15 Climate Change

15.1 Introduction

15.1.1 This chapter of the Environmental Statement provides the context, baseline data, methodology and approach, assessment results and mitigation measures. The climate change topic consists of two parts:

- effects on climate – this considers the impacts of greenhouse gas (GHG) emissions from the scheme; and
- vulnerability of the scheme to climate change – the Climate Change Resilience (CCR) assessment considers the resilience of the project in the context of projected future changes in climate variables.

15.1.2 The combined effects of the scheme and potential changes in climate variables on the receiving environment during construction and operation are considered in each topic in the relevant chapter of the ES. A more comprehensive consideration of the 'in-combination climate impacts' (ICCI) is provided in Appendix 15C: ICCI Table.

15.1.3 Climate change projections are imbedded into the future baseline of the technical assessments. Current and future climate baselines will be outlined from paragraph 15.6.9 for key climate parameters, including winter and summer temperature and precipitation, using UK Climate Projections 2018 (UKCP18).

15.1.4 Climate change is considered in both the assessment of scheme effects and the design of mitigation and enhancement measures. This consideration is mostly qualitative, based on the future climate trends set out from paragraph 15.6.14 to 15.6.18.

15.2 Review of proposed development

15.2.1 The proposed development comprises of a rail testing, maintenance, research development and storage facility, known as the Global Centre of Rail Excellence (GCRE) and the site of the Onllwyn Washery and Nant Helen Open Cast mine. The development proposals for GCRE are described in Chapter 3 of the ES.

15.2.2 GCRE will result in GHG emissions during both construction and operation. During construction, the main sources of emissions will be the embodied emissions in materials and construction activities on site. The operation of buildings, testing facilities and supporting infrastructure will also result in emissions predominately due to energy consumption.

15.2.3 The resilience of the GCRE facilities to future changes in climate variables and subsequent impacts are also considered in this chapter.

15.3 Legislation, policy context and guidance

International legislation

Paris Agreement

15.3.1 Adopted in 2015 and entered into force in November 2016, the Paris Agreement is an international climate agreement aiming to limit global temperature increase this century to less than 2 degrees Celsius above pre-industrial levels.

15.3.2 It additionally establishes a goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change.

EIA Directive 2014/52/EU

15.3.3 The Directive 2014/52/EU states that EIAs shall identify, describe and assess the direct and indirect significant effects of climate change relevant to the project. The regulations implementing this directive were transposed into UK legislation in May 2017.

National legislation

Climate Change Act 2008

15.3.4 The Climate Change Act 2008 committed the UK to its first statutory carbon reduction target to reduce carbon emissions by at least 80% from 1990 levels by 2050. The Climate Change Act 2008 (2050 Target Amendment) Order 2019 amended the Climate Change Act 2008 by introducing a target for at least a 100% reduction of GHG emissions (relative to 1990 levels) in the UK by 2050, following advice from the Committee on Climate Change. The 100% reduction is often referred to as ‘net zero’ GHG emissions.

15.3.5 The Climate Change Act requires that that five-yearly carbon budgets are set and not exceeded to ensure that regular progress is made towards the target. The first three carbon budgets were set in 2009, with the fourth and fifth following in 2011 and 2016 respectively.

15.3.6 The carbon budgets, as set out in the Carbon Budgets Order 2009, the Carbon Budget Order 2011 and the Carbon Budget Order 2016, are based on an 80% reduction as legislated by the Climate Change Act 2008. At the time of undertaking this assessment, they have not been updated to reflect the target for 100% reduction in emissions set out in the Climate Change Act 2008 (2050 Target Amendment) Order 2019. The Committee on Climate Change report that to meet future carbon budgets and the 100% reduction target for 2050 it will require the government to apply more challenging measures.

15.3.7 The Climate Change Act also established a requirement for government to undertake a climate change risk assessment (CCRA) every five-year period and develop a programme for adaptation action in response to the risks identified. The UK Government's second UK CCRA was published in 2017. It establishes six priority risk areas for action over the following five years: flooding and coastal change; health and well-being from high temperatures; water shortages; natural capital; food production and trade; and pests and diseases and invasive non-native species. It is based on the independent evidence report published by the Committee on Climate Change.

15.3.8 The CCRA identifies significant risks to national infrastructure, including transport networks, from embankment and bridge failure, river, surface/ groundwater and coastal flooding, erosion, and increases in the frequency and severity of extreme weather such as high winds, high temperatures, lightening, storms and high waves. It highlights the need for infrastructure to be located, planned and designed and maintained to be resilient to climate change, including severe weather events. It also recognises that more action is needed to encourage information sharing between infrastructure operators to improve overall risk management. Mitigation and enhancement in terms of GCRE's climate resilience is discussed from paragraph 15.6.21 where the identification and implementation of any adaption measures is considered.

Well-being of Future Generations (Wales) Act 2015

15.3.9 The Well-being of Future Generations (Wales) Act 2015 requires public bodies to carry out sustainable development which is the process of improving the economic, social, environmental and cultural well-being of Wales by taking action aimed at achieving the well-being goals.

15.3.10 The Act establishes seven well-being goals, which specifically reference acting on climate change. As such, the Act requires all public bodies to embed climate change into their decision-making.

Environment (Wales) Act 2016

15.3.11 The Environment (Wales) Act 2016 requires Welsh Ministers to meet greenhouse gas reduction targets for Wales and establishes a 2050 emission target of 80% reduction in net emissions from the baseline year (1990 or 1995 depending on the specific greenhouse gas). Progress to this target is supported by interim emissions targets set out for every 10 years until 2050 and carbon budgets established for five-yearly periods. In June 2019, Welsh Government committed to adopting the Committee on Climate Change's recommendation to change the emissions reduction target to 95% by 2050, with an ambition to reach net zero emissions by 2050. Regulations to amend

the existing 2050 target and related carbon budgets will be brought to Welsh Assembly in 2021.

Prosperity for all: A Low Carbon Wales

15.3.12 Prosperity for all: A low carbon Wales was published in March 2019. It sets out how Wales aims to meet the first carbon budget (2016-2020) and consequently the 2020 interim target through 100 polices and proposals across Ministerial Portfolios.

Prosperity for all: A Climate Conscious Wales

15.3.13 Prosperity for all: A Climate Conscious Wales (2019) to influence partners in Wales to take action. The document aims to raise awareness of climate adaptation and offers knowledge and best practice to improve climate resilience.

Local policy

Neath Port Talbot County Borough Council Local Development Plan (2011-2026)

15.3.14 The Local Development Plan (LDP) includes a policy and a strategic objective relating to sustainable development. Of particular relevance is overarching objective OB1 of the plan which states: *"Minimise the causes and consequences of climate change through reduced greenhouse gas emissions and adapt to climate change through consideration of its effects in the design and location of new development."*

15.3.15 Strategic Policy SP1 also focuses on climate change stating the measures that will be implemented to address climate change causes and consequences. The policy sets out measures to be implemented with a focus on reducing impacts associated with transport. Measures are also set out to address risk of flooding and minimise habitat fragmentation.

Powys County Council Local Development Plan (2011-2026)

15.3.16 The Local Development Plan (LDP) for Powys contains objectives relating to climate change and flooding.

15.3.17 Of particular relevance, LDP Objective 4 states: *"To support the transition to a low carbon and low waste Powys through all development, including the reduction of waste to landfill and by directing development away from high risk flood areas and, where possible, to reduce or better manage existing flood risk for communities, infrastructure and business."*

Neath Port Talbot We Want (Well-being Plan 2018 – 2023)

15.3.18 The Neath Port Talbot Well-being Plan was released in March 2018 as required under the Well-being of Future Generations (Wales) Act.

15.3.19 The plan identifies the opportunity for environmental and community resilience including adaptation and improving resilience to future climate change.

Towards 2040 – the Powys Well-being Plan

15.3.20 The Powys Well-being Plan was released in May 2018, as required under the Well-being of Future Generations (Wales) Act.

15.3.21 The plan contains well-being steps that seek to achieve the well-being goals. The steps relevant to climate change include Step 7 and Step 8.

15.3.22 Step 7: Develop a carbon positive energy strategy that maximises green energy production. Powys has an abundance of potential energy resources and will be a centre for environmental research, sustainable and green technologies and renewable energies. Powys will export renewable energy through investment and development of locally owned solar panels, hydro and other schemes. Powys will have charging infrastructure to support electric cars and vehicles.

15.3.23 Step 8: Develop a sustainable environment strategy. Powys has a sustainable and resilient environment that will help mitigate climate change.

Neath Port Talbot Council Decarbonisation and Renewable Energy Strategy (2020)

15.3.24 The Neath Port Talbot Council Decarbonisation and Renewable Energy Strategy outlines the Council's overarching vision and objectives to reduce carbon emissions. It sets out what the Council has already achieved and identifies the potential opportunities that exist. The document is an integral part of the Council's overall sustainability drive and the associated action plan framework will assist the Council in meeting its carbon footprint reduction aspirations.

Neath Port Talbot Environment Strategy (2008-2026)

15.3.25 This is Neath Port Talbot County Borough Council's first Environment Strategy. The purpose of the Environment Strategy is to "*provide the framework within which to achieve an environment that is clean, healthy and thriving, has improving economic prosperity and is valued by the residents, businesses and visitors of the County Borough*".

15.4 Scoping and consultation

Scoping

15.4.1 This chapter has been scoped to include two parts:

- effects on climate – this considers the impacts of GHG emissions from the scheme through the GHG assessment; and
- vulnerability of the scheme to climate change – this considers the resilience of the project in the context of projected future changes in climate variables through the CCR assessment.

15.4.2 There was one response relating to climate change, involving the installation of renewable energy generation to mitigate the effects of climate change - see Table 15.1 below.

Table 15.1 Response to scoping opinion

Scoping opinion clause	Response
Renewable energy developments have significant Landscape and Visual impacts and would therefore require a Landscape and Visual assessment. It was advised that consideration of natural mitigation of climate change, such as soil treatment, woodland planting and creation of wetlands should be included.	The Scoping Report, at para 15.6, refers to installing renewable energy generation to mitigate the effects of climate change. Such development should be included in the description of development, the nature of the development clarified and if it involves stand-alone features, these should be properly assessed as part of the LVIA.

Consultation

15.4.3 Internal meetings with the design team and EIA specialists have discussed the impacts of the proposed development on climate change and proposed mitigation measures against increasing GHG emissions. For the GHG assessment, liaison with transport and air quality specialists within Arup was undertaken to ensure consistency of approach between topics. For the CCR assessment, liaison with the drainage design specialist team was undertaken to understand risks and mitigation measures associated with flooding. Consultation with other EIA topic leads has been undertaken to ensure that the baseline for all topics considers future changes in climate variables.

15.5 GHG emissions assessment

Methodology

15.5.1 The GHG emissions are quantified using the principal steps outlined in Publicly Available Specification 2080:2016 Carbon Management in Infrastructure (PAS 2080), as shown in Figure 15.1 Principal steps of GHG emissions quantification.

Figure 15.1 Principal steps of GHG emissions quantification[1]

15.5.2 In order to adequately capture direct and indirect emissions associated with the proposed development, a lifecycle approach is adopted. Lifecycle phases are outlined in Figure 15.2 below. The GHG emissions assessment scope includes the before use stages (A) and the use stages (B). In order to maintain consistency with other chapters in the EIA the before use stages will be referred to as the construction phase, with use stages being referred to as the operational phase. GHG emissions from decommissioning are not assessed as part of this assessment as decommissioning has been scoped out of the assessment as established during Scoping.

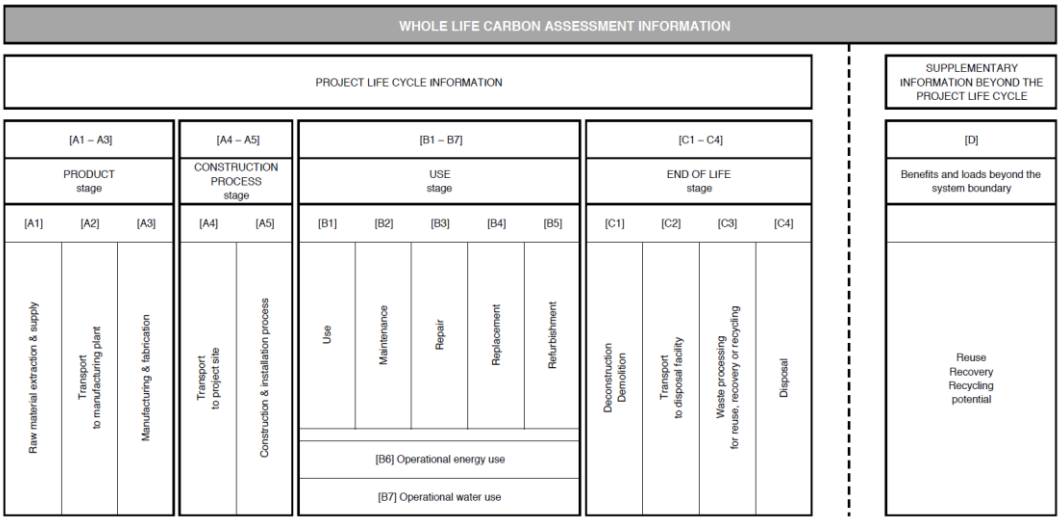

Figure 15.2 Lifecycle stages for a whole life carbon assessment as per EN 15978[2]

15.5.3 GHG emissions arising from the Project are quantified through the conversion of 'activity data' (such as material quantities, energy consumption and transport kilometres travelled) into GHG emissions using a series of emission factors.

15.5.4 As this is an outline planning application, there are some instances where the 'activity data' are derived from benchmarks to approximately calculate GHG emissions of the proposed development.

[1] Construction Leadership Council & the Green Construction Board (2016) PAS 2080:2016 Carbon management in infrastructure. BSI Limited, London, UK.https://shop.bsigroup.com/forms/PASs/PAS-2080/ [Accessed July 2020]
[2] RICS (2017) Whole life carbon assessment for the built environment 1st edition http://www.rics.org/Global/Whole_life_carbon_assessment_for_the_BE_PGguidance_2017.pdf [Accessed June 2020]

15.5.5 These emissions factors and benchmarks, their data sources and assessment methodology for each aspect of the development included in the GHG emissions assessment are summarised in Table 15.2.

15.5.6 The GHG emissions assessment was undertaken on the basis of the information available at the time of assessment. Where assumptions have been made, they have been selected to present the expected average (where the appropriate information is available) to worst-case scenario for the particular item/factor. Within Table 15.2, instances are explicitly mentioned where a worst-case scenario is adopted.

Table 15.2 Methodology for estimating emissions sources included in the GHG emissions assessment

	Assessment methodology	Data sources
Stage A – Construction		
Rail testing infrastructure	Embodied emissions within rail testing infrastructure have been calculated using the RSSB Rail Carbon tool, based on design take-off quantities, using emissions factors from the ICE databases (version 1.6a, 2.0 and 3.0).	RSSB Rail Carbon tool Available at: https://www.railindustrycarbon.com/Account/LogOn?ReturnUrl=%2f University of Bath: Sustainable Energy Research Team (2019) Inventory of Carbon and Energy V1.6a, V2.0[3] & V3.0 (ICE) Available at: https://circularecology.com/embodied-carbon-footprint-database.html
Buildings	Embodied emissions of building materials have been calculated based on the estimated floor area of each building, using benchmarks for typical buildings of each type.	RICS (2012) Methodology to calculate embodied carbon of materials Available at: https://www.igbc.ie/wp-content/uploads/2015/02/RICS-Methodology_embodied_carbon_materials_final-1st-edition.pdf
Public realm	Public realm (access roads, lighting, ancillary civil works) emissions have been calculated using conversion factors from the ICE databases (version 2.0 and 3.0).	University of Bath: Sustainable Energy Research Team (2019) Inventory of Carbon and Energy V2.0[3] & V3.0 (ICE) Available at: https://circularecology.com/embodied-carbon-footprint-database.html
Plant	Energy requirement of plant machinery has been established from BSI standards.	BSI British Standards BS 5228-1:2009 Available at:

[3] Version 2.0, and to a lesser extent Version 1.6a, of the ICE databases are used in addition to Version 3.0 because they contain useful emissions factors, not present in Version 3.0 – such as that for reinforced concrete, rammed soil and general UK steel. These emissions factors are integrated within RSSB Rail Carbon tool packages.

	Assessment methodology	Data sources
	Emissions have been calculated using the BEIS (2020) conversion factors for UK generated electricity.	https://shop.bsigroup.com/ProductDetail?pid=000000000030258086 BEIS (2020) UK Government GHG Conversion Factors for Company Reporting Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020
Transport	Emissions from transport have been calculated using the BEIS (2020) Conversion Factors.	BEIS (2020) UK Government GHG Conversion Factors for Company Reporting Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020
Stage B – Operation		
Buildings – operation	The emissions from operation over the life of the buildings have been estimated based on the ratio of embodied emissions in the phases 'to practical completion' and 'operational', applied to the benchmarks for calculating embodied emissions of building materials (as described above). Using this method, a benchmark that defined the emissions during the operation phase was developed and applied to each building type.	RICS (2017) Whole life carbon assessment for the built environment Available at: https://www.rics.org/globalassets/rics-website/media/news/whole-life-carbon-assessment-for-the--built-environment-november-2017.pdf
Buildings – maintenance and refurbishment	The embodied emissions from maintenance and refurbishment over the life of the buildings have been estimated based on the ratio of embodied emissions in the phases 'to practical completion' and 'in use', applied to the benchmarks for calculating embodied emissions of building materials (as described above).	RICS (2017) Whole life carbon assessment for the built environment Available at: https://www.rics.org/globalassets/rics-website/media/news/whole-life-carbon-assessment-for-the--built-environment-november-2017.pdf

	Assessment methodology	Data sources
	Using this method, a benchmark that defined the embodied emissions during the operation phase was developed and applied to each building type.	
Access and ancillary civils	Energy requirements for lighting have been estimated for access roads on a linear basis and that for walkways and parking areas on an area basis, using benchmarks developed based on Arup's professional experience. Emissions calculated over the 60-year design life using projected emissions intensity of the electricity grid. An allowance for maintenance and refurbishment has been included based on asset life expectancies.	Arup professional experience BEIS (2019) Green Book supplementary guidance: Table 1 Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
Transport emissions	Emissions from transport have been calculated using the BEIS (2019) Conversion Factors. Diesel-powered vehicle emissions are calculated over the 60-year design life using projected emissions intensity of diesel fuel.	BEIS (2019) Green Book supplementary guidance: Table 1 Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
Rolling Stock and Infrastructure Testing	The energy requirements of Rolling Stock and Infrastructure Testing has been estimated based on data published by the Office of Rail and Road (ORR) and Rail Industry Decarbonisation Taskforce. Hydrogen powered vehicle emissions are zero over the 60-year design life. Electric and diesel-powered vehicle emissions are calculated over the 60-year design life using projected emissions intensity of the electricity grid and diesel fuel, respectively. An allowance for maintenance and refurbishment has been included based on asset life expectancies.	ORR data portal Available at: https://dataportal.orr.gov.uk/ Rail Industry Decarbonisation Taskforce (2019) Final Report to the Minster for Rail Available at: https://www.rssb.co.uk/en/Research-and-Technology/Sustainability/Decarbonisation/Decarbonisation-our-final-report-to-the-Rail-Minister BEIS (2019) Green Book supplementary guidance: Table 1 Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

	Assessment methodology	Data sources
Habitat emissions	These activities are not expected to make a material contribution to the lifetime GHG emissions of the development, therefore have been excluded from the assessment.	

Significance Criteria

15.5.7 The Institute of Environmental Management and Assessment (IEMA) guide to assessing GHG emissions and evaluating their significance[4] publishes the over-arching principle:

"The GHG emissions from all projects will contribute to climate change; the largest inter-related cumulative environmental effects…as such any GHG emissions or reductions from a project might be considered to be significant…"

15.5.8 In accordance with this guidance, any carbon emissions associated with the proposed development can be deemed significant. Accordingly, initiatives to mitigate emissions are recommended from paragraph 15.5.21.

Limitations and assumptions

15.5.9 The limitations of the GHG emissions assessment are as follows:

- The GHG assessment uses benchmarks to create an approximate carbon output for development types based on aggregated data from published sources, rather than site or product-specific emissions profiles.
- Bulk infrastructure has also been excluded, which includes water pipes, energy grid connection and communication lines as this information is currently unavailable at this stage in design.

15.5.10 Assumptions made in the GHG emissions assessment are included in Table 15.3.

Table 15.3 GHG emissions assessment assumptions

Emissions source	Assumptions
Construction	
Rail testing infrastructure	Where specific material quantities have not been provided for certain assets, RSSB Rail Carbon tool packages have been applied and are based on structures built for real-world projects. Packages used during the assessment include that for Overhead Line Electrification (package multiplied by number of structures required), drainage (assumed along entire length of track) and acoustic barriers (based on length of acoustic barriers in design drawings). Duel-loop track assumed over single-loop track for rolling stock testing as a worst-case scenario for emissions.
Buildings	The building areas have been based on design drawings where available and otherwise the areas of similar buildings from previous Arup projects. Buildings have been assigned to a typology which represents most closely the use type of the building.

[4] IEMA (2017) Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance

<table>
<tr><th>Emissions source</th><th>Assumptions</th></tr>
<tr><td></td><td>The benchmarks for embodied carbon in buildings are based on collated life cycle assessment data for the production stage emissions (refer to Figure 15.2). As the production of materials are typically the largest proportion of before use stage emissions for buildings, these have been taken to be the entire construction phase emissions.
Further detail of the benchmarks used to calculate the emissions and the emissions breakdown per asset are included in Appendix 15A: GHG Assessment.</td></tr>
<tr><td>Access and ancillary civils</td><td>The car parks and walkways (ancillary civils) are assumed to be constructed as per the elements detailed below:
<table>
<tr><td>Type</td><td>Element for the ICE database</td></tr>
<tr><td>Carpark</td><td>Asphalt, 5% binder (150mm)</td></tr>
<tr><td>Walkways</td><td>Concrete - General (100mm)</td></tr>
<tr><td>Access roads</td><td>Asphalt, 5% binder (200mm) with typical aggregate subbase (320mm)</td></tr>
</table>
Ancillary civil works are assumed to occupy 10% of the main hardstanding areas. For example, car parks occupy 10% of the area of access roads and walkways occupy 10% of the area of buildings.</td></tr>
<tr><td>Plant</td><td>Plant working hours are assumed to be 85 hours per week. Construction duration estimates for plant machinery is recorded in Chapter 3.</td></tr>
<tr><td>Transport</td><td>Assumptions on workforce numbers and distance travelled during construction based on that stated in Chapter 12: Socio Economics and the Transport Assessment. Construction period is assumed to be 4.5 years, with multiple construction activities able to be undertaken simultaneously. It is assumed that each construction worker drives to Site in a small diesel-engine van with two people per vehicle.
Mode of transport of material to site based on Traffic Flows as set out in the Transport Assessment. A project assumption is that materials will be sourced as locally as possible.</td></tr>
<tr><td colspan="2">Operation</td></tr>
<tr><td>Buildings</td><td>Operational energy consumption benchmarks for buildings have been derived from typical breakdowns of whole life carbon emissions for different building types proposed in the RICS (2017) document.
The ratios for embodied emissions from the phases ‘to practical completion’ and ‘in operation’ are as summarised below:
<table>
<tr><th>Building type</th><th>Carbon emissions to practical completion</th><th>Carbon emissions in operation</th><th>Ratio</th></tr>
<tr><td>Office</td><td>35%</td><td>33%</td><td>94%</td></tr>
<tr><td>Warehouse</td><td>47%</td><td>24%</td><td>51%</td></tr>
<tr><td>Residential[5]</td><td>51%</td><td>31%</td><td>61%</td></tr>
</table></td></tr>
<tr><td>Access and ancillary civils</td><td>Lighting is operated for an average of 12 hours per night, 365 days per year. These are considered the worst-case scenario and could be improved by light reduction design measures.</td></tr>
<tr><td>Transport emissions</td><td>Assumptions on workforce numbers and distance travelled during operation based on that stated in the OBC and the accompanying Transport Assessment. It is assumed that local traffic is not affected by the operation of GCRE and transport emissions are associated only with full-time employees commuting</td></tr>
</table>

[5] Residential benchmark included for staff accommodation building

<table>
<tr><th>Emissions source</th><th>Assumptions</th></tr>
<tr><td></td><td>to and from the Site. Each employee drives to Site in a small diesel-engine van with one person per vehicle. Workers travelling to and from Site as a result of indirect employment are excluded from the assessment. Employee shifts are assumed to be 12 hours.</td></tr>
<tr><td>Rolling Stock Testing</td><td>Rolling Stock Testing is operational 24 hours per day for 252 days of the year. Trains are 70% electric-powered, 20% hydrogen-powered and 10% diesel-powered for the first 5 years. Thereafter, trains are 75% electric and 25% hydrogen-powered. Average speed of the trains is assumed to be 70 mph.
Hydrogen powered vehicle emissions are assumed to be zero over the 60-year design life. In this scenario fuel is ‘green’ hydrogen produced from 100% renewable electricity. It is also assumed that hydrogen fuel would be zero carbon at the point of use.
Lighting for sidings is operated for an average of 12 hours per night, 365 days per year. These are considered the worst-case scenario and could be improved by light reduction design measures.</td></tr>
<tr><td>Infrastructure Testing</td><td>Infrastructure Testing is operational 24 hours per day for 105 days of the year. Trains are 100% electric powered for the duration of the 60-year appraisal period. Average speed of the trains is assumed to be 40 mph.
Lighting for sidings is operated for an average of 12 hours per night, 365 days per year. These are considered the worst-case scenario and could be improved by light reduction design measures.</td></tr>
<tr><td colspan="2">Maintenance and refurbishment</td></tr>
<tr><td>Buildings</td><td>In-use energy consumption benchmarks for buildings have been derived from typical breakdowns of whole life carbon emissions for different building types proposed in the RICS (2017) document.
The ratios for embodied emissions from the phases ‘to practical completion’ and ‘in use’ are as summarised below:
<table>
<tr><th>Building type</th><th>Carbon emissions to practical completion</th><th>Carbon emissions in use</th><th>Ratio</th></tr>
<tr><td>Office</td><td>35%</td><td>32%</td><td>91%</td></tr>
<tr><td>Warehouse</td><td>47%</td><td>29%</td><td>62%</td></tr>
<tr><td>Residential[5]</td><td>51%</td><td>18%</td><td>35%</td></tr>
</table>
</td></tr>
</table>

Future baseline environment

15.5.11 The future baseline considers the site following the Nant Helen Complementary Earthworks Project in addition to the restored Nant Helen Coal mine, in the absence of GCRE. The site under the future baseline conditions will have minimal sources of GHG emissions. Carbon sinks on site are also limited to minimal man-made habitats within the washery area. The operation of the Site as a rail testing, maintenance, research, development and storage facility will result in no further habitat loss from that associated with the Nant Helen Complementary Earthworks Project.

15.5.12 Traffic (and the associated emissions) will increase on the roads surrounding the development as a result of worker journeys to and from the Site during the construction and operational phases.

Design mitigation

15.5.13 The benchmarks used to undertake the GHG emissions assessment are assumed to reflect a development built and operated according to standard practice. Therefore, it is recommended that opportunities for mitigation should be regularly reviewed and integrated where practicable as the design develops.

15.5.14 Suggested mitigation to reduce GHG emissions during the construction and operational phases are summarised in paragraphs 15.5.21 to 15.5.25.

Assessment of effects

15.5.15 The GHG emissions resulting from the construction and operation of the proposed development are summarised in Table 15.4 and illustrated in **Figure 15.3**. Operational emissions have been estimated over the 60-year appraisal period of the scheme.

Table 15.4 Total CO_2 emissions by emission sources[6]

Emissions source	Emissions over appraisal period (tCO_2e)
Construction	
Rail testing infrastructure	30,400
Buildings	23,400
Access and ancillary civils	4,700
Plant	15,000
Transport	1,900
Operation	
Buildings	12,200
Access and ancillary civils	800
Transport	1,900
Rolling Stock testing	13,200
Infrastructure testing	23,000
Maintenance and refurbishment	
Rail testing infrastructure	12,700
Buildings	14,600
Public realm	1,500
Total	
	155,300

[6] Note that numbers are rounded to nearest hundred.

15.5.16 Further detail of the benchmarks used to calculate the emissions and the emissions breakdown per asset are included in Appendix 15A: GHG Assessment.

Assessment of effects from construction

15.5.17 The construction phase of the development would result in 75.5 $ktCO_2e$ of GHG emissions, based on the scope of the assessment outlined in this chapter. This is significant as any increase in GHG is considered significant, in accordance with IEMA guidance (see paragraph 15.5.7).

15.5.18 For context, the emissions from the proposed development can be compared to the annual emissions from both the Neath Port Talbot and Powys regions. In 2017, the total reported emissions for all sectors was 7,560 and 838 $ktCO_2e$[7] in Neath Port Talbot and Powys respectively. Construction is over approximately 4.5 years and therefore equates to approximately 0.2% of emissions of the Neath Port Talbot and Powys regions combined. Emissions from construction comprise 0.1% of the estimated Welsh industry sector carbon budget for the period of 2021-2025 (CB2)[8,9]. Sector specific carbon budgets for CB2 have not yet been published, however based on the following assumptions it has been estimated to be 63.3 $MtCO_2e$:

- The industry proportion of the carbon budget remains constant at 32.8% for CB2.
- The percentage reductions achieved in each carbon budget period are approximately in line with those for the future legislated target years (2030, 2040).
- The values are based on data presented in Prosperity for All: A Low Carbon Wales. This document maps a pathway for Wales to reduce its emissions by 80% by 2050 from a 1990. Welsh Government have increased this target to 95%, with an ambition to reach net zero by 2050. Therefore, updates are required and it is likely that future carbon budgets will need to be smaller than those presented here.

[7] National Atmospheric Emissions Inventory (2017) Local Authority CO2 interactive maps http://naei.beis.gov.uk/data/local-authority-co2-map [Accessed July 2020]
[8] Welsh Government (2019) Prosperity for all: A low carbon Wales https://gov.wales/low-carbon-delivery-plan [Accessed July 2020]
[9] Welsh Government (2019) Industry sector emission pathway: factsheet https://gov.wales/industry-sector-emission-pathway-factsheet [Accessed July 2020]

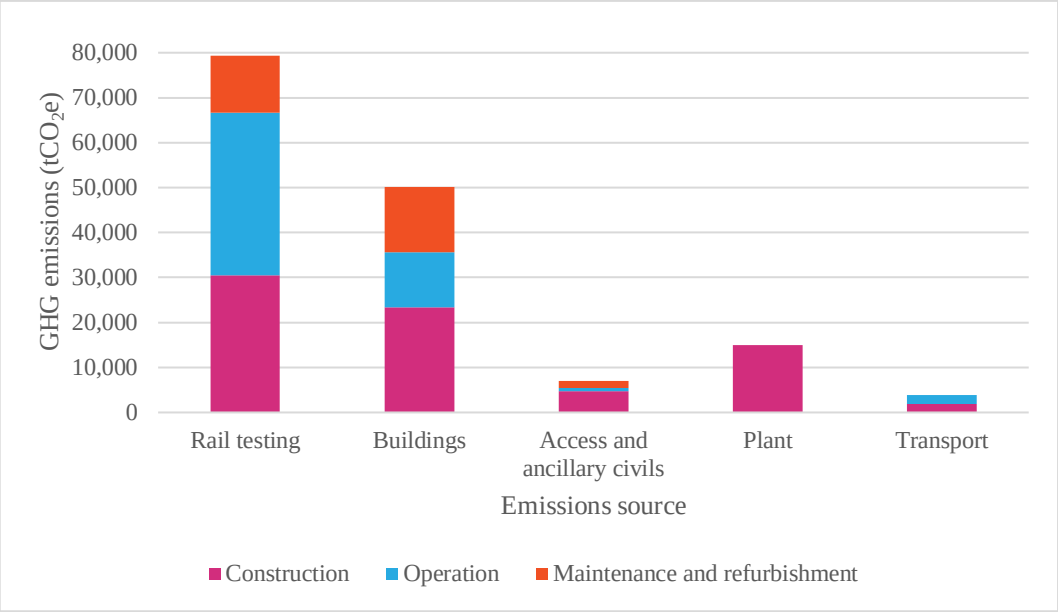

Figure 15.3 Total CO_2 emissions by emission sources

Assessment of effects from operation

15.5.19 The operational phase of the development will result in 79.8 $ktCO_2e$ of GHG emissions over the 60-year appraisal period, based on the scope of the assessment outlined in this chapter. This includes:

- 12.2 $ktCO_2e$ from the annual energy consumption of buildings;
- 36.2 $ktCO_2e$ from the operation of Rolling Stock and Infrastructure testing at the facility; and
- 28.7 $ktCO_2e$ from embodied emissions due to maintenance and refurbishment activities over the 60-year period.

15.5.20 In the first year of operation (2023), the annual emissions from energy consumption relating to transport and the rail testing facility and access and ancillary civils operations will be 1.20 $ktCO_2e$ (see **Table 15.5**), this is considered significant in accordance with IEMA guidance (see paragraph 15.5.7). This equates to 0.01% of the total reported emissions in Neath Port Talbot and Powys in 2017.

Table 15.5 Total CO_2 emissions by emission sources in opening year of operation[6,6]

Emissions source	**Annual emissions in opening year, 2023 (tCO_2e/year)**
Operation	
Buildings	N/A[10]
Access and ancillary civils	100
Transport	13

[10] Operational emissions for buildings are benchmarked in their totality, over the 60-year design life, therefore emissions in the opening year cannot be shown.

Emissions source	Annual emissions in opening year, 2023 (tCO_2e/year)
Rolling Stock testing (operational 2024)	0
Infrastructure Testing	1,100
Total	
	1,200

Mitigation and enhancement

15.5.21 The GHG emissions assessment provides an indication of the emissions associated with the construction and operational phases of the proposed development. As all emissions from the development are considered significant under the definition in paragraph 15.5.7, mitigation actions should be implemented to reduce the GHG emissions from the development.

15.5.22 PAS 2080 provides a framework for the management of carbon projects in the built environment. The use of PAS 2080 to guide the approach to reducing GHG emissions associated with the proposed development, along with further mitigation measures which are outlined below.

15.5.23 At this stage in the project programme, when the details of construction are in outline only and no contractor has yet been appointed, mitigation measures which are outlined in the sections below **are only recommendations** to be evolved during detailed design stage. These mitigation measures are therefore not accounted for in the assessment of significance of effects and the outcomes of the assessments remain as stated above.

Mitigation of effects from construction

15.5.24 The following measures are recommendations for ways to mitigate GHG emissions, that would otherwise be generated during the construction phase:

- Improve baseline understanding over the lifecycle of the project. Clause 10 of PAS2080 sets out the process for ensuring continuous improvement with respect to carbon management, including actions required of each value chain member to ensure lessons learned from the project and elsewhere are integrated where relevant;
- Identify highest impact materials (concrete, steel and plastic) and seek ways to reduce these specifically. The GHG assessment identifies the rail testing infrastructure as the most carbon intensive so designers could target these areas in their design and reduce materials where possible;

- Reduce the quantity of materials required by implementing efficient design;
- Implement the principles of designing out waste to reduce the embodied emissions used to manufacture materials that are subsequently wasted. This might, for example, include off-site manufacturing and modular construction;
- Target best in class for key materials and deliver this through the procurement process; select alternative materials that have a lower emissions intensity e.g. recycled material, cement substitutes and best EPD ratings;
- Use of alternative power sources for operation of plant on site where applicable. Hybrid plant is widely available and can significantly decrease gas oil consumption for activities such as excavation. Smaller items of plant can run on biofuels.
- Where possible, use a green tariff for energy supplied from the grid for use during construction; and
- Implementation of low carbon logistics, through local procurement and route optimisation, in addition to green travel plans for staff working on site.

Mitigation of effects from operation

15.5.25 The following measures are recommendations for design interventions to mitigate the impact of GHG emissions during the operation of the proposed development:

- Take a 'fabric first' approach to building design in order to improve the thermal efficiency of buildings and reduce heating and cooling energy requirements during operation. Including consideration of orientation and design;
- Select energy efficient infrastructure, equipment and fittings in order to reduce energy demand during operation;
- Assess energy supply options, and develop an energy strategy for the proposed development, which focuses on connections to low carbon energy sources (e.g. mine water heat recovery or renewable power[11]) where possible, in order to reduce the emissions intensity of the energy consumed;
- Design for operation, consider service-based material and selection of durable materials with low requirements for maintenance and replacement over the operational life of the development, with consideration of appropriate selection of materials; and

[11] Neath Port Talbot Council (2020) Decarbonisation and Renewable Energy Strategy https://www.npt.gov.uk/media/13541/dare-strategy-may-20.pdf?v=20200522162830 [Accessed August 2020]

- Implement practices for carbon sink creation by targeting: (i) opportunities within the washery for small-scale habitat creation (e.g. tree planting) and enhancements of the retained marshy grassland and acid grassland-heathland; and (ii) opportunities on the embankments created around the tracks, providing additional area for the establishment of vegetation[12].

15.5.26 In paragraph 15.6 of the Scoping Report, on-site renewable energy generation is recommended to mitigate the effects of climate change. As this is the outline design stage, no energy strategy for the site has yet been produced. Therefore, on-site renewable energy generation has not been included in the description of development and has subsequently not been assessed as part of the LVIA. This option will be assessed further at a future design stage.

15.6 CCR assessment

Methodology

15.6.1 The approach and methodology for the CCR assessment is as follows:

- analysis of relevant climate change and weather data, emissions scenarios and probability levels;
- assessment of climate hazards;
- identification of potential risks from these climate hazards to the assets and occupants of the proposed development;
- consideration of the resilience of the proposed development within the context of any incorporated mitigation measures, including resilience measures which are embedded within the design due to regulations and design guidelines; and
- identification of need for any further resilience measures to protect the proposed development against the effects of climate change.

15.6.2 The CCR assessment is composed of three main parts: the identification of climate hazards and benefits; the assessment of likelihood and consequences; and the evaluation of significance. These are shown in Table 15.6 and Table 15.7.

Table 15.6 Qualitative five-point scale of likelihood of climate change risks

Level	Descriptor	Description
A	Very unlikely	Event only occurs in exceptional circumstances and would not be expected to occur in the lifetime of the development
B	Unlikely	Based on the current design, engineering and maintenance standards, the event is not expected to occur more than once during the lifetime of the development

[12] Management and monitoring of any created / enhanced vegetation will be crucial to ensure that soil health is maintained, and rates of carbon sequestration remain as high as possible.

C	As likely as not	Event may occur at least once during the lifetime of the development
D	Likely	Event is expected to occur several times during the lifetime of the development
E	Very likely	Event is expected to occur many times during the lifetime of the development

Table 15.7 Qualitative five-point scale of consequences of climate change risks

Level	Descriptor	Disruption	Financial	Safety	Damage
1	Minimal	Minor disruption to rolling stock and/or infrastructure testing within a single day <30 mins	Insignificant financial loss.	Minor harm or near miss -no adverse human health effects or complaints.	No damage to assets
2	Minor	Minor disruption (<30 mins) to rolling stock and/or infrastructure testing for multiple days.	Additional operational costs. Minor financial loss.	Lost time to injury or medical treatment, short term impact on persons affected.	No permanent damage. Some minor restoration work required.
3	Moderate	Rolling stock and/or infrastructure testing on hold for up to 2h each day for multiple days or for greater than 2h in a single day.	Moderate financial loss.	Long-term injury or illness, prolonged hospitalisation or inability to work.	Widespread damage and loss of service. Damage recoverable by maintenance and minor repair. Partial loss of local infrastructure.
4	Major	Rolling stock and/or infrastructure testing on hold for 1 day or for greater than 2 hr for multiple days.	Major financial loss.	Single fatality/ multiple long-term injuries- emergency response	Extensive damage requiring extensive repair.
5	Catastrophic	Rolling stock and/or infrastructure testing on hold for multiple days.	Significantly high financial loss.	Multiple fatalities - emergency response	Permanent damage and/or loss of service Retreat and translocation of development.

15.6.3 For the CCR assessment, the timeframe for the risk assessment has been selected to align with the start and end of the operational life.

15.6.4 Due to the short temporal phase of construction, it is assumed that the mitigation measures put in place by the Construction Environmental Management Plan (CEMP) would take into account current weather events and the impacts of climate change already being experienced in the UK. Therefore, the construction phase is scoped out of the CCR assessment. An outline CEMP is included in Appendix 3A.

Significance criteria

15.6.5 The significance of the risks identified in the CCR assessment is based upon the likelihood of a hazard having an impact on the proposed development, and the consequence of the impact. The potential likelihood and consequence of impacts to the proposed project were assessed using a qualitative five-point scale as shown in **Table 15.8**.

Table 15.8 Significance matrix

			Consequence				
			1	**2**	**3**	**4**	**5**
			Minimal	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**A**	**Very Likely**	Medium	Medium	High	Very High	Very High
	B	**Likely**	Low	Medium	Medium	Very High	Very High
	C	**As Likely as Not**	Low	Low	Medium	High	High
	D	**Unlikely**	Very Low	Very Low	Low	Medium	Medium
	E	**Very unlikely**	Very Low	Very Low	Low	Low	Medium

15.6.6 Any risk equal to or above “medium” is considered significant.

Limitations and assumptions

15.6.7 The limitations of the CCR assessment are as follows:

- there is uncertainty in the climate change projections used – the UKCP18 Weather Generator is subject to certain limitations which are addressed in detail in the Weather Generator Report published by UKCP[13];

[13] UKCP09 (2010) UK Climate Projections science report: Projections of future daily climate for the UK from the Weather Generator, http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87944&filetype=pdf [Accessed July 2020]

- the assessment is qualitative except for the assessment for flood risk and drainage design which is quantitative and takes into account climate change allowances;
- the evidence base relating to climate change impacts for some assets and environmental topics is limited due to material uncertainty in projections for specific climate variables (in particular extreme wind and storm events).

15.6.8 The CCR assessment is based on the following assumptions:

- the assessment has assumed that mitigation measures for effects assessed by other topics will be implemented effectively;
- a CEMP will be developed for the construction phase that will be effectively implemented and provide appropriate mitigation for extreme weather-related effects during construction.

Future baseline environment

15.6.9 The future baseline environment for the CCR assessment include consideration of:

- Current climate conditions; and
- Projected future climate conditions.

15.6.10 The description of future climate conditions and extreme climate events will be based upon climate change projection data from the UKCP18. UKCP18 data is the most comprehensive and widely used data set of climate projections covering the UK.

15.6.11 This section presents future projected climate conditions for the area encompassing the proposed scheme for the 2020s and 2080s[14]. Future projections for extreme weather events have been projected for the 2020s and 2060s, as there is only data up until 2079. These periods cover the assumed construction period and assumed 60-year operational life.

15.6.12 Using the historical baseline, two methods were implemented to establish the future climate baseline:

- The changes in average climate projections were obtained from the UKCP18 probabilistic projections of climate change[15]; and
- The changes in extreme weather events were obtained using UKCP18 regional projections.

15.6.13 Climate change projections for a range of meteorological parameters are presented for different probability levels within the Representative

[14] The time periods for climate projections are selected based on the lifespan and stages of the proposed development
[15] Met Office, "UK Climate Projections (UKCP) - Met Office," 2018. [Online]. Available: https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index.

Concentration Pathway 8.5 (RCP8.5)[16] high emission scenario for the near-term and long-term future time periods. Table 15.9 and Table 15.10 present changes in extreme weather events for the 2020s and 2060s, such as number of heavy rainy days and presents expected changes in in climate conditions, such as mean temperature and precipitation for the 2020s and 2080s.

15.6.14 Temperatures in the area are projected to increase in both winter and summer. The largest increase in temperature is projected to be in the mean daily maximum temperature in summer, which is expected to increase by 5.4°C to 23.4°C in the 2060s, relative to the baseline in the high emissions scenario.

15.6.15 Mean precipitation rates in the region are anticipated to change, increasing from 5.2% to 22.1% in the winter and decreasing by 10.3% to 37.6% in the summer during the 2020s and 2060s.

15.6.16 Specific humidity is expected to increase from 4.1% to 21.5% in the winter from the 2020s to 2060s. During summer, there is an increase from 3.9% in the 2020s to 17.9% in the 2060s.

15.6.17 The mean number of hot days, when the maximum temperature is above 25°C, is anticipated to increase from 3.4 to 30.6 per year in the 2060s for the high emissions scenario. The average number of days in a given year, when the mean daily temperature is below 0°C, is anticipated to decrease from 57.5 to 25.6 in the 2060s under the high emissions scenario.

15.6.18 In the case of extreme precipitation, the number of days with heavy rain (precipitation greater than 25mm/day) in a given year is expected to increase from 20.4 in the baseline period to 24.4 in the 2060s. The average annual number of dry spells (periods of at least ten consecutive days with no precipitation) is projected to increase from 2.7 to 3.7 for the 2060s in the high emissions scenario.

[16] The RCP8.5 global warming scenario represents a very high baseline emission scenario, representing the 90th percentile of no-policy baseline scenarios available at the time.

Table 15.9 UKCP18 baseline climate data and climate change projections for the local area (based on 25km grid cell, 287500, 212500) for the 2020s and 2060s (under the RCP8.5 high emissions scenario). Biased corrected absolute values from script are shown.

Parameter		Baseline (1981-2010)	2020s (2010-2039)			2060s (2050-2079)		
			Min.	Mean	Max.	Min.	Mean	Max.[17]
Temperature	Number of frost days (daily minimum temperature equal or lower than 0°C)	57.5	30.5	44.5	64.0	18.1	25.6	37.8
	Heatwaves (2 days with maximum temperature higher than 29°C and minimum temperature higher than 15°C)	0.1	0.0	0.4	1.2	1.0	3.5	7.6
	Number of hot days (daily maximum temperature higher than 25°C)	3.4	2.8	8.7	20.9	14.1	30.6	50.7
Precipitation	Dry spells (10 days or more with no precipitation)	2.7	2.3	2.9	3.7	3.1	3.7	4.9
	Annual number of days when precipitation is greater than 25mm per day (Met Office definition of 'heavy rain')	20.4	14.0	21.7	30.1	18.1	24.4	31.6

[17] 12 regional models are used in UKCP18 to project the variables for extreme weather events. The min. (minimum) and max. (maximum) values shown here are the minimum projection from the 12 models and maximum projection from the 12 models for the given parameter.

Table 15.10 UKCP18 climate change projections for climate variables for the local area (based on 25km grid cell, 287500, 212500) for the 2020s and 2080s (under RCP8.5 high emissions scenario)

Parameter		Baseline (1981-2010)	Anomalies from baseline for 2020s (2010-2039)			Anomalies from baseline for 2080s (2070-2099)		
			10th percentile	50th percentile	90th percentile	10th percentile	50th percentile	90th percentile
Temperature (°C, % change from baseline)	Mean winter daily temperature	3.5	-0.1	0.6	1.4	1.0	2.9	4.9
	Mean summer daily temperature	14.0	0.2	0.9	1.6	1.9	4.7	7.7
	Mean daily winter minimum temperature	0.8	-0.1	0.6	1.4	1.0	3.0	5.3
	Mean daily summer maximum temperature	18.0	0.3	1.1	2.0	2.0	5.4	8.9
Precipitation (mm, % change from baseline)	Winter mean precipitation rate	7.3	-3.3	5.2	14.2	1.6	22.1	46.0
	Summer mean precipitation rate	4.3	-26.5	-10.3	5.8	-66.6	-37.6	-8.6
Specific humidity (%, % change from baseline)[18]	Winter	-	-1.6	4.1	10.0	6.4	21.5	38.2
	Summer	-	-1.2	3.9	8.7	3.3	17.9	33.5

[18] No UKCP18 baseline climate data available for specific humidity

Design mitigation

15.6.19 Detail of the embedded mitigation measures associated with each identified climate change risk are included in the risk register in Appendix 15B: CCR Assessment. These include building standards which consider climate change, the operational (climate) ranges of equipment and maintenance standard for roads.

Assessment of effects

Assessment of effects from operation

15.6.20 The risks identified in the CCR assessment have a 'Low' to 'Medium' risk rating due to the mitigation measures embedded in the design. These measures are outlined in Appendix 15B: CCR Assessment. Three risks identified have a 'Medium' risk rating. These include:

- Increased number of extremely hot days causing rail bucking and/or associated misalignment properties (very unlikely with catastrophic consequence);
- Increased risk of rail breaks due to extreme cold conditions given cold weather events have the potential to be more extreme (very unlikely with catastrophic consequence); and
- Increased wind loading on trains running at high cant deficiencies[19] on test tracks can lead to increased overturning force on moving trains. There is a potential risk of derailment by overturning during an extreme weather event (very unlikely with catastrophic consequence).

Mitigation and enhancement

Mitigation of effects from operation

15.6.21 Risks that were identified as medium risk in the CCR assessment have mitigation measures set out in Table 15.11.

Table 15.11 Mitigation of effects from operation of CCR assessment

Risk	Mitigation
Rail buckling and/or associated misalignment problems.	The design shall take into account climate change requirements including effects of increased in temperature. Track buckles are triggered by the presence of at least one other factor (a disturbance, a deficiency or incomplete preparatory maintenance work). Thus, track work will be restricted and maintenance staff shall be deployed ahead of any hot weather event to assess rail infrastructure, in accordance

[19] Cant deficiency involves travelling through a curve faster than the balance speed and produces a net lateral force to the outside of the curve.

Risk	Mitigation
	with Network Rail standards. Climate change allowances are also considered for steel material selection (including stressing for continuous welded rail (CWR)). Maintenance and monitoring measures to be put in place with particular focus on preventing derailment due to a track fault.
Increase risk of rail breaks due to extreme cold conditions	The design shall take into account climate change allowances for steel material selection and stressing of CWR. Maintenance and monitoring measures will also be put in place with particular focus on preventing derailment due to a track fault. Specific maintenance to adjustment switch gaps and overlaps, expansion joints, insulated joints, ball and claw settings in switch and crossing (S&C) and alignment monitoring will be undertaken ahead of cold weather events.
Increased overturning force on moving trains. Potential risk of derailment by overturning during extreme weather event.	Design of track system to ensure that all vehicles meet or exceed the minimum acceptable intrinsic roll-over wind speed, as defined within Railway Group Standards.

15.6.22 Additionally, due to the uncertainties involved in adapting to future climate change, an adaptive pathway approach[20] is recommended for monitoring and managing climate risks in the future. A clear plan, with climate related trigger points for review should be developed to support this, including an understanding of interdependencies.

[20] Adaptation pathways is a planning approach addressing the uncertainty and challenges of climate change decision-making. It enables consideration of multiple possible futures and allows analysis/exploration of the robustness and flexibility of various options across those multiple futures.

15.7 Residual effects

15.7.1 The mitigation measures associated with GHG emissions outlined in this chapter are recommendations to be evolved during detailed design stage and are therefore not accounted for in the residual effects.

15.7.2 The proposed development would result in net positive GHG emissions during both the construction phase and operational phase. Emissions from construction are mostly associated with the embodied carbon within construction materials, and emissions from operation are for the most part associated with the energy consumption and maintenance and refurbishment of rail testing operations and buildings.

15.7.3 Rail infrastructure designed as part of the scheme has the potential to be affected by climate change. A number of potential risks have been identified and assessed; these will be mitigated by applying robust design standards or relevant mitigation measures will be incorporated in the relevant asset management processes. Three risks have been deemed significant and mitigation is identified above in Table 15.11.

15.8 Assessment summary matrix

15.8.1 Significant impacts are summarised in the Table below, refer to Appendix 15B: CCR Table for the full assessment of impacts.

Potential Effect	Receptor (s)	Sensitivity of Receptor	Magnitude (prior to mitigation)	Significance (prior to mitigation)	Mitigation	Magnitude (following mitigation)	Significance (following mitigation)
Increased number of extremely hot days causing rail bucking and/or associated misalignment properties	Rail	Medium	Catastrophic	Major	The design shall take into account climate change requirements including effects of increase in temperature. Track buckles are triggered by the presence of at least one other factor (a disturbance, a deficiency or incomplete preparatory maintenance work). Thus, track work will be restricted and maintenance staff shall be deployed ahead of any hot weather event to assess rail infrastructure, in accordance with Network Rail standards. Climate change allowances are also considered for steel material selection (including stressing for CWR). Maintenance and monitoring measures to be put in place with particular focus on preventing derailment due to a track fault.	Medium	Medium
Increased risk of rail breaks due to extreme cold conditions	Rail	Medium	Catastrophic	Major	The design shall take into account Climate change allowances for steel material selection and stressing of CWR. Maintenance and monitoring measures will also be put in place with particular focus on preventing derailment due to a track fault. Specific maintenance to adjustment switch gaps and overlaps, expansion joints,	Medium	Medium

					insulated joints, ball and claw settings in S&C and alignment monitoring will be undertaken ahead of cold weather events.		
Derailment by overturning during an extreme weather event	Rail	Medium	Catastrophic	Major	Design of track system to ensure that all vehicles meet or exceed the minimum acceptable intrinsic roll-over wind speed, as defined within Railway Group Standards.	Medium	Medium