17. Climate Change

Introduction

17.1 This chapter identifies and assesses the likely effects of the proposed development on climate change (i.e. greenhouse gas/carbon emissions) and how to minimise the impact through mitigation. It also considers how the proposed development adapts to a changing climate, how other EIA topics and sensitive receptors could be affected, and how resilience can be designed into the proposed development. The report is written to support an outline planning application for a mixed use development in Penwortham, South Ribble, England.

17.2 The climate change assessment will be presented in two parts within this chapter:

1. **Assessment of Impacts:** A conventional impact assessment that will focus on the potential effects of the proposed development (i.e. greenhouse gas (GHG) emissions on the climate); This will include an overview of how the proposed development aids in the mitigation of climate change; and

2. **Assessment of Climate Resilience:** A review of the resilience of the proposed development to the potential effects arising from projected changes in future climate. This will include a qualitative discussion of the vulnerability and sensitivity of the proposed development to climate change impacts, with an assessment of the magnitude of effects.

17.3 The chapter describes the methods used to assess the impacts, the baseline conditions currently existing at the site and surroundings, the potential direct and indirect impacts of the development arising from climate change, the mitigation measures required to prevent, reduce, or offset the impacts and the residual effects. It has been written by Wardell Armstrong.

17.4 This Chapter and its associated figures are not intended to be read as a standalone assessment and reference should be made to the front end of this ES (Chapters 1 – 6), as well as Chapter 18 'Cumulative Effects' and Chapter 19 'Summary of Mitigation and Residual Impact'.

17.5 Within this chapter "the Site" refers to land that falls within the application boundaries A and B as identified in the Site Location Plans (**Figure 1.1** and **Figure 1.2**).

Planning Policy Context

Legislation

Climate Change Act 2008

17.6 The Climate Change Act 2008 establishes the framework for the UK to set and deliver greenhouse gas emission reduction targets; mainly through the establishment of the Committee on Climate Change which ensures targets are evidence based and independently assessed. The Act commits the UK government to reduce greenhouse gas emissions to a minimum of 80% below 1990 baseline levels by 2050. In 2019, this target was amended to be more ambitious and now the commitment is to reduce greenhouse gas emissions to a minimum of 100% below 1990 baseline levels by 2050 – Net Zero. In addition to this, the Government is also required to regularly report on emission target progress, assess the risks and opportunities to the UK associated with climate change, and develop preparation and adaptive plans for these.

17.7 Through the UK Government's latest Nationally Determined Contribution (NDC) to global climate change, there is a commitment to reduce emissions by at least 68% by 2030 (compared to 1990 levels). In April 2021, the UK Government set into law a new ambitious climate change target to reduce emissions by 78% by 2035 (compared to 1990 levels).

17.8 The UK Climate Change Risk Assessment is required to be produced every five years under the Climate Change Act 2008, in order to look at the risks and opportunities arising for the UK from climate change. The 2017 series of reports, alongside other documents from the European Commission and National House Building Council Foundation are used in this chapter to assess potential vulnerabilities and adaptive potential of the proposed development and site regarding climate change impacts.

17.9 In June 2021, the Committee on Climate Change published an Independent Assessment of UK Climate Risk which offers advice to Government and will inform the next UK Climate Change Risk Assessment (known as CCRA3). The risks identified in this independent assessment have also been considered in this ES Chapter. The third UK Climate Change Risk Assessment (CCRA3) is expected to be published in 2022.

Town and Country Planning EIA Regulations 2017

17.10 On the 16th May 2017, the European Commission Environmental Impact Assessment Directive (2014/52/EU) was incorporated into English law under the Town and Country Planning (Environmental Impact Assessment) Regulations 2017. This legislation requires the consideration of climate change within an EIA. The key text in relation to climate change is provided below.

Schedule 3: Regulation 5(4)

1(f): "The characteristics of development must be considered with particular regard to the risk of major accidents and/or disasters relevant to the development concerned, including those caused by climate change, in accordance with scientific knowledge."

Schedule 4: Regulation 18(3) INFORMATION FOR INCLUSION IN ENVIRONMENTAL STATEMENTS

"A description of the likely significant effects of the development on the environmental resulting from, inter alia:" …

4: "A description of the factors specified in regulation 4(2) likely to be significantly affected by the development…climate (for example greenhouse gas emissions, impacts relevant to adaptation) …

5(f): "the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the proposed development to climate change"

Building Regulations

17.11 Parts of the subsequent discussion relate to energy use in buildings due to the direct relation with greenhouse gas emissions. Part L of The Building Regulations sets fabric energy efficiency standards, energy efficiency requirements and CO2e emissions limits for dwellings and non-residential buildings. Approved document 'L1A and L2A 2013 edition incorporation 2016 amendments' provide details on the assessment criteria and methodologies used to test whether buildings are compliant. Aside from any local planning policy requirements it must be demonstrated that a building is compliant with the building regulations to be approved by building control. These regulations are the government's key mechanism for reducing CO_2e emissions in buildings.

17.12 Calculations are undertaken using a prescribed methodology - the Standard Assessment Procedure (SAP). A Target Emissions Rate (TER) is calculated, which represents the minimum standard for a building of that size. A Dwelling Emissions Rate (DER) is then calculated which is an estimation of likely emissions for the development in question. The DER must not exceed the TER for a building to be compliant. In addition to the TER, fabric energy efficiency standards define the thermal performance limits of building elements such as walls, doors and roof.

17.13 Whilst these assessments are typically undertaken post planning when specification and information regarding mechanical and electrical systems have been produced, the regulations are significant to this assessment because it legally binds new buildings to be constructed to a minimum standard, which can be utilised as a baseline.

Future Homes Standard / Future Buildings Standard

17.14 In October 2019, consultation began on the Future Homes Standard (FHS) which outlines proposed improvements to Part L (conservation of fuel and power) and Part F (ventilation) of The Building Regulations applicable to new residential dwellings. The proposed changes include stricter energy efficiency, carbon emissions standards as well as the introduction of measuring a dwelling's 'primary energy use'.

17.15 On 19th January 2021, the Government published its response to the FHS consultation, at the same time as publishing a new consultation on 'Future Building Standards' (FBS). The FBS is a similar concept to the FHS, aimed at provoking decarbonisation in new non-residential and existing residential buildings. As part of the FBS, the Government is consulting on a preferred 27b% reduction in carbon emissions relative to Part L 2013 levels for non-residential buildings for the interim period, to facilitate the eventual realisation of zero-carbon buildings.

17.16 The FHS consultation response set out a clear timeline for the introduction of the FHS and the interim arrangements. It is intended (subject to the FBS consultation) that a new Part L 2021 (and Part F 2021) will be introduced towards the end of 2021 and come into effect during 2022. This will formally instigate the interim arrangements for both residential and non-residential developments. Buildings approved prior to June 2022 and commenced prior to June 2023 will remain eligible to be built out under Part L 2013, but this will only apply to individual units not a site in its entirety.

17.17 The consultation response also confirmed the Government's intention that Part L 2021 will apply the 31% emission reduction interim uplift target over Part L 2013 for residential development, moving to a more stringent75%- 80% emissions reduction target for all buildings by 2025.

Electric Vehicle Infrastructure

17.18 In 2019, the UK Government began consultation on adding a new Part S to the English Building Regulations, relating to requirements for electric vehicle (EV) charging infrastructure in new buildings and buildings undergoing material change of use and major renovation.

17.19 The policy position relevant to the proposed development, if adopted, would require:

- Every new residential building with an associated car parking space to have a charge-point. This also applies to buildings undergoing a material change of use to create a dwelling;
- Every residential building undergoing major renovation with more than ten car parking spaces required to have cable routes for electric vehicle charge-points in every car parking space;
- Every new non-residential and every non-residential building undergoing a major renovation with more than ten car parking spaces required to have one charge point and cable routes for an electric vehicle charge point for one in five spaces.

17.20 In addition, the government proposes a requirement of at least one charge-point in existing non-residential buildings with more than twenty car parking spaces, applicable from 2025.

17.21 The proposed specifications are set out in the 'Annex C - Draft technical guidance for Building Regulations requirements for EV charging' document issued in 2019.

17.22 The Proposed Development will need to consider the FHS and FBS reduction requirements as well as provision for EV charging infrastructure within the boundaries of the Site to ensure compliance with the proposed changes to the Building Regulations as outlined above.

National Planning Policy

National Planning Policy Framework

17.23 The policies within the NPPF relevant to climate change can be found in chapter 14 'Meeting the challenge of climate change, flooding and coastal change'. Those most specific to this assessment are detailed below:

17.24 Paragraph 152: *"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 greenhouse gas 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."*

17.25 Paragraph 153: *"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure."*

17.26 Paragraph 154: *"New development should be planned for in ways that: a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards."*

17.27 Paragraph 155: *"To help increase the use and supply of renewable and low carbon energy and heat, plans should: a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts); b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers."*

17.28 Paragraph 157: *"In determining planning applications, local planning authorities should expect new development to: a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not*

feasible or viable; and b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption."

17.29 Paragraph 161: *"All plans should apply a sequential, risk-based approach to the location of development – taking into account the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by: a) applying the sequential test and then, if necessary, the exception test as set out below; b) safeguarding land from development that is required, or likely to be required, for current or future flood management; c) using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques); and d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations."*

Any Other Relevant National Planning or Development Strategies

17.30 Supplementary planning guidance on climate change was issued in 2014 with the aim to advise *"how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change."* This provides guidance to authorities for the implementation of climate change considerations into Local Plans but is helpful in outlining the topic areas for review and suggestions of general mitigation and adaptation methods.

17.31 The UK Government has set out plans to be net zero carbon in the future to tackle climate change. In the Road to Zero strategy published in 2018 , the UK government announced that it wants every new home to have a charge point, where appropriate, to help future proof homes for the transition to EV. The government want to introduce an EV charging requirement in the English Building Regulations and also to transpose the requirements of the European Union (EU) Energy Performance of Buildings Directive (EPBD)3. This EV policy is still in consultation (although now closed to responses). If adopted, Building Regulations Part S would require:

Policy position: Residential Buildings

- Every new residential building with an associated car parking space to have a charge-point. This requirement applies to buildings undergoing a material change of use to create a dwelling.
- Every residential building undergoing major renovation with more than 10 car parking spaces will be required to have cable routes for electric vehicle charge-points in every car parking space.

Policy position: New Non-Residential Buildings

- Every new non-residential building and every non-residential building undergoing a major renovation with more than 10 car parking spaces will be required to have one charge-point, and cable routes for an electric vehicle charge-point for one in five spaces.

Policy position: Existing Non-Residential Buildings

- Existing non-residential buildings with more than 20 car parking spaces will be required to install at least one charge-point, applicable from 2025.

Local Planning Policy

Development Policies

Central Lancashire Core Strategy (adopted in July 2012)

17.32 The 'Vision for Central Lancashire in 2026' is aligned with a sustainable approach to development that states *"energy use will be minimised with an emphasis on sustainable sources, including mitigation measures and wherever possible, adaptation to Climate Change"*. Overall the strategy highlights tackling climate change as one of three key cross cutting themes to be addressed in all areas. For example:

- Chapter 7 'Catering for Sustainable Transport' focuses on the location of development in proximity to work and amenities to reduce to need to travel and reduce transport associated emissions in the area;
- In Chapter 8 'Homes For All' this theme is addressed in the context of delivering new homes that reduce and minimise emissions through energy efficiency and renewable power sources;
- Chapter 10 'Design' discusses high environmental standards for construction and the use of green and blue infrastructure to offset climate change effects;
- Within Chapter 11 'Health and Wellbeing' future climatic conditions are considered a high risk to human health, especially to the elderly and infirm; and,
- Chapter 12 'Climate Change' is dedicated in entirety to achieving the strategic objectives of reducing energy consumption and emissions, encouraging the generation and use of renewables, managing flood risk and reducing water usage to protect and enhance Central Lancashire's resources.

17.33 Core Strategy policies that make direct reference to climate change and energy have been summarised below and, where required, discussion added on the consideration of the policy in this assessment.

Policy 17: Design of New Buildings

"The design of new buildings will be expected to take account of the character and appearance of the local area, including the following:

…

(k) promoting designs that will be adaptable to climate change, and adopting principles of sustainable construction including Sustainable Drainage Systems (SuDS); and

(l) achieving Building for Life rating of 'Silver' or 'Gold' for new residential developments."

17.34 It should be noted that the previous Building for Life (BfL) standards have now been made obsolete, following the publication of Building for Life 12 (BfL 12) in 2015. Therefore 'Silver' and 'Gold' standards have been superseded by a new two-tier award system – Built for Life for schemes that achieve 9 out of 12 Greens and Built for Life 'Outstanding' for schemes achieving the full 12 Greens. The Building for Life Partnership note that there is

no intentional correlation between the previous and new standards and that the purpose of BfL is 12 is move towards a collaborative dialogue between community, developer and local authority.

Policy 27: Sustainable Resources and New Developments

"Incorporate sustainable resources into new development through the following measures: All new dwellings will be required to meet Level 3 (or where economically viable, Level 4) of the Code for Sustainable Homes. This minimum requirement will increase to Level 4 from January 2013 and Level 6 from January 2016. Minimum energy efficiency standards for all other new buildings will be 'Very Good' (or where possible, in urban areas, 'Excellent') according to the Building Research Establishment's Environmental Assessment Method (BREEAM).

Subject to other planning policies, planning permission for new built development will only be granted on proposals for 5 or more dwellings or non-residential units of 500 sq metres or more floorspace where all of the following criteria are satisfied:

(a) Evidence is set out to demonstrate that the design, orientation and layout of the building minimises energy use, maximises energy efficiency and is flexible enough to withstand climate change;

(b) Prior to the implementation of zero carbon building through the Code for Sustainable Homes for dwellings or BREEAM for other buildings, either additional building fabric insulation measures, or appropriate decentralised, renewable or low carbon energy sources are installed and implemented to reduce the carbon dioxide emissions of predicted energy use by at least 15%;

…"

17.35 The Code for Sustainable Homes was unfortunately revoked in a ministerial statement published by the UK Government in March 2015. As such, there is currently no national standards relating to carbon emissions from developments beyond the requirements of Part L of the Building Regulations. The assessment of greenhouse gases from the proposed development will therefore only consider the policy requirements referring to a minimum BREEAM "Very Good" standard and the implementation of decentralised, renewable or low carbon energy sources to reduce emissions from predicted energy use by at least 15%.

South Ribble Local Plan 2012 – 2026 (adopted in July 2015)

17.36 The majority of the local plan makes reference to Core Strategy policies that have been outlined above. Additional relevant policies are summarised below.

Policy A1: Developer Contributions

"New development will be expected to contribute to mitigating its impact on infrastructure, services and the environment and to contribute to the requirements of the community. This may be secured as a planning obligation through a Section 106 agreement, where the development would otherwise be unacceptable and through the Community Infrastructure Levy (CIL) by way of a Charging Schedule.

The types of infrastructure that developments may be required to provide contributions for include, but are not limited to:

…

f) Climate change and energy initiatives through allowable solutions;"

Policy G13: Trees, Woodlands and Development

> *"Development will be required to provide new trees, woodlands and/or hedgerows to provide a wide range of benefits, including health and wellbeing, tackling climate change, landscaping and noise proofing and amenity value. Developers will be required to provide trees, woodlands and/or hedgerows of an appropriate type and maturity for the site, to be decided in liaison with the Council."*

17.37 Chapter J is specific to 'Tackling Climate Change' targeting the core strategy objectives. Within this chapter the principles of the core strategy policies 27-30 are reiterated. In the case of this assessment policy 27 is most related, whilst policies 29 and 30 (Water Management and Air Quality) are covered in other technical chapters. The combined results in the context of climate change are considered in the vulnerability assessment and cumulative effects in the second half of this chapter. Policy 28 is not applicable as the proposed development is not in itself a renewable energy development, and the concepts of using renewable energy within the site are covered in policy 27.

17.38 Policy C1 (Pickering's Farm, Penwortham) discusses the strategic location which was specified in the Core Strategy and has been identified for a residential led development. This site is that of the proposed development and therefore must be compliant with this policy. The key note is that section 6 .14 states that *"A detailed design code/statement in line with the masterplan will need to be prepared by the applicant and agreed with the Council in order to ensure a high quality of development throughout the site to embrace sustainable development principles."* It is anticipated that the recommendations of this assessment will be embedded in to the design of the development moving forward.

Site Specific Policies

Penwortham Neighbourhood Plan 2016 – 2026

17.39 The Neighbourhood Development Plan Vision is *"to see Penwortham continue to thrive as a vibrant and distinctive town. To continue to grow and develop whilst keeping its unique character and individual township, and to provide an outstanding quality of life for current and future generations."* One of the objectives to achieve this is *"endorsing policies that have a positive effect on the environment such as reducing or removing flood risk, mitigate climate change, reduce carbon footprints and protect open spaces".*

17.40 A summary of the carbon emissions reduction targets and timelines for which the proposed development will need to comply is provided in Table 17.1. In addition, all non-residential buildings will be required to meet BREEAM "Very Good" standards as a minimum.

Table 17.1: Summary of Carbon Reduction Targets

Timeframe	Emission Reduction Target	Policy Source
Pre 2022	15% above current Part L 2013 Building Regulations	Local Plan
Post 2022	31% above current Part L 2013 Building Regulations	Future Homes Standard
Post 2025	75%-80% above current Part L 2013 Building Regulations	Future Homes / Buildings Standard

Other Relevant Policy, Standards and Guidance

17.41 Due to the relatively recent incorporation of climate change within EIA regulations, there is currently little guidance on best practise techniques and methodologies to use in the assessment of effects.

17.42 This assessment has considered the following recent guidance:

- The Institute of Environmental Management and Assessment (IEMA), 'Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance' (2017);
- IEMA and European Commission, 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment' (2013);
- BSI - PAS 2080:2016 'Carbon Management in Infrastructure;
- European Investment Bank (EIB) (2020);
- IEMA, 'Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation' (2020); and
- Royal Institute of Charted Surveyors (RICS), 'Whole Life Carbon Assessment for the Built Environment' (2017);
- National House Building Council and European Commission reports and the UK Climate Change Risk Assessment (2017).

17.43 Although not specifically designed for EIA purposes, the European Investment Bank (EIB) guidance sets out a credible and viable definition for the baseline scenario in terms of climate change, as this assessment differs to the definition of a baseline scenario in other sections of the ES. This methodological approach is given additional validity as it is recommended by the European Commission in its guidance document; Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (2013).

17.44 In summary, the baseline scenario does not consider a *"do nothing scenario".* It assumes that there is demand for housing and supply is required for housing targets to be met. Therefore, the assessment baseline scenario can be considered to be a 'typical' development which:

- Delivers the same outputs as the proposed development; and
- Is built to standard building regulations using normal construction practices; and
- Is constructed in a nominal location.

17.45 A 2019 technical note from European Bank for Reconstruction and Development (EBRD) states that this type of baseline is appropriate since "*it is recognised that 'something' must be done*" and allows for a comparison of relative effect.

17.46 The preferred EIB method differs from the IEMA guidance published in 'Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance' that suggests that all emissions are significant and therefore, unless a project is removing as much carbon from the atmosphere as it is emitting its impacts will be considered significant. However, the IEMA method does not enable the scale of effect to be identified and for which measurable mitigation measures can be identified that reduce the residual effects to within an acceptable level.

Part 1: Assessment of GHG Emissions

Assessment Methodology and Significance Criteria

17.47 The assessment considers the CO_2 emissions associated with fossil fuel and electricity use within those buildings forming the proposed development, with specific exclusions detailed in the subsequent sections.

17.48 The assessment considers the operational CO_2 emissions over an 80-year period. It is not possible to fully understand, at this time, how energy and emissions use will change within buildings during this period. As such, it has been assumed that energy use will remain the same, year on year, throughout the assessment period.

Defining Parameters

Residential

17.49 The build mix, floor areas and number of dwellings are indicative at this early stage in the development process. Residential buildings have been grouped into detached, semi-detached and apartments based on their indicative floor areas for the purpose of assessing their projected carbon dioxide equivalent[1] (CO_2e) emissions.

[1] 'Carbon dioxide equivalent' is a measure used to compare the emissions from various greenhouse gases based upon their global warming potential. For example, in line with the IPCC 4th Assessment, the global warming potential for methane over 100 years is taken

17.50 At the current stage of outline planning, it is known that the development will provide a variety of housing types, including a mix of affordable homes and those suitable for the elderly. The typology split, detailed below, has been provided by the architect, and has been modelled on the anticipated average floor area of each dwelling type. It is highly recommended that the model is updated at the detailed planning stage when final floor area specifications and detailed Standard Assessment Procedure (SAP) calculations are known.

17.51 Table 17.2 indicates the residential build mix that has been used in the assessment, based on a maximum residential scheme of up to 1,100 dwellings.

Table 17.2: Residential build mix used in the energy and emission modelling

Build Type	No. of Dwelling Type	Total Modelled Floor Area (m^2) for Dwelling Type
1 bed apartment	52	2,837
2 bed apartment	157	11,080
2 bed mews	121	8,645
3 bed semi-detached	392	34,668
3 bed detached	60	5,173
4 bed semi-detached	139	16,607
4 bed detached	179	19,540
1100 dwellings	**98, 549 m^2 (excludes parking and gardens)**	

Non-Residential

17.52 The non-residential development comprises of a primary school and retail/commercial space (classes E (a,b,c) and Sui Generis). Table 17.3 indicates the estimated non-residential scheme floor areas that have been used in this assessment.

17.53 The energy demand of the non-residential buildings for which we do not yet have detailed designs, are estimated using the energy benchmarks in CIBSE Guide F – Energy Efficiency. Given this guidance was issued in 2012, and building standards and practices have since improved, 'Good practice' energy consumption benchmarks are used instead of those given for 'Typical practice'.

to be 25. This means that emissions of one million metric tons of methane is equivalent to emissions of 25 million metric tons of carbon dioxide. Nitrous Oxide (N2O) has a warming potential of 298 over 100yr period.

17.54 Due to the nature of the early design stage, it is recommended that they are updated at detailed planning once exact specifications and uses are known.

Table 17.3: Non-residential build mix used in the energy and emission modelling

Non-Residential Building	Estimated Floor Area (m^2)
Primary School	1200
Retail/Commercial E a	500
Retail/Commercial E b	500
Retail/Commercial E c	500
Retail/Commercial Sui Generis	500
Retail/Commercial Sui Generis	500

17.55 The figures for residential and non-residential property types are combined to provide an overall projection of the proposed development's energy demands.

Scope of Assessment

17.56 GHG emissions are divided into 3 Scopes according to the GHG Protocol. Scope 1 (Direct) and Scope 2 (Indirect) emissions, from the perspective of the building occupants, will be assessed. These are quantifiable and within the Applicant's reasonable control. In this instance, these emissions are taken to be that associated with the combustion of fossil fuels (such as natural gas in building heating systems) and the generation of electricity (associated with lighting and ventilation) during the operational phase of the built development.

17.57 Construction emissions associated with the proposed development include the emissions associated with on-site machinery, plant equipment and welfare facilities, typically being the emissions associated with diesel fuel combustion. In the absence of project-specific information relating to all on and off-site construction activities, a high-level quantification of construction emissions for the proposed development will be undertaken based on the average figure for building construction site emissions supplied in the RICS guidance (2017).

Effects Not Considered within the Scope of Assessment

17.58 Emissions associated with the transport movements of residents, occupants and visitors once the proposed development becomes operational are classed as Scope 3 emissions. These are not included in the assessment as these are largely tied to actions outside the Applicant's control.

17.59 It is not considered viable to include all Scope 3 emissions associated with the proposed development in the impact assessment. This is due to the extent and current uncertainties associated with the upstream and downstream supply chain for the proposed development.

17.60 The assessment considers CO_2e emissions, but in practice is limited to consideration of CO_2, Methane (CH_4) and Nitrous Oxide (N_2O) only. It is understood that there are other emissions that contribute to climate change, such as those found in refrigerants, e.g., chlorofluorocarbons (CFCs). These emissions are considered to be minimal in volume by comparison to the operational CO_2e emissions, and therefore, have not been considered in the analysis.

17.61 The assessment excludes development floor area associated with on street and residential parking and gardens. This is due to the energy demand being minimal when compared to the regulated and unregulated demand within the home.

17.62 Decommissioning emissions include those associated with the removal, transportation and disposal of waste materials either in landfill or to sites for recycling/re-use at the end of the project's operational lifetime. This is likely to be at least 80 years in the future and the modes of transport and decommissioning techniques and disposal/recycling methods could be very different and considerably less carbon intensive by that time.

17.63 The use of vehicles is considered to be behavioural and not directly connected to the development itself. The people who eventually live in the development will generate these emissions, but they are not caused by the development. If the residents lived elsewhere, they would likely still generate similar transport emissions.

17.64 Where possible, materials for construction will be sourced locally and sustainably-sourced materials will be selected preferentially. Although the embodied carbon in the materials has not been assessed in detail, this is expected to be a relatively minor component of the development's lifetime emissions. The use of sustainably-grown timber will provide a carbon store within the development and whilst this will not offset other embodied carbon, it will help to reduce the impact.

Greenhouse Gas Emissions

17.65 The parameters set out in Table 17.4 were used to calculate baseline emissions for a scenario as outlined in paragraph 17.47.

Table 17.4: Summary of the parameters and assumptions used to develop the baseline

Element	Calculation Method and Assumptions	
	Residential	Non-Residential
Property Types and Floor Areas	Due to the outline planning stage, there is not a confirmed build mix of property types. The residential dwellings have therefore been modelled as four indicative property types (detached, semi-detached, terrace and apartment/flat).	Estimated building use and floor areas for commercial buildings have been supplied by the Applicant. A TM46 benchmark category was assigned to each building based on indicative use.
Build Mix	Information is not yet available on the exact design mix to be used, due to the outline planning stage. An indicative mix has been modelled as shown in Error! Reference source not found. andError! Reference source not found..	
Regulated Energy Use	The baseline energy use is calculated using a SAP assessment[2] for four indicative property types, consistent with Part L1A of the Building Regulations. This provides an expected energy use and Target Emissions Rate (TER) for each property that has been scaled based on dwelling floor area. The TER sets a minimum allowable standard for a notional building of the same size and shape to the proposed building. The TER is the emissions rate that must be met under the Regulations, and be reduced by 20% in local policy targets, therefore forming an appropriate baseline compliant with the EIB methodology.	It is not practicable with the information available for an outline planning application to project the energy use for the mixed-use buildings using a SBEM assessment[3]. Therefore, the buildings are categorised into the appropriate CIBSE TM46 Energy Benchmarks Category[4]. Using the floor areas and Energy Benchmarks in TM46, an estimated baseline energy use can be calculated. These calculations include regulated and non-regulated energy use.
Unregulated Energy Use	Unregulated energy use in dwellings is largely influenced by occupancy, lifestyle, hobbies and human behaviour and is therefore highly variable between dwellings.	

[2] SAP – The Standard Assessment Procedure (SAP) is the methodology used by the Government to assess and compare the energy and environmental performance of dwellings.

[3] SBEM – Simplified Building Energy Model is a software tool developed by Building Research Establishment (BRE) that provides an analysis of a non-domestic building's energy consumption.

[4] Chartered Institution of Building Services Engineers (CIBSE) (2008). TM46: Energy Benchmarks "a comprehensive outline of building energy benchmarks; what they are, how they were developed and how to use them."

Element	Calculation Method and Assumptions	
	Residential	Non-Residential
	A projection on unregulated energy is applied to include cooking activities (currently assumed to be 50% electric, 50% gas), appliances and communal lighting as suggested by the RTPI[5].	
Total Energy Use	The regulated and unregulated energy use are combined to provide the total energy requirements for each property type.	

Proposed Development Calculation

17.66 Once a baseline scenario has been established using the reference properties, the absolute emissions (Ab) of the proposed development are calculated. Table 17.5 provides details of the databases and calculations used in establishing the actual energy use. The property types, floor areas and build mix remain the same as used in the baseline calculation, along with assumptions for residential unregulated energy projection.

Table 17.5: Summary of the parameters and assumptions used to calculate absolute energy use

Element	**Calculation Method and Assumptions**	
	Residential	**Non-Residential**
Regulated Energy Use	The SAP Assessments carried out for indicative property types provide a Dwelling Emissions Rate (DER) for each property that can be scaled based on dwelling floor area. The DER is the emissions rate of a dwelling based on the actual specification. These have been scaled by floor to area to provide an indicative energy demand of the modelled property types constructed to Building Regulation standard.	Mean values were obtained from the Display Energy Certificate (DEC) database for England and Wales for each of the modelled TM46 categories. DECs represent buildings operational energy use using measured data from individual buildings. Using this data combined with the floor area of the proposed development allows an estimated operational energy use to be calculated based on real time data of similar buildings, which can then be compared to the TM46 benchmarks. These datasets represent both regulated and unregulated energy use.
Total Energy Use	The energy use for the DER for each property type can be applied to the proposed development build mix and floor areas to provide a total estimate for electricity and natural gas use.	

[5] Royal Town Planning Institute. Planning for climate change - Delivering Sustainable Buildings and Quality Design. Understanding the Energy Requirements.

Emission Calculation

17.67 Once the operational electricity and fossil fuel use have been calculated for the proposed development, the CO_2e emissions can be projected. The emissions are projected each year for the modelled operational period of 80 years. It is noted that the proposed development does not have a predetermined end of life or demolition plan, however for the purpose of the assessment a defined time period had to be selected.

17.68 The projection relies upon CO_2e conversion factors for grid electricity and fossil fuels provided by The Department for Business, Energy and Industrial Strategy (BEIS).

17.69 The CO_2e conversion factor for grid electricity is likely to decline over time due to the decommissioning of coal fired power stations and the continuing deployment of renewable energy technologies, natural gas generation and nuclear generation. Therefore, the CO_2e conversion factor for grid electricity is based on the long term grid average projection. It should be reiterated that this projection is itself based on a large number of assumptions and could considerably under or overestimate the rate of decarbonisation, which will have a significant effect on the overall emissions associated with the development over its lifetime.

17.70 Emissions are calculated by multiplying the total energy demand in kWh by the associated electricity/natural gas conversion factor.

17.71 In terms of GHG emissions, the proposed development is assessed for its "relative emissions (Re)" or net emissions which is expressed as the difference between absolute emissions generated by the proposed development and the baseline emissions.

Relative Emissions (Re) = Absolute Emissions (Ab) – Baseline Emissions (Be)

Climate Change Projections

17.72 The first stage of the assessment is to is review the future climate projections published by the Met Office (through the UK Climate Projections (UKPC18) website), which includes variables such as annual mean temperatures and annual changes in summer and winter precipitation.

Sensitivity

17.73 The assessment focusses on the impact of an external factor (climate change) on the scheme, as well as the global impact of the scheme on climate change through carbon emissions. This is very different to impacts arising from other EIA topics which consider spatially defined receptors within a limited geographical location.

17.74 Climate change is a global phenomenon. It is understood that certain regions, populations and species are more sensitive to climate change than others, but it would not be reasonable to provide an assessment of the proposed development's potential impact on these receptors as any single development would have an indiscernible impact on global climate change overall.

17.75 However, it is still important to undertake the assessment to ensure the proposed development does not emit unacceptable levels of emissions not only in an effort to reduce future climate change impacts, but to contribute towards local and national emission targets.

Characterisation of Impact

17.76 The proposed development's impact on climate change is assessed in relation to the release of GHG emissions. The resilience of the proposed development to future changes in climate is also assessed using probabilistic climate projections for the region. The categorisation of this in relation to the following criteria is explained below:

- **Positive or Negative** – The impact overall can only be negative due to the guaranteed release of GHG emissions from development. However, the purpose of this assessment is to consider the efforts of the Applicant to minimise the negative impact. Therefore, in the context of this assessment, the impact has been considered 'positive' if the Applicant has gone beyond the minimum requirements of national and local policy to reduce or minimise emissions.
- **Extent** – The release of GHGs may occur locally, however, the associated impact i.e., contribution to global warming and climate change, is a global issue.
- **Magnitude** – Any single development has an infinitesimal impact on global climate change overall, but the assessment is still important to assess a Development's contribution to local and national targets. Additionally, the assessment considers magnitude in the context of emission reduction compared to baseline scenarios. For the purposes of determining the magnitude of effects of climatic variables on the proposed development, a combination of the probability and consequence of likely events are used.
- **Probability** – This takes into account the chance of the climatic effect occurring over the relevant time period (e.g., lifespan) of the development and the likely impact of this if the risk is not mitigated.
- **Consequence** – This reflects the geographical extent of the climatic effect or the number of receptors affected (e.g., scale), the complexity of the effect, degree of harm to those affected and the duration, frequency and reversibility of effect.
- **Duration and Timing** – The duration of the impacts extends from construction, through operational and decommissioning phases of the proposed development. Research has shown that the operational phase typically accounts for around 90-95% of emissions across the lifetime of a development. The duration and timing of a future climatic event will affect resilience.
- **Frequency** – Emissions are likely to occur continuously across the lifetime of the site as a result of fossil fuel combustion, electricity use, transportation and natural processes. However, when assessing the resilience of the proposed development to future climate, the frequency of projected events is used to determine the likelihood and consequence of impacts.

- **Reversibility** – Once emitted into the atmosphere, GHGs are circulated and interact with different processes and reactions to create different molecules, with varying lifespans and effects. This is essentially irreversible. However, it is possible to take actions which can limit the emissions released. It is also possible to sequester certain gases and remove them from the atmosphere, such as the use of green infrastructure and tree planting.
- **Likelihood** – Any form of activity or process will result in the release of GHGs to some degree. This includes activity associated with positive climate change action, such as the development of renewable energy or other low carbon technology. The likelihood of future climate risks is determined by the level of probability. This assessment aims to consider how the inevitable impact of emissions is minimised and reduced, as well as how the resilience to future climate change is increased, in the design and planning of the proposed development.

Significance Criteria

17.77 For the purpose of this assessment, effects that are deemed to be significant are those described as minor, moderate or major in adverse scenarios, and in beneficial scenarios that exceed the local policy. This goes beyond the standard EIA practice and represents a strict and conservative approach, which aligns with the magnitude of climate change as an issue, and local policy targets to reduce carbon emissions beyond Building Regulations. The significance criteria are provided in Table 17.6.

Table 17.6: Significance Criteria

Relative Emissions Compared to Baseline	Impact	Effect	Significance
Over 25% higher	Negative	Major Adverse	Significant
Up to 25% higher	Negative	Moderate Adverse	Significant
Up to 15% higher	Negative	Minor Adverse	Significant
Up to 5% lower or no higher	Neutral	Neutral	Not Significant
Up to 15% lower	Positive	Minor Beneficial	Significant
Up to 25% lower	Positive	Moderate Beneficial	Significant
Over 25% lower	Positive	Major Beneficial	Significant

17.78 All emissions that have an adverse impact are significant because this outcome would indicate that the proposed development will fail to meet the minimum requirements set out in Building Regulations. Emissions from a

proposed development that fall below the baseline can be classed as beneficial as this would indicate that building efficiency and energy use exceeds statutory regulation requirements. The beneficiary impact only becomes significant when the requirements of local policy are exceeded demonstrating the Applicants commitment to sustainable development.

17.79 To avoid misinterpretation, it is important to understand the justification, but also the limitation, behind the use of this significance criteria. It leads to a robust method for comparing likely emissions arising from the proposed development, relative to the baseline of a similar 'typical' development. For planning purposes, where it is important to weigh the benefits of one development against another, this is a useful and practical approach. The alternative approach, which arguably holds to a stricter interpretation of the absolute effects of the proposed development, is to take the baseline to be the 'no development' scenario. If this latter approach were to be adopted, then almost any form of development would result in increased levels of carbon emissions and would be considered to cause adverse (and most likely significantly adverse) impacts. As such, it would be much more difficult to identify whether a particular developer was making a genuine attempt to reduce emissions beyond the requirements of standard regulatory policy.

Assumptions/Limitations

17.80 The assessment considers the operational CO_2e emissions over an 80-year period, which is assumed to be representative of the development's 'lifetime'. It is not possible to fully understand, at this time, how energy use and emissions will vary within buildings during this period, but it has been assumed that energy use will remain the same, year on year, throughout the assessment period.

17.81 Unregulated energy use could vary substantially when the proposed development is operational, but it is not possible to accurately predict this energy use and a reasonable allowance has been made to account for this using indicative Standard Assessment Procedure (SAP) calculations for similar building types. Therefore, the same unregulated energy use has been modelled in both the baseline and absolute scenarios to represent the same behavioural traits of residents and site users.

17.82 Hydrogen and fuel cell technologies have significant potential to enable a transition to a clean, low-carbon energy system and reduce energy demands from natural gas. The use of hydrogen is expected to grow rapidly in coming years. However, the uncertainties associated with this technology means that it is difficult to quantify the emission savings at this stage and modelling of fossil fuel use from natural gas does not currently account for these changes.

17.83 There are currently limited resources able to give the annual energy demand of given building types and uses with improvements made in their energy efficiency. Therefore, this assessment models an increase in energy efficiency of the proposed development based upon our experience of what is sensible and achievable.

Consultation

17.84 The method for the assessment is in accordance with current guidance and industry best practice and was agreed with the local planning authority during the EIA Scoping process. No further consultation has taken place.

Baseline Conditions

Local Greenhouse Gas Emissions

17.85 The UK Government local authority and regional carbon dioxide emissions national statistics provides a reliable and consistent breakdown of CO_2 emissions across the country, using nationally available data sets going back to 2005. The datasets include all emissions from industry, agriculture, forestry, commercial activities, domestic residential and transport. CO_2 emissions in the UK are provisionally estimated to have fallen by 10.7% in 2020 from 2019, to 326.1 million tonnes (Mt), and total greenhouse gas emissions by 8.9% to 414.1 million tonnes carbon dioxide equivalent ($MtCO_2e$). The Lancaster district covers an area of 654 km^2 and the latest figures estimate that the region generates 755 Kt CO_2 each year. This equates to 5.2 tonnes CO_2 per capita. Emissions currently arising in the local area around Penwortham are likely to be generated from surrounding residential areas and transport links.

Site Emissions

17.86 The baseline operational energy demands have been modelled in line with the baseline methodology discussed, and subsequently converted into CO_2e emissions over the development's assumed 80-year operational lifespan. A summary of this data is provided in Table 17.7.

Table 17.7: Total energy demands and emissions for baseline scenario over 80-year operational lifetime

Scenario	Regulated Energy (MWh)	Unregulated Energy (MWh)	Regulated Emissions (tCO_2e)	Unregulated Emissions (tCO_2e)
Residential	8,316	1,898	1,563,432	410,177
Non-Residential	543	543	107,484	107,484
Full Development	**8,859**	**2,441**	**1,670,916**	**566,500**

17.87 The total baseline energy demand for the 80-year operational lifespan has been modelled as 11,300 MWh, which would equate to baseline emissions of 2,237,416 tCO_2e.

Future Baseline

17.88 In June 2019, the UK became the first major economy to legally commit to reducing emissions to net zero by 2050 via an amendment to the Climate Change Act.

17.89 The Department for Business, Energy and Industrial Strategy (BEIS) publishes annual projections of UK energy demand and greenhouse gas emissions. The Energy and Emissions Projections (EEP) are used to monitor progress towards the UK's legislated targets and are updated each year to incorporate new evidence, policy development and methodology improvements.

17.90 Between the 1990 baseline and 2018, the UK cut emissions by 346 $MtCO_2e$ or 43%. The 2019 EEP projections indicate that emissions will fall a further 24% to 344 $MtCO_2e$ in 2040.

17.91 Local adopted polices and emerging policies for the region require new developments to consider low carbon technologies and renewable energy in order to contribute to meeting the Government's national carbon reduction target.

Sensitivity of Receptors

17.92 When considering the effects of the proposed development on climate, unlike other technical areas, assessment of individual receptors is not strictly applicable. Climate change is a global phenomenon and highly localised impacts as a direct result of emissions associated with this development are extremely unlikely.

17.93 It is understood that certain regions, populations and species are more sensitive to climate change than others, but it would not be reasonable to provide an assessment of the proposed development's potential impact on these receptors as any single development would have an indiscernible impact on global climate change overall.

17.94 However, it is still important to undertake the assessment to ensure the proposed development does not emit unacceptable levels of emissions not only in an effort to reduce future climate change impacts, but to contribute towards local and national emission targets.

Embedded Mitigation

17.95 The absolute scenario initially predicts energy use based on SAP predicated DERs for residential dwellings and operational data from non-residential UK buildings (refer to Table 17.5). The purpose of this is to estimate whether any embedded mitigation would be required based on a generalised assessment of development scale. It is often the case that the energy use estimations based on typical buildings do not meet the emission saving requirements of local policy. This is because a typical building will be constructed to Building Regulation standards, whilst local policy nearly always requires an improvement on these standards in relation to emission savings. Therefore, it is not uncommon that embedded mitigation is nearly always required.

17.96 PAS2080:2016 'Carbon Management in Infrastructure' is a framework for the carbon management process that focuses on the four key parts of the chain (Asset Owners/Managers, Designers, Constructors and Product/Material Suppliers). It is based around the concept that as delivery of a development progresses the people involved in managing carbon changes and the earliest stages offer the greatest opportunities to reduce carbon and cost. Following the design freeze and the beginning of the procurement the ability to influence carbon decreases from 80% to 50%, dropping further to 20% once construction begins. This highlights the importance of carbon management early in the design stages.

17.97 In order to meet local policy requirements, the proposed development will need to ensure that non-residential development complies with BREEAM "Very Good" standards, or where possible, "Excellent" in urban areas. Carbon emissions from residential dwellings are to be reduced by 15% either through additional building fabric insulation measures, or the implementation of appropriate decentralised, renewable or low carbon energy sources. Post 2022, the proposed development must meet the interim uplift to Building Regulations as part of the Future Homes Standard which requires at least a 31% reduction in emissions, and this target rises to 75%-80% for buildings post 2025.

Demolition and Construction

17.98 It is assumed that all parts of the proposed development will be built following best practice construction methods to limit the immediate impacts on the surrounding area.

Completed Development

17.99 All elements of the proposed development will be built to meet or exceed Building Regulations in place at the time of construction. In order to reduce energy use, the Applicant will be required to design buildings that reduce space heating/cooling requirement and utilise energy efficient materials for construction, lighting and appliances. It is assumed in this assessment that the Applicant will achieve the required percentage improvement in CO_2e emissions of residential dwellings through improved fabric efficiency measures and will construct non-residential buildings to BREAAM "Very Good" standard. In the absence of specific plans at this stage of planning, this reduction is assumed to be spilt evenly across electricity and fossil fuel demand and that substantial credits are obtained in the 'Energy' portion of the BREEAM assessment.

Electric Vehicle Charging Points

17.100 In addition, the Applicant is intending to provide EV infrastructure as a measure to support resilience to climate change. The intention is for the provision of one charging point per residential dwelling, and an appropriate number of charging points for the commercial uses, with details to be finalised during reserved matters.

17.101 The energy demand associated with EV has been excluded from the projected energy demand and associated GHG emissions for the proposed development. This is because, whilst the use of EV will increase the total energy

demand for the site, their use reduces fossil fuel use and therefore offsets emissions. With the intended decarbonisation of the national grid, emissions from EV use should be zero carbon by 2050.

17.102 The additional energy demand for a 7.2 kW EV charging point has been estimated over the 80-year project life. This is based on an average of 8000 miles per year with 100% uptake of EV usage by residents and other site users. The total emissions associated with the same number of average-sized petrol cars would be 4907 tCO_2e.

17.103 Installation of EV infrastructure has the potential to offset emissions for the proposed development based on these assumptions. These figures for EV infrastructure have been assessed separately to the total projected energy demand as they are classed as Scope 3 emissions and are therefore outside of the Applicant's control once the site is operational.

17.104 The level of effect from the installation of EV infrastructure is deemed to be neutral, not significant, given the uncertainties around uptake and annual usage.

Assessment of Likely Significant Effects

17.105 It is well documented that human activities have, and continue to, cause changes in the Earth's surface and atmospheric composition. Radiative forcing from GHG emissions has been scientifically demonstrated to be a main driver of climate change, most notably the anthropogenic emissions since the Industrial Era that have resulted in an increase in GHG concentrations.

17.106 There is scientific agreement that carbon emissions arising from human activities must be reduced to mitigate the risks associated with the more severe long-term impacts of climate change. To achieve targets of limiting global warming to 1.5°C, renewables are projected to need to supply 70-85% of electricity in 2050 with average annual investment in low carbon energy technology and energy efficiency upscaled by a factor of five by 2050, compared to 2015. The potential risks associated with climate change will increase if these technologies are not implemented and the national grid is not decarbonised as far as possible.

17.107 The potential environmental impact of the proposed development is the release of GHG emissions into the environment as a result of construction and operational activities.

Demolition and Construction

17.108 The emissions arising from construction processes have been estimated as 25,736 tCO_2e based on the Applicant's estimated total construction costs for the whole project. Emissions arising from construction could be associated with:

- Diesel combustion associated with on-site construction machinery, plant equipment and welfare facilities;
- Embodied carbon associated with construction materials; and

- Fuel consumption associated with transport e.g., delivery of supplies, employee commuting during construction and vehicle movements of occupants.

17.109 Without appropriate mitigation measures, the emissions associated with the construction phase of the proposed development are deemed **significant**, with a **moderate adverse** impact over the short term.

Completed Development

17.110 Emissions arising after the completion of the proposed development (the operational phase) could be associated with:

- Natural gas consumption used for heating and cooking;
- Electricity consumption used for lighting, appliances, cooking and/or heating; and
- Fuel consumption associated with transport e.g., vehicle movements of occupants.

17.111 The projected total energy use and CO_2e emissions for the development's 80-year operational lifespan has been modelled to produce an absolute scenario in line with the method outlined above. A summary of this data is provided in Table 17.8.

Table 17.8: Projected GHG emissions over 80-year operational lifetime

Scenario	Regulated Emissions (tCO_2e)	Unregulated Emissions (tCO_2e)	Total Emissions (tCO_2e)
Residential	720,742	410177	1,130,919
Non-Residential	53957	107484	161,441
Full Development	**774,699**	**517,661**	**1,292,360**

17.112 Due to the proposed development's nature and size, construction is likely to be undertaken following a phasing plan. This means that phases may be subject to different Building Regulation requirements and designs will need to be altered accordingly. For the purposes of this assessment, it has been assumed that the baseline energy demands will be reduced to comply with emission reduction targets. As explained in the embedded mitigation section, and in the absence of specific project details available at outline planning, this has been assumed to be achieved through improvements to the building fabric and the deployment of appropriate renewable energy technologies across the site.

17.113 Based on these high-level assumptions regarding building design and phasing, the absolute emissions have been modelled to reduce by 42% overall. This represents a positive, minor beneficial impact which is significant over the long term.

17.114 The impact should be reassessed during reserved matters when the finalised energy strategy is available to ensure designs for the proposed development remain in line with national and local polices.

Additional Mitigation / Enhancement Measures

Demolition and Construction

17.115 No additional mitigation measures associated with the construction phase are proposed.

17.116 There are numerous standards that a contractor is expected to commit to during the construction. Prior to construction commencing, a Construction Environmental Management Plan (CEMP) and Waste Management Plan can be secured by condition which brings together these standards with site specific prescriptions. This can reduce the impacts on the environment during the construction and operation processes and ensure the design allows capacity for effective waste management for residents and site users. For example, measures outlined in the IAQM guidance on recommended dust controls should be included in the CEMP. These are stated in the assessment of Air Quality (ES Chapter 13).

Completed Development

17.117 No additional mitigation measures are proposed associated with the operational phase. However, the proposed development will provide a detailed travel plan which sets out measures to encourage sustainable means of transport (i.e., public transport, cycling, and walking) with the aim of reducing vehicle emissions and improving local air quality. The travel plan will include provision to measure its implementation and effect.

17.118 The design of the proposed development will be finalised during reserved matters to ensure that it complies with the 15% reduction required by local planning policy prior to 2022, as well as the 31% Part L (2021) interim uplift to Building Regulations required from 2022, and the 75%-80% reduction required post 2025. The Applicant is currently working on improving the overall quality and energy efficient design of the base housing stock which it intends to finalise ahead of use for the proposed development.

17.119 The Applicant is committed to meeting or exceeding a 31% emission reduction for residential buildings and a 27% emission reduction for the non-residential elements in line with expected interim building regulations. This will be achieved by improving building fabric and introducing some form of renewable energy technology, which is likely to include either heat pumps or solar PV or something similar. Post 2025 phases will be designed to meet or exceed the relevant future homes/building standards that are applicable. The details of the energy strategy for the whole development will be determined definitively at the reserved matters stage.

Likely Residual Effects and their Significance

17.120 The proposed development will result in the emission of GHGs, which is a long term and permanent effect contributing to global warming and climate change.

17.121 The result of a positive minor beneficial impact for the operational emissions is purely in relation to the Applicant exceeding Building Regulations. This should not be interpreted as the proposed development having no contribution towards climate change because all developments will emit emissions that will have an adverse impact on climate change. Developments with a beneficial impact are where the Applicant demonstrates that they are intending to meet emissions targets within policy or pursues further action and commitment to sustainable development. The development will still contribute to climate change and global warming.

17.122 There will be emissions arising from the construction of the proposed development which are difficult to quantify accurately at this early stage without more detailed information. The high-level estimated figure of 25,736 tCO_2e produced based on the UK average building construction site emissions provides an indication of the possible impact from construction and decommissioning emissions. The proposed development will actively seek to reduce impacts from the construction phase by employing good construction methods.

Table 17.9: Residual Effects Summary

Description of Effect	Potential impact including significance	Mitigation	Residual Effect including significance
Construction and Demolition			
All Construction Activities	Moderate Adverse - Significant	Best Practice Construction Methods	**Minor Adverse – Significant**
Completed Development			
Energy Efficiency of Buildings	Neutral – Not Significant	Improved Fabric Efficiency and Deployment of Renewable Energy Technology	**Minor Beneficial - Significant**

Part 2: Climate Vulnerability

Approach

17.123 The update to the EIA regulations not only requires an assessment of the potential impacts of a proposed development on climate change but also its vulnerability to climate change itself. In context of the proposed development, the spirit of the regulations is to ensure that the risk of climate change effects are identified and mitigated if required (adaptation).

17.124 Assessing the impacts of climate change on a scheme is fundamentally different to the assessment of impacts arising from the scheme in other EIA topics, since it focusses on the global impact of an external factor (climate change) on the scheme, rather than the regional impact of the scheme on geographically defined receptors. The resilience of the proposed development to climate change is assessed based on the susceptibility and vulnerability of a range on different receptors. The magnitude of the effects is deemed to be significant based on a matrix of likelihood and consequence. This assessment considered the hybrid application in its entirety.

Assessment Methodology and Significance Criteria

17.125 The IEMA guidance 'Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation' (2020) explains how our climate is changing but there remain uncertainties in the magnitude, frequency and spatial occurrence, either as changes to average conditions or extreme conditions, which generally makes it difficult to assess the impacts of climate change in relation to a specific project. Therefore, scientific assumptions must be made in order to assess the resilience of new developments to any future changes in climate.

17.126 Climate Change projections for the UK (UKCP18) are based on global climate simulation models to explore regional responses to climate change. UKCP18 considers the effects arising from a series of emissions scenarios and Representative Concentration Pathways (RCP) which project how future climatic conditions in the UK are likely to change at a regional level, taking account of naturally occurring climate variations. Probabilistic projections provide a range of possible climate change outcomes and their relative likelihoods (ranging across 10th to 90th percentiles).

Climate Change Projections

Climate Scenarios and Timelines Considered

17.127 The proposed development was assessed against a low, medium, and high emissions scenario to allow for comparisons between best and worst case across the projected 80-year 'lifetime' of the project. The Representative Concentration Pathways (RCP) show how the climate could change up to the year 2100, compared to a 1982-2000 baseline.

17.128 Subject to planning permission, build out of the proposed development is expected to commence in 2023, with the first buildings operational by 2025, and whole site completion by 2031. Therefore, UKCP18 climate projections for the 2030s, 2050s, 2070s and 2090s time periods were selected to correspond with the proposed timescales for the proposed development's construction and operational phases. The conservative approach recommended as best practice by the IEMA guidance (2020) is to use the central estimate (50th percentile) for the high emissions scenario (RCP8.5) to establish the likely worst-case changes to climatic conditions. This assessment considers the regional variations in north-west England during these periods. A reference range is provided in each case, using the 10% probability level as a lower limit and the 90% probability level as an upper limit. These scenarios and probability levels were used to provide credible projected changes including an indicative level of uncertainty.

Future Climate Baseline

17.129 A summary of a range of projected changes to climate variables will be provided which can be used to build up a holistic view of future climate and assess potential impacts. According to UKCP18, relative probabilities for specific outcomes are typically much higher near the 50% cumulative probability level (median) of the distribution, than for outcomes lying either below the 10% cumulative probability level or above the 90% cumulative probability level.

Sensitivity

Climate Vulnerability and Sensitivity of Receptors

17.130 Potential receptors within elements of the project relevant to the location, nature and scale of the development have been identified and receptor groups include:

- Buildings and infrastructure receptors (including equipment and building operations);
- Human health receptors (e.g., construction workers, occupants and site users);
- Environmental receptors (e.g., habitats and species); and
- Climatic systems.

17.131 The IEMA guidance (2020) describes the sensitivity of the receptor/receiving environment as *"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."* Therefore, in line with the IEMA guidance, the following factors have been considered to ascribe the sensitivity of receptors in relation to potential climate change effects:

- Value or importance of receptor;
- Susceptibility of the receptor (e.g., ability to be affected by a change); and
- Vulnerability of the receptor (e.g., potential exposure to a change).

17.132 The susceptibility and vulnerability of the receptor is determined using the scales outlined in Tables 17.10 and 17.11 below.

Table 17.10: Criteria for determining Susceptibility of Receptors.

Susceptibility	
Low	Receptor has the ability to withstand or not be altered much by the projected changes to the existing/prevailing climatic factors.
Medium	Receptor has some limited ability to withstand or not be altered by the projected changes to the existing/prevailing climatic conditions.
High	Receptor has no ability to withstand or not be substantially altered by the projected changes to the existing/prevailing climatic factors.

Table 17.11: Criteria for determining Vulnerability of Receptors.

Vulnerability	
Low	Climatic factors have little influence on the receptors.
Medium	Receptor is dependent on some climatic factors but able to tolerate a range of conditions.
High	Receptor is directly dependent on existing/prevailing climatic factors and reliant on these specific existing climate conditions continuing in future or only able to tolerate a very limited variation in climate conditions.

Significance Criteria

17.133 In line with the IEMA guidance (2020), a combination of probability and consequence is used to reach a reasoned conclusion on the magnitude of the effect of climate change on the proposed development. The IEMA guidance states that magnitude is based on a combination of:

- Probability, which takes into account the chance of the effect occurring over the lifespan of the development if the risk is not mitigated; and
- Consequence, which reflects the geographical extent of the effect or the number of receptors affected (e.g., scale), the complexity of the effect, degree of harm to those affected and the duration, frequency and reversibility of effect.

17.134 Definitions of likelihood and magnitude will vary between schemes and are tailored to the specific project. Project lifetime is considered to include construction and operational stages and is taken to be 80 years for this assessment of climate risk. A likelihood category is assigned from in Table 17.12 below based on the probability

of the regional climate effect identified using the future climate baseline. From this the consequence of impact is determined as indicated in Table 17.13 (also below).

Table 17.12: Criteria for Assessing Likelihood of Impact

Likelihood Category	Description (Probability and Frequency of Occurrence)
Very High	The event occurs multiple times during the lifetime of the project (assumed 80 years), e.g., approximately annually, typically 80 events.
High	The event occurs several times during the lifetime of the project (80 years), e.g., approximately once every five years, typically 16 events.
Medium	The event occurs limited times during the lifetime of the project (80 years), e.g., approximately once every 15 years, typically 5 events.
Low	The event occurs during the lifetime of the project (80 years), e.g., once in 80 years.
Very Low	The event may occur once during the lifetime of the project (80 years).

Table 17.13: Criteria for Assessing Consequence of Impact

Consequence of Impact	Description of Impact
Extreme Adverse	National-level (or greater) disruption lasting more than 1 week.
Major Adverse	National-level disruption lasting more than 1 day but less than 1 week. OR Regional-level disruption lasting more than 1 week.
Moderate Adverse	Regional-level disruption lasting more than 1 day but less than 1 week.
Minor Adverse	Regional-level disruption lasting less than 1 day.
Negligible	Isolated disruption to the immediate locality lasting less than 1 day.

17.135 The IEMA guidance (2020) denotes that it is likely that if the probability and/or consequence of the effect is high that the magnitude of the effect would also be high. The significance of this impact on the proposed development will be determined using the Significance Matrix for Climate Resilience in Table 17.14 below and assessed in conjunction with the Significance Criteria for determining the impact of the proposed development on climate change.

Table 17.14: Significance Matrix for Assessing Climate Resilience

Significance Matrix for Assessing Climate Resilience		Measure of Likelihood				
		Very Low	Low	Medium	High	Very High
Measure of Consequence (Impact)	Negligible	Negligible (Not Significant)	Negligible (Not Significant)	Negligible (Not Significant)	Minor (Not Significant)	Minor (Not Significant)
	Minor	Negligible (Not Significant)	Minor (Not Significant)	Minor (Not Significant)	Moderate (Significant)	Moderate (Significant)
	Moderate	Minor (Not Significant)	Minor (Not Significant)	Moderate (Significant)	Moderate (Significant)	Moderate (Significant)
	Major	Minor (Not Significant)	Moderate (Significant)	Moderate (Significant)	Substantial (Significant)	Substantial (Significant)
	Extreme	Moderate (Significant)	Moderate (Significant)	Substantial (Significant)	Substantial (Significant)	Substantial (Significant)

Assumptions/Limitations

17.136 The IEMA guidance (2020) explains how our climate is changing but there remain uncertainties in the magnitude, frequency and spatial occurrence, either as changes to average conditions or extreme conditions, which generally makes it difficult to assess the impacts of climate change in relation to a specific project. Therefore, scientific assumptions must be made in order to assess the resilience of new developments to any future changes in climate.

Baseline Conditions

17.137 England is classified under Köppen-Geiger as having a 'Cfb' climate, more commonly known as a temperate oceanic climate. These are typically mid latitude climates with warm summers and mild winters. The average temperature in all months will be below 22°C and there is not an identifiable dry/wet season i.e., precipitation rates are similar year-round. The average temperature in Lancastershire ranges from 3°C in the winter up to 15° in the summer. The city experiences between 13-16 days of rainfall per month, all year round, which is largely associated with the 'rain shadow' effect from the Pennines located to the north of the city.

Global Climate Change Projections

17.138 Table 17.15 highlights the main projected global climate change issues.

Table 17.15: Projected global impacts of climate change

Climate Change Issue	Projected Global Impacts
Solar Radiation	Long term projected changes in surface solar radiation, as a result of global warming, would suggest a decrease in available solar power due to a decrease in downwelling shortwave radiation, likely linked to the increase of water vapour ([XXI]). This is considered to be anthropogenic strengthening of "natural" decadal variability in irradiance, known as global dimming and brightening, which is influenced by synoptic weather patterns, cloud variations and atmospheric aerosols ([XXII]).
Heat Waves	The IPCC ([XXIII]) predict that temperature extremes will increase more rapidly than global mean surface temperature, with the number of hot days projected to increase in most land regions. In the 1.5°C warming scenario heat waves in mid latitudes could warm by up to 3°C.
Extreme Rainfall and Flooding	IPCC and Met Office ([XXIV]) both suggest a general uncertainty in the projection of changes in heavy precipitation for the UK due to position in the transition zone between north and south Europe's contrasting projected changes. It is generally agreed the northern parts of the UK will experience overall increases of up to 10%, whilst southern areas may experiences decreases of up to 5%. Overall, the UK is expected to see a general increase in precipitation trends up to 2100.
Rising Sea Levels	The most recent modelling indicates global sea level rise of 0.26-0.77m by 2100, under a 1.5°C warming scenario ([XXII]). Risk is amplified on small islands and in low lying coastal areas and deltas.
Storms and Winds	Atmospheric circulations have large variability across interannual through to decadal time scales, which makes forming projections with any reasonable confidence very difficult. There is more robust evidence in the Northern Hemisphere that since the 1970s there has been a general poleward shift of storm tracks and jet streams and near-surface terrestrial wind speeds have been declining by approximately 0.1-0.14 m s-1 per decade across land ([XXV])
Cold Spells and Snow	It has been observed the spring snow cover has been continuing to decrease in extent in the Northern Hemisphere and that cold temperature extremes are projected to decrease along with the number of frost days ([XXVI]).

Regional Climate Change Projections

17.139 The UKCP18 dataset provides future climate projections for land and marine regions as well as observed climate data for the UK. Analysing time series plume from UKCP18 provides an indication of climate projections for the regional 25km grid that encompasses the site. The UKCP18 projections make use of new standardised emissions scenarios called Representative Concentration Pathways (RCP) which are used in the IPCCs latest 5th assessment report (AR5) and specify the time-dependant greenhouse gas concentrations to 2100. The RCPs themselves are based on several social and economic assumptions, as well as the degree to which countries choose to reduce their GHGs in the future. The RCPs are used to analyse how different emission scenarios could affect climate projections. These range from RCP2.6 where atmospheric emission concentrations are strongly reduced through

to the worse-case scenario, RCP8.5, where emission concentrations continue to rise unmitigated. The projected climate change scenarios showing the various mean and maximum air temperatures and precipitation rates are depicted in **Figures 17.1 to 17.6.**

Temperature –

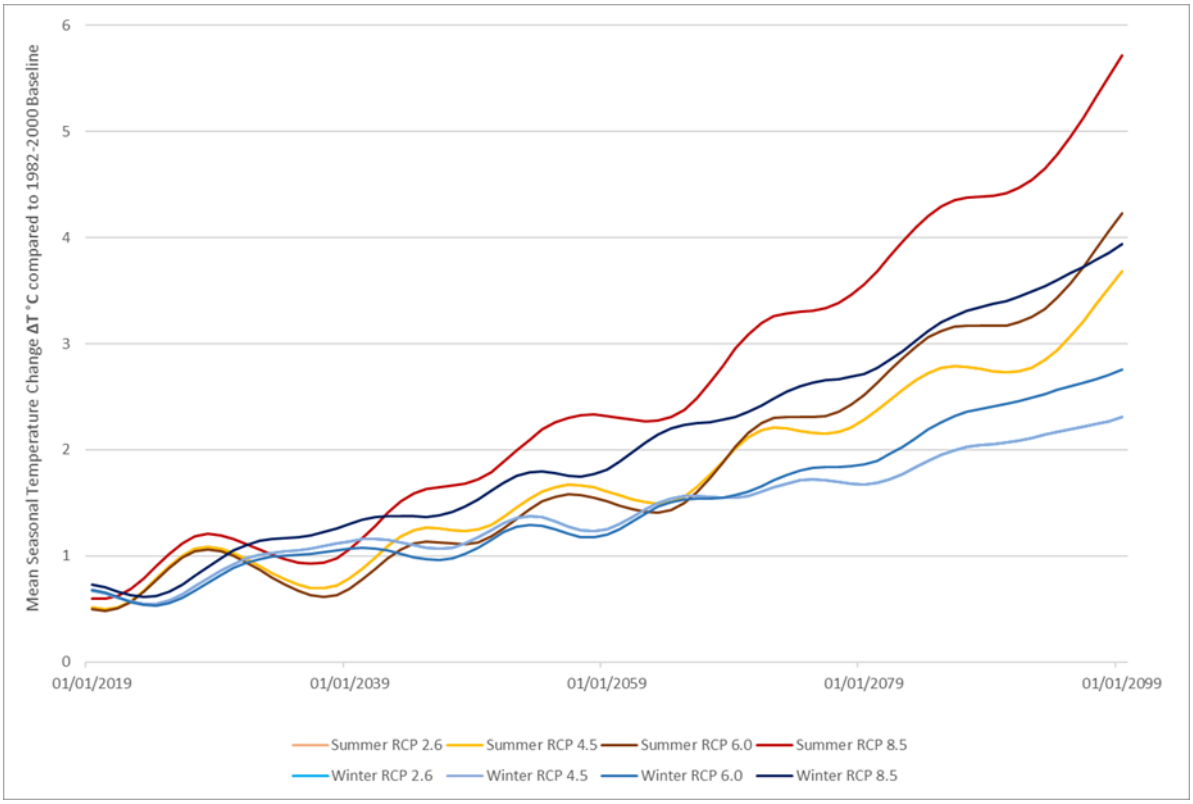

Figure 17.1: Projected changes in seasonal mean air temperature across four RCP scenarios, from 2019-2100 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile).

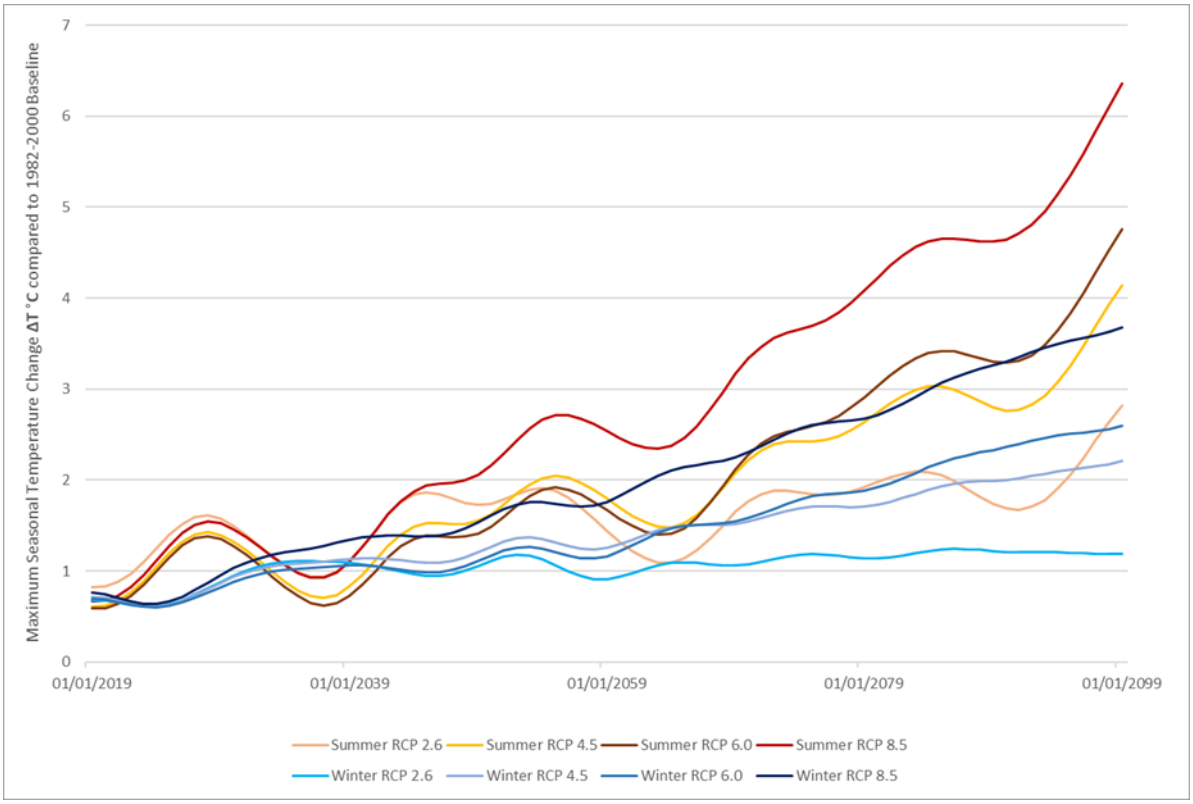

Figure 17.2: Projected changes in seasonal maximum air temperature across four RCP scenarios, from 2019-2100 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile).

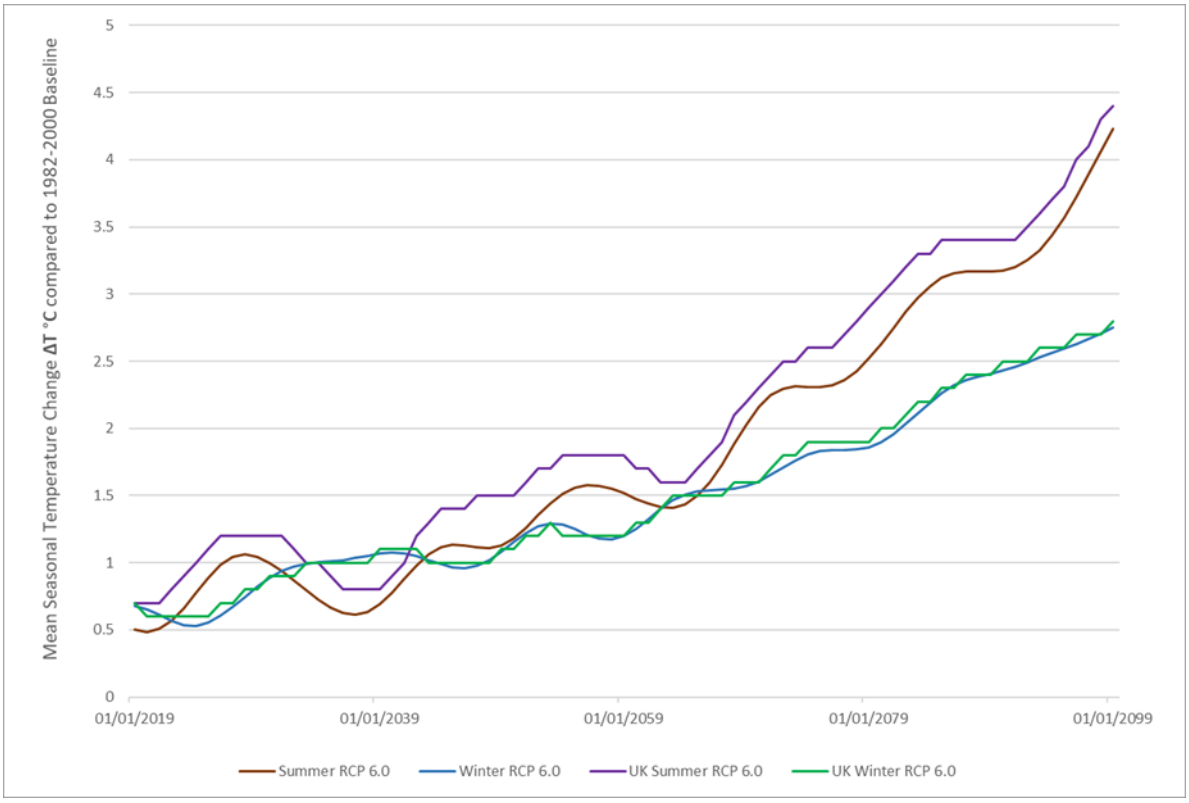

Figure 17.3: Projected changes in summer and winter mean air temperature for the RCP 6.0 scenario, from 2019-2100 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile). Comparison against UK average under the same modelling conditions.

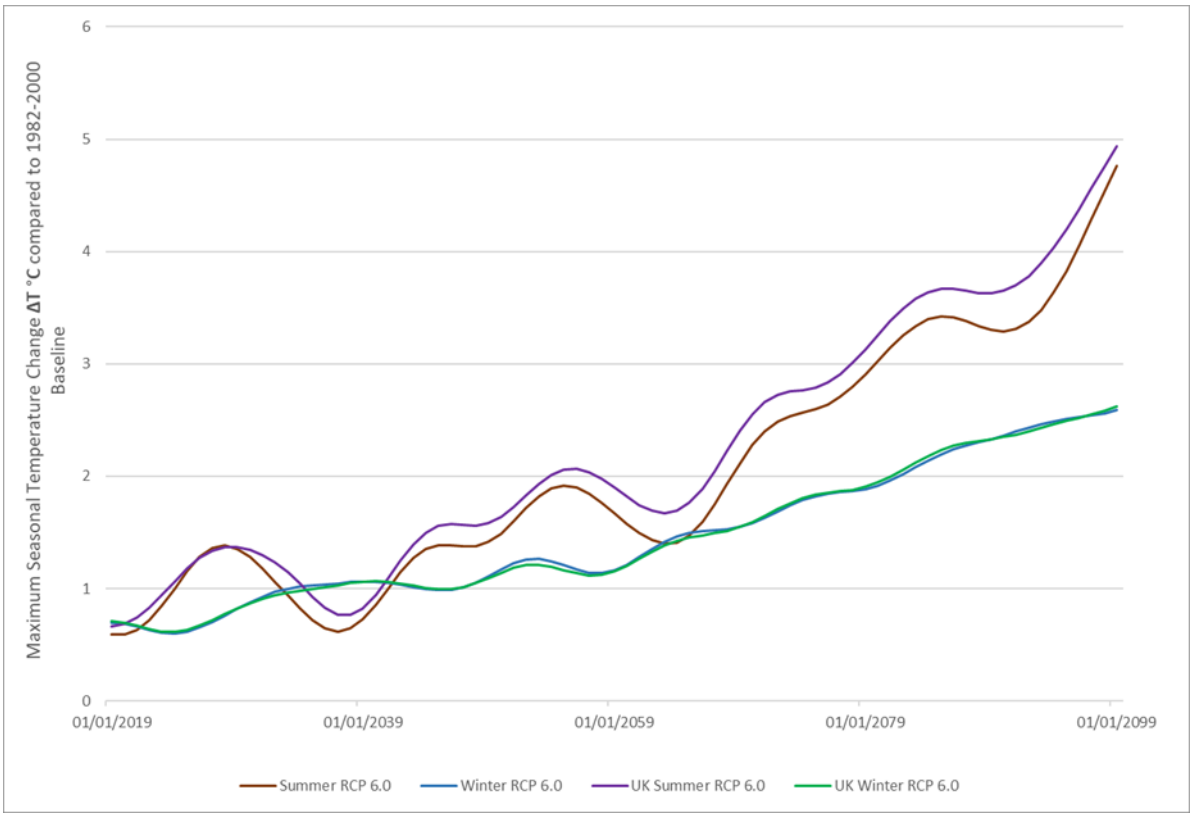

Figure 17.4: Projected changes in summer and winter maximum air temperature for the RCP 6.0 scenario, from 2019-2100 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile). Comparison against UK average under the same modelling conditions.

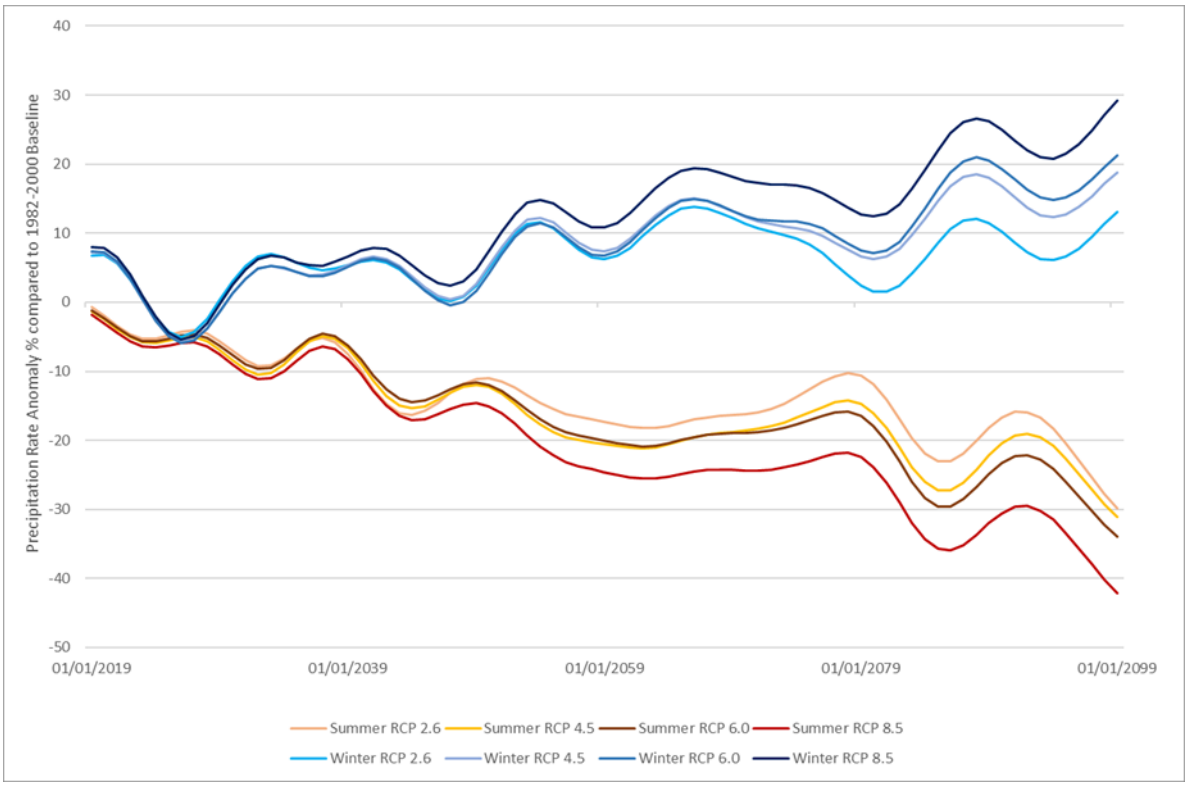

Figure 17.5: Seasonal average precipitation rate anomaly (%) for 2019-2100 compared to the 1981-2000 baseline for all RCP scenarios using probabilistic projections (50th percentile).

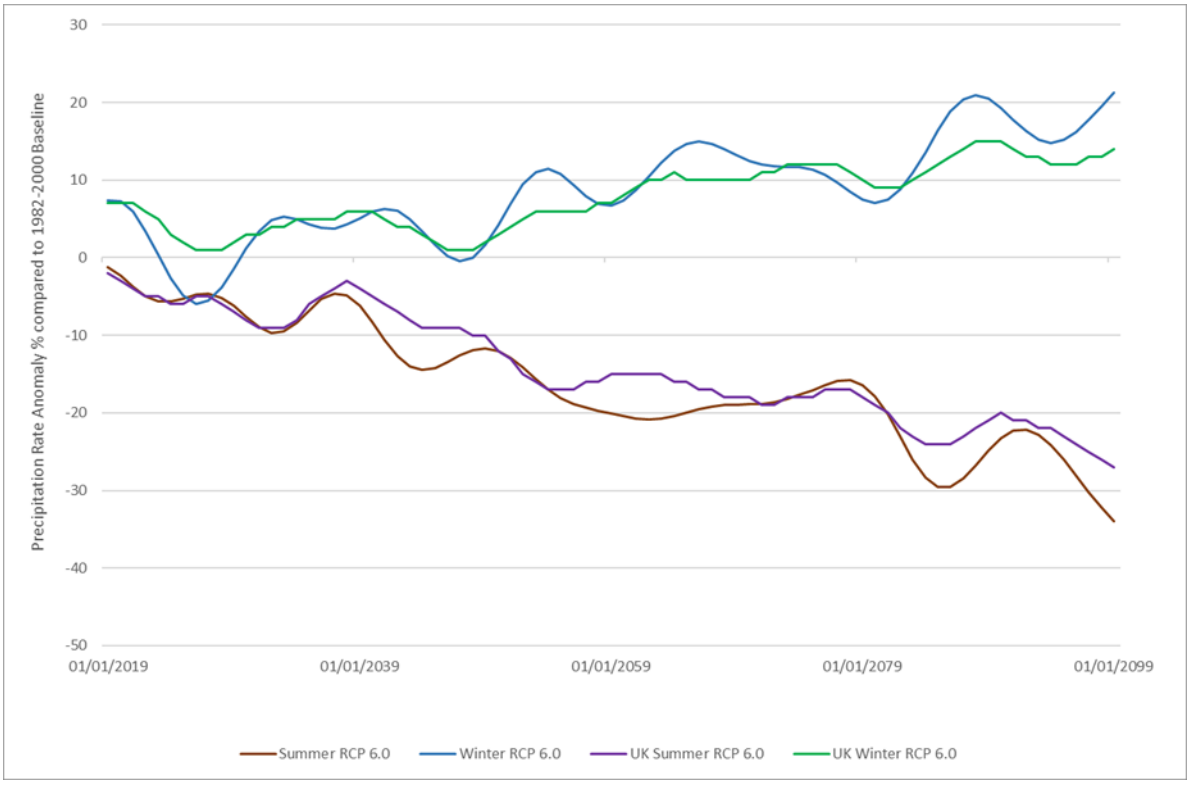

Figure 17.6: Seasonal average precipitation rate anomaly (%) for 2019-2100 compared to the 1981-2000 baseline for the RCP 6.0 scenario using probabilistic projections (50th percentile). Comparison against UK average under the same circumstances.

Climate change projections for the site **(Figures 17.1 to 17.6)** generally show a warming trend over both summer and winter months across all RCP scenarios indicated by progressive temporal increases in both mean and maximum seasonal temperatures to 2100. Mean seasonal summer temperatures for the middle emissions scenarios (RCP 4.5 and RCP 6.0) show a projected increase of approximately 1.6°C to 2060 increasing to 4.1°C to 4.8°C by the end of the century. Maximum summer temperatures follow a similar trend but with increased absolute changes. The pattern of change is broadly consistent with the UK average projections although summer temperatures projections are slightly lower for the site than the UK average.

17.140 Long term seasonal changes in precipitation patterns are also projected for the site. Across all RCP scenarios, albeit to varying degrees, summer precipitation levels are projected to decrease, and winter precipitation levels are projected to increase. For the middle emissions scenarios (RCP 4.5 and RCP 6.0), winter precipitation anomalies are projected to increase by approximately 9% by 2060 and approximately 20% by 2100. Summertime precipitation rate anomalies are projected to decrease by approximately 20% by 2060 and 31% by 2100. The seasonal changes projected are broadly consistent with the average changes projected for the UK as a whole although the absolute winter increases are higher and summer absolute decreases are lower than the UK average.

Future Climate Baseline

17.141 A summary of a range of projected changes to climate variables is provided in Table 17.16 which can be used to build up a holistic view of future climate and assess potential impacts to determine a future climate baseline, using RCP8.5 as a conservative approach.

Table 17.16: Quantitative summary of the future baseline for key climatic variables in South Ribble, UK.

Season	Variable	Time Period*	Projected change at				
			Lower Probability		Median	Higher Probability	
			5th percentile	10th percentile	50th percentile	90th percentile	95th percentile
Winter	Mean Temperature (ºC)	2030s	1.1	0.7	1.0	2.6	3.1
		2050s	0.7	0.2	1.6	3.4	3.9
		2070s	0.3	0.3	2.4	4.5	5.1
		2090s	0.2	0.9	3.4	5.9	6.6
	Mean Precipitation (%)	2030s	-37.8	-29.7	2.8	42.2	54.0
		2050s	-39.5	-29.3	8.6	48.5	61.0
		2070s	-32.4	-22.0	16.4	56.9	68.0

Season	Variable	Time Period*	Projected change at				
			Lower Probability		Median	Higher Probability	
			5th percentile	10th percentile	50th percentile	90th percentile	95th percentile
		2090s	-33.9	-21.6	21.9	67.7	81.5
Summer	Mean Temperature (°C)	2030s	1.0	0.5	1.0	2.5	2.9
		2050s	0.6	0.0	1.8	3.8	4.3
		2070s	0.3	0.4	2.9	5.5	6.2
		2090s	0.7	1.5	4.6	7.7	8.6
	Mean Precipitation (%)	2030s	-54.0	-43.5	-7.3	32.8	45.8
		2050s	-61.4	-52.4	-17.8	23.0	35.5
		2070s	-70.4	-60.9	-24.0	14.5	28.1
		2090s	-80.2	-70.4	-32.9	10.9	24.1

Climate Change Vulnerability

17.142 The Design of Future Climate Report published in 2010 identified three broad risk categories to buildings from future climate change in the UK, which are:

- **Risk to comfort and energy performance:** warmer winters will reduce heating requirements, however the increased use of cooling systems in the summer will present a challenge to energy consumption and carbon emissions;
- **Risk to construction:** resistance to extreme conditions, detailing, and the behaviour of materials; and
- **Risk to water management:** management of water during both flooding and drought events, and changes in soil composition.

17.143 Combined, these categories can be considered climate change threats that could result in increased energy demands, economic losses and loss of life.

17.144 Climate change may result in variations in approach to general building design and construction in order to offer a higher degree of protection against the identified perils. Many of these improvements will be brought about using existing off-the shelf components that are in common use in other places around the world but may not

previously have been considered necessary in parts of the UK. Such design improvements will be beneficial for the overall quality of the UK housing stock, although it may result in some additional costs for developers.

17.145 As well as seeking improvements in the construction techniques for buildings there will also be a need to improve various aspects of their operational performance to provide more resilience for residents and occupants.

17.146 At more localised levels the effects can manifest in different ways and therefore the most appropriate strategies should be selected on a site-specific basis. A coastal village may be at most risk from sea-level rises and storm surges, while at inland locations the threat of heat waves or high winds might be more significant. Adaptation involves developing a resilience and a preparedness to deal with the likely consequences of climate change. It is recommended that the proposed development needs to consider and mitigate against the likely climate impacts during the reserved matters design stage to increase resilience.

17.147 The UK Climate Change Risk Assessment (CCRA) 2017 identifies flooding and high temperature as posing the greatest risks to the built environment. Other potential effects of climate change on the proposed development are summarised in Table 17.17. In the interest of completeness, and to account for potential irregular, adverse extreme weather, this section will also cover reducing risk to snow and ice, however projections suggest that overall these will become a decreasing risk with climate change.

Table 17.17: Potential effects of climate change on the proposed development

Climate Change Issue	General Impact	Component/sub structure impacted
Soil Drying	Increase will affect water tables and could affect foundations in clay soils.	Increased risk of basement heave or subsidence, water ingress, consequential damage to finishes and stored items. Ground shrinkage can lead to failure of electrical, gas and water pipes, foundations and sub-structures.
Temperature Increase	Maximum and minimum changes will affect heating, cooling and air conditioning costs. Frequency of cycling through freezing point will affect durability. Daily maximum and minimum temperature will affect thermal air movement.	Air conditioning/ heating/ cooling systems due to increased cooling/ decreased heating requirements. Overheating of mechanical and electrical equipment effecting lifespan, reliability and potential health and safety issues. Plastic materials will have a reduced lifespan. Structure/cladding/roofing membranes, sealants, pavements and roads have increased risk of cracking. Reduced capacity of overheated power lines. Building overheating (due to increased fabric efficiency and incorrect implementation). Solar PV modules work slightly less efficiently at high temperatures and some studies have shown that high temperatures can age the panels more quickly. Decreased labour productivity.
Relative	Increase will affect condensation and associated damage or mould	Timber framed construction. Internal walls, finishes and

Climate Change Issue	General Impact	Component/sub structure impacted
Humidity	growth.	stored items.
Precipitation, Water Availability	Increase and decrease will affect water tables; cleaning costs will be increased in winter, with associated redecoration requirements; durability and risk of water ingress will be affected by combination of precipitation increase and gales.	Increased damage to roofing and higher risk of failure, increased chances of flooding. Structure/cladding/roofing membranes and sealants have increased risk of cracking due to different moisture movements. Damage to foundations and basements. Delays in construction and increased costs. Increased risk of subsistence.
Gales, Storms, Extreme Weather	Increase will affect need for weather tightness, risk of water ingress, effectiveness of air conditioning, energy use, risk of roof failures.	Increased damage to roofing and higher risk of failure.
Solar Radiation	Increase may affect need for solar glare control.	Window specification and glare control requirement.
Cloud Cover	Increase/decrease in seasonal lighting needs.	Changes in lighting systems and glare control requirement.

Sensitivity of Receptors

17.148 The sensitivity of receptors has been determined through an assessment of the susceptibility and vulnerability of the proposed development to future climate changes. The level of likelihood for the climate change issue was also identified in Table 17.18 according to the future climate baseline outlined in Table 17.16.

Table 17.18: Assessment of Susceptibility and Vulnerability of Proposed Development to Future Climate Baseline

Climate Change Issue	Receptors Impacted	Susceptibility	Vulnerability	Likelihood
Soil Drying	Residents, Building Structures, Species & Habitats	Low	Low	Medium
Temperature Increase	Construction Workers, Residents, Building Structures, Species & Habitats	Medium	Medium	High
Relative Humidity	Residents, Building Structures	Low	Medium	High

Climate Change Issue	Receptors Impacted	Susceptibility	Vulnerability	Likelihood
Precipitation, Water Availability	Construction Workers, Residents, Building Structures, Species & Habitats	Medium	Medium	High
Snow and Ice	Construction Workers, Residents, Building Structures, Species & Habitats	Medium	Low	Low
Gales, Storms, Extreme Weather	Residents, Building Structures, Species & Habitats	Low	Medium	Medium
Solar Radiation	Residents, Building Structures	Low	Medium	Medium
Cloud Cover	Residents	Low	Low	Medium

Magnitude of Effects

17.149 A qualitative assessment has been undertaken based on the data from UKCP18 identified in Table 17.16 to assess the magnitude of the effects of climate change. In line with the IEMA guidance, a combination of probability and consequence is used to reach a reasoned conclusion on the magnitude of the effect of climate change on the proposed development, as shown in Table 17.19. The IEMA guidance (2020) indicates that the greater the probability of an effect, the more likely it is to occur, and the higher significance effect it will have on the proposed development if these projected changes in climate are not considered at the outset of the project.

Table 17.19: Assessment of Magnitude of Effects on Proposed Development from Future Climate Baseline

Climate Change Issue	Likelihood	Consequence	Magnitude of Effects
Soil Drying	Medium	Minor Adverse	Minor Adverse
Temperature Increase	High	Moderate Adverse	Moderate Adverse
Relative Humidity	High	Moderate Adverse	Moderate Adverse
Precipitation, Water Availability	High	Moderate Adverse	Moderate Adverse

Climate Change Issue	Likelihood	Consequence	Magnitude of Effects
Snow and Ice	Low	Minor Adverse	Minor Adverse
Gales, Storms, Extreme Weather	Medium	Moderate Adverse	Moderate Adverse
Solar Radiation	Medium	Minor Adverse	Minor Adverse
Cloud Cover	Medium	Minor Adverse	Minor Adverse

17.150 The impact of changes to the future climate baseline for the proposed development has been assessed to be within the medium to high likelihood and have moderate adverse consequences over the long term. Taking into account the control mechanisms and mitigation measures in place through Building Regulations, which the proposed development would be expected to comply with as a minimum standard, the overall magnitude of effects is considered to be minor adverse for the 80-year lifetime of the project.

Significance Assessment

17.151 The significance of the magnitude of effects on the proposed development has been determined using the Significance Matrix for Climate Resilience outlined in paragraph 17.135 and is summarised in Table 17.20.

Table 17.20: Assessment of Significance

Climate Change Issue	Magnitude of Effect	Significance
Soil Drying	Minor Adverse	Not Significant
Temperature Increase	Moderate Adverse	Significant
Relative Humidity	Moderate Adverse	Significant
Precipitation, Water Availability	Moderate Adverse	Significant
Snow and Ice	Minor Adverse	Not Significant
Gales, Storms, Extreme Weather	Moderate Adverse	Significant
Solar Radiation	Minor Adverse	Not Significant

Climate Change Issue	Magnitude of Effect	Significance
Cloud Cover	Minor Adverse	Not Significant

17.152 The impact of future climate change on the proposed development without embedded mitigation is deemed to be significant. This assessment is based on the reasonable assumption that the proposed development will meet the minimum standards required by Building Regulations.

Mitigation Measures

Temperature

17.153 The CCRA places a high current and high future risk on health, wellbeing and productivity associated with high temperatures as a result of climate change. This problem will be exacerbated by changes in the UK demographic over the project lifetime. The CCRA states that buildings will need to be carefully designed to reduce heat loss during winter, reduce solar gain during summer and maximise the effectiveness of natural ventilation in buildings. The Carbon Trust found that energy costs and associated CO_2 emissions are 30 % higher in an air-conditioned building compared to natural ventilation, on top of increased capital and maintenance costs. Any provision of air-conditioning should, when possible, by coupled with on-site solar PV due to the temporal match in demand and generation profiles and to offset the CO_2 emissions associated with the air-conditioning operation.

17.154 Design measures should be incorporated into the wider development to reduce the urban heat island effect which can include planting deciduous trees and increasing the availability of green and blue spaces. The use of water features and vegetation to improve landscaping can provide a cooling effect as well as providing insects, invertebrates, small mammals and humans shading from the elements.

17.155 It is also essential to limit the heat release rate of materials used in linings, materials and finishes by strict compliance with national fire regulations. The increasing number of heatwaves could result in periods of dry environments, where the fire risk will increase significantly. The use of fire and smoke alarms in all properties is mandatory and the implementation of basic fire preparation and response plans can significantly reduce the risks to human life.

17.156 The proposed development as a whole will be built to current building regulations. Careful design and layout of the proposed development will reduce the overall residual risk associated with building overheating. The standard house type proposed does not include shading or canopies, and no specific additional provisions are proposed for the management of solar gain. All glazing will be low emissivity (soft coat low e) glazing. The exact details proposed will be confirmed during Reserved Matters.

Precipitation

17.157 Following the IPCC Fifth Assessment on Climate Change Report series, key findings for the builder sector were summarised into a briefing called Climate Change: Implications for Buildings. It found that increased precipitation and weather extremes pose a direct threat to building construction through delays, changes to building seasons and the increased likelihood of rebuilding and repair work. The CCRA places a current and future high-risk magnitude on the UK's vulnerability to climate change induced flood risk. These problems could be exacerbated across the UK with an increasing population and a need to house that population. The State of the Climate 2019 report indicates that severe flooding events from persistent heavy rain and flash-flooding events are increasingly affecting parts of the UK. Climate change projections (Figure 17.5 and Figure 17.6) shows increases in winter precipitation anomalies that exceed the UK average, particularly during periods beyond 2050.

17.158 The Site is located entirely within Flood Zone 1, indicating a less than 1 in 1,000 (1:1,000) annual probability of flooding via river or sea sources. The River Lostock meanders north to south east beyond the railway line and Leyland Road. The site itself lies within the catchment of the River Ribble to which Mill Brook outfalls some 4.5km to the north west of the site. Penwortham Way is served by a highway drainage system which is connected to Mill Brook via the various road culverts.

17.159 As part of the ES, a Flood Risk Assessment (FRA) and Drainage Strategy has been undertaken for the proposed development (see ES Chapter 11 and **Appendix 11,1**). This takes into consideration climate change projections of increased rainfall and flooding. An allowance of a 40 % increase in the rainfall intensity values for the period 2060 to 2115 have been included in the FRA and Drainage Strategy to account for the impact of climate change on the design of the proposed development.

Extreme Weather

17.160 According to The Met Office, there are no compelling trends in storminess as determined by maximum gust speeds from the UK wind network over the last five decades. However, the State of the Climate 2019 report highlights how six named storms affected the UK in year 2019 and this was not even a stormy year compared to recent decades. UKCP18 projects an increase in near surface wind speed in the second half of the 21st century during winter, although the increase in wind speed is modest compared to monthly and seasonal variability.

17.161 Storm damage will typically involve the damage or removal of roof slates/tiles or potentially the whole roof structure. The NHBC Foundation recommends that the optimum roof angle is 30° to the horizontal to minimise the suction forces that will apply to the roof. At lower angles the suction forces will be greater and at higher angles the forces will tend to exert downward force on the roof. Eaves and roof structures that overhang external walls may be particularly susceptible to the effects of wind loading and sufficient consideration will be required to ensure that problems are avoided. Wind loading can also apply significant lateral forces to buildings and modelling to ensure that adequate bracing is in place to deal with these forces will be necessary.

17.162 In all cases, within the loading calculations a suitable margin of error will be used to ensure the roof materials remain fixed in position during extremely severe wind conditions although it is not possible to quantify precisely future impacts of climate change vulnerability as insufficient data is available.

17.163 The vulnerability of residents and users of the proposed development to climate change will be dependent upon a variety of factors, including age and physical health. Although projections suggest an overall decrease in cold spells, it is still important to consider risk mitigation in the event of adverse extreme weather.

Water Availability

17.164 Water resources availability presents a challenge that is expected to be exacerbated by a changing climate. United Utilities has the responsibility to supply water to the Site, although water efficiency measures can reduce stresses on the water network overall and improve the networks overall resilience. Part G of the Building Regulations places limits on water use in dwellings with the regulatory maximum being 125 litres per person per day. Many aspects of a dwelling that use water are regulated by specific standards such as Water Supply (Water Fittings) Regulations 1999.

17.165 No specific provision is to be made for reducing water use or rainwater harvesting for the proposed development, however, some measures that can improve water efficiency are being considered in line with regulations and these will be confirmed during Reserved Matters.

Limiting Impacts on Biodiversity

17.166 Impacts on biodiversity can include but are not limited to mortality, biome shifts, ecosystem change, water scarcity/flooding, pest exacerbation and ecosystem feedback capabilities, including carbon sequestration.

17.167 In the establishment of landscapes and ecological habitats as part of detailed design the proposed development will need to consider the climate resilience of enhancements that are used. Key aspects suggested for consideration when designing climate resilient landscaping are:

- Species selection: Drought tolerant species e.g., enzymic resilience to warmer temperatures;
- Sensitivity to watering e.g., induced root hypoxia and rot from oversaturation;
- Growth inhibition e.g., pollution tolerance;
- Wind tolerance e.g., strong, deep root structures;
- Year-round ecosystem services e.g., forage and shelter capability during difficult seasons to continually support ecology and human needs;
- Avoiding fragmentation of green spaces, landscapes and ecological habitats where possible; and,

- Control use and ongoing spread of invasive and alien species that may impede native species ability to adapt or be in competition for resources during times of decreased availability e.g., as a response of extreme weather.

17.168 The proposed landscaping scheme for the proposed development will have native hedge planting and incorporate specific species to encourage insects, etc, to increase resilience to climate change. The Ecology and Nature Conservation assessment (ES Chapter 7) identified the presence of bats, barn owls, and other breeding birds within the scheme. An iterative design process for the proposed development has resulted in the planned retention and protection of key habitat features within the site, or like-for-like replacement within the scheme as a minimum, with replacement tree planting at a ratio of 3:1. The proposals will include the installation of artificial habitats including barn owl, bat and bird boxes and sensitive lighting design. Mitigation measures will also be implemented for features which may hold importance at site level including the small onsite stream, native bluebell, badgers and hedgehogs.

Air Quality and Transport

17.169 The relationship between air quality and climate change is highly complex but is an important consideration due to the direct risk to human health. For example, when atmospheric pressure increases pollutants are concentrated to the ground, resulting in increased respiratory health issues. Climate variations across regions will affect air quality differently. Increased precipitation aids the clearing of pollutants from air, whilst warmer, drier conditions stalls air that is saturated in pollutants e.g., smog.

17.170 The impact of the proposed development on local transport infrastructure likely to be affected has been assessed by Vectos in a Transport and Access Assessment (ES Chapter 12). Overall, it is considered that the existing pedestrian and cycling infrastructure will facilitate safe and direct linkages between the site and local destinations. The proposed development site is considered to be highly accessible by bus, and there would be the potential for rail to be used by residents as part of a multi-modal journey with cycling. These measures will help to reduce emissions resulting from vehicle use as a result of the proposed development. The inclusion of electric charging points will help encourage the uptake of electric vehicles within the proposed development, potentially leading to a greater number of zero emission vehicles and improved air quality for the residents in the local area.

17.171 The Air Quality Assessment undertaken by Ensafe Consultants (ES Chapter 13) has assessed emissions from operational road traffic, taking into consideration baseline pollutant concentrations of NO_2, PM_{10} and $PM_{2.5}$. There is the potential for air quality impacts as a result of fugitive dust emissions from the site during construction, and good practice dust mitigation measures should be implemented through a CEMP. Dispersion modelling results indicated that pollutant levels at sensitive locations across the site were below all relevant national Air Quality Objectives (AQO) set by DEFRA, and there would be no significant residual effects on human receptors as a result of the proposed development.

Likely Residual Effects and their Significance

17.172 The proposed development should implement mitigation measures to reduce GHG emissions and build in resilience to future changes in climate as outlined in throughout the ES. This would then result in the residual effects being minimised. As shown in Table 17.21, this represents a minor adverse impact over the long term which is deemed not significant.

17.173 According to the IPCC's 2018 Special Report on Global Warming of 1.5°C, there is high confidence that climate-related risks for natural and human systems depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options. The report states *"Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (high confidence). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (medium confidence)."* The Applicant can implement measures to reduce the impacts and increase climate resilience according to global and regional climate projections with relevance to the scale of the proposed development. However, the uncertainties associated with probabilistic climate projections are outside of the Application's control and cannot be fully mitigated against.

Table 17.21: Residual Effects of Future Climate Change on Proposed Development

Description of Effect	Potential impact including significance	Mitigation	Residual Effect including significance
Construction			
Air Quality	Moderate Adverse - Significant	Best Practices	Minor Adverse – Not Significant
Completed Development			
Soil Drying	Minor Adverse - Not Significant	Good Design	Minor Adverse - Not Significant
Temperature Increase	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant
Relative Humidity	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant
Precipitation, Water Availability	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant
Snow and Ice	Minor Adverse – Not Significant	Good Design	Minor Adverse - Not Significant
Gales, Storms, Extreme Weather	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant

Description of Effect	Potential impact including significance	Mitigation	Residual Effect including significance
Solar Radiation	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant
Cloud Cover	Minor Adverse – Not Significant	Good Design	Minor Adverse - Not Significant

Conclusions

Assessment of Impacts from Emissions

17.174 The project is in the early stages of planning, and based on a number of high-level assumptions, the proposed development's absolute emissions with mitigation were modelled to be the below the baseline emissions. A 42% saving was achieved over the 80-year project lifetime with mitigation. However, this was also when taking into account the decarbonisation of the national grid which negates any additional savings over a longer timeframe. Overall, this represents a positive, minor beneficial impact which is significant over the long term.

17.175 This result should not be interpreted as the proposed development having no impact on climate change through greenhouse gas emissions. It signifies that the proposed development, by exceeding Part L 2013 Building Regulations, will have less impact than a development of the same size, with comparable facilities, constructed to the 2013 Part L building regulations.

17.176 It has been shown that the proposed build types will provide slight emission reductions over current building regulations. It is however, recognised that these buildings will not be appropriate in their current form if construction has not commenced prior to the introduction of the proposed new 2021 building regulations.

17.177 Although not yet in legislation nor even presented in its final form, the underlying principle behind the Future Home Standard is something that the Developer fully embraces. The Applicant is in the process of designing and developing new units that will, in future, be able to meet these more stringent requirements. However, unfortunately at this stage that process is incomplete, and those units are not available for use in this outline application.

17.178 Subject to the necessary consents, the proposed development is expected to be built out between 2023 to 2031 so will span changes to Building Regulations. It is recommended that the emissions reduction target and associated impacts should be reassessed during Reserved Matters when more detail is available regarding the energy strategy for the proposed development.

Assessment of Climate Resilience

17.179 It will not be possible to eliminate every risk associated with climate change but through intelligent design, preparation and responsible construction, these risks will be minimised. Discussion and recommendations have detailed reducing these risks in key areas such as overheating, flooding and extreme weather, which has taken into consideration not only the health and safety of the users of the proposed development, but the resilience of the proposed development itself.

17.180 It is assumed that with the mitigation each individual technical discipline has suggested throughout the ES Chapters, there will not be a significant impact on the development as a result of climate change in the long-term.

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