO. (2021). 'ISO 14091:2021 Adaptation to climate change — Guidelines on vulnerability, impacts and risk assessment'. Available at: <https://www.iso.org/standard/68508.html>
- ¹³ Chemical Industries Association. (2021). 'Safeguarding chemical businesses in a changing climate'. Available at: <https://www.cia.org.uk/Portals/0/Safeguarding%20chemical%20businesses%20in%20a%20changing%20climate%20-%20How%20to%20prepare%20a%20Climate%20Change%20Adaptation%20Plan.pdf>
- ¹⁴ Redcar and Cleveland Borough Council - Climate Change Strategy 2021-2030 (online) Available at: <https://greenerfuture.redcar-cleveland.gov.uk/wp-content/uploads/2022/09/CLIMATE-CHANGE-STRATEGY-RCBC.pdf>

- ¹⁵ Redcar and Cleveland Borough Council - Climate Change Action Plan 2021-2025 (online) Available at: <https://greenerfuture.redcar-cleveland.gov.uk/wp-content/uploads/2022/09/CLIMATE-CHANGE-ACTION-PLAN-RCBC.pdf>
- ¹⁶ The Planning Inspectorate. (2023). 'Scoping Opinion: Lighthouse Green Fuels Project'. Available at: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010150/EN010150-000012-EN010150%20-%20Lighthouse%20Green%20Fuels%20-%20Scoping%20Opinion.pdf>
- ¹⁷ Met Office. (n.d.) 'UK Climate Averages [Online]'. Available at: <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages>
- ¹⁸ Kendon, M., McCarthy, M., Jevrejeva, S., Matthews, A., Sparks, T., Garforth, J. and Kennedy, J. (2023). 'State of the UK Climate 2022', International Journal of Climatology [Online] Available at: <https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/joc.8167#:~:text=2022%20was%20the%20warmest%20year,records%20by%20a%20large%20margin>
- ¹⁹ UKCP User Interface. (n.d.) *UKCP UI Products* [Online] Available at: <https://ukclimateprojections-ui.metoffice.gov.uk/products>
- ²⁰ Nigel Arnell et. al. (2021). 'The Climate Risk Indicators'. Available at: <https://uk-cri.org/>
- ²¹ European Commission. (2016). 'Directorate-General for Climate Action, Climate change and major projects – Outline of the climate change related requirements and guidance for major projects in the 2014-2020 programming period – Ensuring resilience to the adverse impacts of climate change and reducing the emission of greenhouse gases, Publications Office'. Available at: <https://data.europa.eu/doi/10.2834/7004>
- ²² Environmental Agency. (2019). 'Flood risk summary'. Available at: <https://www.gov.uk/check-long-term-flood-risk>
- ²³ Stockton-on-Tees Borough Council. (2016). 'Stockton-on-Tees Local Flood Risk Management Strategy'. Available at: https://www.stockton.gov.uk/media/2981/Local-flood-risk-management-strategy/pdf/Local_flood_risk_management_strategy.pdf?m=637813986536300000
- ²⁴ Met Office. (2018). 'Snow and low temperatures February to March 2018'. Available at: [snow-and-low-temperatures-february-to-march-2018---met-office.pdf \(metoffice.gov.uk\)](https://www.metoffice.gov.uk/news/2018/02/snow-and-low-temperatures-february-to-march-2018---met-office.pdf)
- ²⁵ The Independent. (2018). 'Storm Emma as it happened'. Available at: https://www.independent.co.uk/news/uk/home-news/uk-weather-live-updates-storm-emma-snow-ice-forecast-flights-airports-roads-traffic-freezing-met-office-a8236006.html?page=3&jw_start=%7Bseek%20to%20second%20number%7D
- ²⁶ Teeside Live. (2022). 'Storm Eunice LIVE'. Available at: <https://www.gazettelive.co.uk/news/teeside-news/live-storm-eunice-weather-traffic-23138174>
- ²⁷ Met Office. (2022). 'Storms Dudley, Eunice and Franklin'. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2022/2022_01_storms_dudley_eunice_franklin_r1.pdf
- ²⁸ Met Office. (2022). 'Unprecedented extreme heatwave, July 2022'. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2022/2022_03_july_heatwave.pdf



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