Tritax Symmetry (Hinckley) Limited

HINCKLEY NATIONAL RAIL FREIGHT INTERCHANGE

The Hinckley National Rail Freight Interchange Development Consent Order

Project reference TR050007

Environmental Statement Volume 1: Main Statement

Chapter 18: Energy and Climate Change

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Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(a)

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 Regulation 14

This document forms a part of the Environmental Statement for the Hinckley National Rail Freight Interchange project.

Tritax Symmetry (Hinckley) Limited (TSH) has applied to the Secretary of State for Transport for a Development Consent Order (DCO) for the Hinckley National Rail Freight Interchange (HNRFI).

To help inform the determination of the DCO application, TSH has undertaken an environmental impact assessment (EIA) of its proposals. EIA is a process that aims to improve the environmental design of a development proposal, and to provide the decision maker with sufficient information about the environmental effects of the project to make a decision.

The findings of an EIA are described in a written report known as an Environmental Statement (ES). An ES provides environmental information about the scheme, including a description of the development, its predicted environmental effects and the measures proposed to ameliorate any adverse effects.

Further details about the proposed Hinckley National Rail Freight Interchange are available on the project website:

http://www.hinckleynrfi.co.uk/

The DCO application and documents relating to the examination of HNRFI can be viewed on the Planning Inspectorate's National Infrastructure Planning website:

https://infrastructure.planninginspectorate.gov.uk/projects/east-midlands/hinckley-national-rail-freight-interchange/

Chapter 18◆ Energy and Climate Change

INTRODUCTION

18.1 This Chapter has been prepared by BWB Consulting Ltd and reports the assessment of the likely significant effects of energy and climate change, both upon and from HNRFI.

18.2 Scientific evidence links Greenhouse Gas (GHG) emissions associated with human activity to global warming (an increase in the global mean surface temperature) which is triggering changes to the global climate system. The resultant impact of climate change is evident through sea level rises and increasing occurrence of extreme weather events.

18.3 Climate change will continue to cause damage to the environment and potentially compromise economic development. Climate change mitigation is essential to minimise the most dangerous impacts of climate change, as previous global GHG emissions have already committed us to some degree of continued climate change for at least the next 30 years. Climate change is likely to mean that the UK will experience hotter, drier summers and warmer, wetter winters. There is an increased risk of flooding, drought, heatwaves, intense rainfall events and other extreme events such as storms and wildfires, as well as rising sea levels. In this regard, it is appropriate to assess the impact of projects on climate (for example GHG emissions) and their resilience to climate change.

18.4 By nature of new development, the construction and operation of new infrastructure results in GHG emissions. As such, TSH, has given careful consideration to how HNRFI contributions to climate change can be minimised, which includes commitments embedded in design and set-out in the Design and Access Statement (document reference 8.1).

18.5 This chapter presents an assessment of:

- GHG emissions - the potential effects of HNRFI on the magnitude and mitigation of GHGs emitted during construction and operation; and
- Climate change resilience - the resilience of HNRFI to the potential impacts of climate change in particular impacts from extreme weather and long-term climate change during construction and operation.

Competence

18.6 This report has been prepared by BWB Consulting Ltd ('BWB'); Matt Wilby (Associate Member of the Institute of Environmental Management and Assessment (IEMA) and approved by Gael Forest, (CEnv MIEnVSc MIAQM), full member of the Institution of Environmental Sciences (IES) and Institute of Air Quality Management (IAQM). Matt has over 10 years' experience in the built environment sector, specialising in the environmental appraisal of construction and operational effects on large scale projects both nationally and internationally and including the effects of climate change over the last 5 years. Gael has 25 years of industrial and commercial experience in sustainable design and construction sustainable design and construction. Both Matt and Gael are experienced in climate change policy in addition to BWB's experience in whole life GHG emission assessments for planning applications.

LEGISLATION, POLICY AND GUIDANCE

Legislative and policy framework – international legislation

18.7 The international and legislative framework for the consideration of climate change and GHG emissions established the basis for the approach to the assessment methodology. The legislative background is briefly set out below along with the approach to the legislative requirements through policy.

Paris Agreement

18.8 The Paris Agreement[1] sets out a global framework to avoid dangerous climate change by limiting global warming to well below 2 degrees Celsius (°C) and pursuing efforts to limit it to 1.5°C. It also aims to strengthen the country's ability to deal with the impacts of climate change and support them in their efforts. This Agreement is the first-ever universal, legally binding global climate change agreement, adopted at the Paris climate conference ('COP21') in December 2015.

Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment (the EIA directive)

18.9 European Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment (the EIA Directive)[2] provides the overarching legislative framework for assessing the significance of impacts and effects from the schemes on the environment.

18.10 The Directive requires environmental impact assessments (EIAs) to identify, describe and assess the direct and indirect significant effects of a project on climate (Article 3). It also stipulates that the information to be included within the Environmental Statement (ES) should include '*the impact of the project on climate (for example the nature and magnitude of GHG emissions) and the vulnerability of the project to climate change*' (Annex IV).

18.11 The requirement to consider a project's effects in relation to climate resulted from the

[1] United Nations Climate Change (2015): The Paris Agreement.

[2] Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the Assessment of The Effect of Certain Public and Private Projects on The Environment (2014).

2014 amendment to the EIA Directive (2014/52). The Directive has been fully transposed into UK law in the Infrastructure Planning (Environmental Impact Assessment) Regulations and came into force in the UK on the 16 May 2017[3]. The Directive requires: '*A description of the likely significant effects of the project on climate (for example the nature and magnitude of GHG emissions) and the vulnerability of the project to climate change*'.

Legislation and policy framework - national legislation and policy

UK Climate Change Act 2008

18.12 The Climate Change Act 2008[4] established a legal requirement for an 80% reduction in the GHG emissions of the UK economy by 2050 in comparison to a 1990 baseline. The Act also created the Committee on Climate Change, with a responsibility for:

- advising on setting five-year carbon budgets, covering successive periods of emissions reduction to 2050;
- advising and scrutinising the UK Government's associated climate change adaptation programmes; and
- producing a national adaptation plan for the UK Government to implement.

18.13 In 2019, the target was revised to achieve 100% reduction (net zero) GHG emissions by 2050.

18.14 In December 2020, the UK announced plans to reduce GHG emissions by at least 68% by 2030 in comparison to a 1990 baseline[5]. This replaced the previous target of a 53% reduction by 2030.

18.15 In 2021, the Climate Change Committee (CCC) recommended that the UK's 6th Carbon Budget to cover the years 2033 – 2037 be set at 965 million tonnes of carbon dioxide equivalent. This recommendation was adopted by the government and set by The Carbon Budget Order 2021.

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

18.16 Schedule 4, Clause 5(f) of these Regulations notes information should be included in the ES on the likely significant effects of HNRFI on the environment resulting from the '*impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change*'.

[3] *The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.*

[4] *HM Government (2008) Climate Change Act 2008.*

[5] *https://www.gov.uk/government/news/uk-sets-ambitious-new-climate-target-ahead-of-un-summit*

Infrastructure Carbon Review 2013

18.17 In 2013, the UK government published the Infrastructure Carbon Review[6] aiming to '*release the value of lower carbon solutions and to make carbon reduction part of the DNA of infrastructure in the UK*' (page 5). Major infrastructure owners, operators, and developers, including Highways England (HE, as was; now National Highways), were invited to endorse, become signatories and make commitments under the review. The review provided increased emphasis on 'capital carbon' (GHG emissions associated with raw materials, activities and transport for construction, repairs, replacement, refurbishment and de-construction of infrastructure) while acknowledging that 'operational carbon' (associated with energy consumption for the operation and use of infrastructure) will continue to dominate overall emissions to 2050 and beyond. The Infrastructure Carbon Review highlighted the importance of assessing GHG emissions early in the lifecycle of an infrastructure scheme when there is the greatest carbon reduction potential. The Infrastructure Carbon Review also led to the publication of a Publicly Available Specification on infrastructure carbon management; PAS2080:2016[7].

Department for Transport's national policy statement for national networks 2014

Government's policy for addressing need for SRFIs

18.18 Government policy for nationally significant infrastructure rail and road projects within England, and the need that underpins this, is set out in the National Policy Statement (NPS) for National Networks 2014[8].

18.19 A key driver identified for the national rail network is to provide for the transport of freight across the country, and to and from ports, in order to help meet environmental goals and improve quality of life.

18.20 Paragraph 2.35 states that '*Rail transport has a crucial role to play in delivering significant reductions in pollution and congestion. Tonne for tonne, rail freight produces 70% less CO_2 than road freight, up to fifteen times lower NO_x emissions and nearly 90% lower PM_{10} emissions. It also has de-congestion benefits – depending on its load, each freight train can remove between 43 and 77 HGVs from the road.*'

Climate change adaptation

18.21 The NPS also sets out Government policy on climate change mitigation and adaptation, and in particular how applicants should take climate change effects into account when developing infrastructure.

18.22 Because of the impacts of climate change, '*Adaptation is therefore necessary to deal with*

[6] *HM Treasury (November, 2013); Infrastructure Carbon Review.*

[7] *British Standards Institution (May, 2016); Carbon Management in Infrastructure (PAS2080:2016).*

[8] *Department for Transport (December, 2014); National Policy Statement for National Networks*

the potential impacts of these changes that are already happening. New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change' (Paragraph 4.38).

18.23 The NPS specifies the following to ensure a robust approach to climate change adaptation:

'Where transport infrastructure has safety-critical elements and the design life of the asset is 60 years or greater, the applicant should apply the UK Climate Projections 2009 (UKCP09) high emissions scenario (high impact, low likelihood) against the 2080 projections at the 50% probability level. (Paragraph 4.41)

The applicant should take into account the potential impacts of climate change using the latest UK Climate Projections available at the time and ensure any environment statement that is prepared identifies appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure. Should a new set of UK Climate Projections become available after the preparation of any environment statement, the Examining Authority should consider whether they need to request additional information from the applicant. (Paragraph 4.42)

The applicant should demonstrate that there are no critical features of the design of new national networks infrastructure which may be seriously affected by more radical changes to the climate beyond that projected in the latest set of UK climate projections. Any potential critical features should be assessed taking account of the latest credible scientific evidence. (Paragraph 4.43)

Any adaptation measures should be based on the latest set of UK Climate Projections, the Government's national Climate Change Risk Assessment and consultation with statutory consultation bodies. Any adaptation measures must themselves also be assessed as part of any environmental impact assessment and included in the environment statement, which should set out how and where such measures are proposed to be secured.' (Paragraph 4.44)

18.24 The NPS also states that climate change adaptation measures should not cause '*an adverse effect on other aspects of the project and/or surrounding environment*' (Paragraph 4.47).

(Former) Department for Energy and Climate Change's Overarching National Policy Statement for Energy 2011 (NPS EN-1) and National Policy Statement for Renewable Energy Infrastructure 2011 (EN-3)

Department for Business, Energy and Industrial Strategy's Draft Overarching National Policy Statement for Energy 2021 (NPS EN-1 – draft) and Draft National Policy Statement for Renewable Energy Infrastructure 2021 (NPS EN-1 – draft)

18.25 Although the Proposed Development is not an Energy NSIP, a critical component of HNRFI is the development of energy infrastructure. This infrastructure includes the provision of roof-mounted photovoltaic arrays with a generation capacity of up to 42.4 megawatts peak (MWp) providing direct electricity supply to the building or exporting power to battery storage, and also includes provision of an energy centre, incorporating an energy substation connected to the local distribution network, battery storage and a gas-fired combined heat and power plant (designed to be ready for 100% hydrogen in the grid gas supply) with an electrical generation capacity of up to 5MW. With these energy facilities in mind, the suite of energy NPSs are considered to be relevant to Chapter 18. The emerging draft suite of Energy NPSs which have been reviewed by the Government as a result of the Energy White Paper[9] are also relevant. These draft Energy NPSs aim to reflect the policies and broader strategic approach set out in the White Paper and ensure that we continue to have a planning policy framework which can support the infrastructure required for the transition to net zero and are a material policy consideration.

18.26 The existing and emerging draft NPSs set out the critical need and strong policy support for decarbonising energy generation, including the need for renewable generation such as solar PV, the benefits of energy generating efficiency through Good Quality Combined Heat and Power (CHP) and, in the draft NPS EN-1, an indication of the likely increasingly significant role that hydrogen will play in the energy supply mix in future.

National Planning Policy Framework (NPPF) 2021

18.27 The revised NPPF (last updated July, 2021[10]) sets out the core planning principle of '*moving to a low carbon economy*': Chapter 9: Promoting Sustainable Transport, encourages the pursuit of '*…opportunities to promote walking, cycling and public transport'* as well as '*limiting the need to travel and offering a genuine choice of transport modes*' (Paragraph 73).

18.28 In accordance with NPPF Chapter 14: Meeting the challenge of climate change, flooding and coastal change; *'The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to:*

- *shape places in ways that contribute to radical reductions in GHG emissions;*
- *minimise vulnerability and improve resilience;*
- *encourage the reuse of existing resources, including the conversion of existing buildings; and*
- *support renewable and low carbon energy and associated infrastructure" (Paragraph 152).'*

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[9] *HM Government (2020); Energy White Paper – Powering our Net Zero Future*

[10] *Ministry of Housing Communities & Local Government (2021); National Planning Policy Framework*

Legislation and policy framework – regional policy

Leicestershire County Council: Environment Strategy 2018 – 2030

18.29 LCC declared a climate emergency in 2019. Their Environment Strategy 2018 - 2030[11], which was revised to reflect this emergency declaration, sets out the council's commitment to carbon neutrality by 2030 and enforces LCC's commitment to '*minimising its environmental impacts, protecting and enhancing the Leicestershire environment and helping to deliver sustainable development by recognising and fostering the links between the environment, people and our economy*'.

18.30 This Strategy will be updated every 5 years to be '*consistent with 'stocktakes' as agreed in the Paris Agreement and the timeframes used for the UK Government's carbon budgets*'.

Blaby District Council (BDC): Blaby District Local Plan 2013 – 2029

18.31 Strategic objectives set out by the plan in Policy CS21 – Climate Change include:

- '*to minimise energy use and use of valuable resources and to encourage renewable energy production in suitable locations;*
- *to minimise the risk of flooding (and other hazards) to property, infrastructure and people; and*
- *to deliver the transport needs of the District and to encourage and develop the use of more sustainable forms of transport (Including walking, cycling and public transport)*'.

18.32 The plan supports development which mitigates and adapts to climate change. BDC will *'contribute to achieving national targets to reduce greenhouse gas emissions by:*

- *focussing new development in the most sustainable locations; and*
- *seeking site layout and sustainable design principles which reduce energy demand and increase efficiency.'*

'The Council recognises that preparing for the effects of climate change (adaptation) by minimising vulnerability and providing resilience is also important. Some degree of climate change is already inevitable, and is likely to have a range of impacts, including increased temperatures in the summer and increased risk of flooding or droughts. The Council will encourage development to plan for these impacts recognising the role of Green Infrastructure in bringing together important considerations of biodiversity, heat, water, healthy living and transport needs to create environments in which people want to live and work in the future. Good site selection is also important, particularly in relation to flooding and water resources.'

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[11] *Leicestershire County Council (Revised 2020); Environment Strategy 2018 – 2030: delivering a better future*

Blaby District Council Climate Change Strategy 2020 – 2030

18.33 Although BDC have not declared a climate emergency, they created a Climate Change Strategy. The BDC Climate Change Strategy 2020 – 2030[12] identifies six overarching aims to meet the challenges of climate changes. The aims most relevant to this assessment include:

- '*significantly reduce our carbon emissions by increasing the use of renewable energy,*
- *reducing the demand for energy and protecting and enhancing carbon sinks;*
- *reduce the environmental impact of travel and transport across the district, recognising that this is the biggest greenhouse gas emitting activity in the district;*
- *actively support the development of a sustainable travel network. Based on significant shifts in the mode of travel to active transport (walking and cycling), promoting the use of public transport and developing electric vehicle infrastructure; and*
- *improve air quality by complementing and supporting transport policy that promotes cycling and other healthy and sustainable travel options*.'

Hinckley and Bosworth Borough Council: Local Development Framework (LDF) – Core Strategy 2006 - 2026

18.34 Thirteen Spatial Objectives were identified in the Hinckley and Bosworth Borough Council (HBBC) core strategy to ensure the strategy's vision is achieved. The following objective specifically relates to climate change:

- Spatial Objective 12: Climate Change and Resource Efficiency – '*To minimise the impacts of climate change by promoting the prudent use of resources through sustainable patterns of development, investment in green infrastructure (GI), minimising the use of resources and energy, increasing reuse and recycling of natural resources, increasing the use of renewable energy technologies and minimising pollution, including greenhouse gas emissions*.'

HBBC climate emergency

18.35 HBBC declared a climate emergency in 2019. Although a Climate Change Action Plan is yet to be completed, HBBC has set *'the target of becoming carbon neutral by 2030'*[13].

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[12] *Blaby District Council (2019): Climate Change Strategy 2020 – 2030.*

[13] *HBBC (no date): Climate change strategy 2022- 2024*

APPROACH AND METHODOLOGY

18.36 The likely significant environmental effects to be considered within this Energy and Climate Change chapter are as follows:

- the resilience of HNRFI to climate change;
- the influence of HNRFI on climate change; and
- the in-combination climate change impacts (ICCI) assessment.

18.37 It was proposed in the Scoping Report (dated November 2020, document reference 6.2.6.1) to address the request for a climate change chapter with a focussed quantitative and qualitative approach, that is proportionate and that will draw on recognised climate change projections, existing guidance and emerging good practice[14,15] as well as being informed by relevant information presented in other chapters of the ES and further documents which form part of the application. As such, an effective balance between the assessment of GHG emissions emitted by HNRFI and consideration in the absence of detailed design information required to fulfil a comprehensive GHG assessment of the construction process and buildings functions has been recommended by the practitioner. Where it is not possible to quantify effects, the assessment qualitatively defines the boundaries of the GHG assessment and identify where the majority of emissions are likely to arise and outline appropriate mitigation strategies to inform later design practice. Where a quantitative assessment has been deemed unfeasible, the consultant will recommend that further assessment is conditioned at an appropriate stage to ensure minimum target reductions are achieved. GHG emissions stemming from activities associated with HNRFI that are quantified and non-quantified are confirmed in paragraphs 18.47 and 18.61.

18.38 Through adopting a precautionary approach to the assessment, recommendations have been made to reduce unmitigated emissions and incorporate mitigation measures (such as renewable energy sources and low carbon materials) into HNRFI's design where appropriate.

Consultation

The 2020 scoping opinion

18.39 An EIA Scoping Report was submitted to the Planning Inspectorate (PINS) in November 2020 (document reference 6.2.6.1) which provided an outline approach for the identification and assessment of likely significant effects of HNRFI on climate change and the effects of climate change on HNRFI.

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[14] *IEMA (2022): Assessing Greenhouse Gas Emissions and Evaluating their Significance*

[15] *IEMA (2020): Climate Change Resilience and Adaptation*

18.40 In December 2020 PINS, on behalf of the Secretary of State (SoS) and key stakeholders, returned their Scoping Opinion (document reference 6.2.6.2) to the applicant and comments related to Energy and Climate Change are provided in Table 18.1.

Table 18.1: Planning Inspectorate's comments

Secretary of State	**Scoping Opinion Response**	**Response to Comments**
Vulnerability to climate change during construction	The Scoping Report proposes to scope out the construction phase from the assessment of the vulnerability of the Proposed Development to climate change, as the estimated construction period is <10 years, commencing in 2022. The Inspectorate draws the Applicant's attention to paragraph 4.40 of the NPS which states that "*applicants must consider the impacts of climate change when planning location, design, build and operation*". On this basis, the Inspectorate is unable to scope this matter out of the ES.	The Climate Change Risk Assessment (CCRA) has included an assessment of effects during the Construction Stage. An assessment of the impacts of GHG emissions during the Construction Stage has also been undertaken. Although no significant impacts are anticipated, design measures to bolster the resilience of the Proposed Development and to minimise its effects upon climate change during the Construction Stage have been recommended (paragraphs 18.247 – 18.258 and 18.280 – 18.283, respectively).
Impacts on climate change – direct and indirect emissions	The Scoping Report proposes that the following matters are scoped out of the assessment and conditioned to the 'Reserved Matters stage', given the absence of detailed design information: • Embodied carbon in building materials; • Transportation of building materials and construction staff (to and from the Proposed Development); • Transportation and disposal of construction waste; • Emissions arising under operational circumstances e.g. energy consumption; and • Service vehicle movements during	Quantitative assessments have been undertaken for each of the matters listed in the Scoping Opinion. The methodologies associated with these quantitative assessments are set out in Paragraphs 18.65 – 18.72 and any relevant methodological assumptions are set out in Appendix 6.2.18.3 (document reference 6.2.18.3). Results associated with GHG emissions arising from the transportation of materials, waste, personnel and employees (during the

Secretary of State	Scoping Opinion Response	Response to Comments
	operation (e.g. deliveries and refuse collection). The Inspectorate does not agree that matters referred to in the Scoping Report as 'reserved matters' can be scoped out of the assessment in the ES. The Applicant should be aware that reserved matters is a term associated with outline planning consent obtained through the Town and Country Planning Act and is not directly applicable to applications made under the Planning Act 2008. The ES should assess all impacts of the Proposed Development where significant effects are likely to occur. Where uncertainty exists Applicants may choose to apply for flexibility in their DCO application, the Inspectorate's Advice Note 9 explains how such flexibility can be addressed in assessment terms with reference to a worst case assessment.	Construction Stage and Operational Stage) and energy use are set out in Table 18.15, Table 18.16, Table 18.17 and Table 18.18. Quantified results associated with embodied carbon in building materials are set out in Table 18.16 and Appendix 6.2.18.2 (document reference 6.2.18.2).
Vulnerability to climate change during operation	The Scoping Report proposes to undertake a Climate Change Risk Assessment (CCRA), following the methodology in Appendix 1 of the IEMA (2020) EIA Guide to Climate Change Resilience and Adaptation. The Inspectorate notes that the risk assessment set out as the Applicant's scope of assessment is only the initial step in the IEMA methodology. The Inspectorate considers that whilst CCRA is a useful tool for building climate resilience into the project design, should the CCRA identify risks to the Proposed Development from climate change, the ES should assess the likely significant effects and identify appropriate mitigation measures where necessary.	A CCRA has been undertaken following IEMA 2020 guidance, as set out in Appendix 18.4 (document reference 6.2.18.4). The CCRA as set out in this chapter comprises all seven stages of the IEMA guidance, including; Step 0 - 'Building Climate Resilience into the Project', Step 1 - 'Scoping Requirements', Step 2 – 'Defining the Baseline', Step 3 – 'Determining Sensitivity of Receptors', Step 4 – 'Determining Magnitude of Effect', Step 5 – 'Determination of Significance' and Step 6 – 'Developing Adaptation / Mitigation Measures'. With due consideration given to

Secretary of State	Scoping Opinion Response	Response to Comments
		mitigation embedded within the design of HNFRI, it was determined that no significant effects are anticipated. However, measures have been recommended to further bolster resilience to climate change during the operational phase (paragraphs 18.279 – 18.286).
Emissions impacts from the modal shift to rail	The Scoping Report states that *"the impact that the Proposed Development has on freight will be assessed separately*". The Inspectorate understands this to refer to the benefits in terms of GHG emissions reductions arising from a shift from road to rail. No methodology is provided for this assessment and it is not clear where this assessment will be presented. The ES must clearly explain (or cross-reference to) the reasoning and assumptions behind the conclusions reached. It must explain the significance of effect and the criteria used to determine significance. The Applicant should seek agreement on the approach to this assessment with the relevant consultees.	The assessment of GHG emissions has included a quantitative assessment of the impact from the modal shift to rail – this is consistent with the findings of the Market Assessment (document reference 16.1). The methodology for this assessment is set out in Paragraphs 18.85 and 18.86 and the methodological assumptions upon which it is based is set out in Appendix 18.3 (document reference 6.2.18.3). The outcome of this assessment is set out in Paragraphs 18.226 – 18.228. Consultation with relevant key stakeholders regarding the methodological approach is set out in Table 18.2 and from paragraph 18.42.
Significance of GHG emissions	The Scoping Report states that there is no specific standard for reporting infrastructure GHG emissions in EIA. Given the significance of any increase in GHG emissions, the Inspectorate considers that the ES should contextualise the project's carbon contribution against	At the time of writing, a detailed best practice methodology was not available. The methodology as set out in this chapter takes account of subsequent guidance as defined by IEMA, 2022. The GHG Assessment has therefore

Secretary of State	Scoping Opinion Response	Response to Comments
	relevant UK carbon budgets and demonstrate whether the Proposed Development would have a material impact on the ability of Government to meet its carbon reduction targets.	determined the significance of effects by utilising preferred best standard methodologies and tools. The results of which contextualise HNRFI's carbon contribution against relevant UK carbon budgets, in accordance with IEMA 2022 guidance.
In-combination climate change impacts	The Scoping Report does not explain how the in-combination climate change impact assessment will be undertaken or reported. The Inspectorate considers that should this be undertaken within other aspect chapters, standard methodologies for each relevant environmental aspect should be used. The Climate Change chapter should collate the assessments undertaken in other aspect chapters.	The approach to assessing the impacts of in-combination effects differs when appraising effects from climate change and effects on climate change. The methodology for assessing in-combination effects is explained in paragraphs 18.136 – 18.141. It should be noted however, with respect to GHGs, that GHG emissions are not geographically limited and therefore have a global effect rather than applying to specific local receptors (see paragraph 18.54). The respective cumulative / in-combination effects of HNRFI's resilience to climate change takes account of both intra (i.e. combined effects of the development) and inter (i.e. relationship with other significant developments) related effects by utilising information within other ES Chapters to determine the significance of effects. This assessment is provided within Table 18.23.

Section 42 consultation

18.41 S.42 consultation was undertaken C for a period of 12 weeks and two days from the 12th January to 8th April 2022. Table 18.2 summarises the S42 consultation comments received in relation to Energy and Climate Change, and how these comments have been considered in TSH's assessment of this topic.

Table 18.2: Consultation comments and responses

Consultee	Consultee Comment	Response
HBBC	*'There is limited analysis as far as we can see without access to the evidence base and data submission particularly where carbon emissions in the local area are relevant to assessment of impacts. The traffic modelling while a work in progress, has not necessarily been run through or tested thoroughly leaving gaps in the understanding on the number of lorries using the local roads networks as well as major highway interchanges. Therefore, it is unknown what the emissions will be in the local area- it is likely it will increase due to the increase in vehicles.* *This means carbon/climate impacts on Hinckley have not been fully considered. There is no carbon emission breakdown. When will this be produced and supplied? There is an expectation that emissions will be stated for the development as a whole and not in isolation.'*	At the time of consultation, there was little quantitative data upon which to assess GHG emissions. However, the assessment now includes quantitative assessments of GHG emissions where data has been made available. Sources of GHG emissions that have been quantified include: • Vehicular emissions during the construction stage; • Embodied carbon in construction materials; • Vehicular emissions during the operational stage; and • Energy demand during the operational stage.
	'Full carbon emissions are not known as sources have been excluded. These exclusions have the potential to be high carbon emissions and could adversely impact the GHG assessment and therefore need to be included as some point before construction/development.'	It is considered that the approach to the GHG Assessment for this ES has led to a proportionate assessment and that any remaining GHG emissions are expected to constitute a small minority of total emissions and, therefore, have been qualitatively assessed.

Consultee	Consultee Comment	Response
	'All materials used should be sourced in the UK where possible to reduce the embodied carbon.'	This is discussed in the 'Proposed Mitigation' section of this ES Chapter.
	'There is no mention of timescale in terms of when the assessment will be extended to include energy use for heating, cooling, and lighting? This will have a significant impact on the total emissions. Which energy sources are being considered? Will this be from renewable sources and have all possible sources been considered? It would be nice to see a breakdown of the energy sources and the associated emissions. This is an important factor when aiming for net zero and should be considered from the start. *Would it not be wise to consider the emissions if they are deemed to be significant? Again, these are emissions which, during operation, are expected to be reported as they contribute to the total emissions.'*	The Energy Strategy (Appendix 18.1, document reference 6.2.18.1) details the potential for renewable energy provision during the operational phase, which will greatly reduce GHG emissions compared to procuring this energy from the National Grid.
	'Electric vehicle charging points has been poorly explored and there needs to be sufficient infrastructure to allow the transition from diesel to electric. Therefore, included in this, needs to be a consideration to the capacity of the grid and the future capacity. 18.165 (referring to a paragraph of the PEIR) *states EV charging points could increase electricity requirements, but if this were to be renewably sourced, there is the potential for electricity demand to be produced on site.'*	During the operational phase, provisions will be made on-site for electric vehicle charging points. Given the UK Government's intention to phase out the sale of new petrol and diesel vehicles by 2030, it is anticipated that many end users of HNRFI would drive electric vehicles, which will greatly reduce the amount of vehicular GHG emissions.
	'Offsetting should be a last resort.	The Consultant acknowledges and

Consultee	Consultee Comment	Response
	Carbon reduction should be the focus. This should be considered for construction and operation.'	agrees with the principles of the mitigation hierarchy for development. That being said, in the experience of the Consultant, it is not feasible, achievable nor practical to achieve true net-zero for a development of this size, scale and nature without procuring means to offset residual effects. However, the *Applicant* intends to offset any outstanding output of carbon following the mitigation measures embedded into the design of HNRFI. A net-zero target is met when residual emissions are offset by carbon dioxide (CO_2) removals. Where a building cannot generate all its own energy and draws energy from the gas or electrical grids, then some form of carbon offsetting would be required to allow the building to be verified as net zero carbon. Likewise achieving a net zero carbon construction would currently require carbon offsetting to negate the embodied carbon emissions (associated with constructing the building) for a project to be verified as net zero carbon in construction. In their Net Zero UK report the CCC set out a recommended strategy for the UK to become net zero carbon by 2050. In this report they state: '*Most sectors (including buildings and power stations) will need to reduce emissions close to zero without offsetting; the target cannot be met by simply adding mass removal of CO_2 onto existing plans*'. They do include a small amount of offsetting in their strategy for the whole UK and point out that this needs to be reserved for the hard-

Consultee	Consultee Comment	Response
		to-treat sectors of aviation, shipping and freight. The Applicant currently measures the carbon in construction of all new buildings, both during the design stage and at practical completion, and to ensure they achieve net zero for construction using the UK Green Building Council's (UKGBC) net zero framework. The Developer will apply best practice principles during construction; as set out in the mitigation, construction will aim to reduce its energy and material consumption as far as possible and install heating equipment which does not burn hydrocarbon fuels (gas, oil, biomass etc). It will also set out management plans to dictate best practice procurement and operation of machinery and plant to best reduce both direct and indirect emissions. Where residual emissions cannot be mitigated, offsetting will be utilised using best practice and certified means.
BDC	*'Average journey lengths are used for calculating train journeys/GHG. The location of the site and ports it will serve are known, as is the quantum of train slots for journeys in either direction so the location of ports it can serve should be largely known. A specific journey length calculation should be provided to make any analysis site specific.'*	An average journey length of 150 miles has been assumed based on information from the Government Office for Science, as referenced in Appendix 18.3 (document reference 6.2.18.3).
	Referring to Paragraph 18.164 of the PEIR, the council stated the following: *'A number of options to reduce GHG*	The Energy Strategy (Appendix 18.1, document reference 6.2.18.1) states that 83% of the peak operational energy requirements would be

Consultee	Consultee Comment	Response
	below the figures are provided within this paragraph. One includes the possible future provision of a CHP/on-site heat network. There is an energy centre being proposed and reference to the provision of a CHP has been made. If a CHP is to be provided, then this must be included within any GHG/energy requirement calculations. It is however disappointing that reliance is being placed on fossil fuels for a main energy source to the facility. This shows a lack of ambition for this project, particularly given it will be constructed over the next 10 – 15 years and thus needs to comply with future requirements on such matters. *Reference is also made to the option to include on-site charging for HGVs. If the site is to be future proofed, then this must be included within the plans. Additionally, an aim to have all site based vehicles as electric/ non-fossil fuel should be included.'*	produced by solar photovoltaics (PV) if 51.4% of the total roof space was utilised (100% of roof space is not feasible given structural requirements and the installation of light wells to increase natural light, thus reducing energy demand). In situations where energy demand is greater than the amount of energy that can be created by solar PV, the shortfall will be made up via an on-site battery storage system once building load profiles are known.
CPRE (The Countryside Charity)	Objections to HNRFI in relation to climate included the 'lack of evidence relating to a reduction in CO_2 emissions and contributing towards net-zero', the 'flaws in the assessment as it doesn't consider all sources of emissions/energy use / embedded carbon' and the assertion that there is 'no indication of a contribution towards mitigating climate change'.	This Chapter of the ES considers the likely significant effects of energy and climate change, including CO_2 emissions. The scope of the GHG Assessment includes emissions associated with road and rail transport, energy emissions and embedded carbon. The GHG Assessment includes CO_2 reductions from solar PV provision.
Elmesthorpe Parish Council	Energy for the site is primarily to be provided by an on-site gas power plant rather than from greener sources.	Solar PV is expected to generate up to 83% of the electricity requirements as per the Energy Strategy (Appendix 18.1, document

Consultee	Consultee Comment	Response
		reference 6.2.18.1).
Sapcote Parish Council	'The development's commitment to tackling climate change is not demonstrated in the supporting documentation. In particular it does not address the issues related to traffic generation from changes to the road network beyond the development traffic and compares emissions from site traffic with overall traffic levels.'	This Chapter of the ES considers the likely significant effects of energy and climate change, including CO_2 emissions. Its appendices including the Energy Strategy at Appendix 18.1, document reference 6.2.18.1) and Embodied Carbon Report at Appendix 18.2, document reference 6.2.18.2) set out key carbon reduction commitments made. These include commitments to achieving net zero carbon construction and to reducing emissions in operation such as via substantial solar photovoltaic panel provision.

Section 47 consultation

18.42 In relation to climate change, Section 47 consultation responses largely related to concern over the lack of zero carbon HGVs and rail to facilitate the objective of reducing GHG emissions associated with transporting freight. There was also concern about the effect of GHG emissions on the local climate.

18.43 Given the UK Government's commitments to incentivise the take up of low carbon rail freight transportation and their objective of having all diesel-only trains removed from the rail network by 2040, it is considered that over the long-term, HNRFI would lead to a reduction in GHG emissions as a result of the efficiencies inherent in a modal shift from road to rail. This would help in achieving a net zero country by 2050.

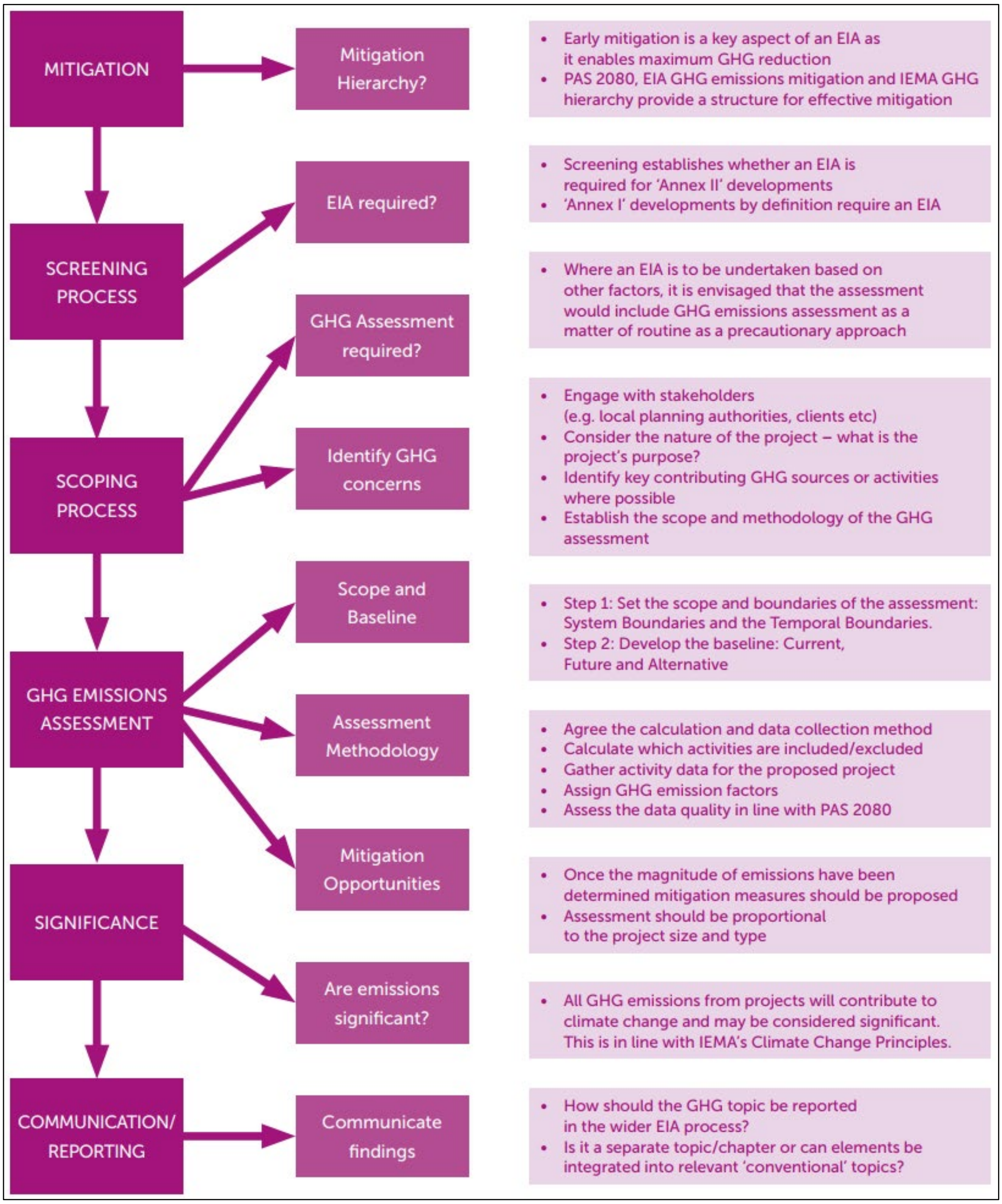
18.44 In relation to the localised impact of GHG emissions, the receptor of these emissions is the global, rather than the local, atmosphere according to IEMA[14]. As such, the geographical location of GHG emission sources is not a material consideration within the GHG assessment.

Assessing effects of HNRFI on climate change (GHGs)

Introduction

18.45 The GHG Assessment is of the effects of GHG emissions relating to HNRFI which would contribute to climate change. HNRFI has been assessed within the context of the UK's evolving carbon agenda. The assessment follows best practice procedures[14] for an assessment of GHG emissions, the steps of which are set out in Figure 18.1.

Figure 18.1: IEMA's Steps Involved in Assessing GHG Emissions for EIA



18.46 As set out in the EIA Scoping Report (dated November 2020) (document reference 6.2.6.1), a number of edits and alterations have been made to the methodological approach following review of the consultation responses to the 2018 opinion. In selecting or developing an approach for an EIA GHG emissions assessment, the aim has been to deliver a robust, proportionate, appropriate and consistent assessment; the scoping process was used to determine a proportionate assessment to HNRFI.

18.47 In summary, this ES chapter provides for the following quantitative assessments of GHG emissions:

- Construction traffic and vehicles, inclusive of:
  - Transportation of building materials, disposal of construction waste and other vehicular arrivals and departures and any associated re-routing of traffic flows for the following ‘construction elements’ (Rail Terminal, Main HNRFI Site, motorway slip roads and new A47 Link Road and associated off-site highway works – see Table 18.15);
  - Plant and machinery associated with the construction of the Main HNRFI Site, the Rail Terminal,A47 Link Road, motorway slip roads and associated offsite highways junctions (see Table 18.16 and Appendix 6.2.18.2 (document reference 6.2.18.2).
- Embodied carbon in construction materials; inclusive of the Rail Terminal, Main HNRFI Site, motorway slip roads, new A47 Link Road and associated off-site highway works (as set out in Table 18.16 and Appendix 18.2 (document reference 6.2.18.2);
- Vehicle use during operation inclusive of; re-routing of background traffic and all estimated development-based traffic flows (including heavy duty vehicles (‘HDV’s) and light duty vehicles (LDV’s) used for both commuter and operational means (see Table 18.17), consistent with the findings of the transport assessment (document reference 6.2.8); and
- Energy consumption and generation under operational circumstances (see Table 18.18).

18.48 The GHG assessment relates to the effects of HNRFI on GHG emissions contributing to climate change. HNRFI will be assessed within the context of the UK’s evolving carbon agenda as set-out above.

18.49 This includes the consideration of likely significant effects of HNRFI on the environment, taking into account the following:

- The magnitude and spatial extent of the impact (e.g. the geographical area and size of the population likely to be affected);
- The nature of the impact;
- Any transboundary impacts;
- The intensity and complexity of the impact;

- The probability of the impact;
- The expected onset, duration, frequency and reversibility of the impact;
- The cumulation of the impact with the impact of other existing and/or approved projects; and
- The possibility of effectively reducing the impact.

18.50 The following seven steps outline the framework which a GHG emissions assessment should incorporate:

1. Set the scope and boundaries of the GHG assessment;
2. Develop the baseline;
3. Decide upon the emissions calculation;
4. Methodologies;
5. Data collection;
6. Calculate/determine the GHG emissions inventory; and
7. Consider mitigation opportunities and repeat steps 4 and 5.

18.51 The application is supported by a separate Energy Strategy (Appendix 18.1, document reference 6.2.18.1), RIBA Stage 1 Embodied Carbon Report (Appendix 18.2, document reference 6.2.18.2), and the Design and Access Statement (document reference 8.1) which set out mitigation in respect of energy minimisation and efficiency which are embedded in design.

18.52 GHGs have been considered utilising data from the Transport Assessment (TA) (document reference 6.2.8.1) relating to traffic impacts, and with regard to the benefits of enabling a shift from road to rail. Scenarios of current and future baselines have been built on the changing travel patterns and modal shift for operational circumstances. Baseline transport data have been based on the latest model as detailed in Chapter 8: *Transport and traffic* (document reference 6.1.8). The transport model reports on travel patterns by mode (road) on the route of HNRFI. Transport efficiency improvements over time have also been considered.

18.53 The assessment prescribes best practice for GHG assessments in accordance with IEMA guidance[14]. It should be recognised that qualitative assessments are acceptable, for example: where data is unavailable or where mitigation measures are agreed early in the design phase with design and engineering teams.

Study area

18.54 GHG emissions are not geographically limited. They have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The receptor for GHG emissions is the global atmosphere. The receptor has a high sensitivity, given the severe consequences of global climate change and the cumulative contributions of all GHG emission sources (IEMA, 2022[14]).

18.55 The project boundary for the HNRFI informs the spatial extent and life cycle stages relevant to the scope of the assessment.

18.56 The GHG emissions assessment is not restricted by geographical area and a spatially limited study boundary cannot be clearly drawn as the scale of the impact considered in the context of atmospheric GHG concentrations is global. Reference has been made to the global context as appropriate; however, for the purposes of this assessment, the study area primarily relates to the affected transport network as set-out in Chapter 8: *Transport and Traffic*. Therefore, where feasible, the GHG Study Area includes all GHG emissions from vehicle movements that either start of finish within the HNRFI Site boundary area arising during the operation and compares them against the regional baseline. The regional baseline area for vehicular emissions is set out in Figure 18.2 and is consistent with the Pan-Regional Transport Model (PRTM), explained further within Appendix 8.5 (document reference 6.2.8.5).

Application of the Rochdale Envelope

18.57 The use of the Rochdale Envelope has been adopted to assess the potential environmental impacts of the maximum parameters of HNRFI that cannot yet be fixed. The parameters are described in more detail in Chapter 1: *Introduction* (document reference 6.1.1), with other references in Chapter 3: *Project description* (document reference 6.1.3) and Chapter 6: *EIA methodology* (document reference 6.1.6).

Identifying sensitive receptors

18.58 As per IEMA Guidance[14], the global atmosphere within which GHG emissions are emitted is considered to be the sensitive receptor within the GHG Assessment; the sensitivity of the global atmosphere is high.

Sources of GHG emissions

18.59 The Study Area is comprised of 'direct'[16] and 'indirect'[17] emissions sources as set out in Table 18.3.

[16] *Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity.*

[17] *Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity but occur at sources owned or controlled by another entity.*

Table 18.3 – Summary of significant GHG emissions sources

GHG Emissions Sources		**Description**
Construction	Direct	Direct sources of GHG emissions associated with vehicle and plant movements. This is inclusive of any re-routing of background traffic.
	Indirect	Embodied carbon associated with construction (materials, construction process and in-use building component maintenance).
Commercial Occupiers	Direct	User behaviour during the operational phase, including heavy duty vehicles (HDVs) associated with general functionality.
	Direct	Business travel, employee commuting and other vehicular trips that start or end within the community. This is inclusive of the re-routing of background traffic.
Operational Requirements	Indirect	On-site energy consumption and generation.

18.60 At the time of writing, there is insufficient information available to accurately quantify direct GHG emissions associated with construction plant. Therefore, information pertaining to the construction of the A47 Link Road (including motorway slip roads), Main HNRFI Site, Rail Terminal and offsite highway work is based upon consultant experience and assumption. This source of emissions is however not expected to significantly affect the overall GHG emissions during the Construction Stage as according to a report from the Department of Business, Innovation and Skills (2010)[18], direct and indirect GHG emissions due to on-site operations generally contributes less than 1% of total emissions for projects. Nevertheless, mitigation measures have been recommended within the 'Proposed Mitigation' section of this Chapter to reduce GHG emissions from construction plant.

18.61 As set out in the EIA Scoping Report (dated November 2020) (document reference 6.2.6.1)

[18] *Department of Business, Innovation and Skills (2010): Estimating the Amount of CO_2 Emissions that the Construction Industry Can Influence*

the GHG emissions sources set out in Table 18.4 have been excluded from the assessment. Whilst it is recognised that the infrastructure provided can lock-in positive or negative user behaviour in operation, the GHG emissions are influenced by a number of factors beyond design decisions.

18.62 The EIA Scoping Opinion (document reference 6.2.6.2) stated that "*The ES should assess all impacts of the Proposed Development where significant effects are likely to occur*". Information in relation to the use and application of waste and wastewater arising from the operational development is unknown at this stage of design. In accordance with IEMA guidance (2022) (see paragraph 18.53), where information is limited it is deemed suitable to provide a qualitative assessment of these GHG emissions rather than a quantitative assessment. Quantitative assessments of emissions sources not assessed in this chapter are set out in Table 18.4. Measures to mitigate the effects of emissions sources associated with those not quantified are included in their respective ES Chapters and summarised in paragraphs 18.280 – 18.283.

Table 18.4 – GHG emissions sources excluded from the assessment

GHG Emissions Sources	Description
Natural Capital	Green and blue infrastructure (e.g. soft landscaping, water bodies, sustainable drainage features).
Water	Water demand associated with the non-domestic buildings.
Solid Waste	Waste arising from building occupants and visitors.

Baseline data collection

18.63 The current baseline represents existing GHG emissions from within the HNRFI Site boundary area and the PRTM area prior to construction and operation of HNRFI.

18.64 The future baseline is consistent with predicted future GHG emissions from within the PRTM should HNRFI not be constructed (the 'do nothing' scenario). This is set out in the 'Future Baseline' sub-section of this Chapter.

Quantifying effects

18.65 GHG quantification follows the principles outlined in key documents such as the GHG Protocol Corporate Standard[19], BS EN ISO 14064-2:2019[20] or PAS 2080.

18.66 The assessment seeks to quantify the difference in GHG emissions between HNRFI and the baseline scenario. Assessment results reflect the difference in whole life net GHG emissions between the two options.

18.67 GHG emission factors vary in their scope and coverage and may be representative of a single process/activity or multiple of these, sometimes incorporating multiple life cycle stages.

18.68 Calculations have been taken at different scales reflecting specific activities, components or elements of construction. Therefore, individual calculations have been summed to form a GHG emissions inventory for the quantification as a whole.

18.69 GHGs include seven gases but only the following are relevant to the assessment of GHG emissions within this Chapter: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O),. Carbon dioxide (CO_2) equivalent, abbreviated as 'CO_2e', is a metric used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP) for a 100 year period, by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.

18.70 When undertaking a quantification calculation the formula for determining a GHG emission (or removal value), associated with the construction works, energy consumption and vehicular trips has applied the following structure:

GHG emission factor × Activity data = GHG emission or removal

18.71 The CO_2e for a gas is derived by multiplying the tonnes of the gas by the associated GWP. Reporting of GHG emissions in this Chapter is done in kilo tonnes of CO_2e ($ktCO_2e$), which is the cumulative emissions of GHGs for a particular process (i.e. fossil fuel-powered vehicles emissions result in more types of GHGs than just CO_2).

18.72 PAS 2080[21] introduces a lifecycle assessment approach centred around a number of "Work Stages of Infrastructure Delivery". Those stages relevant to this assessment are:

- Construction and Commissioning; and

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[19] World Resources Institute (2004): The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard.

[20] British Standards Institute (2019): Greenhouse gases - Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements.

[21] *British Standards Institution (2016): PAS-2080 'Carbon management in infrastructure'.*

- Operation (including periodic replacement of key elements, and use of the asset).

18.73 Both are assessed in this chapter.

18.74 The assessment methodology for the ES is based upon the information available at the time of assessment. In some cases, conservative assumptions have been made to provide a reasonable worst-case scenario for the particular item or factor to seek to provide for a precautionary assessment. Further information on assessment assumptions and limitations is provided in the Assumptions and limitations.

Assessing the effects of construction

18.75 The GHG assessment presented here is a mix of quantitative and qualitative, according to data availability. Where particular information was not able to be specified at this stage, assumptions and limitations have been clearly stated and this includes Highways infrastructure. In this Chapter, efforts have been made to complete high level indicative assessments of the new Rail Terminal, the Main HNRFI Site and the highway infrastructure where information is available. A breakdown of GHGs associated with each construction element is provided in Table 18.16.

18.76 The quantification process has covered the following GHG emission sources with reference to PAS 2080[22]: a. Embodied GHG emissions associated with the construction of buildings (A1-3); b. Transportation of materials to Site (A4). Though it is expected the construction will result in a potential net increase in carbon stock as a result of landscaping, the effects upon e. Land use, land use change and forestry at construction phase (A5) has not been quantified as the quality, grade and extent of the spoils and their qualities are unknown at this stage (see Appendix 18.2 document reference 6.2.18.2).

18.77 High level construction traffic figures have been reviewed against the phasing plan and likely activity on site during construction and represent the reasonable worst-case impacts based on the average daily traffic flows across the most intensive construction period.

18.78 At this stage, the construction programme for the HNRFI Site has been set out in an indicative programme in Chapter 3: *Project description* (document reference 6.1.3) and assessed. More detail on construction traffic movements including details of material removal, construction traffic management and environmental management is included in the Construction Traffic Management Plan (document reference 17.7). Further details on this information are included in the Construction Environmental Management Plan (CEMP, document reference 17.1).

18.79 The effects of indirect carbon emissions in buildings materials have been appraised in the RIBA Stage 1 Embodied Carbon Report by Ridge and Partners LLP, the methodology for which is set out in Appendix 18.2 (document reference 6.2.18.2). In summary, eTool LCA was used to estimate the embodied carbon for the industrials units, the RSSB Rail Carbon Tool was used to estimate the embodied carbon for the Rail Terminal and One Click LCA

[22] *British Standards Institution (2016): PAS-2080 'Carbon management in infrastructure'*.

was used to estimate the embodied carbon for the highway works.

Assessing the effects of operation

18.80 The PRTM Local Model Validation Report (LMVR) details that there are a total of 1,475 zones in the traffic model. Multiplying the total number of zones by the average flow per link has therefore been used to estimate the average total flow within each network[23].Though it is recognised the CTMP (document reference 17.6) identify the scheme will result in 759 light duty vehicles (LDV) and 316 heavy duty vehicles (HDV) during the year of peak period of construction activity (2026), construction traffic has been averaged across entire construction phase to estimate the life-cycle (up to ten years) effect. It is therefore estimated that HNRFI will result in a daily average of 250 light duty vehicles (LDV) and 139 heavy duty vehicles (HDV) during construction activity (2026 - 2036). This inclusive of a 10% margin for error. It also determined that HNRFI will result in an annual average daily traffic (AADT) flow of 16,438 LDVs and 8,998 HDVs during the first year of maximum occupancy (the year 2036).

18.81 Using the sum of all traffic flows on all links will result in a single origin-destination (OD) flow being multiplied by the number of links used to travel. Therefore the sum of all links has been taken and this has been divided by the total number of links within the model. This equates to an average flow per link.

18.82 An indicative assessment for vehicular emissions during both the Construction Stage and operational phase was determined for relevant scenarios using applicable traffic data and Department of the Environment, Food and Rural Affairs (Defra) Emission Factors Toolkit (EFT) version 11.0, which is deemed suitable for large scale and high-level applications. The EFT allows users to calculate road vehicle pollutant emission rates for NOx, PM_{10}, $PM_{2.5}$ and CO_2, the GHGs which comprise the vast majority of exhaust fumes from vehicles, for a specified year, road type, vehicle speed and vehicle fleet composition[24]. The main product of fuel combustion in vehicles is CO_2. Though long-lived gases, like CH_4, N_2O, CO, and H_2, are greenhouse gases and have global effects on atmospheric chemistry and climate, they have not been assessed independently as they are more difficult to estimate and depend strongly on technology, vehicle type and driving conditions, information which is not available at the time of writing. What is more, the contribution of CH_4, N_2O, CO, and H_2 emissions are considered small in comparison to CO_2.

18.83 The EFT is updated periodically due to updates to underlying data including vehicle fleet composition and emissions factors. The default fleet projections in EFT v11.0 are based on fleet growth assumptions which were current before the Covid-19 outbreak in the UK. In

[23] *To avoid double counting vehicle movements, the practitioner has estimated a truer reflection of total vehicular movements by applying this method. To use the sum of all traffic flows on all links as used for transport assessments would result in a single origin-destination flow being multiplied by the number of links used to travel which would not present a representative of the number of AADT vehicles in the PRTM model.*

[24] *Department for Environment Food & Rural Affairs: Emissions Factors Toolkit.*

consequence, default fleet outputs from the tool do not reflect short or longer term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns. The projection method takes into account the local baseline Euro fleet and the national fleet projections. It is assumed that the local fleet will follow the same profile as the national fleet, and that the difference between the two fleets is due to the local fleet being either 'ahead' or 'behind' the national fleet in terms of Euro class uptake.

18.84 The full results of GHG emission modelling for both the construction stage and operational phase are included as Table 18.5 and Table 18.6.

Table 18.5: Results of vehicular GHG emissions during the Construction Stage

Scenario	LDV Flow	HDV Flow	24 hour AADT Total Flow	LDV ($ktCO_2e$)	HGV ($ktCO_2e$)	Total ($ktCO_2e$)
Scenario 1: 2019 Baseline Year	3,839,770	501,160	4,340,930	2,111.67	8,811.14	10,922.81
Scenario 2: 2026 'Do Nothing' Construction Year	4,161,102	514,426	4,675,528	2,293.75	10,350.05	12,643.80
Scenario 3: 2026 Construction Year with Development	4,161,352	514,565	4,675,917	2,293.89	10,352.85	12,646.74

Table 18.6: Results of vehicular GHG emissions during the operational phase

Scenario	LDV Flow	HDV Flow	24 hour AADT Total Flow	LDV ($ktCO_2e$)	HGV ($ktCO_2e$)	Total (ktCO2e)
Scenario 1: 2019 Baseline Year	3,839,770	501,160	4,340,930	2,111.67	8,811.14	10,922.81
Scenario 2: 2036 'Do Nothing' Operational Year	4,525,180	527,692	5,052,872	2,488.61	9,277.62	11,766.23
Scenario 3: 2036 'Do Something' Operational Year	4,541,618	536,690	5,078,308	2,497.65	9,435.82	11,933.47

18.85 GHG Emissions associated with rail were calculated by multiplying the average amount of GHG emissions from a single rail freight journey per kilometre (27.5 grammes), as per data from the Office of Rail and Road (2021)[25] by the average length of rail freight journeys (150 miles), as per data from the Government Office for Science (2017)[26]. The average weight of freight has been assumed to be 3,000 tonnes.

18.86 To calculate the final normalised output, published totals of CO_2e emissions for freight operators were normalised by net tonne kilometres respectively.

18.87 GHG emissions because of energy were assessed within the Energy Strategy (Appendix 18.1, document reference 6.2.18.1). The Energy Strategy considered a number of scenarios for energy demand based on the amount of solar PV that would be provided on-site.

18.88 For reporting purposes, organisations should use the 'electricity generation' figures for scope 2 electricity. The total amount of GHG emissions that would be emitted yearly, should the total required energy be procured from the UK National Grid, was calculated by using the UK government's latest GHG conversion factor (0.19338 $kgCO_2e$ / kWh as stated in the most recent document from the Department for Business, Energy and

[25] *Office of Rail and Road (25 August 2022): Rail Emissions April 2021-March 2022*

[26] *Government Office for Science (February 2019): Understanding the UK Freight Transport System*.

Government Strategy[27]). This document states that UK electricity conversion factors should be used to report on electricity used by an organisation at sites owned/controlled by them.

18.89 In order to ascertain the GHG emission savings due to the provision of solar PV, the amount of energy produced by solar PV was determined by multiplying the estimated total yearly energy demand by the average of the annual carbon emissions factors presented in Table 30 of the 'Draft National Calculation Methodology (NCM) modelling guide (for buildings other than dwellings in England)[28]. Savings were calculated by deducting non-emitting and sustainable solutions to compare with the scenario in which all energy would be procured from the National Grid.

18.90 Maintenance associated with HNRFI is not considered to be a large emissions source as only a small amount will be additional to the general maintenance that already takes place and has therefore been scoped out.

18.91 The effects of the decommissioning phase of HNRFI have been scoped out due to a design life of over 25 years and uncertainties around deconstruction techniques HNRFI's end of life relating to the carbon intensity of fuels used within these deconstruction techniques. It is therefore not possible to proportionally assess impacts and effects during decommissioning, however given that decommissioning would not involve the construction of new infrastructure it would be anticipated that GHG emissions would be less than at construction phase. Given that decommissioning is anticipated to occur post 2050, and consistent with policy, the UK construction sector (for decommissioning works) is expected to be net zero.

Determining significance

18.92 IEMA guidance (2022[14]) states the following in relation to determining the significance of effects of GHG emissions:

- '*The GHG emissions from all projects will contribute to climate change, the largest interrelated cumulative environmental effect. GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit; as such any GHG emissions or reductions from a project might be considered to be significant*';
- '*The crux of significance is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net*

[27] *Department for Business, Energy and Government Strategy 'Conversion factors 2022: full set (for advanced users)'*

[28] *UK National Calculation Method (2021): 'DRAFT National Calculation Methodology (NCM) modelling guide (for buildings other than dwellings in England'*

zero by 2050';

- '*The UK has set a legally binding GHG reduction target for 2050 with interim five-yearly carbon budgets which define a trajectory towards net zero. The 2050 target (and interim budgets set to date) are, according to the CCC, compatible with the required magnitude and rate of GHG emissions reductions required in the UK to meet the goals of the Paris Agreement, thereby limiting severe adverse effects*';
- '*To meet the 2050 target and interim budgets, action is required to reduce GHG emissions from all sectors, including projects in the built and natural environment. An EIA for any development must therefore give proportionate consideration to whether and how that development will contribute to or jeopardise the achievement of these targets*';
- '*For the avoidance of doubt, a '**minor adverse**' or '**negligible**' non-significant effect conclusion does not necessarily refer to the magnitude of GHG emissions being carbon neutral (i.e. zero on balance) but refers to the likelihood of avoiding severe climate change, aligning project emissions with a science-based 1.5°C compatible trajectory, and achieving net zero by 2050*'.
- '*When evaluating significance, all new GHG emissions contribute to a significant negative environmental effect; however, some projects will replace existing development that have higher GHG profiles. The significance of a project's emissions should therefore be based on its net impact, which may be positive, negative or negligible*'.

18.93 IEMA guidance[14] states that the significance of effects can be defined and compared against various carbon budgets, such as local authority budgets and sectoral budgets. Where this cannot be achieved, or where it is more suitable, the determination of significance has also been defined and compared against UK Carbon Budget Targets, as set out in Table 18.7. Most notably, this has been applied when comparing multiple sources of GHG emissions (i.e. multiple sectoral values) as it provides a single, combined threshold to which performance can be quantitively defined.

18.94 In considering the effects of HNRFI, local, regional and national carbon budgets and sectoral targets were considered. Given the scheme is recognised as 'Nationally Significant' and data sets are considered greater than local or regional and exceed the geographical limits of both Blaby District Council and Hinckley and Bosworth District Council, the effects of HNRFI were overall compared against the national context. Where feasible, results were compared against the respective sectoral performance and targets.

18.95 In the absence of agreed, quantifiable, thresholds for what level of GHG emissions is considered significant in an EIA, IEMA guidance[14] and professional judgement based on the UK carbon budgets, as set out below, has been used to assess the significance of effects. Using these carbon budgets to assess significance accords with Paragraph 5.17 of the NPS for National Networks[8]:

- 4th UK carbon budget (2023 to 2027) = 1,950 $MtCO_2e$ (1,950,000 $ktCO_2e$);
- 5th UK carbon budget (2028 to 2032) = 1,765 $MtCO_2e$ (1,765,000 $ktCO_2e$); and
- 6th UK carbon budget (2033 to 2037) = 965 $MtCO_2e$ (965,000 $ktCO_2e$).

18.96 IEMA Guidance[14] notes an indicative threshold of 5% of the UK carbon budget for the applicable time period should be proposed, at which the magnitude of GHG emissions from very large-scale development irrespective of any reductions is likely to be significant. A project that meets this threshold can materially affect achievement of the carbon budget. As HNRFI is not considered to qualify as a development of the largest-scale in this context, a more stringent threshold of 1% of the UK carbon budget has been set, as presented in Table 18.7.

18.97 Comparisons of GHG emissions associated have also been made with sectoral budgets, as set out in the Sixth Carbon Budget Dataset (2021)[29], where appropriate.

18.98 Though it is acknowledged that construction life will span the 4th, 5th, and 6th budgets, where necessary the 6th budget has been applied as a comparator as it represents the most conservative targets and therefore the worst case.

Table 18.7: Significance criteria for GHG emissions

Effect Significance	**Description of Criteria**
Negligible	The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions; or emissions are equal to the emissions predicated in the 2036 'Do Nothing' baseline.
Minor adverse	The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero, and/or: An increase in combined (i.e. total) emissions predicted in the 2036 'Do Nothing' scenario, but less than 1% of total emissions from the 6th UK carbon budget and with a commitment to reasonable and deliverable

[29] *Climate Change Committee (December 2021); The Sixth Carbon Budget Dataset Version 2*

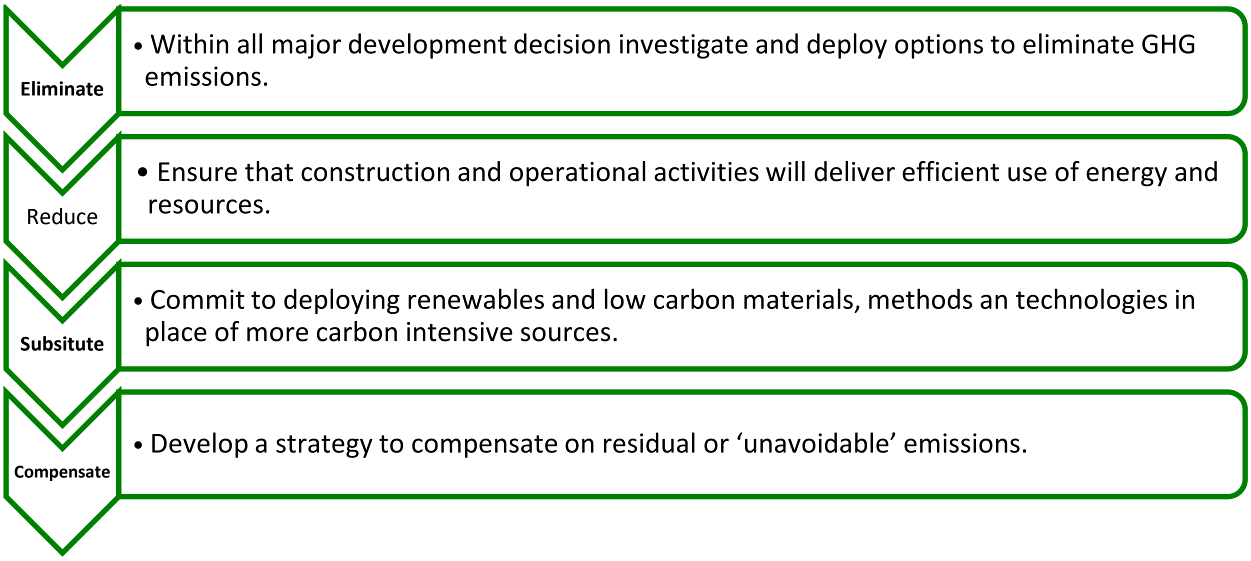
Effect Significance	Description of Criteria
	measures to seek to reduce these emissions in accordance with relevant policy and guidance.
Moderate adverse	The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero, and/or: An increase in combined (i.e. total) emissions predicted in the 2036 'Do Nothing' scenario, but less than 1% of total emissions from the 6th UK carbon budget and without a commitment to reasonable and deliverable measures to seek to reduce these emissions, in accordance with relevant policy and guidance.
Major adverse	The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero, and/or: An increase in combined (i.e total) emissions predicted in the 2036 'Do Nothing' scenario, that results in GHG emissions representing greater than 1% of total emissions from the 6th UK carbon.

18.99 For the purposes of the assessment of GHG emissions, negligible and minor adverse effects are not considered to be significant in EIA terms and in line with measures necessary to achieve the UK's trajectory towards net zero, whereas moderate adverse and major adverse effects are considered to be significant. The level of significance (moderate or major) would be applied using professional judgement.

Applying mitigation

18.100 It is important that project designers incorporate measures to reduce GHG emissions at an early stage. GHG mitigation is best achieved by taking a planned and focused approach following the IEMA GHG management hierarchy principles. The IEMA GHG Management Hierarchy, as shown in Figure 18.3, comprises the following stages: eliminate, reduce, substitute and compensate.

Figure 18.3: EIA hierarchy for managing project related GHG Emissions (adapted from IEMA, 2022[14])



Assumptions and limitations to assessing the effects of GHGs

18.101 Uncertainty can arise from quality of data, study boundaries and period of assessment, and can never be eliminated from a study.

18.102 The assumptions and limitations which apply to this assessment are outlined in Table 18.8. For each assumption or limitation, an explanation of the possible effect of the assumption has been provided as well as a description of any corrective actions that have been taken to adjust for any limitations. These assumptions are considered reasonable and are not likely to impact on the outcome of the assessment.

18.103 It should be noted that a calculated approach for quantifying GHG emissions is of course completed in advance of supply chain mobilisation and associated construction works.

Table 18.8: GHG assessment assumptions and limitations

Assumption / Limitation	Consequence	Resolution
Data on the anticipated transportation distance for materials brought to site and wastes taken from site during both the Construction Stage and operational phase are not available and have been based on average journey distances as defined by the National Travel Survey[30].	Any changes to the distances could be considered to materially affect the chapter outcomes.	The transportation distances have been used to complete the Defra EFT to calculate materials and waste GHG emissions related to transport. The transportation distances are considered reasonable based on professional judgement.
The future traffic levels for the assessment of HNRFI are based upon an opening year predicted to be in 2036. An operational period of 60 years has been assumed for the assessment of GHG emissions.	If HNRFI was to become fully operational in a year other than 2036, vehicular GHG emissions would be less accurate.	To model the GHG emissions, the assessment has taken into account the proportions of the vehicle types, fuel type, forecast fuel consumption parameters and emission factors were used for the opening date 2036. As the assessment provides an indicative amount of GHG emissions, it is considered that calculations would be representative of approximate emissions if the year HNFRI becomes fully operational deviates a little from 2036. This has produced a worst case scenario for vehicular emissions.
The default fleet projections in EFT v11.0 are based on fleet growth assumptions which were	The growth assumptions will not be as accurate as previous versions of the EFT	The growth assumptions used in EFT v11.0 are considered to be sufficient

[30] *Department for Transport (2019); National Travel Survey England.*

Assumption / Limitation	Consequence	Resolution
current before the Covid-19 outbreak in the UK. In consequence, default fleet outputs from the tool do not reflect short or longer term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns.	as the Covid-19 outbreak will have disturbed the natural growth of fleet projections. However, if traffic modelling throughout the Covid-19 outbreak had been used, it would provide much less accurate growth assumptions given that much fewer vehicles were in use.	to capture real life growth assumptions.
The most accurate way to calculate emissions from rail freight is to use direct measurements of fuel used.	Fuel usage in rail freight can vary significantly across different locomotives and other factors such as the gradient of the route and weight / length of the freight train. This information is not available for the extent of the rail network and as the type and quantity of freight is yet to be defined and variable, it has not been directly assessed.	To estimate the effects of GHG emissions from rail freight, the assessment has taken into account the average savings as defined from the total number of trains expected per day using annual statistical data released for freight trains in the UK. Freight train data has been normalised to show the average CO_2e emission per net tonne kilometre of freight moved.
When calculating the amount of CO_2 emissions that would be avoided through the generation of electricity by solar PV, it is assumed that the energy demand that this replaces would have been procured from the national grid at a national, annual-average emissions factor for the present day.	Making this assumption compares CO_2 emissions savings due to PV provision with the worst-case scenario as much of the energy provided by the national grid is generated from carbon-intensive fossil fuels.	It is considered appropriate to compare emissions savings from PV provision against energy procured from the national grid to estimate emissions savings. Though it is recognised that decarbonisation of the grid will occur over time, given the large uncertainty over the transition of energy provision and transition of the grid at the time of writing, the present day

Assumption / Limitation	Consequence	Resolution
		has been used as a comparator and will account for the worst case.
Data associated with plant and specific end user requirements is not available to provide a quantified assessment of the GHG emissions from the construction and operation of HNRFI.	Where particular information was not able to be specified at this stage, assumptions and omissions have been clearly stated.	The GHG assessment presented here is therefore a combination of quantitative and qualitative, according to data availability.

The resilience of HNRFI to climate change

18.104 IEMA's 'Climate Change Resilience & Adaptation' guidance (2020[15]) for making a development resilient to, and adaptable against, climate change stresses that climate change should be an integrated consideration within the EIA. This includes, for example, in the review of alternatives and the project design, how baseline environmental conditions may change with a changing climate and the resilience of mitigation measures to climate change. It should be informed by an understanding of future climate change scenarios and of the potential range of effects associated with these projections. By its very nature, climate change spans a range of topics and therefore elements of this topic are considered throughout this ES and other planning documents.

18.105 The climate resilience assessment focusses on identifying the impacts and effects of climate change, including extreme weather events, on receptors. It follows IEMA's best practice procedures[15]. The steps involved within these criteria, as well as the specific actions that are likely to be required at each step of the process, are included in Table 18.5.1 of Appendix 18.4 (document reference 6.2.18.4).

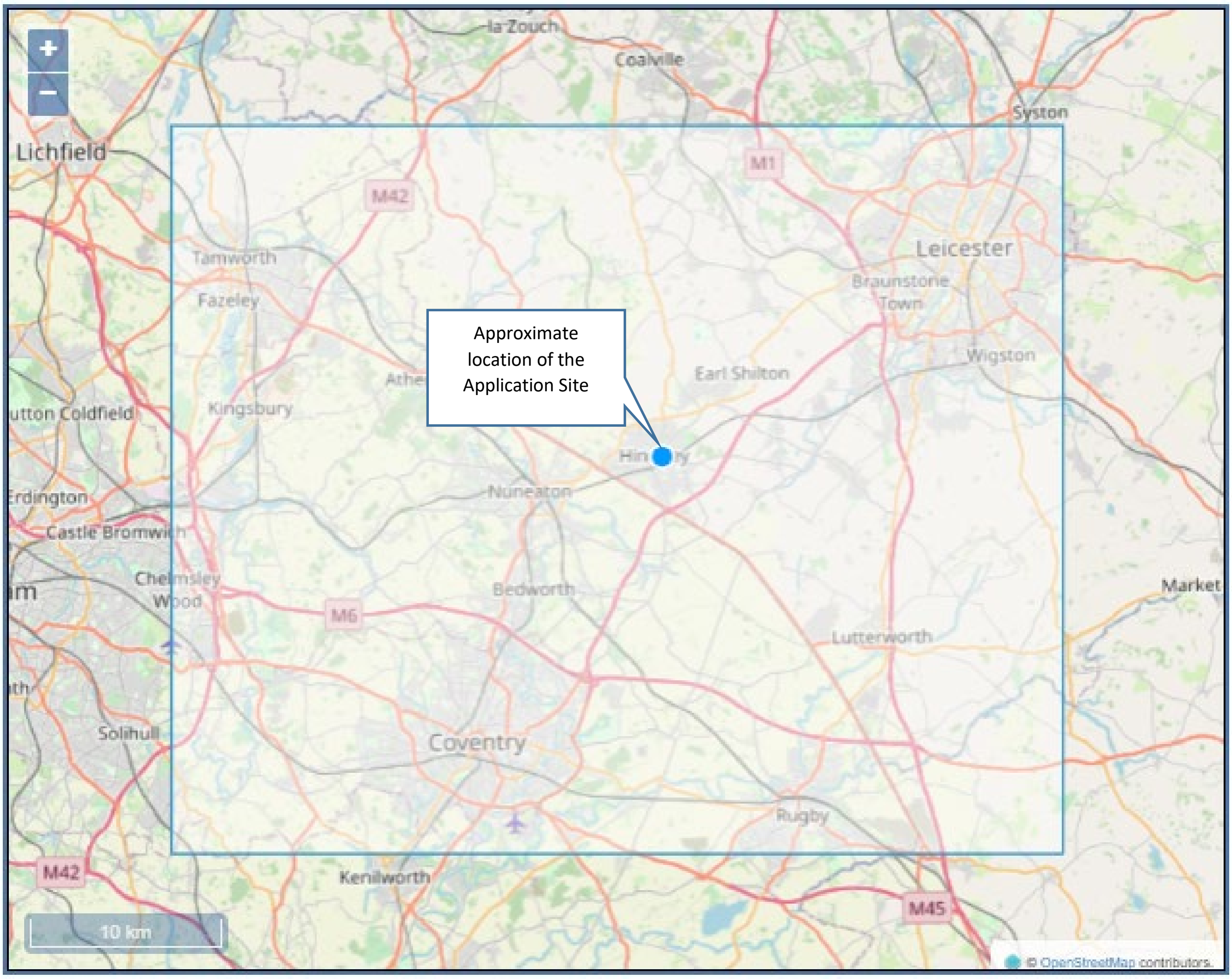
Study area

18.106 The Study Area considered for the assessment of resilience of HNRFI to climate change consists of the infrastructure within the Order Limits, looking at changes over the planned lifetime of the 60 years from commissioning. Information on climate trends and projections at the national and local scale (where available) are utilised. Climate trends and projections are published by the Met Office through the UK Climate Projections (UKCP) website and provide the most up to date assessment of how the climate of the UK may change over this century.

18.107 The climate resilience assessment has used Met Office published historical regional weather data to establish the current climate impacts on the Study Area for which the UKCP probabilistic projections are based.

18.108 The projections that are used to define the future baseline against which resilience of HNRFI is assessed are 'UKCP18' projections for the 2080s for the 25 km^2 UKCP18 grid square (northern extent: 311012.50, southern extent: 273212.50, eastern extent: 463850.00, western extent: 417450.00) for a high emissions scenario ('Representative Concentration Pathway (RCP[31]) 8.5') which encompasses HNRFI (Figure 18.4).

Figure 18.4: Study area (resilience to climate change)



[31] A Representative Concentration Pathway (RCP) is a greenhouse gas concentration (not emissions) trajectory adopted by the IPCC.

Baseline data collection

18.109 The baseline data collected and presented in this chapter were sourced through desktop research.

18.110 The UK Meteorological Office ('Met Office') provides historical regional climatic data for Leicestershire, England. This report illustrates the typical local weather in Hinckley, based on statistical analysis of historical hourly weather reports from weather stations in proximity to Hinckley to estimate typical weather conditions.

18.111 To model and predict future climate it is necessary to make assumptions about the economic, social and physical changes to our environment that will influence climate change. RCPs are a method for capturing those assumptions within a set of scenarios. RCPs specify the concentration of GHG in the atmosphere which will result in target amounts of radiative forcing at the top of the atmosphere by 2100, relative to pre-industrial levels. Four RCPs are modelled in UKCP18 (RCP2.6, RCP4.5, RCP6.0 and RCP8.5), representing four different climate outcomes; RCP8.5 is the highest emissions scenario and was applied to identify the 'worst case' scenario with respect to climatological trends.

18.112 In combination, climate change and extreme weather events will bring challenges for the UK's infrastructure over time, including in the short- (2020s), medium- (2050s) and long-term (2080s). The design life of HNRFI as detailed in Chapter 3: *Project Description* (document reference 6.1.3) has been used to identify the temporal boundary for the climate resilience assessment. UKCP18 data does not extend beyond the 2080s timescales. In light of the above, the assessment presented here considers the 2080s timescales under RCP8.5.

18.113 The projections provided by UKCP18 are probabilistic, which means that rather than a single 'best-guess' of the impact of climate change they provide a range of outcomes based on an 'ensemble' of multiple climate model runs. To help demonstrate consideration of uncertainty inherent within climate modelling, projections for the 50th (central) percentile are stated, where possible. The 50th percentile is the value at which half the climate scenarios fall below the figure and half fall above it. Projections presented herein utilise the 50th percentile.

18.114 HNRFI is not in a coastal or estuarine location and is not at risk of tidal flooding. Other variables associated with sea level rise do not require further inclusion in this Chapter but are included in Chapter 15: *Hydrogeology* (document reference 6.1.15) of this ES.

18.115 Data included in this Chapter has been collected from the following sources:

- UK Climate Projections (2018) (UKCP18)[32] – UK climate change projections used to define the future baseline against which resilience of HNRFI to climate change is

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[32] Met Office (2019) UK Climate Projections User Interface. Available at: http://ukclimateprojections-ui.metoffice.gov.uk

assessed;

- Centre for Environmental Data Analysis (CEDA)[33] – for observed climate data;
- Met Office regional climate profile for the English Midlands – for observed climate data;
- Assessments offered in respect of, Chapter 8: *Transport and Traffic*, Chapter 9: *Air Quality*, Chapter 12: *Ecology and Biodiversity*, and Chapter 14: *Surface Water and Flood Risk* that accompanies the application have all been utilised to better understand the resilience of HNRFI to climate change.

18.116 Taken together, it is considered that the data sources in combination with other topical assessments that form the application provide a robust indication of the prevailing baseline situation relevant to the assessment reported within this Chapter.

Temporal scope

18.117 As HNRFI will take approximately 10 years to construct, the variability of the climate in the last 10 years has been taken into account when judging its resilience to climate change during the Construction Stage. This includes identifying recent extreme short-term weather events, as recommended by IEMA[15]. Therefore, this assessment will recommend climate change-related mitigation measures based on these recent conditions during the Construction Stage.

18.118 For the assessment of the resilience of HNRFI to climate change during the operational stage, the long-term impacts of climate change, as predicted in the UKCP18, will be used to judge its resilience. This accords with IEMA guidance[15]. Climate change-related mitigation measures for the operational phase will be based on these long-term projections.

Identifying sensitive receptors

18.119 Sensitive receptors were identified through examination of:

- The Parameters Plan for HNRFI (document reference 2.7);
- Other technical Chapters as contained within this ES;
- Other documents which will be submitted as part of the planning application, such as the Design and Access Statement (document reference 8.1); and
- Professional judgement.

18.120 Following a review of the above information, the following sensitive receptors have been

[33] Centre for Environmental Data Analysis (CEDA) (2019). Available at: http://www.ceda.ac.uk/

identified:

- Substructure;
- Infrastructure / Building Structures;
- Roads;
- Bridges;
- Landscaping;
- Pedestrian and Cycle Ways; and
- Rail Infrastructure.

18.121 Table 18.5.1 of Appendix 18.5 (document reference 6.2.18.5) lists the climate variables, including extreme weather events which have been considered in this assessment (indicated with a tick in the table). Blank cells indicate variables that have not been considered further in this assessment due to geography and/or the context of HNRFI. A risk-based approach to assessing change adaptation for settlements and infrastructure has been applied and adapted using best practice guidance and professional judgement[14,34].

18.122 The potential effects on sensitive receptors from extreme weather events have been included as Appendix 18.6 (document reference 6.2.18.6).

Assumptions and limitations

18.123 The assumptions and limitations which apply to the assessment of resilience are outlined in Table 18.9. For each assumption or limitation, an explanation of the possible effect of the assumption has been provided as well as a description of any corrective actions that have been taken to adjust for any limitations. These assumptions are considered reasonable and are not likely to impact on the outcome of the assessment.

[34] Standards Australia (2013) 'Climate change adaptation for settlements and infrastructure - A risk based approach'. The Australian risk-based model is considered more comprehensive than UK guidance and has therefore been adopted in this assessment in order that best practice is followed.

Table 18.9: Climate resilience assessment assumptions and limitations

Assumption / Limitation	Consequence	Resolution
The assessment undertaken provides a broad indication of the potential impacts of climate change on HNRFI.	The assessment is based on a qualitative assessment and professional judgement.	An approach has been developed and applied in this assessment based on existing best practice, as set out in Appendix 18.4 (document reference 6.2.18.4).
There is currently no agreed methodology that should be applied for assessing the resilience of major schemes, including road infrastructure, under the EIA regulations.	The assessment has not been undertaken in line with specific standards.	An approach has been developed and applied in this assessment based on existing best practice guidance, as set out in Appendix 18.4 (document reference 6.2.18.4).
The UKCP18 projections have been used to infer future changes in a range of climate variables that may affect the resilience of HNRFI to climate change. At the time of writing, these represent the most up-to-date representation of future climate in the UK.	The UKCP18 data currently available does not provide data from extreme, drought, snow and ice, extreme, solar radiation, wind or relative humidity. 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 baseline climate against which the resilience of HNRFI has been assessed depending on global emissions over the next century.	A 'high' emissions scenario (RCP 8.5) using the 2080s timeslice (2070- 2099 – the longest temporal scale available through UKCP18) has been used to develop the baseline against which resilience has been assessed. This is consistent with the precautionary principle (i.e. 'worst case' scenario).
Analysis of climate projections is based on selected observational data available at the time of assessment.	Future climate projections, which may be more accurate, could not be accounted for within this assessment.	Any future decision-making, beyond DCO, based on this analysis should consider the range of literature, evidence and research available at that time and

Assumption / Limitation	Consequence	Resolution
		any changes to this.
The determination of resilience has been undertaken under the assumption that industry design standards will be adhered to where detailed information is unavailable.	Industry design standards may not have been updated to account for climate resilience.	To be applied, as applicable, as the design, construction and operation of HNRFI develops.
Limitations associated with the approach taken for the ICCI assessment relate to uncertainties inherent within UKCP18 Projections.	Climate change, by its very nature, is associated with a range of assumptions and limitations. For example, there is uncertainty regarding how global climatic trends will be reflected at the regional scale. To overcome these issues, probabilistic forecast climate change data has been used from UKCP18. This has been coupled with the replication of proven effective approaches undertaken for similar project types.	Assessments made in relation to 'consequence' and 'likelihood' rely on professional judgement and evidence gathered through other environmental disciplines. All assumptions and limitations, including any exclusions, together with assumptions for choices and criteria leading to exclusion of input and output data have been documented as part of the assessment.

Determining the significance of effect

18.124 The assessment has not only identified HNRFI's potentially sensitive receptors to climate change, but also determined each receptor's sensitivity to these changes. The sensitivity of the receptor/receiving environment is the degree of response of a receiver to a change and a function of its capacity to accommodate and recover from a change if it is affected. Identifying the sensitivity of receptors can be achieved by determining each receptors susceptibility and resilience to climate change.

18.125 A receptor's susceptibility is its ability to be affected by a change. In this sense, it is the opposite of resilience. Determining the susceptibility of the receptor has been undertaken using the scale in Table 18.4.2 of Appendix 18.4 (document reference 6.2.18.4).

18.126 A receptor's resilience is a measure of its potential exposure and ability to adapt to and/or withstand the changing climate. It can be defined using a scale set out in Table 18.4.3 of

Appendix 18.4 (document reference 6.2.18.4).

18.127 Assessing the significance of potential effects on HNRFI has applied a risk-based methodology for identifying potential climate impacts and assessing their severity (IEMA 2020[15]) and can be summarised into the following steps:

- identifying potential climate change risks to a scheme or project;
- assessing these risks (potentially prioritising to identify the most severe); and
- formulating mitigation actions to reduce the impact of the identified risks.

18.128 The assessment of risk to HNRFI includes assessing the likelihood (or probability) and magnitude (or severity) of the impacts identified. The likelihood of an event and the consequence of the event have been qualitatively assessed using the descriptions in Table 18.4.4 and Table 18.4.5 of Appendix 18.4 (document reference 6.2.18.4) respectively, based on professional judgement and emerging best practice (IEMA, 2020[15]).

18.129 The assessment of the magnitude of impacts has taken into account factors including:

- the acceptability of any disruption in use if the project fails;
- its capital value if it had to be replaced;
- its impact on neighbours;
- the susceptibility of the project element or receptor; and
- if there are dependencies within any interconnected network of nationally important assets on HNRFI.

18.130 The significance of the effects of climate change on receptors is determined by combining the likelihood and consequence ratings, as shown in Table 18.10. Therefore, in accordance with IEMA guidance[15], the significance of potential effects have been assessed as being significant or not significant.

Table 18.10: Matrix for significance

Measure of Consequence	Measure of Likelihood				
	Very Low	**Low**	**Medium**	**High**	**Very High**
Negligible	Not significant	Not significant	Not significant	Not significant	Not significant
Minor	Not significant	Not significant	Not significant	Significant	Significant
Moderate	Not significant	Not significant	Significant	Significant	Significant
Large	Not significant	Significant	Significant	Significant	Significant
Very Large	Not Significant	Significant	Significant	Significant	Significant

18.131 The above approach has been used to assess the likely significant environmental effects for each phase of HNRFI. These phases comprise:

- The development works (i.e. the Main HNRFI Site preparation, demolition and construction works required to facilitate HNRFI); and
- the completed and operational HNRFI.

18.132 There may be some instances where the effects of climate change may be beneficial for receptors. This is clearly stated if relevant within the assessment.

18.133 Short-term effects are defined as temporary effects related to a specific construction event of no more than a year's duration – such as the construction of an individual building or a specific element of infrastructure such as a section of road. Medium-term effects are considered temporary effects of longer duration, such as those arising over an extended period of construction ranging from one year to the full construction period, envisaged to be ten years. Long-term effects are those permanent effects arising from the operation of the HNRFI or from the permanent presence or removal of physical features.

Applying mitigation

18.134 Suitable mitigation measures to address adverse effects on the ability of resources and receptors to adapt to climate change has been considered by other topic specialists and chapter authors contributing to the ES. For example, for ICCIs relating to flood risk, climate change projections based on current Environment Agency guidance have been used in the relevant flood risk assessment as part of the assessment of drainage and flood-risk issues, and appropriate mitigation and design responses proposed.

18.135 These measures will be embedded into the design of HNRFI and would increase its resilience to climate change. Following the identification of any residual impacts, additional mitigation measures might also be recommended to further increase HNRFI's resilience to climate change.

Assessing in-combination effects

18.136 The ICCI assessment relates to the combined effect of the impacts of HNRFI and the potential for climate change impacts to modify other environmental topic impacts on the receiving environment.

18.137 As GHG emission impacts and resulting effects are global rather than affecting one localised area, the approach to cumulative effects assessment for GHGs differs from that for many EIA topics where only projects within a geographically bounded study area of, for example, 10km would be included. Therefore, all global cumulative GHG sources are relevant to the effect on climate change, and this has been taken into account in defining the receptor (the atmospheric concentration of GHGs) as being of 'high' sensitivity to further emissions. Effects of GHG emissions from specific cumulative projects therefore in general should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has GHG emissions for assessment over any other (IEMA, 2022[14]).

18.138 The approach to the ICCI followed the guidance set out in by IEMA and included within Table 18.4.1 of Appendix 18.4 (document reference 6.2.18.4). This involved a review of other chapters within the ES which have the potential to affect the significance of impacts identified in relation to climate change.

18.139 The ICCI assessment includes receptors in the surrounding environment, as defined by each environmental discipline in their technical assessments reported in chapters 6 - 17 of this ES.

18.140 The ICCI assessment scenario considers construction and operation of HNRFI. The baseline for the ICCI assessment is the same as that identified for the resilience assessment. It has been informed using historic climate observations and climate change projection data to identify existing and future climate conditions in the geographical location of the Main HNRFI Site; forecast climate change data has been used from UKCP18.

18.141 The likelihood of an in-combination impact occurring is determined based on the likelihood of a climate hazard occurring, combined with the sensitivity of the receptor to the combined impact of the climate hazard and HNRFI. The determination of significance is the same as that for resilience, outlined in Appendix 18.4 (document reference 6.2.18.4).

RELEVANT BASELINE CONDITIONS

GHG emissions

National emissions

18.142 In 2021, net territorial emissions in the UK of the basket of seven GHGs covered by the Kyoto Protocol were estimated to be 424.5 million tonnes CO_2 equivalent ($MtCO_2e$), a decrease of 5.2% compared to the 2019 figure (the most recent pre-Covid pandemic year) and 47.3% lower than they were in 1990. CO_2 made up around 80% of the 2021 total[35].

18.143 The transport sector consists of emissions from road transport, railways, domestic aviation, shipping, fishing and aircraft support vehicles. It is estimated to have been responsible for around 31.5% of CO_2 emissions in the UK in 2021. The main source of emissions from this sector is the use of petrol and diesel in road transport. CO_2 emissions from transport fell by 11.2% in 2021 compared to 2019 (due to Covid-19). Between 1990 and 2019, there has been relatively little overall change in the level of GHG emissions from the transport sector.

Local, regional and national emissions comparison

18.144 A summary of regional GHG emissions (2020) for Blaby, Hinckley and Bosworth, Leicestershire, the Midlands and nationally is included in Table 18.7.1 in Appendix 18.7 (document reference 6.2.18.7). This is based on statistics published by the Department for Business, Energy and Industrial Strategy (BEIS, 2022)[36].

Existing Site Land Use

18.145 The baseline GHG emissions from within the Main HNRFI Site are expected to be very low given current land uses and limited human and natural activity including energy consumption (fuel, power), agriculture and rail movements as outlined in Chapter 2: *Site Description*.

18.146 Due to the Main HNRFI Site currently comprising agricultural fields which do not comprise intensive agriculture uses and a single dwelling, no construction works are anticipated to take place in the 'Do Nothing' scenario, and as such no quantified assessment of emissions

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[35] *Department for Business, Energy and Industrial Strategy (February 2022): 2021 UK Greenhouse Gas Emissions, Provisional Figures (latest available at the time of writing for 2021).*

[36] *Department for Business, Energy and Industrial Strategy (2022) '2005 to 2020 local authority greenhouse gas emissions dataset'.*

are included within the baseline.

Vehicular Emissions from Road

18.147 BEIS (2022) data sets demonstrate a trend in the reduction in vehicular carbon emissions from local, regional and national sources from the year 2005, with forecasts showing a continuation in reductions over the next years in keeping policy, targets and a betterment in technology. The data projects that combined, road networks in Blaby and Hinckley and Bosworth (259 ktCO_2e) contributed approximately 32% of the total vehicular GHG emissions in Leicestershire (1,597 ktCO_2e), 0.6% of vehicular GHG emissions in England and 0.5% of vehicular GHG emissions in the UK in 2020.

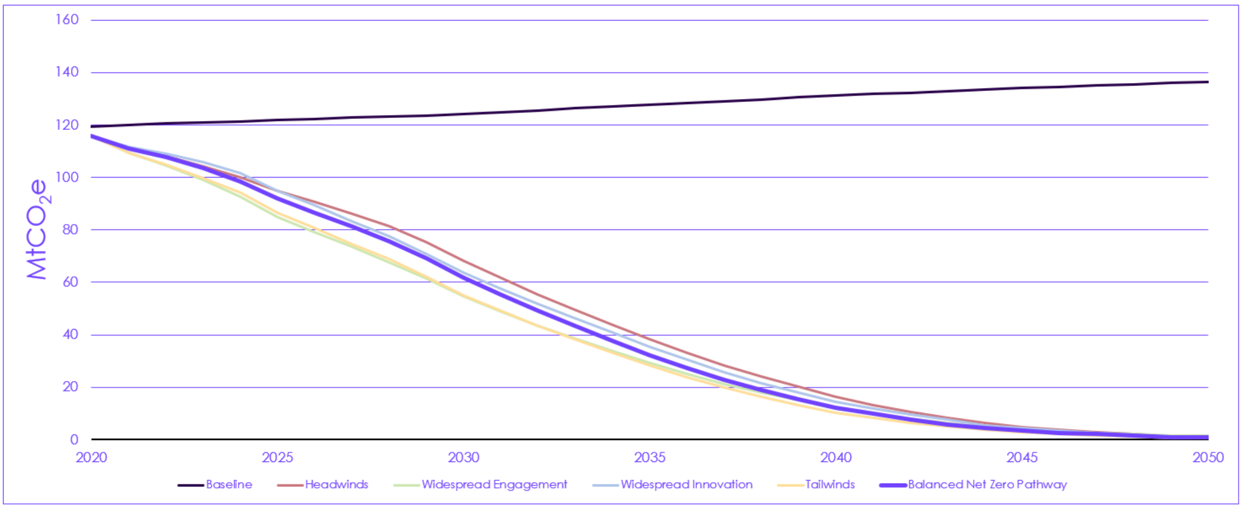
18.148 On average, vehicular emissions locally and at country level have declined since 2005 by approximately -0.1 and -0.3 ktCO_2e per annum respectively.

18.149 Using traffic data in the PRTM for the baseline scenario (2019), total vehicular CO_2 emissions from the modelled transport network in Leicestershire (the Study Area), without the development, have been estimated to result in 10,923 ktCO_2e a year as presented in Table 18.11. There is a difference of 32% between the projected BEIS data and the projected PRTM data for 2019, which may accounted for by discrepancies in vehicular projections in both methods. Regardless, the forecast trajectory for future emissions is in keeping the respective sectoral Balanced Net Zero Pathway for the 6th Carbon Budget, as shown in Figure 18.5[29].

Table 18.11: Average Annual GHG emissions for all traffic in the PRTM traffic model area

Total LDV (ktCO_2e/yr)	Total HGV (ktCO_2e/yr)	Average Number of Vehicles (per annum)	Total ktCO_2e/yr
2,112	8,811	4,340,930	10,923

Figure 18-5: Balanced Net Zero Pathway for Transport (CCC, 2021)



Rail

18.150 The total volume of rail freight moved dropped to 16.6 billion net tonne kilometres in the financial year 2019-20, its lowest total in 23 years[37]. In 2018, 8.9% of freight moved in Great Britain was by trains, a 0.2 percentage point decrease compared with the previous year. In 2019/20, the total amount of rail freight transported decreased to 16.6 billion net tonne kilometres, a 4.6% decrease from 2018/19[38]. Trends demonstrate this decrease could account for the decline in consumption, and therefore demand, of coal as non-coal related freight has on balance increased since 2009. Domestic Intermodal (which includes retail stocks transported by rail) retains the largest share in 2019-20, with a 41% share (6.77 billion net tonne kilometres). The second largest, Construction, rose by 3% in 2019-20 taking it to its largest total (4.64 billion net tonne kilometres) since the time series began in 1998-99.

18.151 Today, less than 10% of rail freight is moved using electric locomotives. In 2020, diesel freight in Hinckley & Bosworth and Blaby collectively accounted for less than 1% (3.9 ktCO_2e) of the UK diesel rail freight emissions, with Leicestershire estimated to account for 2% (32.3 ktCO_2e). Total freight traction CO_2e emissions in the latest year were 457 kilotonnes. This was an increase of 5% compared with the previous year but still 7% down on the 493 kilotonnes recorded in the pre-pandemic year April 2019 to March 2020[25].

18.152 Under normal operating circumstances (pre-Covid 19), the adjacent rail network

[37] Q4 freight statistics have been affected by the Coronavirus (Covid19) pandemic, although the impact is small given the number of days affected up to the end of March 2020 (Office of National Statistics, Freight Rail Usage and Performance 2019-20 Q4 Statistical Release).

[38] Department for Transport (December 2020): Rail Factsheet.

accommodates a total of 79 train movements per day. Of this, 37 (46%) are rail freight[39].

18.153 The electricity consumption for freight trains increased by 2% compared with the year April 2020 to March 2021. The diesel consumption for freight trains increased by 5% compared with the previous year, but it was down 7% compared with two years ago (April 2019 to March 2020). Electric vehicle kilometres increased by 11%, and diesel vehicle kilometres increased by 14%. The resulting CO_2e emissions for freight trains have increased to 27.5g CO_2e per tonne-km or 598g per diesel vehicle-km. This is the highest level since the comparable time series started in 2011-12.

18.154 The average GHG emissions from a single freight journey are estimated to be approximately 6.4 metric tonnes of CO_2e. The adjacent network is therefore estimated to be responsible for approximately 86.4 ktCO_2e a year from freight travel alone (i.e. 37 freight trains per day on average, for 365 days a year, each with a typical weight and journey length giving rise to 6.4 tCO_2e)[40].

Regional climatic conditions

18.155 The Midlands lie at the geographic heart of England. As such, according to the Met Office[41], it has a climate that is essentially transitional between northern and southern England regarding temperature and between Wales and eastern England regarding rainfall.

Temperature

18.156 Mean annual temperatures over the region vary from around 8°C to just over 10°C, with variation mainly associated with altitude. This range is more pronounced than other regions within the country due to its distance to the sea. Both winter frosts and occasional very hot summer days are common. These temperature extremes of both winter and summer are a key characteristic of the Midlands climate.

18.157 January is the coldest month, with mean daily minimum temperatures varying from just below 0°C to about 1.5°C. The lowest temperature recorded in the region was -26.1°C at Newport, Shropshire in January 1982.

18.158 July is the warmest month, with mean daily maximum temperatures exceeding 22°C in the south and east Midlands, whilst extreme maximum temperatures can occur in July or August. A temperature of 36.7°C was recorded at Raunds, Northamptonshire on August 9th 1911.

18.159 The average number of days with air frost in the Midlands varies from about 40 to 60 days

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[39] Realtime Trains (2021): Hinckley Rail Station.

[40] Average link length is estimated at 150 miles / 238 km. Average weight of the rail freight asset is estimated at 3,000 tonnes.

[41] Met Office (2016) 'Midlands: climate'.

per year across the region, whilst ground frost occurs on average on about 100 to 125 days per year.

Rainfall

18.160 Rainfall in the region is affected by Atlantic depressions, convection and altitude. The wettest areas in the Midlands are to the west and north-west of the region with an average of over 800 – 1,000 mm per year. The more sheltered areas of the South and East Midlands are the driest with less than 600 mm per year in parts of Northamptonshire, the lower Trent valley and the Avon valley.

18.161 Rainfall is generally well-distributed through the year, but the wettest month varies across the region, with more even distribution throughout the year to the east and south of the region. The number of days with rainfall totals of 1 mm or more varies from between 40 – 45 mm in winter to approximately 30 mm in summer in areas of highest altitude to 30 – 35 mm in winter and 20 – 25 mm in summer to the east and south.

18.162 Flooding events occasionally occur in the region. One example occurred at Easter 1998 when a stationary band of heavy rain that stretched across the Midlands resulting in the death of five people and the evacuation of thousands more.

18.163 Thunderstorms are most likely to occur from May to September, reaching their peak in July and August, with eastern areas among the most prone in the UK. High intensity rainfall is often associated with summer showers and thunderstorms, rates of 100 mm/hr or more being possible for short periods. One example that affected Birmingham was the storm of 14 July 1982, with about 35 mm falling in 20 minutes and peak intensities of over 250 mm/hour at Edgbaston, causing extensive flooding.

Snowfall

18.164 The number of days with snow falling at any one area within the region is about 20 per winter in the lower lying areas and about 35 days is typical of upland areas in the north and west.

18.165 The number of days with ground snow ranges between six and 20 at any one area within the region, depending on altitude and proximity to cold and warm air masses.

18.166 A notable example of a blizzard on 8/9th January 1982 when 36 hours of snow accompanied by easterly gales gave 30 to 50 cm of level snow.

Wind

18.167 The prevailing wind throughout the year is south-westerly across the region.

18.168 The Midlands area is one of the more sheltered parts of the UK. The strongest winds are associated with depressions and generally during winter, especially from December to February.

18.169 Over the Midlands generally, the average number of days when gale force is reached (when wind reaches a mean speed of 34 knots or more over any ten consecutive minutes) is around 2 days per year but rises to 5 days of the year in more exposed areas to the west and north. Gusts of wind of between 60 – 80 knots have been recorded in the region, whilst a tornado in Birmingham 2005 resulted in damage to 420 homes.

Local climatic conditions

Historical weather data

18.170 Average climate condition data for 1991 - 2020 at Coundon, Coventry, which is the nearest climate station to Hinckley and located 16 km away, was obtained from the Met Office. This data is included as Figure 18.6.

18.171 This figure shows that average maximum and minimum temperatures are lowest between November and March, whilst average maximum and minimum temperatures are highest between June and September.

18.172 Most frost occurs between December and February.

18.173 The wettest period of the year is generally between June and January, with the remaining months of the year generally drier.

18.174 The windiest period of the year is usually between December to April, with the remaining months of the year slightly less windy.

Figure 18.6: Average weather conditions at Coundon, Coventry between 1991 – 2020

Month	Maximum temperature (°C)	Minimum temperature (°C)	Days of air frost (days)	Sunshine (hours)	Rainfall (mm)	Days of rainfall ≥1 mm (days)	Monthly mean wind speed at 10 m (knots)
January	7.24	1.79	9.07	54.91	61.36	12.02	6.53
February	7.93	1.75	8.98	74.74	46.77	10.21	6.60
March	10.43	3.07	5.26	115.09	45.60	9.81	6.75
April	13.57	4.81	1.80	147.17	49.14	9.80	6.39
May	16.77	7.69	0.17	191.64	52.73	9.31	6.12
June	19.72	10.64	0.00	184.71	65.84	9.29	5.66
July	21.97	12.64	0.00	197.55	61.24	9.14	5.31
August	21.51	12.44	0.00	179.63	66.20	9.63	5.23
September	18.58	10.28	0.00	137.09	54.88	9.48	5.22
October	14.31	7.49	0.83	100.60	68.66	10.74	5.75
November	10.15	4.36	3.62	63.10	64.62	12.18	5.87
December	7.49	2.12	8.89	60.99	61.26	11.72	6.18
Annual	14.17	6.62	38.62	1507.22	698.30	123.33	5.96

Recent weather data

18.175 Weather data for 2021 from the Weatherspark website[42] was collected to build a profile of recent weather conditions at Castleford, where the Site is located. These weather conditions are based on data from the following nearby weather stations:

- Birmingham Airport (27 km west and -14 m elevation change);
- East Midlands Airport (33 km north and -20 m elevation change); and
- RAF Cottesmore (54 km north-east and 27 m elevation change).

18.176 Where information from other sources have been utilised, this has been stated and a source has been provided.

Temperature

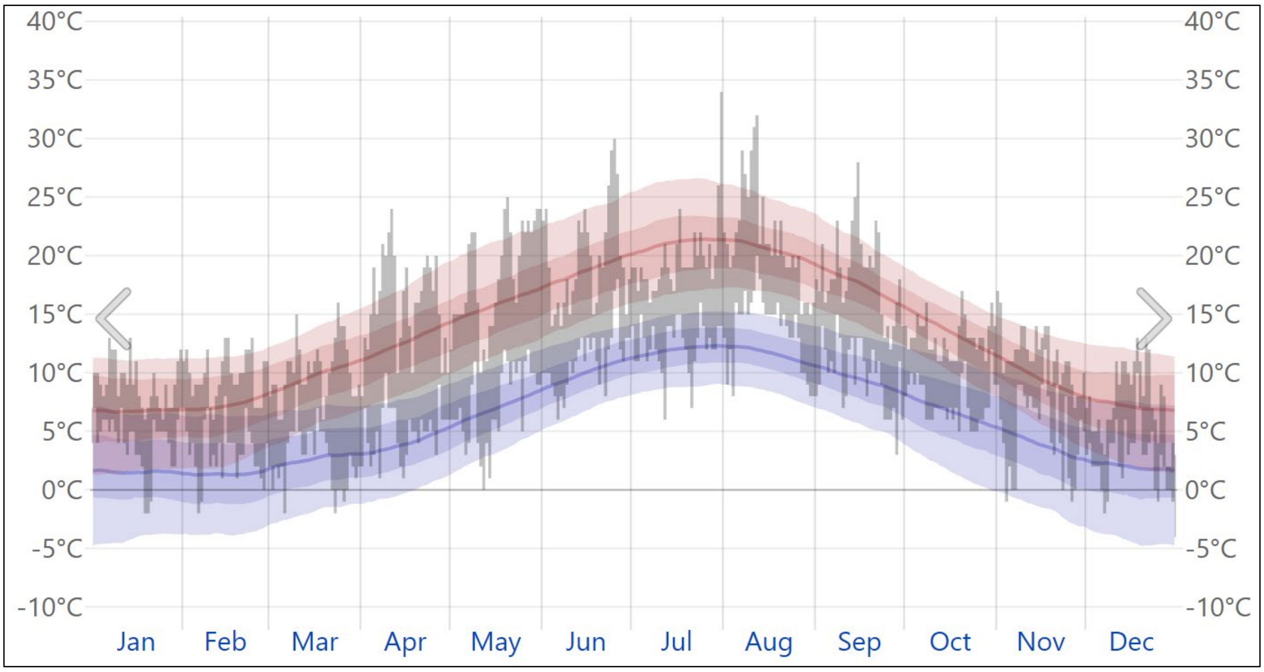
18.177 In 2021, the warmest part of the year was between early June and late September when daily average high temperatures were 16°C or higher. The coldest part of the year was

[42] *Weatherspark (no date); Climate and Average Weather Year Round in Hinckley.*

between January to late March and December when daily average low temperatures were 3°C or lower.

18.178 The maximum temperatures peaked at 30°C on 18th July at Birmingham Airport, whilst the lowest temperature was -5.0°C recorded on 15th January at the same location. Average, minimum and maximum temperatures at Birmingham Airport for 2021[42] are shown in Figure 18.7.

Figure 18.7: Average, minimum and maximum temperatures at Birmingham Airport in 2021



18.179 A local newspaper reported that the Met office recorded a temperature of 35.6°C in Leicestershire on 18th July 2022[43].

Precipitation

18.180 The nearest weather station to the Main HNRFI Site for which precipitation was recorded in 2021 was Birmingham Airport. The total amount of precipitation recorded in 2021 was approximately 694 mm. The months with the highest amount of precipitation were January (66 mm), November (64 mm) and December (71 mm), whilst the lowest amounts occurred in February (41 mm) and March (49 mm).

Daylight

18.181 The length of the day in Hinckley varies over the course of the year. In 2020, the shortest day was 21st December, with 7 hours, 39 minutes of daylight; the longest days was 21st June, with 16 hours, 50 minutes of daylight.

[43] *Leicester Mercury (2022); Leicestershire melts record for highest temperatures ever recorded with another scorching day on the way.*

18.182 In terms of cloudiness in Hinckley, the clearer part of the year in Hinckley begins around 18 April and lasts for 5.7 months, ending around 10 October. On 15 July, the clearest day of the year, the sky is clear, mostly clear, or partly cloudy 56% of the time, and overcast or mostly cloudy 44% of the time. The cloudier part of the year begins around 10 October and lasts for 6.3 months, ending around 18 April. On 26 December, the cloudiest day of the year, the sky is overcast or mostly cloudy 75% of the time, and clear, mostly clear, or partly cloudy 25% of the time.

Wind

18.183 The nearest weather station to the Main HNRFI Site for which wind speed was recorded in 2021 was Birmingham Airport.

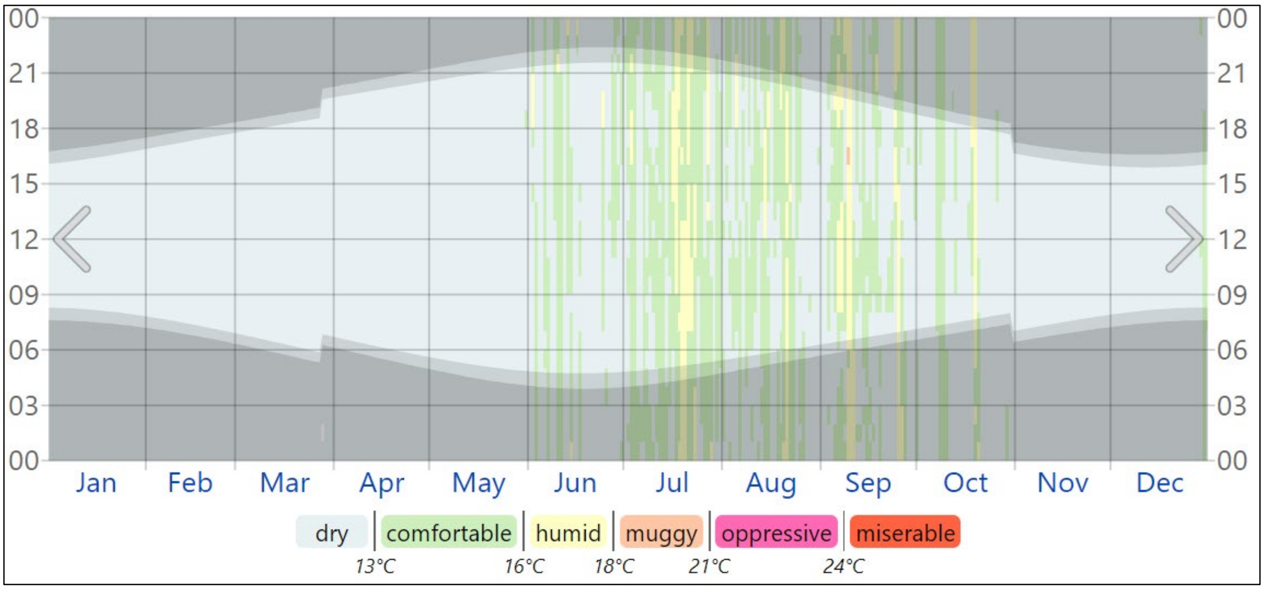
18.184 Wind speeds were variable throughout 2021 at Birmingham Airport but were generally higher in spring and winter months. The strongest gust of wind at this airport in 2021 was recorded at 75.9 km/h on 26th of November.

18.185 A wind rose has been included as Appendix 9.6 (document reference 6.2.9.2) of this ES.

Humidity

18.186 The humidity comfort level is based on the dew point, as it determines whether perspiration will evaporate from the skin, thereby cooling the body. The perceived humidity level in Hinckley, as measured by the percentage of time in which the humidity exceeds the comfort level and would be defined as muggy, oppressive, or miserable, does not vary significantly over the course of the year. As illustrated in Figure 18.8 (humidity levels at Birmingham Airport, the closest weather station that records humidity[42]), humidity levels very rarely exceed 'humid'.

Figure 18.8: Humidity levels at Birmingham Airport in 2021



Future baseline

18.187 The future baseline stands to outline projected climatic and emissions trends without the development. Given the limited human and natural activity as discussed in the current baseline section, the effects of industrial and residential practices have not been assessed.

Road network GHG emissions

18.188 The Intergovernmental Panel on Climate Change (IPCC) Special Report 'Global Warming of 1.5°C' (2018) is clear on the causes and the effects of climate change on the world. The report states that the primary driver of long-term global warming is carbon dioxide (CO_2) emissions and that global temperatures relate to increased cumulative CO_2 emissions from human activity, primarily from energy use. This will result in significant loss of ecosystems and biodiversity along with increased impacts on human health and the economy. The world is already around 1°C warmer than preindustrial times and is currently on track to reach between 3- 4°C global temperature increase by 2100 if no action is taken. Action on climate change can deliver many local benefits, including lower energy bills, economic regeneration and the creation of local jobs, reductions in fuel poverty and improved air quality.

18.189 Under the 2026 'Do Nothing' scenario (the peak year of construction without the HNRFI) for the Construction Stage of HNRFI, GHG emissions are expected to increase by 1,720 $ktCO_2e/yr$ across the network as shown in Table 18.12.

Table 18.12: Baseline GHG emissions data for traffic in the region of HNRFI, 2026

Year	Total LDV ($ktCO_2e/yr$)	Total HGV ($ktCO_2e/yr$)	Average Number of Vehicles (per annum)	Total $ktCO_2e/yr$
2019	2,112	8,811	4,340,930	10,923
2026	2,293	10,350	4,675,528	12,643.6
Magnitude of Change	+181	+1,539	+334,598	+1,720

18.191 Under the 2036 'Do Nothing' scenario (opening year without the HNRFI) for the operational phase of HNRFI, GHG emissions are expected to increase by 853 ktCO2e/yr across the network as shown in Table 18.13. This is as a result of an increase in road traffic, though increases in vehicle efficiency (including an increase in hybrid and all-electric vehicles) resulted in a reduction in emissions from LDVs.

Table 18.13: Baseline GHG emissions data for end user traffic in the region of HNRFI, 2036

Year	Total LDV ($ktCO_2e/yr$)	Total HGV ($ktCO_2e/yr$)	Average Number of Vehicles (per annum)	Total $ktCO_2e/yr$
2019	2,112	8,811	4,340,930	10,923
2036	2,498	9,278	5,052,872	11,776
Magnitude of Change	+386	+467	+711,942	+853

Rail Trends

18.192 In 2018, DfT challenged the rail industry to remove all diesel-only trains from the network by 2040.

18.193 In 2019, the Rail Safety and Standards Board (RSSB) published as part of the 'Rail Industry Decarbonisation Taskforce' a 'Final Report for the Minister for Rail'. This looks at the challenge set by DfT to remove diesel only trains from service by 2040, and produces a vision for how the rail industry will decarbonise[44].

18.194 In 2020, Network Rail published a 'Traction Decarbonisation Network Strategy'[45], which aimed to provide recommendations for Government '*to inform decisions required to remove diesel trains from the network, achieve net-zero legislative targets, and identify the capital works programme required to achieve this*'.

18.195 DfT published their transport decarbonisation plan in July 2021, which sets out plans to achieve a net zero emission rail network by 2050[46].

18.196 This could be achieved by further electrification of the rail network, leading to a removal of diesel passenger trains and investment in new electric locomotives for freight. The alternatives to diesel passenger trains are battery, electric or hydrogen rolling stock.

Energy Trends

18.197 In 2021, the UK Government committed to decarbonise the electricity system by 2035, bringing forward the government's commitment to a fully decarbonised power system by 2050. The plans will focus on building a secure, home-grown energy sector that reduces reliance on fossil fuels and exposure to volatile global wholesale energy prices[47]. It follows the government's 'Ten Point Plan for a Green Industrial Revolution' in which pledged to support clean electricity supply as well as hydrogen fuel and '*making our buildings more energy efficient*' though specific plans for design practices were not laid out.

Climatic trends

18.198 With respect to temperature, UKCP18 suggests that the region will experience hotter summers and warmer winters, with more extreme temperature events (heatwaves).

18.199 Projections for the region in the 2080s under a high emissions scenario (RCP8.5) are as follows:

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[44] *Rail Industry Decarbonisation Taskforce (July 2019): Final Report for the Minister for Rail*

[45] *Network Rail (2020): Traction Decarbonisation Network Strategy*

[46] *Department for Transport (2021): Decarbonising Transport A Better, Greener Britain*

[47] *Department for Business, Energy & Industrial Strategy (October 2021): Plans unveiled to decarbonise UK power system by 2035 [press release]*

- Mean winter temperature is projected to increase by approximately 3°C (50th percentile).
- Mean summer temperature is projected to increase by approximately 5°C (50th percentile).
- Mean annual temperature is projected to increase by 3-4°C (50th percentile).

18.200 With respect to precipitation, UKCP18 projections suggest that the region will become wetter in winter and drier in summer, with more extreme rainfall events. This will cause increased drought conditions during summer months, a trend which will grow throughout the 21st Century, and increased risk of flooding during winter months.

18.201 Projections for the region in the 2080s under a high emissions scenario (RCP8.5) are as follows:

- Mean winter precipitation is projected to increase by up to 20% (50th percentile);
- Mean summer precipitation is projected to decrease by between 30-40% (50th percentile); and
- Mean annual precipitation is projected to decrease by up to 20% (50th percentile).

18.202 According to UKCP18 projections[48], there is projected to be '*an increase in near surface wind speeds over the UK for the second half of the 21st century for the winter season when more significant impacts of wind are experienced. However, the increase in wind speeds is modest compared to natural variability from month to month and season to season, so confidence is low*'.

18.203 The resilience of HNRFI to climate change depends on the level of exposure of the receptors to changes in different climate variables. In the short-term, natural vulnerability will dominate the weather-related risks that are experienced, including any extreme events (such as storms and heatwaves). Over the long term, the climate we experience will be influenced by levels of GHG emissions.

18.204 Sensitive receptors were identified through examination of the parameters plan and description of development (set-out in Chapter 3: *Project description*) for HNRFI and professional judgement. The sensitivity of each receptor was also determined through professional judgement, for which Table 18.14 details the outcomes.

[48] *Met Office (no date) 'UK and Global extreme events – Wind storms'*

Table 18.14: The sensitivity of identified receptors

Receptor	Susceptibility	Vulnerability	Sensitivity
Substructure	Low	Low	**Low**
Infrastructure / Building Structures	Moderate	Moderate	**Moderate**
Road	Moderate	Moderate	**Moderate**
Bridges	Low	Low	**Low**
Landscaping	Low	Moderate	**Moderate**
Pedestrian and Cycle Ways	Moderate	Moderate	**Moderate**
Rail Infrastructure	Moderate	Moderate	**Moderate**

SIGNIFICANCE OF EFFECTS

Assessment of the effects of HNRFI on the climate (GHG emissions)

18.205 HNRFI will inevitably have an impact on climate change due to GHG emissions during both the Construction Stage and operational phase.

18.206 GHG emissions result in the same global climate change effects wherever they occur.

18.207 However specifically in the EIA context it now provides relative significance descriptions to assist assessments.

Construction

18.208 During the Construction Stage, there will be some GHG emissions from construction traffic accessing the Main HNRFI Site and areas of highway works, non-road mobile machinery and small generators temporarily used to power machinery and equipment on-site. However, these emissions will be periodic and temporary occurring between 2026 and 2036 – they are therefore considered to occur in the 'medium-term'.

Embodied carbon

18.209 The greatest contribution to construction emissions is the embodied carbon within construction product. The RIBA Stage 1 Embodied Carbon Report (Appendix 18.2, document reference 6.2.18.2) provided an estimate of the amount of carbon that would be embodied within building materials for each of the twelve units for HNRFI, as well as for the Rail Terminal. The figures for the warehouse units were based on comparisons with historic embodied carbon data generated and collated for other similar units on Tritax Symmetry logistic parks across the UK. This was completed using Etool software and the Ecoinvent database. The results for the Rail Terminal has been based on the outline plans modelled using the RSSB Rail Carbon Tool (by Atkins and Faithful & Gould) which utilises the Institution of Civil Engineers (ICE) database and assumptions in the construction of the track and freight storage and handling areas. The results for the highway works was modelled using One Click LCA, using product specific Environmental Product Declarations (EPDs) and One Click's default ISO 14040 / 14044 compliant dataset.

18.210 The carbon intensity of warehouse building is reducing with time as contractors find ways of delivering lower carbon developments. TSH is dedicated to providing best-in-class greener logistics buildings by going beyond complying with buildings regulations and designing to better materials consumption and embodied carbon. Due to the limited design information available at this stage of assessment, the embodied carbon associated with the warehouse designs has been estimated based on data collected from historic TSH built units. Based on the life-cycle analysis, estimations of embodied carbon (inclusive of energy) within the build for all twelve units would result in approximately 287.8 ktCO_2e, whilst the amount of embodied carbon within the Rail Terminal amounts to 10.1 ktCO_2e. Embodied carbon associated with the construction of the of the motorway slips, A47 link road and off site junction works, would result in a net increase of 13.7 ktCO_2e. Total embodied carbon for construction of HNRFI would result in a total of 311.6 ktCO_2e.

18.211 Compared against the most stringent benchmark (i.e. the 6th carbon budget), unmitigated, 311.6 ktCO_2e would account for 0.03% of the UK's 6th Carbon Budget and 0.2% of the sectoral targets set for non-residential buildings across the 10 years of construction (145 million tonnes of CO_2e) and is therefore considered to result in a **permanent moderate adverse** effect. In accordance with the methodology for determining significance, this is considered to be a significant impact in EIA terms.

Road traffic

18.212 Due to the location, worker commuting is expected to be by private car which has higher GHG emissions than public transport. However, commuting distances are expected to be relatively short and a Framework Travel Plan (document reference 6.2.8.2) which will provide recommendations which will keep the resultant emissions low.

18.213 Total vehicular GHG emissions during the Construction Stage are presented in Table 18.15 for the 'Do Nothing' scenario year 2026 (i.e. the year of peak construction without HNRFI being built out) and the 'Do Something' scenario year 2026 (i.e. the year of peak construction without HNRFI being built out). A comparison of the differences between the total traffic flow and associated $ktCO_2e$ is also provided.

Table 18.15: Comparison of Construction Stage road user emissions for the do nothing vs do something scenarios

Scenario	**Daily Total LDV / $ktCO_2e$**	**Daily Total HGV / $ktCO_2e$**	**Annual Total Vehicles**	**Annual Total $ktCO_2e$**
Do Nothing Scenario 2026 (without development)	2,294	10,350	4,675,528	12,644
Do Something Scenario 2026 (with completed HNRFI)	2,294	10,353	4,675,917	12,647
Flow Increase	**+0**	**+3**	**+ 389***	**+3**

**250 LDV and 139 HGV:*

GHG emissions from vehicles associated with construction of the motorway slip roads, A47 Link Road and associated off-site highway works: 133 LDV and 91 HGV (1.9 $ktCO_2e$)

GHG emissions from vehicles associated with construction of the Main HNRFI Site: 117 LDV and 49 HGV (1.1 $ktCO_2e$)

It should be noted that according to calculations provided within the RIBA Stage 1 Embodied Carbon Report (Appendix 18.2, document reference 6.2.18.2) GHG emissions from vehicles associated with the construction of the Rail Terminal would result in a total of 0.5 $ktCO_2e$.

18.214 The total regional traffic GHG emissions for the peak Construction Stage of HNRFI (2026) is 3 $ktCO_2e$ higher than the 'Do Nothing' scenario.

18.215 In order to estimate a worst-case scenario for total vehicular GHG emissions during the Construction Stage, this figure of 3 $ktCO_2e$ is multiplied by 10 (the maximum anticipated length of construction in years). This results in a maximum of 30 $ktCO_2e$ GHG emissions from traffic during the Construction Stage. Given the extent of the transport network modelled, and the fact that the amount of construction works that would be undertaken in 2026 is likely be much greater than many of the other nine years of the Construction Stage.

18.216 The RIBA Stage 1 Embodied Carbon Report (Appendix 18.2, document reference 6.2.18.2) includes an estimate of 0.5 ktCO_2e associated with the transport of construction materials for the Rail Terminal. In order to ensure this figure is not double-counted, it has been taken from the figure of 30 ktCO_2e in the paragraph above. This results in an overall figure of 29.5 ktCO_2e for road traffic during the Construction Stage.

18.217 Unmitigated, and in comparison with regional trends (i.e. an average annual reduction of 0.3 ktCO_2e), this net value would represent an increase that is considered a major adverse effect as it is locking in emissions and does not make a meaningful contribution to the region's trajectory.

18.218 By comparison, construction traffic would represent 0.03% of the sectoral transport target (87 million tonnes CO_2e) under the representative target for the 4th carbon budget for 2026 (i.e. opening year of construction), or 0.1% of the respective 6th carbon budget (27 million tonnes CO_2e) for 2036 (i.e. the completed year of development). On average, this would represent 0.05% of the respective sectoral targets for the 4th, 5th and 6th carbon budgets (average of 56 million tonnes CO_2e) which would be considered a minor adverse effect.

Total GHG emissions during the construction stage

18.219 Unmitigated, GHG emissions as a result of construction are likely to result in a net increase of 341 ktCO_2e across the network during the 10 years of the Construction Stage, as shown in Table 18.16.

18.220 When assessing this figure against the UK's 6th Carbon Budget (965,000 ktCO_2e), unmitigated, it represents 0.04% of this budget and, therefore, is considered to constitute a **moderate adverse** effect. In accordance with the methodology for determining significance, this is considered to be a significant impact in EIA terms.

Table 18.16: Estimation of GHG emissions during construction

Logistics & Welfare (ktCO_2e)	Rail Terminal Infrastructure (ktCO_2e)	Highways Infrastructure	Total Vehicle Emissions (ktCO_2e)	Total GHG emissions (ktCO_2e)
287.7	10.1	13.7	29.5	341

The completed and operational HNRFI

Road emissions

18.221 The UK Government intends to phase out new petrol and diesel LDVs by 2030, new <26t gross vehicle weight HGVs by 2035 and heavier HGVs by 2040[49]. Due to the resulting anticipated increase in uptake of electric and other alternative fuel vehicles over the design life of HNRFI, the end-user emissions calculated here are likely to be an overestimate. As projections for the uptake of electric vehicles are limited and uncertain, this has not been calculated as part of the end-user assessment.

18.222 Total end user GHG emissions are presented in Table 18.17 for the 2036 'Do Something' and compared against the daily occupier increase for HNRFI whilst fully operational.

Table 18.17 - Comparison of operational phase road user emissions for the do nothing vs do something scenarios

Scenario	**Daily Total LDV / $ktCO_2e$**	**Daily Total HGV / $ktCO_2e$**	**Annual Total Vehicles**	**Annual Total $ktCO_2e$**
Do Nothing Scenario (without development)	2,489	9,278	5,052,872	11,767
Do Something Scenario (with completed HNRFI)	2,498	9,436	5,078,308	11,934
Occupier Increase	**+9**	**+158**	**25,436***	**+167**
**16,438 LDV and 8,998 HGV are contributed by HNRFI*				

[49] Department for Transport (2022): Decarbonising Transport, One Year On. [Online] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1090420/Decarbonising-transport-one-year-on-review.pdf, accessed 11/10/22

18.223 The total regional traffic GHG emissions for the operational phase of HNRFI is 167 ktCO_2e per year higher than the 'Do Nothing' scenario.

18.224 Unmitigated, and in comparison with regional trends (i.e. an average annual reduction of 0.3 ktCO_2e), this net value would represent an increase that is considered a major adverse effect as it is locking in emissions and does not make a meaningful contribution to the region's trajectory. In accordance with the methodology for determining significance, this is considered to be a significant impact in EIA terms.

18.225 By comparison, operational traffic would represent 0.19% of the sectoral transport target (87,000 ktCO_2e) under the representative target for the 4th carbon budget for 2026 (i.e. opening year of construction), or 0.09% of the respective 6th carbon budget (170,000 ktCO_2e) for 2036 (i.e. the completed year of development). On average, this would represent 0.14% of the respective sectoral targets for the 4th, 5th and 6th carbon budgets which would be considered a minor adverse effect.

Rail emissions

18.226 It is considered that the average freight train can carry the same load as up to 43 HGVs meaning operating costs are much lower and CO_2 emissions for a shipment are reduced; tonne for tonne, rail freight produces 76% less CO_2 than road freight[50].

18.227 Considering the average GHG emissions from a single freight journey are estimated to be approximately 6.4 metric tonnes of CO_2e, the increase of 16 freight trains per day (32 movements) under a fully operational scenario, is expected to be responsible for approximately 78.4 ktCO_2e a year (i.e. 16 freight trains per day on average, for 365 days a year, each with a typical weight and journey length giving rise to 6.4 tCO_2e)[51].

18.228 In total, HNRFI can result in an approximate saving of 83 million HGV road miles per annum (document reference 6.2.3.1) in comparison with non-rail connected developments. As a result, the switch from road to rail will save approximately 194.3 ktCO_2e in total per annum.

Energy emissions

18.229 At the current stage of design, detailed information is not available on the exact specification or operation of the proposals. The predicted energy consumption breakdown is, therefore, based on available data and reasonable assumptions of likely plant and equipment consistent with the maximum parameters. The workforce amenity, welfare facilities and offices have been assumed to be entirely electrically powered, including

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[50] *Department for Transport (2016): Rail Freight Strategy*

[51] *Average link length is estimated at 150 miles / 238 km. Average weight of the rail freight asset is estimated at 3,000 tonnes.*

space heating, catering, auxiliary plant and hot water.

18.230 In support of HNRFI, securing the necessary power requirements during operation, an assessment was undertaken as part of the development of the design. This was built-up using a comprehensive list of the likely equipment required to fulfil the needs of anticipated energy consumers during operations. The Energy Strategy (Appendix 18.1, document reference 6.2.18.1) concludes that the highest proportion of energy consumption is expected to be because of commercial activity and associated plant (including vehicular charging). It should be noted that this assessment does not include the electrification of rail should it be introduced in the future.

18.231 The total baseline estimated operational energy demands for occupancy, heating and EV charging are included in Table 18.18. The amount of carbon savings due to Solar PV provision is discussed in the mitigation section.

Table 18.18: Estimated energy demands

Scenario	Typical Annualised Demand (MWh)	Expected Peak Site Demand (MW)	UK grid 2021 carbon emissions factor ($kgCO_2e$ / kWh)	Estimated annual Carbon Emissions ($ktCO_2e$)
Occupancy + Heating + EV	58,088	17.6	0.19338	11.23

18.232 There are no local or regional sectoral targets for energy. As shown in Table 18.18, the total amount of GHG emissions associated with the energy production is expected to be 11.23 $ktCO_2e$ per annum. Without mitigation, and fully operational, it is considered that HNRFI would represent 0.13% when compared against the current national non-residential sectoral target for 2036 (8,960 $ktCO_2e$) in the 6th UK Carbon Budget would result in a **permanent moderate adverse** effect. In accordance with the methodology for determining significance, this is considered to be a significant impact in EIA terms.

Total GHG emissions during operational phase

18.233 Prior to mitigation, operations of HNFRI are estimated to give rise to approximately 256.63 $ktCO_2e$ per annum for all sectors. This figure represents 0.15% of the UK's 6th Carbon Budget for the year 2036 (170,000 $ktCO_2e$) which is considered to result in a **permanent moderate adverse** effect. In accordance with the methodology for determining significance, this is considered to be a significant impact in EIA terms.

Total GHG emissions during the construction stage and operational phase

18.234 The combined (construction, rail, road and operational energy) GHG emissions for HNRFI is estimated to result in approximately 584.0 ktCO_2e, with 256.6 ktCO_2e reoccurring annually as a result of operations in the worst-case scenario. The total estimated GHG emissions are included in Table 18.19.

18.235 Prior to mitigation, construction and operation of HNFRI is estimated to give rise to approximately 584.0 ktCO_2e for all sectors. This figure represents 0.06% of the UK's 6th Carbon Budget, more specifically, 0.34% of the specific budget for 2036 (170,000 ktCO_2e), which is considered to result in a **permanent moderate adverse** effect. In accordance with the methodology for determining significance, this is considered to be a significant impact in EIA terms.

Table 18.19: Estimated total GHG emissions (unmitigated)

Emissions Source	**Total Emissions (ktCO_2e)**
Construction	341
Operational Vehicles (per annum)	167 (saving of 193.7 ktCO_2e from road to rail)
Energy (per annum)	11.2
Rail (per annum)	78.4
Total	**597.6**

Assessment of the resilience of HNRFI to climate change

18.236 The potential climate and weather-related impacts on HNRFI receptors during operation are included as Table 18.6.1 in Appendix 18.6 (document reference 6.2.18.6). Unless stated, the effects identified are only expected to impact receptors located on the Main HNRFI Site. Table 18.8.1 of Appendix 18.8 (document reference 6.2.18.8) outlines the embedded mitigation measures that have been integrated into the design and construction methodology of HNRFI in order to improve the resilience of HNRFI to the potential impacts identified.

18.237 HNRFI has been designed, as far as possible, to avoid and minimise impacts and effects relating to GHG and climate change through the process of design-development and by embedding mitigation measures into the design and the supporting Design and Access Statement (document reference 8.1).

18.238 Measures include best practice design measures and mitigation associated with the conservation of ecological assets and flood risk protection.

18.239 The significance of climate impacts depends on the likelihood of them occurring and the consequence if they do occur.

18.240 The anticipated future climate, as set out in the 'Future Baseline' section of this Chapter, was considered when assessing the significance of climate impacts.

18.241 The assessment has assumed that rail infrastructure will be designed with due consideration given to UKCP18 under RCP 8.5. It is also assumed that the management and maintenance of rail infrastructure would consider future IPPC reports and updated climate projections.

18.242 Table 18.9.1 of Appendix 18.9 (document reference 6.2.18.9) presents the outcome of the significance assessment (taking account of the embedded mitigation measures as described in Table 18.8.1 of Appendix 18.8, document reference 6.2.18.8). The effects relate to operation unless specifically stated.

18.243 With the embedded mitigation measures described in Table 18.8.1 of Appendix 18.8 (document reference 6.2.18.8), it is considered that climate change would likely have **no significant impacts** on HNRFI.

PROPOSED MITIGATION

18.244 Adaptation and mitigation are complementary strategies for reducing and managing the risks of climate change. Many adaptation and mitigation options can help address climate change, but no single option is sufficient by itself[52]. The overarching principles for management of carbon emissions follows the process outlined in Figure 18.2. Where GHG emissions cannot be avoided, the assessment should aim to reduce the residual significance of a project's emissions at all stages – design, construction and operation.

Influence of HNRFI on climate change

18.245 A number of standard mitigation measures have also been embedded that are considered standard practice, these include Building Energy Management System (BEMS) to control the heating, lighting, ventilation, hot water supply and renewable energy interfaces in full accordance with the Chartered Institution of Building Services Engineers (CIBSE) guidelines to control the use of and save energy.

18.246 Prior to their implementation, the energy efficiency and sustainability measures will be

[52] *IPCC (2014): Climate Change 2014 Synthesis Report.*

assessed for suitability, technical review, installation costs, running costs, payback periods and plant space availability. The materials demand of the development will be addressed by maximising the use of reclaimed and recycled materials where practicable throughout the construction process. This will be considered in the early detailed design stages and written into the building specifications. The demand upon the development for the provision of recycling and waste storage will be addressed in the early detailed design stages and when detailed discussions can be held with prospective operators regarding the specific operations of the proposed units. In addition, recycling and waste will be considered for the Construction Stage. Provision has been made in the scheme for the inclusion of recycling and waste storage / compaction within the identified service areas.

Construction stage

18.247 This commitment by TSH to deliver net-zero buildings should not be underestimated and will result in a significant reduction in embodied carbon sources during construction. Therefore, opportunities for further reduction will be encouraged and captured through the incorporation of carbon targets within the procurement process. In light of the above, emissions associated with construction of HNRFI are not anticipated to materially affect the ability of the UK to achieve its carbon reduction targets, and thus are not predicted to have a significant effect on the global climate.

18.248 A framework Construction Environmental Management Plan (CEMP) supports the DCO for HNRFI. The Framework CEMP will include all best practice measures. Best practice mitigation measures should be included in the Framework CEMP to reduce emissions during construction, including from construction plant, for example:

- Training employees in how to handle machinery to reduce GHGs;
- Switching off machinery and vehicles when not in use;
- Regular maintenance of machinery to ensure they work efficiently;
- Using electric or alternative low/zero carbon emission machinery where possible;
- Reducing water consumption where possible; and
- Using efficient vehicles and machinery where possible.

18.249 A Construction Traffic Management Plan (CTMP) (document reference 17.6) will minimise and mitigate the environmental impacts of construction activities, including the reduction of GHG emissions.

18.250 During the demolition of on-site structures, the re-use, recycling and reduction of construction waste will be promoted to reduce HNRFI's overall carbon footprint by reducing the need to extract raw materials. This management of waste has been set out in the Site Waste and Materials Management Plan (SWMMP, document reference 17.3).

Indirect sources

18.251 As construction is likely to result in indirect GHG emissions, it is important to consider mitigation measures for the construction stage of HNRFI to reduce emissions associated with construction methods and embodied emissions in construction materials.

18.252 TSH are a Gold Leaf member of UKGBC and as part of this carbon offsetting, TSH will adopt an approach to the measurement of residual carbon output which accords with the UKGBC's framework definition for net zero carbon in construction. TSH currently measures the carbon in construction of all new buildings, both during the design stage and at practical completion, and to ensure they achieve net zero for construction using UKGBC's net zero framework. According to the RIBA Stage 1 Embodied Carbon Report (Appendix 18.2, document reference 6.2.18.2), the post-construction (RIBA Stage 6) phase, as-built verification of the embodied carbon for the logistic units will form the basis of the TSH Net Zero Carbon 'In Construction' declaration for each building.

18.253 Embedded emissions of HNRFI will be calculated at each stage of design as it develops to ensure that it is meeting its project specific targets and legal requirements including Building Regulations Part L and to seek to achieve a BREEAM 'Very Good' rating. This will consider both operational CO_2 emissions affected by design and embodied carbon. HNRFI will consider sourcing building materials from sustainable and, where possible, local sources whilst restricting materials which cause environmental harm. Ultimately, this strategy will reduce the overall carbon footprint and lead to a potential reduction in GHG emissions associated with HNRFI over its lifetime.

18.254 The following also form principal considerations of the proposed design and function:

- The re-use, recycling and reduction of any construction waste should be promoted to reduce HNRFIs overall carbon footprint by limiting the need to extract raw materials;
- Mechanisms will be established for designing out waste, reducing waste generated on-site, assessing the value of reusing or recycling materials and for reducing construction waste, and implementing procedures to sort and reuse/recycle construction waste on and off-site. The SWMMP (document reference 17.3) is consistent with the CEMP and, as such, assist in achieving the BREEAM credits as required; and
- Prioritise the procurement of high quality, durable, ethical and sustainable materials (from local sources where appropriate) to reduce lifetime embodied carbon emissions of the building process.

18.255 Typical measures to mitigate waste in a SWMMP during construction include providing adequate capacity for the storage and reuse or disposal of recyclable materials.

18.256 Standard practice measures should be employed to reduce carbon emissions associated with building materials include:

- Ordering materials at appropriate times and appropriate storage of materials to avoid waste;
- Utilising a less carbon-intensive alternative to cement in concrete;

- Increasing the use of low carbon products in lieu of high carbon materials, such as steelwork; and
- Liaising with contractors and suppliers to engage in their research to reduce embodied carbon.

18.257 Further to the above, a life cycle assessment should be undertaken during the detailed design stages to inform the selection of materials for the projects. There are a range of tools available considered best practice to undertake this assessment, including the BRE Green Guide to Specification.

18.258 By considering the effective mitigation measures, including the choice and procurement of building materials, it is expected that emissions from indirect sources of GHGs during construction will be greatly reduced.

Operational phase

Direct emissions

18.259 It is expected that CO_2 emissions will decrease gradually over HNRFI's operational lifetime to account for Government standards and polices and industry trends as the proportion of hybrid and electric vehicles on the road will increase and petrol and diesel vehicles are phased out with new vehicles meeting progressively tighter European type approval emissions categories, referred to as 'Euro standards'. This in turn, could limit the effects on the tropospheric ozone and lead to a cooling effect, while the effect of reduced NO_X may also limit overall effects on warming. The increase in electrical vehicles may also result in a decrease of direct emissions, though it will in turn increase the demand on the national grid where indirect emissions may result depending on the energy source.

18.260 As stated in the DfT's NPS for National Networks, SRFIs are favoured in government policy for their ability to provide sustainable development through the reduction of transport-based GHG emissions by encouraging a modal shift of freight from road to rail. Furthermore, this modal shift will help to reduce traffic congestion and improve air quality in the wider East Midlands region.

18.261 HNRFI includes a package of transport and access improvements which will help reduce GHG emissions associated with the transport of employees to and from the Main HNRFI Site during the operational phase. This includes provision of high quality, safe and convenient walking and cycling routes permeating through the Main HNRFI Site and a Framework Site Wide Travel Plan (document reference 6.2.8.2) for the operational phase which minimises and mitigates GHG emissions associated with staff vehicle movements. Other examples of mitigation could include increasing the efficiency of plant by procuring cleaner equipment, phasing out fossil fuels by switching to low-carbon energy vehicles and plant and championing the use of sustainable transport types.

18.262 The degree of reduction in emissions is dependent on the final design of HNRFI and future occupiers. Mitigation can be more cost-effective if using an integrated approach that combines measures to reduce energy use and the GHG intensity of end-use sectors, procure low-carbon energy and reduce net emissions. The implementation of some or all of the options above, where appropriate, will lead to an overall reduction in GHG emissions associated with HNRFI over its lifetime.

Energy

18.263 A feasibility assessment of low and zero carbon (LZC) technologies was carried out as part of the Energy Strategy. According to this assessment, the most suitable technologies for HNRFI were found to be:

- PV panels which feed into a sitewide microgrid;
- The installation of battery storage technology once building energy use data is understood;
- Combined Heat and Power (CHP), which is only a renewable source when it is powered by biofuel or hydrogen, to provide resilience in terms of power supply; and
- Air source heat pumps.

18.264 The Energy Strategy determined that 47,930 MWh (83%) of the yearly energy demand (in the worst case) on the Main HNRFI Site will be met by solar PV. Where there is a shortfall in terms of PV energy output, additional energy will be made up through an on-site battery storage system once building load profiles are known. As a last resort for situations such as a grid fault, and to provide resilience to building occupiers, a CHP energy centre will be used. The energy centre could also be used to provide heating via a district heat network should there be a demand on site. For example, heating may be provided to the warehouse areas of a building but typically to a temperature of 16^{o}C. It should be noted that by the time HNRFI would be operational, any CHPs would be hydrogen ready and would be capable of operating on 100% hydrogen as grid gas is decarbonised in accordance with Government policy, thus reducing the GHG emissions associated with the use of this source compared to its current use.

18.265 Further to the above, HNRFI would require a connection to the UK National Grid even though it is not expected that energy would be procured from it. In the event that energy is required from the National Grid, it is likely to be procured from a green energy provider. Moreover, the UK National Grid is expected to be greatly decarbonised by the time HNRFI is operational.

18.266 Based on the above, Table 18.20 sets out the amount of CO_2e that would be saved due to the energy produced on-site from solar PV (9.27 ktCO_2e). As mentioned above, the shortfall of 1.96 ktCO_2e is anticipated to be alleviated via the on-site battery storage.

Table 18.20: Carbon savings due to PV provision

Energy Demand	MWh/yr	UK Grid carbon emissions factor ($kgCO_2e$ / kWh)	Estimated annual Carbon Emissions ($ktCO_2e$)
Annual Predicted Energy Demand	58,088	0.19338	11.23
Expected Yearly Demand Provided by PV	47,930		-9.27
Shortfall	10,158		1.96

18.267 No details on how the reduction of unregulated emissions would be achieved are available at this stage. Unregulated energy includes small power electricity use (computers, plug in devices) and catering energy consumption. Currently, unregulated energy is not included within the guidance due to the difficulty in accurately predicting the likely consumption. Whilst it is considered that unregulated energy could form a significant part of overall energy consumption and CO_2 emissions it is considered negligible in the context of HNRFI as a whole.

Sustainable credentials

18.268 HNRFI will consider measures to conserve water during operation, which increases HNRFI's resilience to future temperature rises and potential droughts as a result of climate change. The Energy Strategy (Appendix 18.1, document reference 6.2.18.1) states that '*the site will have a low anticipated requirement for hot water except for hand wash sinks in toilets and teamaking areas and occasional shower usage*'.

Indirect emissions reduction / carbon savings

18.269 TSH has committed to constructing energy efficient buildings with the intention of delivering sustainable development. To achieve this, they require all new projects to, at a minimum, achieve the following Green Building Certification standards:

- BREEAM: Very Good;

- DGNB[53]: Gold;
- LEED[54]: Silver; and
- EPC[55]: B or equivalent country operational energy performance standard.

18.270 Around 75% of an industrial unit's heat is lost through the building fabric therefore taking a 'fabric first'[56] approach is fundamental to the energy performance of a building. Improving and maintaining the building fabric offers many advantages and opportunities[57], including:

- reduced energy and maintenance costs;
- better temperature control and thermal comfort for occupants;
- lower capital expenditure (a more efficient, well-insulated building requires smaller heating and cooling systems, or even none at all);
- sound investment (better insulation or well-maintained/modified building fabric can increase a building's value and aesthetics); and
- compliance with regulation.

18.271 According to the Energy Strategy (Appendix 18. 1, document reference 6.2.18.1), a range of energy efficiency measures will be implemented within HNRFI in accordance with the energy hierarchy, which encompasses the adoption of a fabric first approach (passive design measures) and energy efficient building servicing (active design measures). These measures would ensure compliance with Building Regulations Part L 2021 (Volume 2) in relation to GHG emissions rates.

18.272 The passive design measures which would be incorporated into the design of HNRFI include the following:

- Efficient building envelope with enhanced U-values beyond the Part L, Volume 2 (2021

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[53] German Green Building Council's certification system for sustainable construction.

[54] Leadership in Energy and Environmental Design rating system for sustainable construction. It is the US Green Building Council's most widely used rating system and provides a framework for healthy, highly efficient and cost-saving green buildings.

[55] Energy Performance Certificates which rate how energy efficient your building is using grades from A to G.

[56] The building fabric refers to the roof, walls, windows, floors and doors of a building.

[57] Carbon Trust: Building Fabric; Energy saving techniques to improve energy performance of buildings.

edition) limiting values;

- Enhanced air permeability to reduce heating demand in the winter months;
- Glazed façades throughout to provide natural daylighting and reduce reliance on artificial lighting; and
- Balanced g-value for translucent elements to ensure optimised internal conditions in the winter and summer months but reduce the risk of overheating in the summer months.

18.273 The active design measures which would be incorporated into the design of HNRFI include the following:

- Dedicated high efficiency mechanical ventilation heat recovery systems to serve office areas;
- High efficiency LED lighting to reduce electrical consumption and heat gains from lighting;
- Passive infrared (PIR) presence detection and daylight dimming control for lighting within the office core and warehouse space; and
- The installation of energy metering and sub-metering in all buildings to comply with Building Regulations Part L (2021) to facilitate automatic metering and targeting. This would provide data upon which occupiers can better manage their specific needs. The outputs of all renewable energy systems will be separately monitored.

18.274 Further to the above, a maximum air permeability of 3.0 $m^3/h.m^2$ @50 pascals (Pa), which is an improvement upon the standard Part L2A (2021) value of 8.0 $m^3/h.m^2$ @50Pa.

18.275 Beyond measures detailed in the Energy Strategy (Appendix 18. 1, document reference 6.2.18.1), the following standard practice measures will also be included in the design of the operational phase of HNRFI:

- implementing facilities to support EV charging for future occupiers;
- minimise the use of finite sources and use renewable sustainable elements instead;
- develop a green transport plan in collaboration with local councils;
- providing recycling facilities; and
- use recycled components wherever possible.

18.276 A focus on making consumption from businesses greener and more efficient will be an important part of the move towards a low carbon future. The CO_2 emissions of HNRFI will be calculated at detailed design to ensure that it is meeting legal requirements including

Building Regulations Part L.

18.277 Product and service footprint assessments, including life cycle assessments of the associated carbon emissions, are rapidly becoming an integral part of new development and eco-design. By assessing the environmental impacts of a product/service throughout its entire life cycle, the occupant will be able to identify 'hot-spots' for cost and emission reductions as well as support in developing environmental product declarations. Once implemented, well designed and managed Energy Strategies, Emissions Strategies and Environmental Management Systems (EMS) can help occupiers understand and reduce the environmental impact of their operations over the life-cycle of HNRFI as well as increasing the image and bettering the corporate and social responsibility of a business.

18.278 Emissions associated with water use and waste management are expected to comprise a very small percentage of GHG emissions. Measures recommended within the Energy Strategy are likely to minimise emissions due to water consumption, whilst emissions stemming from waste are likely to be reduced through measures in the SWMMP. Measures that are usually recommended in SWMMP to reduce waste during operation include:

- Ensuring there is adequate provision of both recyclable and non-recyclable facilities within a development; and
- Making recommendations on the location and design of waste facilities to ensure they are secure and used as much as possible.

Resilience of HNRFI to climate change

Construction stage

18.279 The impacts of climate change on HNRFI during the construction stage would be managed through the outline CEMP, which would contain detailed procedures to mitigate any potential impacts associated with extreme weather events, as listed in Appendix 18.6 (document reference 6.2.18.6). This will compliment best practice mitigation measures employed in the construction industry.

18.280 Construction contractors will use a short to medium-range weather forecasting service from the Met Office, or other approved meteorological data and weather forecast provider, to inform short to medium-term programme management, environmental control and impact mitigation measures.

18.281 The lead contractor will ensure appropriate measures within this outline CEMP are implemented and, as appropriate, additional measures to ensure the resilience of the proposed mitigation of impacts during extreme weather events.

18.282 The lead contractor’s Environmental Management System will consider all measures deemed necessary and appropriate to manage extreme weather events and should specifically cover training of personnel and prevention and monitoring arrangements. As appropriate, method statements should also consider extreme weather events where risks have been identified.

18.283 Table 18.21 details examples of mitigation measures for each of the identified receptors during the Construction Stage.

Table 18.21: Mitigation measures to protect receptors during the construction stage

Receptor	**Mitigation**
Substructure / Built Structures	Stormwater management system, including water tanks to store water for drought events, to reduce risk of flooding and subsidence; Vegetation planting to improve slope stability; Appropriate storage of construction materials when not in use to prevent drying out; Good design and earthwork failure monitoring; Establish a fire safety manual; Provision of lightning rods on built structures; and Appropriate ventilation to reduce humidity.
Landscaping / Habitats	Provision of guidance on ecological best practice methods to be followed in order to mitigate potential ecological effects during construction; Ensure potential on-site flood risk does not occur near sensitive ecological receptors; and Ensure pollutants do not migrate to sensitive areas during heavy rainfall events.
Roads, Pedestrians and Cycleways	Ensure construction activities do not increase flood risk on travel infrastructure; and Erect temporary fencing where appropriate to protect pedestrians and cyclists from heavy winds.
Rail	Trench excavation alongside rail line to protect from flooding.

Receptor	Mitigation
Ancillary Equipment	Stormwater management system to stop drain blockage and water accumulation during heavy rainfall; Provide shading for equipment during heatwaves; Provide buffers to block heavy winds at wind-sensitive receptors; and Ensure power supply and other linked infrastructure is appropriately located to avoid damage/disruption.
Employees and Users / Operators	The Principal Contractor will ensure that: • Adequate breaks are taken during hot weather; • Drinking water is readily available; and • Provision for areas to shelter during extreme rainfall events.

Operational phase

18.284 As no significant effects have been identified during operations, no monitoring of significant effects is proposed. End-users should however consider their individual effects and, where feasible, monitor annual emissions to better understand their impacts and identify potential savings and betterment as contributors and under best practice. No other specific monitoring activities would be required.

18.285 Adaptation and resilience to climate and weather-related risks would be considered periodically through maintenance regimes. A schedule of general inspections and principal inspections of each structure should be carried out to determine condition of the structure and identify any potential maintenance requirements. In addition, a list of extreme weather-related incidents (for example, road surface deformations, snow and ice, etc.) should be maintained by the occupant to assist in identifying thresholds which, when exceeded, would require maintenance. Where not specifically identified as embedded mitigation measures, The following measures to increase the resilience of HNRFI should be implemented appropriately through requirements in the DCO (it should be noted that some of these measures may already be embedded within HNRFI):

- emergency response and contingency plans in place;

- ensure effective, essential winter maintenance;
- regularly reviewed and updated winter maintenance plans;
- regular inspection of building structures, road and infrastructure and pedestrian / cycle ways to detect deterioration and damage;
- standard operating procedures in place for use in the event of necessary road/rail closure and/or traffic diversion;
- use of construction materials which offer increased tolerance to fluctuating temperatures;
- road user warning systems in place in areas exposed to high winds;
- regular sweeping and cleaning to remove debris;
- effective vegetation maintenance;
- regular maintenance and cleaning of all estate drainage systems; and
- implementation of measures within the Landscape Ecological Management Plan (LEMP) (document reference 17.3) and the Ecological Mitigation and Management Plan (EMMP) (document reference 17.6) to maintain the resilience of landscaping.

18.286 HNRFI will employ Sustainable Urban Drainage Systems (SuDS) and other flood risk minimisation measures to mitigate the impact of heavy precipitation events.

RESIDUAL ENVIRONMENTAL EFFECTS

Influence of HNRFI on climate change

18.287 Table 18.22 shows the likely residual impacts following the implementation of mitigation measures.

Table 18.22: Likely residual effects post mitigation

Emissions Source	Total Emissions ($ktCO_2e$)
Construction (of buildings, inclusive of Main HNRFI Site, Rail Terminal and highways infrastructure)	
Pre-Mitigation	**341**
Post Mitigation	**13.7**
Residual	**13.7**
Operational Vehicles	
Pre-Mitigation	167/yr
Post Mitigation	167/yr
Residual	**167/yr**
Energy	
Pre-Mitigation	11.2/yr
Post Mitigation	1.96/yr
Residual	**1.96/yr**
Rail	

Emissions Source	Total Emissions (ktCO_2e)
Pre-Mitigation	78.4/yr
Post Mitigation	78.4/yr
Residual	**78.4/yr**
Total Operational Per Annum	**247.36**

18.288 Commitments to reasonable and deliverable measures to reduce emissions in accordance with relevant policy and guidance have been outlined. Following the mitigation measures that are to be employed, HNRFI is not expected to result in residual GHG emissions following the construction stage as a result of TSH's commitment to monitor and offset construction emissions. It is however anticipated that there will be a residual emission of 13.7 ktCO_2e associated with embodied carbon for the highway works during the Construction Stage, whilst operations will result in a residual annual emission of approximately 247.36 ktCO_2e. Considering the commitments to design and mitigation that have been made by TSH, it is concluded by the practitioner that it has been demonstrated that such measures are *'fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type'.* Furthermore, in accordance with the significance criteria, a notional residual effect of approximately 247.36 ktCO_2e would not inhibit commitments necessary to achieve the UK's trajectory towards net zero as they represent less than 1% of both the representative target for 2036 and the total UK's 6th Carbon Budget, which constitutes a **non-significant effect** (**minor adverse)**.

18.289 It is important to reconsider, however, that given the outline nature of the design and some preliminary data sets, non-quantifiable means that will better HNRFI's performance have not been considered. These include, but are not limited to, the following means:

- Decarbonisation of the energy grid: despite pledges to decarbonise the national energy grid by 2035, a significant strategy for both public and private entities has yet to be presented. That being said, the National Grid in the UK is decarbonising year on year; the commitment to stop burning coal in power stations by 2023 and the uptake in solar and heat transfer using heat pumps linked to ground and air source energy is bettering performance. It is also anticipated that decarbonisation of the supply chain will occur over time as better more efficient technology will also reduce emissions associated with grid exchanges as well as the corporate responsibility of private energy companies migrating to greener fuel types. Decarbonisation of the rail network: though HNRFI will future proof and encourage operators to transition to renewable energy sources, the increase in electric and/or hydrogen locomotives has not been appraised due to market uncertainties and it being the choice of the operator; and

- Decarbonisation of the road network: the Government's Transport Decarbonisation Plan puts Britain on a trajectory to do the same for heavy goods vehicles from 2040. TSH's commitments will help roll out solutions to decarbonise HGVs, and support the uptake of electric cars and vans sooner. However, despite the investment by TSH to encourage the use of both private and commercial Evs and to futureproof the scheme for a 100% renewable network, the effects of this network have not been assessed due to market uncertainties.

18.290 Continuing to pro-actively monitor and identify ways to reduce GHG emissions associated with the supply chain will be undertaken by the Applicant in support relating to HNRFI. Although not the applicable National Policy Statement (NPS) for this development, the 2021 draft overarching NPS for Energy (EN1) notes under paragraph 15.3.10 that steps taken to minimise and offset emissions should be set out in a GHG Reduction Strategy. Though this does not diminish TSH's commitment to achieving a net-zero construction, it is recommended that given the outline nature of the assessment, it is considered that a GHG Reduction Strategy should be drafted at a time considered practicable when a detailed design is available.

Resilience of HNRFI to climate change

Construction stage

18.291 Due to the anticipated length of the Construction Stage, it is not anticipated that there would be any significant effects as climate extremes are unlikely to deviate beyond the climate experienced in the local area in the recent past.

Operational phase

18.292 As shown in Table 18.9.1 of Appendix 18.9 (document reference 6.2.18.9), the assessment of the resilience of HNRFI to climate change during the operational phase determined that there would be no significant effects. Mitigation measures have been recommended to bolster the resilience of the identified receptors.

CUMULATIVE AND INCOMBINATION EFFECTS

Influence of HNRFI on climate change

18.293 GHG emissions are inherently cumulative for the following reasons:

- the environmental impact arising from GHG emissions is the aggregation and increased concentration of GHGs within the atmosphere, and the resulting warming effect this causes;

- the location of the emissions source is not relevant to the impact arising from it; any development leading to GHG emissions has the same impact regardless of its location; and
- the climate change impacts on a given location arise from the aggregated GHG levels in the atmosphere, not from the magnitude of GHG emissions in the local area.

18.294 Given this, the identified receptor is the global atmosphere as the effects of GHG emissions are not geographically constrained. As all development emits GHGs, each has the potential to result in a cumulative effect on climate change. For this reason, it is not possible to define a study area and carry out a cumulative effects assessment for GHG emissions. As a result, consideration of the effects of HNRFI, together with other developments on GHG emissions, is not considered to be applicable. This accords with IEMA Guidance[14].

18.295 The predicted GHG emissions of cumulative schemes are not known at this stage. Furthermore, the cumulative GHG emissions would not just be limited to the cumulative schemes as the receptor of the GHG emissions assessment is the global climate, with the UK National Carbon Budget used as a proxy. Therefore, whilst any GHG emissions across the UK could be considered to have cumulative effects with the GHG emissions of HNRFI, the assessment methodology has by default already covered this wider perspective.

18.296 It is considered that committed developments will have undertaken similar best practice appraisals and embedded mitigation into design to limit their respective effects on climate change.

Resilience of HNRFI to climate change

18.297 Projected changes to average climatic conditions, as well as an increased frequency and severity of extreme weather events have the potential to affect the ability of the natural environment surrounding HNRFI and surrounding schemes to adapt to climate change. Of the climate variables included in consideration for the assessment of resilience, only extreme precipitation events have been considered applicable due to the potential for excess surface water runoff from committed developments to enter the Main HNRFI Site or increase the demand on drainage infrastructure in proximity to the Main HNRFI Site.

18.298 No significant residual cumulative effects are anticipated as it is expected that any committed developments which gain approval would need to demonstrate that national and local policies related to flood risk and drainage, including accounting for climate change, are met prior to the granting of planning permission.

18.299 Full details of embedded design measures that reduce the likelihood or severity of in combination effects on receptors are detailed within the framework CEMP and other technical disciplines, such as those detailed in Chapter 9: *Air quality*, Chapter 10: *Noise and vibrat*ion, Chapter 12: *Ecology and biodiversity*, Chapter 14: *Surface water and flood risk* and Chapter 15: *Hydrogeology*. These measures are summarised within Appendix 18.8 (document reference 6.2.18.8).

18.300 Taking into account the design and mitigation measures already identified for HNRFI, it is concluded that climate change is not anticipated to change the significance of any effects for the environmental topics assessed.

In-combination Effects

18.301 Environmental receptors that have been identified as being potentially sensitive to the combined impacts of climate change and HNRFI have been assessed to consider the likelihood and consequence of an ICCI occurring. Conclusions of the ICCI assessment are provided in Table 18.23. None of the impacts related to climate change within other Chapters would change the significance of potential impacts considered within the Resilience Assessment. However, mitigation measures within the CEMP and standard landscaping measures have been discussed which will reduce the potential for these impacts to cause in-combination climate change impacts.

Table 18.23: In-combination Climate Change Impact Assessment

Environmental Topic	Receptor	Sensitivity	Potential Impact	Significance of Effect	Proposed Mitigation
Construction					
Air Quality	Local residents and habitats	Local residents and habitats and likelihood of droughts / heatwaves. Stronger prevailing winds.	Increased risk of soil erosion from working areas/ stockpiles. Increase in dust.	Not Significant	Best practice measures for dust abatement outlined in the CEMP.
Terrestrial Ecology / Biodiversity & Soils	Soils and habitats.	Increased in mean temperatures and likelihood of droughts / heatwaves. Increase in rainfall intensity.	Degradation / loss of habitats and soil resources.	Not Significant	The CEMP includes measures such as minimising the area and duration of soil exposure and timely reinstatement of vegetation or hardstanding to reduce soil exposure/ erosion.
			Reduced success of establishment of new planting as part of the restoration of temporary	Not Significant	Landscaping/ species choice resilient to climate change. The timing of planting to align with spring and/or late

Environmental Topic	Receptor	Sensitivity	Potential Impact	Significance of Effect	Proposed Mitigation
			associated development sites due to hotter drier conditions.		autumn where rainfall would naturally irrigate.
Noise	Local residents and habitats	Local residents and habitats.	Increase in temperatures would very slightly affect the speed of sound and noise propagation, but this would be very minor compared to day-to-day variability due to wind speed/direction and humidity.	Not Significant	The CEMP includes measures for controlling and monitoring noise during construction.
Ground conditions / Water	Soils, surface and groundwater quality.	Increase in winter precipitation rate Increase in mean summer air temperature. Decrease in annual precipitation rate.	Increase in risk of contamination leaching from soils from precipitation and being carried within soils overland with heavier precipitation events and flooding. Increased evapotranspiration	Not Significant	The CEMP provides details of how soils should be restored, including the measures to be employed to apply soil amendments and to prevent them washing off (for example mixing the materials into the topsoil rather than as a surface addition).

Environmental Topic	Receptor	Sensitivity	Potential Impact	Significance of Effect	Proposed Mitigation
		Decrease in summer precipitation rate	leading to lower water table unable to support groundwater dependent ecosystems		
Operation					
Noise	Local residents and habitats	Local residents and habitats.	Increase in temperatures would very slightly affect the speed of sound and noise propagation, but this would be very minor compared to day-to-day variability due to wind speed/direction and humidity.	Not significant	Monitoring and modelling has identified mitigation measures, such as acoustic barriers, that will reduce exposure to noise.
Landscape and Visual Impact	Local residents and commuters	Increased in mean temperatures and likelihood of droughts / heatwaves.	Reduced success in establishment of new planting and longevity of existing established trees.	Not significant	Consideration will be given to the potential effects of climate change on the selection of species for proposed planting and the

Environmental Topic	Receptor	Sensitivity	Potential Impact	Significance of Effect	Proposed Mitigation
					management of new and existing planting
Ecology / Biodiversity	Soils and habitats	Increase in volume of water in short periods.	Rainfall is likely to be more extreme, larger volumes compressed into shorter times with the potential to flood.	Not significant	Maintain permeability of land, planting of trees that can attenuate up to 60 times more than grassland alone. SDS designed to attenuate rainfall, including projections accounting for climatic change.
Flood risk	Soils and habitats / local residents	Impermeability of superstructure and land.		Not significant	
Ground conditions / Water	Soils, surface and groundwater quality.	Increase in winter precipitation rate Increase in mean summer air temperature. Decrease in annual precipitation rate. Decrease in summer precipitation rate	Increase in risk of contamination leaching from soils from precipitation and being carried within soils overland with heavier precipitation events and flooding. Increased evapotranspiration leading to lower water table unable to support	Not significant	The SDS sets out pollution prevention measures and accounts for increased flows resulting from climate change.

Environmental Topic	Receptor	Sensitivity	Potential Impact	Significance of Effect	Proposed Mitigation
			groundwater dependent ecosystems		

SUMMARY AND CONCLUSIONS

18.302 An assessment of the following was undertaken using IEMA guidance[14,15]:

- the influence of HNRFI on climate change; and
- the resilience of HNRFI to climate change.

Baseline conditions

18.303 Information on baseline conditions were gathered from a range of sources including:

- UKCP18;
- Weather-related websites;
- Data on embodied carbon in construction materials from Ridge and Partners LLP;
- Traffic data from the appointed Transport Consultant (BWB Consulting Ltd);
- Energy-related data for the operational phase from MBA Consulting Engineers; and
- Rail-related data from Baker Rose Consulting.

Likely significant effects

Influence of HNRFI on climate change

18.304 The assessment has given proportionate consideration to whether and how HNRFI will contribute to or jeopardise the achievement of the targets identified. For the avoidance of doubt, a 'minor adverse' or 'negligible' non-significant effect conclusion does not necessarily refer to the magnitude of GHG emissions being carbon neutral (i.e. zero on balance) but refers to the likelihood of avoiding severe climate change, aligning project emissions with a science-based 1.5°C compatible trajectory, and achieving net zero by 2050. As IEMA (2022) stipulate; '*When evaluating significance, all new GHG emissions contribute to a negative environmental impact*, [however], *the crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline*'.

18.305 The effects of GHG emissions were assessed across both the construction Stage and operational phase. Prior to mitigation, it is considered that HNRFI would lock in emissions and would not be compliant with do-minimum standards set through regulation or make a meaningful contribution to the UK's trajectory towards net zero, resulting in a net **significant, moderate adverse, effect**.

18.306 Commitments to reasonable and deliverable measures to reduce emissions for both construction and operation in accordance with relevant policy and guidance have been outlined. Considering the commitments to design and mitigation that have been made by TSH, it is concluded that such measures are '*fully consistent with applicable existing and* *emerging policy requirements and good practice design standards for projects of this type'.* However, there will be a residual emission of 13.7 ktCO_2e associated with the highways infrastructure during the Construction Stage. Furthermore, though HNRFI would result in a net residual effect of approximately 247.36 ktCO_2e per annum, it is considered that this would not inhibit commitments necessary to achieve the UK's trajectory towards net zero as they represent less than 1% of both the representative target for 2036 and the total UK's 6th Carbon Budget, which constitutes a **non-significant minor adverse impact**.

Resilience of HNRFI to climate change

18.307 Due to the anticipated length of the Construction Stage, it is not anticipated that there would be any significant effects as climate extremes are unlikely to deviate beyond the climate experienced in the recent past. However, mitigation measures have been recommended to improve resilience to the effects of extreme weather.

18.308 Following the consideration of embedded mitigation measures, as set out in Appendix 18.8 (document reference 6.2.18.8), the assessment of the resilience of HNRFI to climate change (Appendix 18.9, document reference 6.2.18.9) during the operational phase determined that there would be no significant effects. Mitigation measures have been recommended to bolster the resilience of the identified receptors.