

Land at Barnham, Eastergate and Westergate Environmental Statement

Chapter M: Climate Change and Resilience

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M1.0 Introduction

- M1.1 This Chapter of the Environmental Statement (ES) identifies, describes and assesses the likely significant effects arising from the construction and operation of the Proposed Development in relation to climate change, with focus on embodied carbon and carbon dioxide emissions from the operation of the proposed buildings. The Chapter has been prepared by Hoare Lea. It is supported by further detailed information contained within the energy & sustainability strategy, prepared by Hoare Lea, and submitted as part of this planning application.
- M1.2 Since the late 19th century, the global average temperature has risen by about 1°C and the global sea level has risen by about 20cm. Other impacts of climate change that have been detected include acidification of the oceans, receding glaciers and sea ice, and slowing of increases to crop productivity. There is no clear threshold at which the impacts of climate change become dangerous to life on earth, but at the current rate of change some disruption and irreversible losses of natural habitats and resources are expected to occur. Rapid global action to curb greenhouse gas (GHG) emissions could reduce the likelihood of global temperatures increasing by 2°C, but with no action global temperatures could increase by 4°C or moreⁱ.
- M1.3 The main focus of the Climate Change chapter is on GHG emissions. GHG emissions throughout the chapter are presented as “carbon” emissions. The GHG Protocolⁱⁱ, which was originally published in 2001, defines carbon dioxide equivalent (CO₂e) as the standard unit for measuring and reporting emissions. In line with this, this chapter reviews all GHG emissions in mass of CO₂e. The terms ‘carbon’, ‘carbon dioxide (CO₂)’ and ‘greenhouse gas (GHG)’ are used interchangeably in this Chapter in accordance with the terminology of referenced documents.
- M1.4 In accordance with Regulation 18(3) of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (hereinafter referred to as the ‘EIA Regulations’), this ES chapter sets out the information relating to climate change outlined in Schedule 4 as follows:
1. An estimate, by type and quantity, of expected GHG emissions, generated during the construction and operational phases, produced on the basis of the available environmental information and scientific knowledge.
 2. A description of the likely significant effects of the Proposed Development on the environment resulting from:
 - Impacts of the Proposed Development on the nature and magnitude of GHG emissions;
 - Impacts of the Proposed Development relevant to adaptation in a changing climate; and
 - Impacts of the Proposed Development associated with its vulnerability to climate change.
 3. Where the effects resulting from any potential changes caused by the Proposed Development are expected to be significant, a description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment in the context of the following:
 - Climate change mitigation (i.e. measures implemented in the design of the Proposed Development to avoid, prevent, reduce or offset GHG emissions); and
 - Climate change resilience & adaptation (i.e. measures implemented to future-proof the Proposed Development and adapt to the anticipated impacts of a changing climate).
- M1.5 Climate change adaptation for the Proposed Development has been addressed in individual assessments, notably Water Environment and Drainage, and Ecology which set out appropriate

action adopted by the scheme to prevent or minimise the damage climate change can cause, or taking advantage of opportunities that may arise.

M1.6 Key measures have been summarised in the climate change chapter for ease of reference. Climate change interrelationship effects with other topics have been assessed in consultation with the design team and EIA consultants working on the relevant subjects. Moreover, cumulative effects associated with the interaction and combination of environmental effects of the Proposed Development affecting the same receptor are captured in ES Volume 1, Chapter N.

M1.7 There are no Chapter M climate change and resilience technical appendices.

About the Author

M1.8 Tom obtained a master's degree in Physics with Astrophysics from the University of Bristol and now has over four years' experience in the sustainability and energy sectors. In his current role at Hoare Lea, Tom supports the firm's sustainability strategy, energy strategy, building physics, and EIA climate change assessment service offering, with a track record including a range of medium- to large-scale residential-led and mixed-use masterplan developments.

M2.0 Policy Context

Legislative Context

Climate Change Act (2008)

- M2.1 The Climate Change Actⁱⁱⁱ established the context for government action to enable the UK to achieve its long-term carbon reduction goals. Through the Climate Change Act, the UK government has set a target to reduce UK GHG emissions by at least 80% by the year 2050, relative to 1990 levels, and outlined a path to get there.
- M2.2 The Act incorporates a requirement for the government to produce a UK Climate Change Risk Assessment (CCRA) every five years and to develop a National Adaptation Programme (NAP) to address the opportunities and risks arising from climate change.
- M2.3 The Act also further introduced a key institutional innovation in the form of legally-binding five-year 'carbon budgets' with distinct five-year targets to act as stepping stones towards the 2050 target. A carbon budget is essentially a cap on the amount of GHGs that are allowed to be emitted in the UK over a five-year period. The Act also established the Committee on Climate Change (CCC) to ensure that emissions targets are evidence-based and independently assessed.
- M2.4 The EIA Regulations build on this effort and seek to examine the potential impacts of development projects on climate in greater detail. They require a description of 'the impact of the Proposed Development on climate', and 'the vulnerability of the Proposed Development to climate change' (Schedule 4, paragraph 5(f)).

The Climate Change Act 2008 (2050 Target Amendment) Order 2019

- M2.5 On 26th June 2019, the UK parliament passed the Climate Change Act 2008 (2050 Target Amendment) ("Order")^{iv} implementing the recommendations of the Committee on Climate Change committing the country to a new legally binding "net-zero" carbon target for 2050, thus exceeding the previous legally binding net GHG emissions reduction target of 80% relative to 1990 levels, introduced by the Climate Change Act. With this act the UK became the first G7 economy to introduce a legal obligation on its Government to achieve net zero emissions.
- M2.6 The Order was enacted following a recommendation made by the UK Committee on Climate Change that the UK should adopt a target of "net-zero" emissions by 2050 contained in a report which was published shortly after the UK Parliament had declared a climate change emergency.

The UK Climate Change Risk Assessment (2017)

- M2.7 The Government and the Adaptation Sub-Committee (part of the CCC) published the second five-year CCRA^v in January 2017. The CCRA draws upon the findings contained in the Adaptation Sub-Committee's (ASC) independent evidence report for a range of potential impacts of climate change in a UK context.
- M2.8 The Government commissioned the ASC to produce an Evidence Report to inform the second CCRA (CCRA2). The full CCRA2 Evidence Report^{vi} comprises eight chapters written by leading academics, consultants and other experts in the public and private sectors and civil society representing organisations across Great Britain and Northern Ireland. It highlights priority risks across different sectors where additional action is recommended over the next five years to tackle current and future risks, and realise opportunities, arising for the UK from climate change.

M2.9 The ASC's CCRA2 Evidence Report identified six key areas of climate change risk that need to be managed as a priority over the next five years. It divided the key groups of risk into areas where there is an urgent case for stronger policies and areas where additional research is required in order to inform future policy approaches.

More action needed:

- Flooding and coastal change risks to communities, businesses and infrastructure;
- Risks to health, wellbeing and productivity from high temperatures;
- Risk of shortages in the public water supply, and for agriculture, energy generation and industry, with impacts on freshwater ecology;
- Risks to natural capital including terrestrial, coastal, marine and freshwater ecosystems, soils and biodiversity; and
- Risks to domestic and international food production and trade.

Research priority:

- New and emerging pests and diseases, and invasive non-native species, affecting people, plants and animals.

M2.10 Figure M2.1 below presents the 'urgency scores' assigned to the 56 individual risks and opportunities identified by leading academics and experts in the CCRA2 Evidence Report.

Figure M2.1: Risks and opportunities identified in the CCRA2 Evidence Report

MORE ACTION NEEDED	RESEARCH PRIORITY	SUSTAIN CURRENT ACTION	WATCHING BRIEF
Ne1: Risks to species and habitats from changing climate space	Re1: Changes in suitability of land for agriculture & forests	Ne9: Risks to agriculture, forestry, landscapes & wildlife from pests/pathogens/invasive species	Ne14: Risks & opportunities from changes in landscape character
Ne2: Opportunities from new species colonisations	Re7: Risks to freshwater species from high water temperatures	Ne10: Extreme weather/wildfire risks to farming, forestry, wildlife & heritage	In7: Low/high river flow risks to hydro-electric generation
Ne4: Risks to soils from increased seasonal aridity and wetness	Re13: Ocean acidification & higher water temperature risks for marine species, fisheries and marine heritage	Ne11: Saltwater intrusion risks to aquifers, farmland & habitats	In8: Subsidence risks to buried surface infrastructure
Ne5: Risks to natural carbon stores & carbon sequestration	In5: Risks to bridges and pipelines from high river over-erosion	Ne15: Extreme heat risks to rail, road, ICT and energy infrastructure	In10: Risks to electricity generation from drought and low flows
Ne6: Risks to agriculture & wildlife from water scarcity & flooding	In11: Risks to energy, transport & ICT from high winds & lightning	In14: Benefits for infrastructure from reduced extreme cold events	Pe3: Opportunities for increased outdoor activity in warmer weather
Ne8: Risks of land management practices exacerbating flood risk	In12: Risks to offshore infrastructure from storms and high waves	Pe13: Risks to health from poor water quality	Pe12: Risks of food-borne disease cases and outbreaks
Ne12: Risks to habitats & heritage in the coastal zone from sea level rise, loss of natural food production	Pe2: Risks to passengers from high temperatures on public transport	Pe14: Risk of household water supply interruptions	Bu4: Risks to business from reduced access to capital
In1: Risks of cascading infrastructure failures across interdependent networks	Pe6: Risks to viability of coastal communities from sea level rise	Bu3: Risks to business operations from water scarcity	Bu7: Business risks/opportunities from changing demand for goods & services
In2: Risks to infrastructure from river surface groundwater flooding	Pe7: Risks to building fabric from moisture, wind and driving rain	Bu6: Risks to business from disruption to supply chains	Id: Opportunities from changes in international trade routes
In3: Risks to infrastructure from coastal flooding & erosion	Pe8: Risks to culturally valued structures and historic environment		
In4: Risks of sewer flooding due to heavy rainfall	Pe10: Risks to health from changes in air quality		
In6: Risks to transport networks from embankment failure	Pe11: Risks to health from vector-borne pathogens		
In9: Risks to public water supplies from drought and low river flows	Bu2: Risks to business from loss of coastal locations & infrastructure		
Pe1: Risks to public health and wellbeing from high temperatures	Bu5: Employee productivity impacts in hotwaves and from severe weather infrastructure disruption		
Pe4: Potential benefits to health & wellbeing from reduced cold	R2: Imported food safety risks		
Pe5: Risks to people, communities & buildings from flooding	R3: Long-term changes in global food production		
Pe9: Risks to health and social care delivery from extreme weather	R5: Risks to the UK from international violent conflict		
Bu1: Risks to business ops from flooding	R6: Risks to international law and governance		
R1: Weather-related shocks to global food production and trade			
R4: Risks from climate-related international human displacement			

KEY TO CHAPTERS:

Chapter 3: Natural environment and natural assets

Chapter 4: Infrastructure

Chapter 5: People and the built environment

Chapter 6: Business and industry

Chapter 7: International dimensions

- M2.11 The risks and opportunities relating to Chapter 3 ‘Natural environment and natural assets’ and Chapter 5 ‘People and the built environment’ are of particular relevance to the Proposed Development and are, therefore, considered throughout this chapter.

National Policy and Guidance

National Planning Policy Framework (2021)

- M2.12 The National Planning Policy Framework (NPPF)^{vii} was revised on 20th July 2021 and sets out the Government’s planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced. In relation to meeting the challenge of climate change, flooding and coastal change, the NPPF states the following:
- M2.13 Para 150: New development should be planned for in ways that:
- 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
 - 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.
- M2.14 Para 151: To help increase the use and supply of renewable and low carbon energy and heat, plans should:
- 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);
 - consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
 - 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.

Planning Practice Guidance

- M2.15 National Planning Practice Guidance (PPG)^{viii} has been developed to support the NPPF. The guidance advises how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change.
- M2.16 Addressing climate change is one of the core planning principles regarding the use of land which the NPPF expects to underpin both plan-making and decision-taking.
- M2.17 The PPG on climate change (paragraph 005 of the PPG) states that the impact of climate change needs to be taken into account in a realistic way. In doing so, local planning authorities will want to consider:
- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity
 - Building in flexibility to allow future adaptation if it is needed, such as setting back new development from rivers so that it does not make it harder to improve flood defences in future

- The potential vulnerability of a development to climate change risk over its whole lifetime.
- M2.18 The PPG on climate change (paragraph 007 of the PPG) recognises that every area will have different challenges and opportunities for reducing carbon emissions from new development such as homes, businesses, energy, transport and agricultural related development.
- Robust evaluation of future emissions will require consideration of different emission sources, likely trends taking into account requirements set in national legislation, and a range of development scenarios.
 - The distribution and design of new development and the potential for servicing sites through sustainable transport solutions, are particularly important considerations that affect transport emissions. Sustainability appraisal should be used to test different spatial options in plans on emissions.
 - Different sectors may have different options for mitigation. For example, measures for reducing emissions in agricultural related development include anaerobic digestion, improved slurry and manure storage and improvements to buildings. In more energy intensive sectors, energy efficiency and generation of renewable energy can make a significant contribution to emissions reduction.

Local Policy

Arun Local Plan 2011-2031

Policy SD SP1 Sustainable development

M2.19 When considering development proposals the Council will take a positive approach that reflects the presumption in favour of sustainable development contained in the National Planning Policy Framework. It will work pro-actively with applicants to jointly find solutions which mean that proposals can be approved wherever possible and to secure development that will contribute to the social, economic and environmental conditions south of the National Park through to the coast and throughout its settlements (both coastal and inland).

M2.20 This presumption will not be applicable where development requires an Appropriate Assessment or where consideration of the need for one is being undertaken. Other Guidance / Best Practice.

Policy ECC SP1 Adapting to climate change

M2.21 The Council will support development which is located and appropriately designed to adapt to impacts arising from climate change such as the increased probability of tidal and fluvial flooding; water stress; health impacts as a result of extreme temperatures and a decline in the quality of habitats and richness of biodiversity.

M2.22 In order to achieve this, development must be designed to take account of the following issues:

- a Location (in relation to flood risk and vulnerability to coastal erosion);
- b Water efficiency;
- c Shade, cooling, ventilation, solar gain;
- d Connectivity to the green infrastructure network;
- e Layout and massing;
- f Resilience of buildings and building materials to extreme weather events; and

- g Capacity of drainage systems and incorporation of Sustainable urban Drainage Systems (SuDS)

Policy ECC SP2 Energy and climate change mitigation

- M2.23 All new residential and commercial development (including conversions, extensions and changes of use) will be expected to be energy efficient and to demonstrate how they will:
- a Achieve energy efficiency measures that reflect the current standards applicable at the time of submission;
 - b Use design and layout to promote energy efficiency; and
 - c Incorporate decentralised, renewable and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.
- M2.24 All major developments must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. The Council will consider 'allowable solutions' where it is clearly demonstrated that the provision of on site renewable or low carbon energy generation is unviable or not feasible.
- M2.25 Where planning permission is required to retrofit energy efficiency measures into existing development, schemes will be permitted, subject to the Design and Built Heritage policies. In assessing the achievement of these standards the Council will consider:
- Site constraints;
 - Technical viability;
 - Financial viability; and
 - Delivery of additional benefits

Policy ECC DM1 Renewable energy

- M2.26 The Council will support renewable energy development subject to the criteria in this Policy. Schemes will be expected to contribute to the social, economic and environmental development and overall regeneration of the District.
- M2.27 Within areas of protected landscapes, areas or buildings, development should generally be small scale or community based.
- M2.28 The Council will support proposals for appropriately located renewable energy development, and their ancillary development where they meet the following criteria:
- a The proposal is located and designed to minimise adverse impacts to landscape, habitats, the historic environment and residential amenity including visual, noise and odour impacts;
 - b The location and design of proposals will need to take account of the Council's landscape assessment and landscape sensitivity studies (or successor documents) and proposals for large scale renewable energy projects will need to be supported by a zone of theoretical visibility and viewpoint assessment;
 - c Priority should be given to proposals that integrate with existing or new development where appropriate to do so having regard to (a); and
 - d All proposals will need to demonstrate a suitable connection to the electricity distribution network, or appropriate energy storage facility, and provide evidence to

demonstrate that the connection will not result in unacceptable impacts upon the landscape, natural and historic environment or visual and residential amenity.

Barnham Eastergate and Westergate (BEW) Framework Masterplan (November 2020)

- M2.29 This document has been prepared for the Land at Barnham, Eastergate and Westergate (BEW) and it is intended for it to be used to guide future planning applications on the site.
- M2.30 This masterplan demonstrates how the requirements for the site as set out in Policy H SP2c SD5 can be delivered. These requirements include the building of up to 4,300 new homes, of which only 2,300 would be delivered in the Local Plan period to 2031; two new Primary Schools, two local centres which will include shops and a library facility.
- M2.31 The Framework Masterplan provides an indication of the broad layout of the site and demonstrate how the requirements in the Local Plan can be translated into a well-designed successful place. This strategic and flexible guide will sit alongside the High Level Development Principles (appended to this document) and will seek to ensure the delivery of a new high quality neighbourhood that is future proofed to ensure it can be readily adapted to respond to changing circumstances should the need arise.
- M2.32 This Framework Masterplan has been prepared by The Church Commissioners for England and Hanbury Properties in consultation with other landowners within the allocation. It covers all land within the Strategic Allocation. It is expected that any planning applications brought forward by all landowners will have regard to this Framework Masterplan. It has also been subject to public consultation in August 2020. This engagement process has been integral to the design process informing the Framework Masterplan.

Arun District Design Guide – Supplementary Planning Document (SPD)

K.01 Energy & Carbon

- M2.33 All new development including conversions, extensions and changes of use must be designed to reduce energy demand and carbon emissions in line with national and local standards including the Arun Local Plan.
- M2.34 Approaches to design must demonstrate that each step of the energy hierarchy has been followed whilst also ensuring the incorporation of low and zero carbon (LZC) technologies and clear commitments to comprehensive energy monitoring and transparency of performance.
- M2.35 Passive design should be the first step, considering form and orientation, effective insulation, air-tightness and utilising natural ventilation where this can avoid the risk of overheating, both today and in the future. Existing buildings should incorporate retrofitting measures such as cavity wall insulation and additional glazing, but these interventions must be supported by detailed analysis of moisture risk.
- M2.36 Make sure the scheme:
- Sets targets for energy and carbon reductions beyond the relevant Part L Building Regulations.
 - Demonstrates consideration of embodied carbon (emissions from the manufacture, transport and construction of building materials, together with end of life emissions).
 - Incorporates passive solar design measures such as avoiding single aspects, including south facing windows on habitable rooms, minimising north-facing glazing, using roof lights and providing shading to south facing windows through tree cover.

- Where mechanical ventilation is installed these are heat recovery systems (MVHR).
- Considers the ventilation strategy alongside proposed air tightness levels, to ensure buildings are not left susceptible to mould growth. This may include hydrothermal modelling.

M2.37 Feasibility studies should be carried out to explore a range of passive design measures and low and zero carbon technologies appropriate to the site, to reduce energy consumption to a minimum. Following the energy hierarchy, once maximum savings have been achieved through passive design, a further minimum 10% of the energy requirement should be generated through on-site renewable or low carbon technologies.

K.03 Adapting to Climate Change

M2.38 Adapting the built environment has a key role to play in the global response to climate change. This involves future-proofing development to be resilient to impacts including flooding (refer to section K.04), overheating (sections K.01 and K.06) and resource scarcity (section K.02). These impacts will be intensified by population growth, meaning that developments will need to adapt to changing requirements, such as those for heating and cooling. Future proofing ensures resilience to extreme weather events with minimal consumption of resources and interventions, through either capacity integrated now or the opportunity to improve adaptive capacity in the future. This should include designing in access for maintenance and replacement of building systems and making allowances for the incorporation of future technologies (refer to section K.01). Incorporating the measures set out in sections K.01, K.02 and K.04 will go some way to ensuring that development is resilient to the challenges of climate change. These should be fully integrated with Arun's historic environment, which should not be in conflict with high quality sustainable design. Rather, the introduction of sustainable design and construction techniques in Conservation Areas or to Listed Buildings will enhance these assets and provide improved longevity.

M2.39 Make sure that the scheme:

- Demonstrates ability to cope with rising temperatures as for a projected climate change scenario as per UKCP 2018, applied to modelling outlined in K.06.
- Reviews material selection to ensure durability to withstand projected climate change temperatures.
- FRA (refer to section K.04) makes allowances for climate change in accordance with advice from ADC, the EA and other relevant flood risk management authorities.
- Has adaptive capacity (or potential for it) designed in for buildings and their systems, and resilience measures e.g. ensuring critical plant is located above ground level.

M2.40 Proposals should be informed by a Climate change adaptation strategy appraisal in line with BREEAM 2018 issue Wst 05 and Functional adaptation strategy in line with Wst 06.

M2.41 All design team members should consider future demands and conditions in order to design for future flexibility.

Other Guidance / Best Practice

The Sixth Carbon Budget

M2.42 The sixth carbon budget^x, covering the period 2033-2037, was issued by the CCC in 2020. The two main outcomes of this report were:

- A recommended level for the sixth carbon budget for the period covered (2033-2037) set at 965 MtCO₂e, including emissions from international shipping; and
- A recommended limit to annual emissions in the period covered to an average 78% below 1990 levels

Table M2.1: UK National Carbon Budgets

Budget	Carbon budget level	Reduction below 1990 levels
1 st carbon budget (2008 – 2012)	3,018 MtCO ₂ e	25%
2 nd carbon budget (2013 – 2017)	2,782 MtCO ₂ e	31%
3 rd carbon budget (2018 – 2022)	2,544 MtCO ₂ e	37% by 2020
4 th carbon budget (2023 – 2027)	1,950 MtCO ₂ e	51% by 2025
5 th carbon budget (2028 – 2032)	1,725 MtCO ₂ e	57% by 2030
6 th carbon budget (2033 – 2037)	965 MtCO ₂ e	78% by 2035

UK Greenhouse Gas Statistics

M2.43 The Department for Business, Energy & Industrial Strategy (BEIS) reports on energy and emissions projections by source, and reports on local and regional GHG emissions. This has allowed the performance of a review of trends over the period 2005-2017 for Arun.

M2.44 BEIS also publishes conversion factors for GHG reporting^x.

M3.0 **Assessment Methodology & Significance Criteria**

Assessment Methodology

M3.1 The Climate Change and Resilience chapter aims to:

- Determine the existing sources of carbon emissions currently present at the site, and consider how these could change in the future;
- Identify the likely sources of carbon emissions arising from the construction and operation of the Proposed Development, and measure them as far as practical; and
- Review measures in which different alternatives (such as development type, construction methodology and operating mechanisms) can demonstrably reduce carbon emissions.

Carbon Impact Assessment: Study Area

M3.2 The carbon emissions assessment study area considers all carbon emissions arising over the lifecycle of the Proposed Development (subject to the limitations and assumptions listed below). The assessment of the Proposed Development's carbon footprint for the purpose of EIA provides an opportunity to identify the potential for effects to be designed out or reduced/offset through iterative design, and thereby maximise the Proposed Development's contribution towards a net zero carbon society.

M3.3 Climate change is the most pressing environmental issue currently facing humanity. We recognise that all new development emits carbon emissions that contribute towards global climatic change. In fact, IEMA stipulates that all carbon emissions might be considered significant because "the GHG emissions from all projects will contribute to climate change...". However, we also recognise that new developments need to work within the constraints of a changing climate and have the potential to contribute positively towards a thriving, net zero carbon society.

M3.4 The analysis contained in this chapter encompasses a description relating to the sensitivity of the relevant receptor (global climate), nature and magnitude of an increase in greenhouse gas emissions as a result of the Proposed Development, determination of overall effect significance and recommended mitigation and adaptation measures for the Proposed Development.

M3.5 There is no standard methodology for identifying and assessing the significance of carbon emissions within the EIA process. This assessment follows the recommendations and best practice contained within the IEMA Principles Series: Climate Change Mitigation & EIA (2010)^{xi}, IEMA guidance to Assessing Greenhouse Gas Emissions and Evaluating Their Significance (2017)^{xii}, the EU Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (2013)^{xiii} and IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation (2020)^{xiv}.

M3.6 A detailed review of key legislative instruments and national and local planning policy and related guidance (set out in the Policy Context section) has also been undertaken to inform the approach and effect significance classification.

M3.7 This chapter examines both direct (Scope 1) and indirect (Scope 2 and Scope 3) carbon emissions. The Greenhouse Gas (GHG) Protocol defines direct and indirect emissions as follows:

- Scope 1 emissions are direct emissions from owned or controlled sources

- Scope 2 emissions are indirect emissions from the generation of purchased energy
- Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain, including both upstream and downstream emissions.

The key anticipated carbon emission sources reviewed in this assessment are summarised in Table M3.1.

Table M3.1: Key Anticipated Carbon Emission Sources from the Proposed Development.

Lifecycle Stage	Activity	Emissions Sources	Scope of assessment
Construction (including enabling works and demolition)	Raw material extraction and manufacturing of building materials	Embodied carbon in building materials as per lifecycle stages A1-A3 (EN 15978)	Scoped in
	Transportation of building materials	Transportation of building materials to the site as per lifecycle stage A4 (EN 15978)	Scoped out
	On-site construction activity	Fuel use in mobile plant & equipment as per lifecycle stage A5 (EN 15978)	Scoped in
	Waste disposal and transportation	Transportation and disposal of waste	Scoped out
Operation	Building operation	Regulated components of the Proposed Development's operational energy	Scoped in
		Unregulated components of the Proposed Development's operational energy	Scoped in
	Occupant commuting and visitor transportation	Occupant commute to and from the site Transportation of visitors to and from the site	Scoped out
	Waste disposal and transportation	Transportation and disposal of waste	Scoped out

Enabling and construction

Embodied carbon in buildings

M3.8

The assessment has measured the embodied carbon of buildings introduced as part of the Proposed Development. Embodied carbon is the total carbon emissions generated to produce a built asset. It is often defined as the 'carbon emissions associated with energy consumption (embodied energy) and chemical processes during the extraction, manufacture, transportation, assembly, replacement and deconstruction of construction materials or products.'

M3.9 Embodied carbon assessment is an area which has undergone significant development in recent years. Traditionally the greatest impact on an asset's whole life carbon has been associated with its operational phase. With the ongoing decarbonisation of the UK electricity grid, this trend is expected to shift, and embodied carbon is expected to assume an ever-increasing significance in the overall carbon footprint of developments (made up of embodied and operational carbon emissions).

M3.10 An initial appraisal of the anticipated CO₂ emissions associated with the raw material extraction and manufacturing of the building materials used on site has been carried out using the general guidance and benchmark estimates of embodied carbon associated with construction materials for various building types provided by the Royal Institution of Chartered Surveyors (RICS) set out in the RICS 2014¹ and 2017² papers. The RICS methodology enables the quantification of the carbon emissions associated with life cycle stages: A1-A3 (construction materials) and A5 (construction & installation) by assigning suitable carbon factors to materials used in the development via acceptable data sources, such as manufacturing databases.

Fuel use in construction plant & associated facilities

M3.11 At this stage of the project, there is limited information about specific plant and site office requirements. The parameters of any equipment utilised during the construction process will depend on the selected contractor. However, for completeness and in line with the RICS methodology, an additional allowance for the construction site emissions, such as fuel use in mobile plant and equipment (as per lifecycle stage A5 (EN 15978)), has been made using the RICS factor: 1,400 kg CO₂e/£100,000 of project value.

Completed development

Operational CO₂ emissions generated by buildings

M3.12 The operational emissions associated with this Proposed Development have been evaluated using regulated and unregulated carbon emissions projections.

M3.13 The assessment has reviewed the estimated total operational energy of the Proposed Development. This is made up of regulated components – including heating, cooling, hot water, fans, pumps and lighting – and unregulated, such as IT equipment, plug-in devices and catering facilities.

M3.14 GHG emissions can vary significantly depending on the use type. Typically, Class A shops and services and Class D Health and Leisure uses can be reasonably expected to consume more energy and produce higher emissions compared to Class C residential elements. Variations are also generally observed between the various class A use types often associated with differences in water consumption.

M3.15 Regulated energy uses are inherent in the design of a building. Estimated carbon emissions from regulated operational energy uses of buildings have been calculated from benchmarks based on modelling undertaken in line with Part L 2013 of the Building Regulations (Conservation of fuel and power).

M3.16 The unregulated operational emissions are typically mainly attributable to energy consumption associated with IT equipment, domestic appliances, plug-in devices and catering facilities.

¹ RICS (2014) Methodology to calculate embodied carbon. 1st Edition. Available at <https://bit.ly/2HAFd7> [Accessed: 29/06/2020].

² RICS (2017) Whole life carbon assessment for the built environment. 1st Edition. Available at: <https://bit.ly/2NWvur6> [Accessed: 29/06/2020].

Unregulated carbon emissions have likewise been calculated based on Part L of the Building Regulations. Although unregulated carbon emissions are not included within Part L targets, an estimate of unregulated energy consumption is still an output produced as part of this methodology.

Climate change resilience & adaptation review

- M3.17 There is broad consensus that the UK as a whole must adapt to the impacts of inevitable future climate change. Climate change resilience and adaptation have been addressed within each respective chapter of the ES. This chapter summarises the broader climate change related risks to infrastructure and assets associated with the Proposed Development identified in individual assessments. It also sets out a range of adaptation measures to be incorporated in order to craft an adaptable and flexible design, and thus improve the Proposed Development's resilience to potential climate change impacts. Climate adaptation and resilience interrelationship effects shared with other EIA topics have been assessed in collaboration with the design team and EIA consultants working on the relevant subjects.

Significance Criteria

Receptor Sensitivity

- M3.18 The global climate has been identified as the 'sensitive receptor' for the purposes of the carbon impact assessment. In light of the extreme importance of limiting global warming to below 2°C and in the absence of published standard definition of receptor sensitivity of carbon emissions, this assessment asserts that the sensitivity of global climate to increases in carbon emissions is always considered to be 'high'.

Impact Magnitude

- M3.19 Impact magnitude is determined by predicting the scale of any potential change in the baseline conditions. The assessment of magnitude is carried out taking account of any embedded/inherent design mitigation in the proposal that forms part of the Proposed Development's description. In the absence of a clearly defined criteria for assessing impact magnitude in the context of carbon emissions, a blended quantitative-qualitative assessment utilising professional judgement relying on standard GHG accounting and reporting principles has been conducted.
- M3.20 To provide context and to assist with determining the magnitude, the carbon emissions generated by the Proposed Development have been assessed in the context of emissions at a local scale (West Sussex), regional scale (South East), and national scale (the UK as a whole) reflecting the various levels where emissions may occur.
- M3.21 Carbon emissions observed at local and regional level have been sourced from UK national statistics collated by the Department for Business, Energy & Industrial Strategy (BEIS) whereas the national-scale data is based on the five-year National Carbon Budgets produced by the CCC, which reflect the requirement to remain within agreed global emission limits. The relevant national carbon budgets have effectively been used as a proxy of the level of effect produced by the Proposed Scheme on the global climate. They have been apportioned to reflect the contribution of the built environment towards the UK total carbon footprint (estimated to be nearly 40%^{xv}). This approach is in alignment with Section 6.2 of the IEMA Guidance, which provides a steer on contextualising a project's carbon impacts.
- M3.22 Consequently, the 3rd, 4th, 5th and 6th carbon budgets are the ones deemed to be applicable to the operational phase of the Proposed Development (please refer to Table M2.1: UK National

Carbon Budgets). No data is available post-2032 so it is not possible to assess the anticipated operational emissions against UK carbon emissions beyond this date. However, in light of the ambitious sustainability target set by the UK government for the country, i.e. the new legally binding “net-zero” carbon target for 2050, it can be expected that the magnitude of operational emissions would only increase in significance. Therefore, the delivery of a low-carbon energy strategy relying on an all-electric solution complemented by renewables, which would follow the downward carbon intensity trend of national electricity grid, has been a critical consideration during the design process.

- M3.23 In GHG accounting, it is a widely accepted practice to exclude emission sources that do not have a material contribution to the overall carbon footprint on the basis of the De Minimis rule. ISO guidance on GHG reporting (ISO 14064-1)^{xvi} states that ‘the organization may exclude from quantification direct or indirect GHG sources or sinks whose contribution to GHG emissions or removals is not material or whose quantification would not be technically feasible or cost effective’. In this context, multiple sources have introduced a ‘materiality threshold’. PAS 2050, for example, stipulates that in order to be considered ‘material’, the contribution from any one source of GHG emissions should be more than 1% of the anticipated total GHG emissions associated with the element being assessed^{xvii}.
- M3.24 The UK Emissions Trading System (UK ETS) replaced the EU Emissions Trading System (EU ETS) from 1st January 2021. It retains the provision for small installations^{xviii}, which states that small installations whose emissions do not exceed a threshold of 25,000 tCO₂e per annum and, where they carry out combustion activities, have a rated thermal input below 35 MW, excluding emissions from biomass, can opt out from the scheme.
- M3.25 Additionally, as part of its public reporting under the Task Force on Climate-related Financial Disclosures framework (IFC Performance Standard 3: Resource Efficiency and Pollution Prevention), the International Finance Corporation (IFC) discloses emissions of projects with estimated annual emissions over 25,000 metric tons of carbon dioxide equivalent through the Environmental and Social Review Summary for each project.
- M3.26 In line with the above, a 1% materiality threshold has been implemented in this assessment when determining magnitude of effect of the relevant carbon emissions increase. To ensure a robust approach, a second reference point has been included, i.e. 25,000 tCO₂e annual emission maximum level. It is, therefore, assumed that any annual carbon emissions quantum <1% of the (proportional value) of the relevant carbon budget(s) and < 25,000 tCO₂e would not be considered to have a ‘material’ contribution to the national UK GHG inventory. More details are provided in Tables M3.2 and M3.3 below.

Table M3.2: Receptor Sensitivity and Impact Magnitude.

Receptor Sensitivity to Change	Impact Magnitude	Magnitude Criteria
High	High	1. Annual carbon emissions represent a contribution equal to or higher than 1% of the local/regional baseline emissions and (annual proportion) of the relevant UK National Carbon Budget’s share attributable to the built environment sector; and 2. Annual carbon emissions are higher than 25,000 tCO ₂ e in any year.
-	Medium	1. Annual carbon emissions represent a contribution lower than 1% of the local/regional baseline emissions and (annual proportion) of the relevant UK National Carbon Budget’s share attributable to the built environment sector; and 2. Annual carbon emissions are equal to or higher than 25,000 tCO ₂ e in any year.

Receptor Sensitivity to Change	Impact Magnitude	Magnitude Criteria
-	Low	1. Annual carbon emissions represent a contribution lower than 1% of the local / regional baseline emissions and (annual proportion) of the relevant UK National Carbon Budget's share attributable to the built environment sector; and 2. Annual carbon emissions are lower than 25,000 tCO₂e in any year.

Table M3.3: Impact Magnitude Criteria (1% Carbon Emissions Threshold).

Reference Point	Timeline	CO ₂ emissions	Magnitude Criteria (1%)
West Sussex (local)	2018 (annual)	3,610,000 tCO ₂ e	36,100 tCO ₂ e
South East (regional)	2018 (annual)	42,746,500 tCO ₂ e	427,465 tCO ₂ e
UK National Carbon Budget (national)	3 rd carbon budget (2018 – 2022): Built environment annual share	203,520,000 tCO ₂ e	2,035,200 tCO ₂ e
	4 th carbon budget (2023 – 2027): Built environment annual share	156,000,000 tCO ₂ e	1,560,000 tCO ₂ e
	5 th carbon budget (2028 – 2032): Built environment annual share	138,000,000 tCO ₂ e	1,380,000 tCO ₂ e
	6 th carbon budget (2033 – 2037): Built environment annual share	77,200,000 tCO ₂ e	772,000 tCO ₂ e

Effect Significance

- M3.27 Currently there is not a single approved methodology to assess and evaluate the significance of GHG emissions; nor is there a defined significance threshold for GHG assessments. In fact, the IEMA Guidance (2017) states that the application of the standard EIA significance criteria is not considered to be appropriate for climate change mitigation assessments. In this context, as set out above, the proposed approach is to assess the potential effects on climate change of the carbon emissions arising as a result of the Proposed Development in the context of the approved UK national carbon budgets and local and regional baselines.
- M3.28 The consideration of significance has also been informed by an evaluation of the anticipated environment within which the Proposed Development is expected to exist driven by the ongoing decarbonisation of the national electricity grid and the country's new legally binding "net-zero"

carbon target for 2050 as well as the influence and validity of any assumptions adopted when undertaking the prediction of impacts. The UK Climate Projections (UKCP)18^{xi}, which is the fourth generation and latest published national climate projections for the UK, have been used to help formulate suitable and forward-looking resilience and adaptation measures for the Proposed Development.

- M3.29 To determine level of significance, the assessment of likely significant effects to sensitive receptors has considered the sensitivity of the receptor (always considered to be ‘high’) and the anticipated magnitude of change in the baseline conditions – on a scale of high, medium and low. Significant effects have been determined on the basis of the impact magnitude criteria described above and through professional judgment.
- M3.30 In categorising effect significance, due consideration has also been given to the nature, duration and geographical scale of the effect in question (e.g. direct/indirect, temporary/permanent, short/medium-term, etc). A common list of EIA significance criteria used throughout the ES has been provided in ES Volume 1, Chapter B: Scope, Methodology and Consultation.
- M3.31 For the purposes of this assessment, the geographical scope of the identified likely significant effects has been assumed to be ‘international’ in all cases due to the global nature of climate change and its transnational ramifications. Furthermore, in view of the findings of the Intergovernmental Panel on Climate Change (IPCC) Special Report on the effects of global warming of 1.5 °C that some effects from climate change may be long-lasting or irreversible^x, the duration of all effects assessed in this chapter is assumed to be long-term and permanent.
- M3.32 Effects will also be categorised as beneficial or adverse. For the purposes of this assessment, mitigation measures have been recommended to reduce the significance of any effects which have been identified as potentially significant (whether the significance level has been determined as minor, moderate or substantial). This reasoning is consistent with both the IEMA guidance and the Precautionary Principle^{xxi}, which stipulates that if there is a threat or risk of serious or irreversible damage to human health or the environment, precautionary actions must be taken even if there is lack of full certainty surrounding the issue.
- M3.33 A number of design principles and solutions have been embedded within the Proposed Development’s design to minimise climate-related risks (referred to as Primary mitigation). Moreover, there are certain actions that are required regardless of the EIA process such as measures imposed by other existing legislative requirements and/or standard sectorial practices which are known as ‘tertiary’/ ‘inexorable’ mitigation. In arriving at the significance of the identified environmental effects, primary together with tertiary mitigation measures have been considered as inherent components of the Proposed Development. Embedded/inherent design measures of particular relevance to the present carbon emissions assessment have been highlighted in the Embedded Design Mitigation section below.
- M3.34 The term ‘Neutral/Negligible’ has been removed from the effect classification criteria due to the fact that by virtue of their nature, an increase in carbon emissions cannot be ‘neutral’ in the absence of a commitment to a net zero carbon scheme. The level of effect has been based on professional judgement and Table M3.4 has been a tool which has assisted with this process.

Table M3.4 Effect Significance Matrix

Impact Magnitude	Criteria	Receptor Sensitivity	Effect Scale	Definition
	High	High	Substantial	The Proposed Development is likely to cause a considerable change from the baseline conditions and the receptor has limited adaptability, tolerance or recoverability or is of the highest sensitivity. This effect is considered to be 'Significant'.
	Medium		Moderate	The Proposed Development is likely to cause either a considerable change from the baseline conditions at a receptor which has a degree of adaptability, tolerance or recoverability or a less than considerable change at a receptor that has limited adaptability, tolerance or recoverability. This effect is considered more likely to be 'Significant' but will be subject to professional judgement.
	Low		Minor	The Proposed Development is likely to cause a small, but noticeable change from the baseline conditions on a receptor which has limited adaptability, tolerance or recoverability or is of the highest sensitivity; or where the Proposed Development is likely to cause a considerable change from the baseline conditions at a receptor which can adapt, is tolerant of the change or/and can recover from the change. This effect is considered less likely to be 'Significant' but will be subject to professional judgement.

Consultation

- M3.35 Extensive consultation has been carried out throughout the EIA process. A wide range of statutory and non-statutory organisations were consulted either directly by the Applicant's EIA Team or through the Arun District Council as part of its consultations. More details can be found in ES Volume 1, Chapter B: Scope, Methodology and Consultation.
- M3.36 An EIA Scoping Report was submitted to Arun District Council in September 2020. The Scoping Opinion issued by the local council in response to it has approved of the scope and proposed approach for the Climate Change and Resilience chapter.
- M3.37 This assessment has been prepared with full consideration of recent developments on climate change including the declaration of climate change emergency by the UK Parliament last year. The chapter has outlined a number of proposed solutions to avoid, reduce or offset carbon emissions as well to strengthen the Proposed Development's resilience to a changing climate, thereby identifying a range of mitigation and adaptation measures respectively.

Assumptions and Limitations

- M3.38 To ensure transparency within the EIA process, the following limitations and assumptions have been identified.
- It is currently assumed that the site baseline carbon emissions are zero as a worst-case approach. In reality the increase to the operational emissions resulting from the Proposed Scheme will be partly offset by the emissions that are already present at the existing site.

- The RICS benchmark values have been used to calculate the anticipated embodied carbon emissions including A1-A3 (construction materials) associated with the Proposed Development. These benchmark emissions factors are based on broad building use type/size and are provided on a per floor area basis. As such they may not be wholly representative of the project at detailed design. Nonetheless, the RICS factors are considered to be appropriate for an initial analysis of the anticipated embodied carbon.
- The CO₂ emissions associated with A5 (construction & installation) activities have been determined using the relevant CO₂e/£100k RICS factor and the total construction value for the project as provided by the cost consultant, excluding Section 106 financial contributions.
- The estimated carbon emissions associated with the operational energy consumption are indicative values based on benchmark Part L data for different building types and indicative areas for different uses included in the Proposed Development. The Part L methodology uses standardised parameters, including operational profiles, ventilation rates, and heating and cooling setpoints, based on the building use, which may be different from how the buildings will operate in practice;

M3.39 In line with IEMA guidance, activities which account for under 5% of the energy usage and, therefore, do not have a significant contribution to the overall energy consumption will be excluded from the assessment. These include:

- Temporary construction site accommodation
- Street lighting, traffic signals and security cameras.

M4.0 **Baseline Conditions**

Existing Conditions

Site Level

- M4.1 Barnham, Eastergate and Westergate are in West Sussex, on the Sussex coastal plain east of Chichester, north of Bognor Regis, and north-west of Littlehampton. The characteristics of the coastal plain define the area, namely low-lying fields - often small in size - divided by planting and/or watercourses. Much of the open land is devoted to agriculture and horticulture, and is subject to a high groundwater table. The total area within the Strategic Allocation is circa 270 hectares / 668 acres which extends north and south of Barnham Road, Westergate Street and Lidsey Road to the west, and the existing settlement edge of Barnham to the east. The boundary is determined by the Local Plan Policy Map.
- M4.2 As noted, the Site is predominantly open farmland and arable fields with supporting drainage ditches occupying the majority of the centre and south west of the Site, bisected by the railway line heading east to west. A new barn located in the centre of the site, south of the railway line, is a distinct landscape element due to the lack of surrounding vegetation. Manor Farm is located to the western edge of the Site, accompanied by supporting agricultural facilities such as barns, silos, courtyards, and associated hardstanding. To the west of the Site, the Lidsey Rife runs north to south. The rife valley contains designated rights of way and informal paths. To the west of the rife, Woodgate Equestrian area contains a collection of barns and sheds set within areas of hardstanding, along with paddocks. To the north of the site, located between Eastergate and Westergate, sits Barnham Plant Nurseries, comprised predominantly of glasshouses and plant stock areas, interspersed with areas of hardstanding. There are two dwellings in this area. To the north of the plant nursery, an area of woodland interspersed with scrub and grassland extends north west around the northern edge of Eastergate.
- M4.3 Due to the relatively low provision of energy-consuming uses which currently exist on the Site, the current carbon baseline is assumed to be zero emissions. This is for conservative estimate purposes, meaning any calculated increase in emissions over this baseline can be considered 'worst case'.

Local Level (West Sussex)

- M4.4 The latest CO₂ emissions for the West Sussex administrative area shows that in 2018, 3,610.0 ktCO_{2e} were emitted. This is based on the latest available data from the Department for Business, Energy & Industrial Strategy, published in 2020.
- M4.5 The data show emissions allocated on an 'end-user' basis where emissions are distributed according to the point of energy consumption (or point of emission if not energy related). Except for the energy industry, emissions from the production of goods are assigned to where the production takes place.
- M4.6 In order to help understand the trends in carbon emissions at a regional level, Table M4.1 provides a breakdown of total carbon emissions from three main sources (industry & commercial, domestic and transport) for West Sussex over the period 2005-2018 based on national statistics provided by the government^{xxiii}.

Table M4.1: Carbon emissions within West Sussex 2005-2018.

Year	Industry and Commercial Total (ktCO ₂)	Domestic Total (ktCO ₂)	Transport Total (ktCO ₂)	Grand Total (ktCO ₂)	Population ('000s. mid-year estimate)	Per Capita Emissions (t)
2005	1,906.2	1,979.9	1,794.3	5,434.7	770.8	7.1
2006	1,896.8	1,989.6	1,762.5	5,391.2	777.4	6.9
2007	1,846.2	1,925.0	1,753.9	5,262.7	784.3	6.7
2008	1,819.5	1,931.8	1,661.2	5,142.8	791.0	6.5
2009	1,640.8	1,753.5	1,604.3	4,728.7	796.0	5.9
2010	1,759.7	1,887.9	1,580.5	4,952.4	803.2	6.2
2011	1,588.6	1,644.2	1,562.4	4,514.6	808.9	5.6
2012	1,675.1	1,777.2	1,524.5	4,692.2	816.0	5.8
2013	1,590.1	1,733.0	1,492.2	4,520.1	822.9	5.5
2014	1,396.3	1,475.4	1,506.3	4,084.0	830.5	4.9
2015	1,295.2	1,431.9	1,553.9	3,978.0	838.5	4.7
2016	1,171.9	1,353.0	1,612.7	3,838.6	846.9	4.5
2017	1,133.3	1,265.3	1,608.7	3,699.3	852.4	4.3
2018	1,089.3	1,260.7	1,570.3	3,610.0	858.9	4.2

M4.7 Overall, carbon emissions have declined faster in the UK since the early 1990s than in almost any other large economy. In line with this, the statistics for Arun demonstrate a downward trend whereby the per capita carbon emissions have decreased by approximately 41%. Total emissions have also gone down by approximately 34% over the studied period, despite the observed population growth.

The main reductions are observed in industry and commercial emissions followed by domestic emissions in line with an overall downward trend for the whole of the UK. In comparison, the reduction observed in the transport sector for the region is considerably smaller amounting to about 12.5%.

M4.8 A study conducted by analysts Carbon Brief reveals that the decline in industry and commercial as well as domestic emissions is driven by a combination of the introduction of a low- and zero-carbon electricity mix based on gas and renewables instead of coal and a reduced non-electric energy consumption in the industrial and residential sectors. The latter is explained mainly by improvements in energy efficiency and switching to lower-carbon fuels. A structural movement towards a less carbon-intensive mix of industrial output, with some energy-intensive industry moving to other countries and UK industry increasingly focusing on higher-value manufacturing with lower energy intensity is also considered to have been a significant factor in the case of industry-related emissions^{xxiii}. We expect this downward trend to continue in light of current government commitments including the continuous phasing out of coal.

Regional Level (South East)

M4.9 The latest BEIS annual CO₂ emissions data for the South East were 42,746.5 ktCO₂e. The BEIS national statistics data from the UK government are available for the period 2005-2018.

National Level (United Kingdom)

M4.10 The latest BEIS data available for the UK was published in 2020 and relates to the year 2018. The total CO₂ emissions generated in the UK in 2018 amount to 344,824 ktCO₂e. According to a

report by the World Resources Institute, the UK demonstrates one of the largest declines in CO₂ emissions, with a 20% reduction in the period 2000-2014^{xxiv}. This is one of the biggest percentage reductions in CO₂ emissions of all large economies. In line with this trend, the statistics for West Sussex and the South East as a whole demonstrate a continuing downward trend over the 2005-2018 period.

Future Baseline

- M4.11 As the current carbon baseline is assumed to be net zero carbon emissions, it is considered that the most conservative future scenario would be to assume the Site continues to demonstrate net zero emissions.
- M4.12 Known trends and policy initiatives for curbing carbon emissions under the auspices of the UK flagship commitment to reduce the country's emissions by at least 80% by the year, relative to 1990 levels indicate that the electricity grid is likely to undergo a low-carbon transformation – indeed trends in the industry indicate this has already commenced. What is more, the UK government implemented the recommendations of the CCC through the passing of the Climate Change Act 2008 (2050 Target Amendment) Order 2019 (the "Order") last year committing the UK to a new legally binding “net-zero” carbon target for 2050, thus exceeding the previous legally binding target introduced by the Climate Change Act.
- M4.13 With this in mind, any emissions for which the Site is currently responsible would be expected to reduce in future. However, to reiterate, the Baseline assumes that the site is responsible for zero carbon emissions to provide the most conservative comparator against which to assess the impact of the Proposed Development.

M5.0 **Potential Effects**

Built-in Mitigation

- M5.1 A number of design principles and solutions have been ‘embedded’ or ‘built in’ the Proposed Development design to minimise climate-related risks. This is known as ‘primary’ or ‘embedded’ mitigation. Such measures are defined as ‘modifications to the location or design of the development made during the pre-application phase that are an inherent part of the Proposed Development, and do not require additional action to be taken’. In arriving at the significance level of the identified likely significant environmental effects, ‘primary’ or ‘embedded’ mitigation measures have been taken into consideration as inherent components of the Proposed Development.
- M5.2 Primary mitigation sits at the top of mitigation hierarchy, with greater ability to avoid detrimental environmental impacts. A full description of the Proposed Development can be found in ES Volume 1, Chapter C: Site and scheme description.
- M5.3 To manage uncertainty and ensure that the site incorporates measures proportionate to risk levels as identified by the UKCP18 national UK climate projections, the Proposed Development shall seek to embed capacity for future adaptation alongside periodic assessment of climate change risks to the operational development.
- M5.4 Key design solutions directly relevant to the carbon emissions assessment include:
- A sustainable transport strategy which prioritises active modes of travel in the first instance will be deployed, with a network of high-quality walking and cycling routes and commensurate cycling parking in key locations. Public transport will be explored for journeys where walking and cycling are not preferable by the provision of new bus routes and easy connection via multiple modes to Barnham Station. Travel by private car is intended as a ‘last resort’. Recognising that some level of private car use is inevitable, at least in the medium term, the transition to electric vehicles will be facilitated by providing electric car charging points at buildings and homes.
 - The energy strategy to be deployed for the buildings of the Proposed Development will be determined at the point of application for Reserved Matters for each development plot. This allows the buildings to deploy the most appropriate servicing approach at the time of development. This is critical given the dynamism and rate of change of the energy sector over the past 10 years which is likely to continue to the future. ‘Locking in’ the Proposed Development to a single technology at the time of Outline Application would unlikely result in the most sustainable development.
 - The energy strategy for the Proposed Development will follow the ‘Lean, Clean, Green’ hierarchy, prioritising passive design solutions to reduce energy demand in the first instance, before seeking opportunities to supply energy efficiently, finally maximising the provision of on-site renewable generation.
 - A sustainable drainage strategy (SUDS) will enable the Proposed Development to achieve greenfield run off rates for the 1-in-100-year event, including a 40% allowance for climate change. This means the Proposed Development will be resilient to flooding even in the wetter winters predicted as a consequence of climate change.
- M5.5 More details on the approach that will be taken to minimise the greenhouse gas emissions of the Proposed Development design can be found in the Energy and Sustainability Strategy submitted with the planning application.

- M5.6 This assessment considers potential impacts of the Proposed Development throughout its whole lifecycle. The following sections provide an overview for each stage.

During Construction

- M5.7 Traditionally the greatest impact on an asset's whole life carbon has been associated with its operational phase. As briefly mentioned, this trend is expected to shift due to the ongoing decarbonisation of the UK electricity grid, better performing buildings, and a transition to electric heating and transport. As a result, the embodied carbon of the Proposed Development is expected to represent a significant proportion of the Proposed Development's whole life carbon emissions.

- M5.8 In summary the key sources of carbon emissions at the Construction stage, which have been reviewed as part of this assessment, include the following:

- Embodied carbon of the materials used to construct the buildings of the Proposed Development (RICS Stages A1-A3)
- Construction processes, including site fuel and energy use (RICS Stage A5)

Embodied carbon in building materials

- M5.9 As discussed earlier in the chapter, the carbon emissions associated with the raw material extraction and manufacturing of the building materials used on site have been calculated using benchmark data from the Royal Institute of Chartered Surveyors (RICS) for lifecycle stages A1-A3.

- M5.10 The areas utilised for this assessment are only indicative and based off the parameters plans of the outline planning application area and framework masterplan.

- M5.11 The A1-A3 embodied carbon emissions have been estimated to be approximately **68,808** tCO₂e. The RICS carbon factors represent the embodied carbon in the construction materials (as per lifecycle stages A1-A3 (EN 15978)) and are shown by Table 1. The resulting embodied carbon has been calculated by multiplying the proposed GIA per land use type by the most relevant RICS carbon factor.

- M5.12 Table 1: Extract of RICS 2014 Embodied Carbon Benchmarks per use type, 2014.

Use type	kgCO ₂ /m ²
Local Centre	690
Mixed use city block (commercial/resi)	720
Semi detached	540
Low rise apartment (3-5 storey)	550
Detached single family home	550
Libraries and community centre	485
Primary/nursery education	690

- M5.13 **Effect significance:** As the embodied carbon is confined to the process of the raw material extraction and manufacturing of the building materials used for the Proposed Development rather than being emitted annually, using the quantitative elements of the effect significance criteria and comparing the overall embodied carbon emissions to the (annual proportion) of the national carbon budget's share attributable to the built environment sector would not be appropriate. Instead a qualitative assessment has been made based on professional judgment

and experience with similar schemes. It is expected that the magnitude of produced effects would be low. This considered alongside the identified high sensitivity of global climate has led to a conclusion that any emissions generated in the process are likely to result in **indirect, long-term and permanent international** effects of **minor adverse significance**.

Carbon associated with construction site processes

- M5.14 The carbon emissions associated with the construction processes, such as fuel use in mobile plant and equipment (as per lifecycle stage A5 (EN 15978)), have been calculated using the Royal Institute of Chartered Surveyors (RICS) factor: 1,400 kg CO₂e/£100,000 of project value.
- M5.15 The A5 embodied carbon emissions have been estimated to be approximately **3,710** tCO₂e. This has been calculated by multiplying the proposed RICS factor above by the total anticipated project value.
- M5.16 **Effect significance:** As the carbon associated with the construction process is confined to the period of construction of the Proposed Development, rather than being emitted annually, using the quantitative elements of the effect significance criteria and comparing the overall embodied carbon emissions to the (annual proportion) of the national carbon budget's share attributable to the built environment sector would not be appropriate. Instead a qualitative assessment has been made based on professional judgment and experience with similar schemes. It is expected that the magnitude of produced effects would be low. This considered alongside the identified high sensitivity of global climate has led to a conclusion that any emissions generated in the process are likely to result in **indirect, long-term and permanent international** effects of **minor adverse significance**.

During Operation

- M5.17 The key sources of carbon emissions at the Operational stage, which have been reviewed as part of this assessment, are listed below:
- Regulated components of the Proposed Development's operational energy
 - Unregulated components of the Proposed Development's operational energy

Regulated energy uses

- M5.18 The Proposed Development will meet the carbon emission limits specified in Part L 2013 of the Building Regulations 2013. The target emission rate for all buildings in the Proposed Development has been calculated to be **2,062** tonnes of CO₂ per year. This baseline has been calculated based on a 'notional gas-fired' scheme, i.e. a scheme identical to the Proposed Development in terms of areas and use of each building, but serviced by a standard gas-fired heating system.
- M5.19 Due to the Outline nature of the application, detail on the energy strategy, including the thermal performance and the servicing strategies of the buildings, is not available at this stage. The Building Regulation baseline has been used when assessing the energy strategy as this baseline represents a 'worst case' scenario.
- M5.20 Please refer to the Energy and Sustainability Strategy for further detail.

Unregulated energy uses

- M5.21 Unregulated carbon emissions have likewise been calculated based on Part L of the Building Regulations. Although unregulated carbon emissions are not included within Part L results, an estimate of unregulated energy consumption has nevertheless been provided as an output of this

methodology. The annual unregulated energy usage anticipated for the Proposed Development is **1,973** tonnes of CO₂ per year.

Operational emissions overall impact

M5.22 The opening year for the complete Proposed Development is expected to be 2024 (subject to successfully gaining planning permission). Therefore, the 3rd, 4th and 5th carbon budgets are the ones applicable to its operational phase.

M5.23 The total emissions associated with operational energy (regulated and unregulated) have been estimated to be **4,035** tonnes of CO₂ per year. This accounts proportionally for:

- 0.025% annual proportion of the 4th carbon budget (2023 – 2027) (40% share attributable to the built environment sector)
- 0.029% annual proportion of the 5th carbon budget (2028 – 2032) (40% share attributable to the built environment sector)
- 0.052% annual proportion of the 6th carbon budget (2033 – 2037) (40% share attributable to the built environment sector)

M5.24 Therefore, it can be concluded that the estimated total regulated carbon emissions:

- a. represent a contribution lower than 1% of the (annual proportion of the) relevant National Carbon Budgets' share attributable to the built environment sector; and
- b. are lower than 25,000 tCO₂e in any year.

M5.25 Following the methodology described in **Significance Criteria section above**, this means that the magnitude of produced effects is anticipated to be low. This considered alongside the identified high sensitivity of global climate has led to a conclusion that any emissions generated in the process are likely to result in a combination of ***direct and indirect, long-term and international*** effects of ***minor adverse significance***.

M6.0 Mitigation and Monitoring

- M6.1 The climate is changing. Even with strong efforts to limit the impacts of climate change, there is an overwhelming consensus that further changes are unavoidable. Therefore, it is essential to have up-to-date information on climate change to support decision-making and effectively manage the increasing risks associated with climate change.
- M6.2 The UKCP18 national climate projections for the United Kingdom provide the latest scientific evidence on projected climate changes. Adopting a conservative approach, a future scenario of global mean warming of 2°C has been utilised to inform this assessment and help articulate suitable additional mitigation and enhancement measures.
- M6.3 Over land the projected general trends of climate change in the 21st century are similar to UKCP09, with a move towards warmer, wetter winters and hotter, drier summers. However, natural variations mean that some cold winters, some dry winters, some cool summers and some wet summers will still occur.
- M6.4 The UKCP18 projections show that there are likely to be changes to the average weather conditions in the future. Not all years will fit a clear trend of change, leading to a variable and unpredictable climate. The projections do, however, enable the identification of the likely effects of climate change, and inform appropriate recommendations for changes to design, construction and maintenance policies, standards and practices.
- M6.5 Rainfall patterns across the UK are not uniform and will continue to vary on a seasonal and regional basis in the future.
- M6.6 At 2°C of global mean warming:
- For temperature:
 - The largest warming in the UK will be in the South East where summer temperatures may increase another 3 to 4°C relative to present day (1981-2000);
 - Median warming will be at least 1 to 2°C throughout the year across the whole of the UK;
 - Winter cool days will warm by 1 to 1.5°C across the country, whilst temperatures on warmer winter days increase by less than 1°C;
 - In summer both hot and cool days warm by 1 to 1.5°C across Scotland and 1.5 to 2°C across England.
 - For precipitation:
 - Changes are uncertain, but suggest slightly wetter winters and drier summers, with summer drying more in the South;
 - Dry days in summer have 30% less precipitation in parts of the South West.
- M6.7 It is projected that average sea levels will continue to rise in the future, increasing the risk of coastal flooding and erosion, but the pattern of sea level rise is not uniform across the UK. Extreme coastal water levels driven mainly by increases in mean sea level rise are expected. For example, for London, sea level rise by the end of the century (when compared to 1981-2000), for the low emission scenario is very likely to be in the range 0.29 m to 0.70 m. For a high emission scenario, the range is very likely to be 0.53 m to 1.15 m. This, combined with a predicted increase in storm surges, will lead to a significantly increased risk of flooding.

Figure L6.1: Projected change in temperature at 2°C global warming above pre-industrial levels.

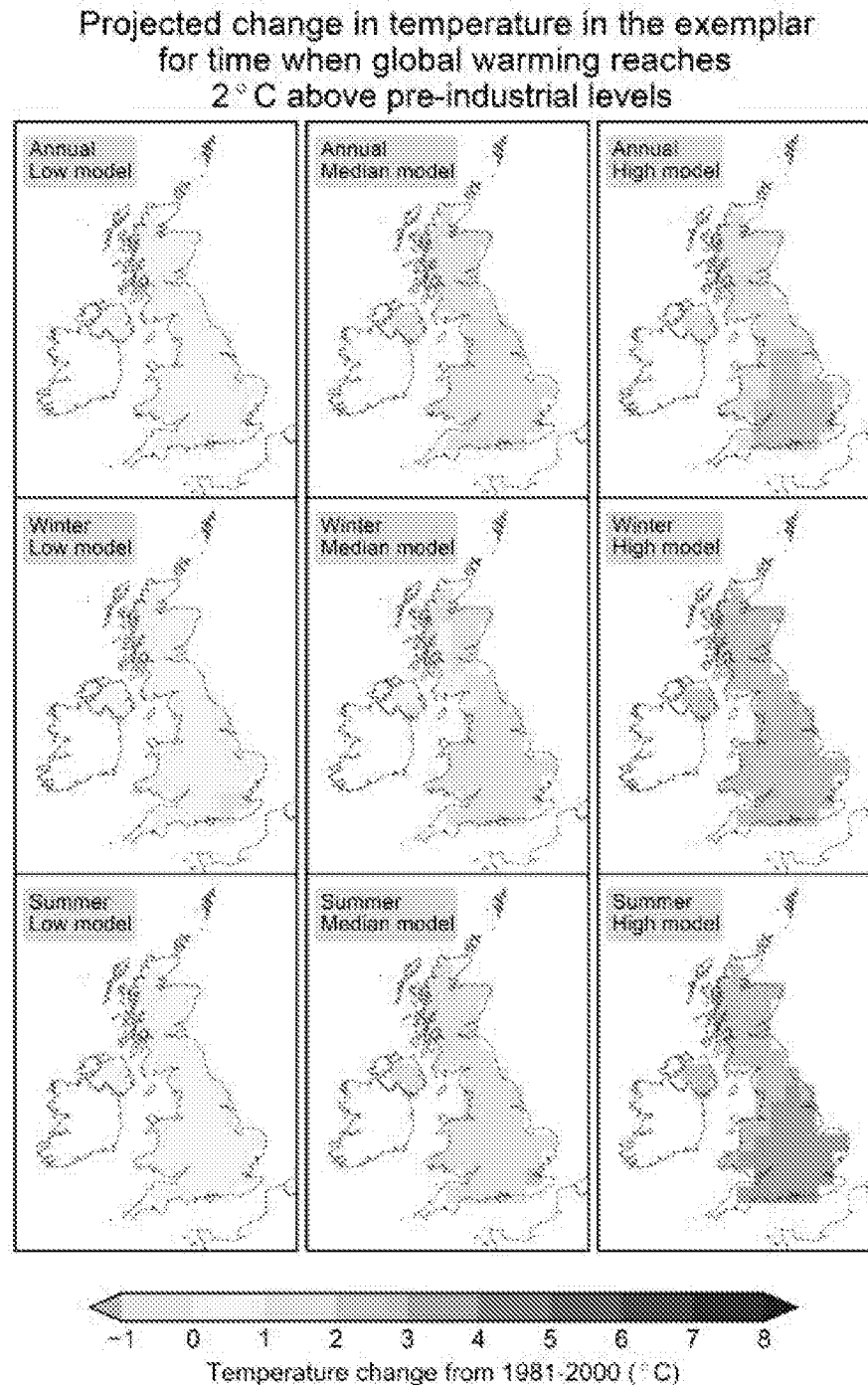


Figure 1: Projected changes in UK temperatures at a global mean warming of 2°C (GWL2) above pre-industrial (1850-1900). Changes are shown relative to present day (1981-2000). Rows show annual (top), winter (December-February; middle) and summer (June-August; bottom) changes. Columns shows maps for the model projection with a UK mean temperature changes which are relatively low (left), high (right) or median (centre).

Figure L6.2: Projected change in precipitation at 2°C global warming above pre-industrial levels.

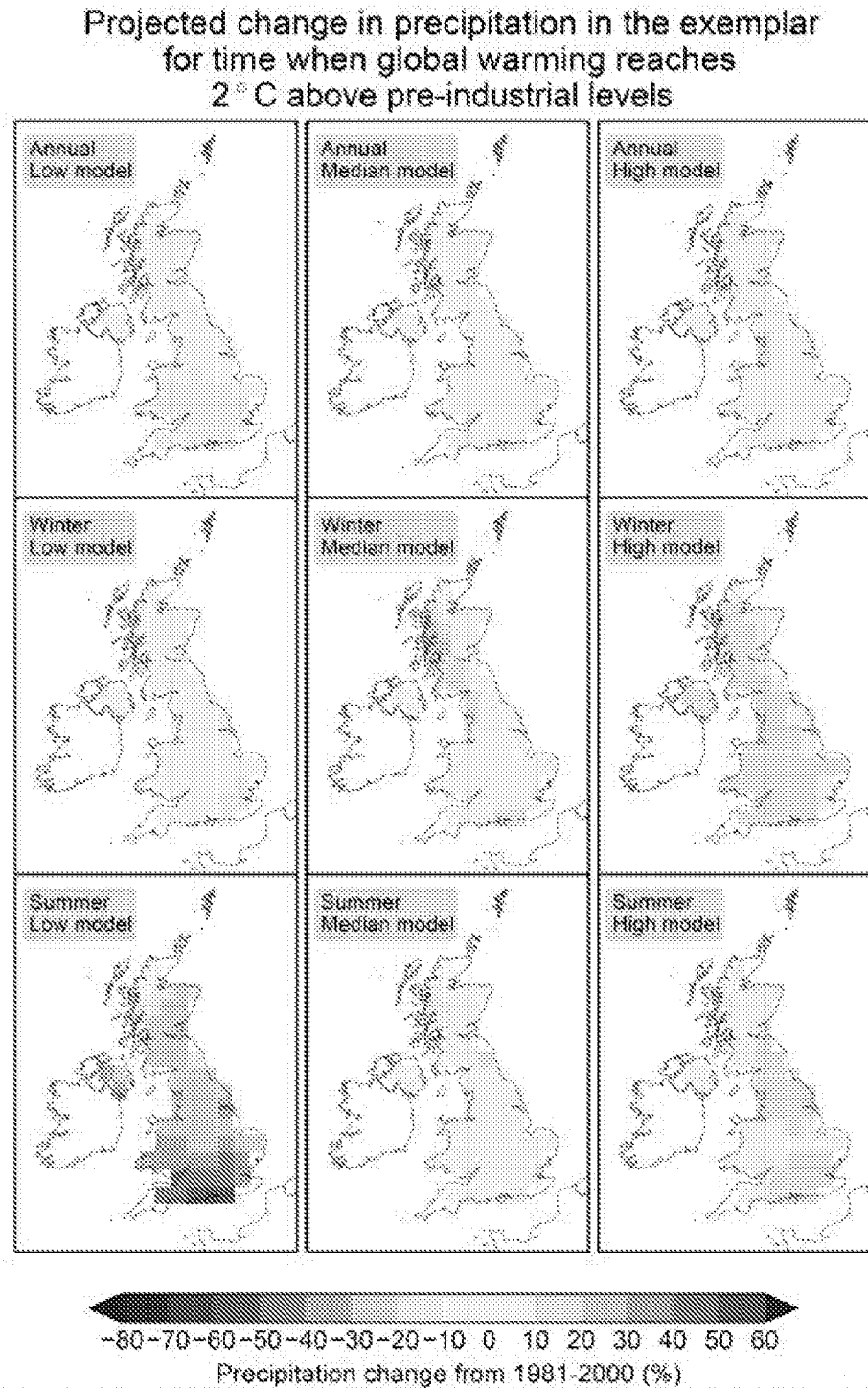


Figure 2. Projected changes in UK precipitation at a global mean warming of 2°C (GWL2) above pre-industrial (1850-1900). Changes are shown relative to present day (1981-2000). Rows show annual (top), winter (December-February; middle) and summer (June-August; bottom) changes. Columns shows maps for the model projection with a UK mean precipitation changes which are relatively low (left), high (right) or median (centre).

- M6.8 There are several option solutions that the Applicant is exploring within the design (in the form of embedded/primary mitigation) to ensure the Proposed Development avoids, prevents or reduces carbon emissions to the extent possible. These have been set out in the Assumed Embedded Design Mitigation section with further detail available in the Outline Sustainability and Energy Strategy.
- M6.9 This analysis has concluded that all reviewed sources of carbon emissions are likely to result in effects of minor significance relative to the defined effect significance criteria. Nonetheless we have elected to discuss additional mitigation and adaptation measures in this chapter in order to identify further opportunities for reducing any potential adverse impacts of the Proposed Development. The proposed mitigation measures should be considered further during the detailed design stages.
- ‘Additional’ or ‘secondary’ mitigation refers to measures that require additional action beyond the core function of the development, which can be proposed at any point within the EIA process, including during the decision-making process. Such interventions tend to operate in the middle of the mitigation hierarchy, focusing on reducing the significance or likelihood of adverse effects.
- M6.10 The rest of this section sets out the key additional mitigation measures proposed to further strengthen the Proposed Development and minimise any potential impacts on the environment.

During Construction

- M6.11 This chapter suggests the following additional measures that could be adopted at site level to effectively manage and further reduce the significance of carbon emissions during construction:
- Key materials extracted as part of the enabling works to be re-used and/or recycled in accordance with the waste hierarchy giving priority to on-site uses where practical.
 - Use of energy-efficient construction plant and machinery.
 - Deployment of right size generators.
 - Reuse/recycling targets for the construction activities set at the outset.
 - Preference for local suppliers (within the Arun district) to shorten the supply chain and reduce its associated environmental footprint coupled with prioritisation of responsibly sourced goods and services where feasible whilst maximising the proportion of recycled content within materials used in construction.
 - Monitoring of energy, water and waste data during the construction stage to encourage transparency and accountability.
 - All waste generated during construction to be diverted from landfill (where technically feasible). All waste materials during the construction phase to be managed in accordance with a Project Waste Management Plan and Outline Construction Environmental Management Plan (included in Appendix C2 of this ES) and in accordance with all applicable waste legislation and the recommendations of Herts County Council as the local Waste Authority.
 - Exploration of the potential for low carbon construction materials and techniques – such as timber frame and offsite manufacture – which can help reduce the embodied impact of construction.
 - Consideration of flexibility and adaptability in building design, allowing buildings to evolve to meet future demands and needs.

- M6.12 As with the additional mitigation suggested for the ‘During Construction’ emissions, these potential interventions have not been relied upon when reaching conclusions around the significance of anticipated effects.

During Operation

- M6.13 In addition to these inherent design principles, which have already been built in the Proposed Development design to avoid, prevent or reduce carbon emissions associated with the energy usage and transportation during the operational phase, this section suggests the following additional measures that could be adopted to effectively manage and further reduce the significance of carbon emissions expected to be generated through the operational stage of the scheme:
- Installation of smart meters and/or sub-meters to monitor operational consumption more accurately.
 - Production of a Framework Travel Plan to set out all relevant targets/measures in relation to encouraging more sustainable travel patterns and identify future monitoring and management arrangements.
 - Suitable space for waste storage and management facilities to be factored into the design to enable adequate waste segregation for optimal collection and subsequent treatment.
 - Given the historic and projected continuing decarbonisation of grid-supplied electricity in the UK, opportunities to deploy an ‘all-electric’ servicing strategy should be explored. A strategy such as this would be low carbon on day one, leveraging the continued decarbonisation of electricity in future to achieve net zero carbon operation in the mid-2030s based on National Grid ESO’s Future Energy Scenarios (FES) 2020 projections, if we are to achieve our national net zero target by 2050.

- M6.14 As with the additional mitigation suggested for the ‘During Construction’ emissions, these potential interventions have not been relied upon when reaching conclusions around the significance of anticipated effects.

Climate Change Resilience & Adaptation

- M6.15 Climate change interrelationship effects with four key other topics – flood risk & water resources, overheating, biodiversity and air quality – have been assessed in consultation with the design team and EIA consultants working on the relevant subjects.

Flood Prevention & Water Resources

- M6.16 As part of the early Framework Masterplanning for the site, flood risk was identified as a key constraint and so thoroughly considered as part of the development layout. The Lidsey Rife flows in a southerly direction along the western boundary and has associated areas of Flood Zone 2 and Flood Zone 3 within a well-defined floodplain. The Environment Agency has also carried out a process of assessing the impacts of climate change on these fluvial floodplains to demonstrate the extent. Flooding from the Lidsey Rife can also be affected by coastal/tidal influences which again has been considered in the extent of flooding shown.
- M6.17 A suitable stand off from the Lidsey Rife and its associated floodplain therefore provides robust mitigation and adaptation to the potential future effects of climate change on flood risk. When considering the impacts of climate change of fluvial river flows, the Environment Agency follow the climate change allowances outlined in the South East River basin management Plan that stipulates an increase of 35%, 45% and 105% on peak river flows for the design flood event. The

degree of change is related to the eventual design life of the proposed development, and so the 105% increase has been used as part of the Flood Risk Assessment as a conservative approach.

- M6.18 Groundwater flooding was also identified as a potential risk to the future development, as current monitoring identified high Winter groundwater levels across the site, supplemented by wider district-wide monitoring to identify the scale of the issue across the Arun area. Mitigation is recommended in the form of an appropriate dewatering strategy put in place during construction and appropriate design of buildings to avoid basements or sub-ground floor levels. Both Arun and West Sussex Council's are actively monitoring groundwater levels across the area, which will also help identify trends and future patterns of groundwater flood risk across the area, feeding in to promoting awareness of the issues to help improve resilience. Further details on flood risk and associated mitigation are provided in the Flood Risk Assessment prepared by Pell Frischmann.
- M6.19 A surface water drainage strategy has also been developed for the scheme based on sustainable drainage principles. The strategy is based on preferential use of above-ground drainage systems to convey and store water across the site, using features such as ponds, basins and swales and retains existing topographical catchments as far as possible to limit potential impacts on watercourses associated with catchment transfer. Other SuDS measures are recommended for inclusion throughout the scheme as a means of managing surface water runoff as close to source as possible, utilising localised infiltration to the ground as a sustainable way of managing surface water. Details on the strategy are provided in the Sustainable Drainage Report prepared by Pell Frischmann.
- M6.20 The restricted runoff rate is based on the current greenfield discharge rate for the event known as QBAR (roughly equivalent to a 1 in 2 year storm event) and will restrict flows leaving the site for all storm return periods up to and including the 100 year event. A 40% increase in peak rainfall intensities is applied to the design standard to account for the potential future impacts of climate change on rainfall events. Furthermore, future adaptability is also embedded within the drainage strategy as it has made allowance for future 'urban creep' where soft landscaping is eventually replaced by hard paving, in line with WSCC supplementary drainage guidance.
- M6.21 Foul drainage in the area is provided by Southern Water, and the strategy for the development intends to drain wastewater to Ford Wastewater Treatment Works to the east of the site. Ford is reported to have significant additional capacity to treat flows, and currently operates within its permitted limits in respect of discharge consents to the River Arun. Lidsey Wastewater Treatment Works is located to the south of the site, and may have capacity to treat a proportion of the site. However, it is currently operating close to environmental permitted limits, and there is little scope to improve the treatment capacity, therefore flows may be directed here but pumped to Ford for treatment as part of Southern Water's strategic upgrade to their wastewater management. Foul water can therefore be disposed of in a sustainable way.
- M6.22 Potable water is provided by Portsmouth Water, who have reported that there is sufficient strategic-scale reserves to accommodate development within their catchment as much of their supply is abstracted from groundwater reserves. There may be localised reinforcement work needed to the distribution pipework to serve the development however it is thought that water supply can be provided in a sustainable manner, as outlined within the Environmental Statement chapter.

Overheating

- M6.23 Anticipated rising temperatures and more frequent heatwaves increase the risk of overheating experienced in enclosed spaces with potentially significant health implications for building occupants and visitors in the form of heat stress leading to fainting, heat exhaustion, muscle

cramps and even potentially heat stroke. Moreover, a growing body of research suggests a link between wellbeing and productivity. Risks to health, well-being and productivity from high temperatures have been identified as a priority risk area of inter-related climate change risks for the UK.

- M6.24 To minimise the risk of overheating in these changing weather conditions, the Proposed Development shall deliver thermally efficient and resilient structures.
- M6.25 Several design solutions could improve the Proposed Development's resilience to anticipated climate change effects. Key measures which will be explored include form, fabric performance, orientation, suitable glazing ratios, solar control glazing, appropriate ventilation levels, internal blinds, external shading and preference for light-coloured materials.
- M6.26 Passive design is intended to provide the cornerstone of energy demand and carbon emissions reduction which will be supplemented by energy efficient systems. The design of the buildings of the Proposed Development shall seek to implement a range of passive design measures including an efficient thermal envelope, appropriate level of fabric air permeability and 'fabric first' approach which aims to achieve the optimum balance between offering natural daylighting benefits to reduce the use of artificial lighting, the provision of passive solar heating to limit the need for space heating in winter and minimise summertime solar gains to reduce space cooling demands.
- M6.27 In addition, materials/ fixings/ joints with high tolerance to temperature and solar exposure shall be prioritised where possible to ensure a robust building fabric. Where appropriate, generous movement joints and sufficient tolerance shall be provided to allow for differential thermal expansion between materials.
- M6.28 All relevant units shall be required to meet Criterion 3 of Part L: Limiting the effects of heat gains in summer when they submit for Building Control approval.
- M6.29 It is recommended that an assessment using CIBSE Technical Memorandum (TM) 52: The Limits of Thermal Comfort: Avoiding Overheating in European Buildings be undertaken for the key non-domestic buildings in the later design stages, particularly if/where cooling is not provided. Likewise, it would be beneficial to assess key dwelling typologies using the CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017).
- M6.30 As a minimum, all spaces will be provided with ventilation rate in accordance with Part F via either natural or mechanical ventilation. Where natural ventilation is not provided or is not suitable, mechanical ventilation is an important addition to the building services to maintain good indoor air quality, by providing fresh air and extracting vitiated air to occupied areas. Providing fresh air minimises the risk of stale and stagnant air. Coupled to a heat exchanger, the warmth/coolth in extracted air can be recovered and delivered to the supply air.
- M6.31 Green spaces have been identified as one of the solutions to help avoid overheating on a city scale^{xv}. Accordingly, the landscaping strategy for the site shall seek to maximise the beneficial impacts of the proposed green infrastructure and minimise the 'urban heat island' effect through enhanced biodiversity and habitat creation & preservation (please refer to the section below for further details).

Ecology

- M6.32 An Ecological Assessments of the site were undertaken in June 2018 and April, May and August 2020 to identify likely key ecological constraints and opportunities to the development site. This comprised of a desk study and an extended Phase 1 habitat survey. The majority of the site is of negligible ecological value comprising of large open areas of arable land (crop monoculture).

Other habitats in the site were considered to be of low ecological value including semi-improved grassland and ruderal vegetation. Those habitats of relatively greater value include the waterbodies and treelines at the field boundaries and the stream that runs along the western boundary of the site. No habitats of principal importance have been identified.

M6.33 While the proposed development will result in a direct loss of habitats, the vast majority of the habitat lost will be arable land which is of negligible biodiversity value. The vast majority of hedgerows and treelines will be retained and bolstered as part of the proposals with the stream along the western boundary being fully retained and buffered from the development by large areas of green open space. Overall, the vast majority of the habitats of value will be retained and enhanced as part of the proposals.

M6.34 These biodiversity enhancements will be delivered as an integral part of the design proposals. This includes a vast area of open green space known as the Rife Valley Park which will run the entire length of the site's western boundary from the north to the south. The landscape design of the scheme includes several measures to strengthen the Proposed Development's resilience to climate change and extremes of weather change through the use of robust material and planting. Any habitat loss associated with the small areas of grassland, ruderal vegetation, hedgerows and treelines will be offset by enhancements. This includes the large-scale Rife Valley Park which will encompass the entire western region of the site and will be planted with new areas of species-rich grassland, tree, hedgerow and shrub planting, and a number of new waterbodies.

Air quality

M6.35 Climate change can have an impact on air quality and air quality can have an impact on climate change. These interactions are complex and not fully understood at present. Higher summertime temperatures and increased solar radiation are expected to increase the formation of ozone and other reactive compounds in the air, affecting the concentrations of both Nitrogen dioxide (NO₂) and particulate matters (PM). The net effect may be an increase in background concentrations of NO₂ and particulate matter compared to the future without development scenarios.

M6.36 Air quality has and will continue to be a key consideration during the design of the Proposed Development and the site layout. Road traffic movements are anticipated to be the greatest contributor to local air pollution. As such, developing a transport strategy which prioritises active and sustainable modes of transport wherever possible, with private car intended as a 'last resort' mode, has been a key tenet from the early design stages. Facilitating a transition to low and zero emission vehicles, through appropriate provision of electric vehicle charging infrastructure, will be achieved with specific detail of this to be established at later design stages.

M6.37 Air quality will also be considered in the ventilation design to design out potential detrimental impacts and/or embed the right level of design flexibility to enable adaptation to the anticipated impacts of a changing climate on the local air quality.

M6.38 Deploying an energy strategy which is cognisant of its impact on local air quality will be a priority during detailed design.

Residual Effects

- M6.39 The likely residual effects identified in this assessment consist of the remaining carbon emissions that get released into the atmosphere as a result of the Proposed Development during the various stages of its lifecycle following the adoption of the recommended additional mitigation and enhancement measures (not considered to be an intrinsic part of the proposed scheme).

During Construction

Embodied carbon in building materials

- M6.40 As described in the Potential Effects section, the effect significance of the embodied carbon in building materials is expected to be minor adverse, which represents the lowest level of significance as per the proposed assessment methodology. Therefore, the effect significance of any residual emissions would remain the same, i.e. combination of **direct** and **indirect, long-term and permanent international** effects of **minor adverse significance**.

Carbon associated with construction site processes

- M6.41 As described in the Potential Effects section, the effect significance of carbon associated with construction site processes, including fuel use in mobile plant and equipment, is expected to be minor adverse, which represents the lowest level of significance as per the proposed assessment methodology. Therefore, the effect significance of any residual emissions would remain the same, i.e. combination of **direct** and **indirect, long-term and permanent international** effects of **minor adverse significance**.

During Operation

Regulated and unregulated energy uses

- M6.42 As described in the Potential Effects section, the effect significance of the regulated energy emissions is expected to be **minor adverse**, which represents the lowest level of significance as per the proposed assessment methodology. Therefore, the effect significance of any residual emissions would remain the same, i.e. **indirect, long-term and permanent international** effects of **minor adverse significance**.

M7.0 **Summary & Conclusions**

- M7.1 The National Planning Practice Guidance (PPG) expressly states that “Environmental Impact Assessments should not be a barrier to growth...”. As discussed earlier in this chapter, the PPG on climate change goes on to say that the “impact of climate change needs to be taken into account in a realistic way” with focus on identifying “no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity...and building in flexibility to allow future adaptation if it is needed...”.
- M7.2 The present assessment has not identified any carbon emissions expected to be generated throughout the lifecycle of the Proposed Development that are likely to result in effects of ‘substantial’ significance for the global climate. In fact, following widely accepted GHG accounting practice, all likely effects associated with the carbon emissions produced during the lifecycle of the Proposed Development have been classified as being of minor (adverse) significance in the context of the UK national carbon budgets (apportioned to reflect the contribution of the built environment’s estimated share).
- M7.3 However, the IEMA’s overarching principles on Climate Change Mitigation & EIA acknowledge that the carbon emissions from all projects will contribute to climate change. For that reason, this assessment has outlined a range of mitigation and adaptation measures proposed for the scheme to avoid, prevent and reduce emissions generation and boost its resilience to the anticipated impacts of climate change to the extent possible.
- M7.4 Following the PPG’s recommendations, key solutions which have been built or in the design or will be explored as part of the Reserved Matters applications for each plot, including a sustainable transport strategy which prioritises active modes, energy efficient building fabric and building services as part of a low-carbon energy strategy, and a sustainable drainage strategy which includes allowances for the impacts of climate change. The effective implementation of agreed primary mitigation measures (considered as part of the Proposed Development) has significantly reduced the need for additional mitigation and enhancement. Nevertheless, this chapter also recommends a range of ‘additional’ or ‘secondary’ mitigation measures suggested to further reduce the significance or likelihood of adverse effects throughout the development’s lifecycle ranging from the monitoring of energy, water and waste data during the construction stage to including suitable space for waste storage and management.
- M7.5 As part of the climate change resilience & adaptation review, this chapter has also set out a number of measures which have been or will be incorporated into the Proposed Development’s design to improve its resilience to potential climate change impacts with particular focus on considerations around flood risk and water resources, overheating, biodiversity and air quality.
- The ongoing electrification of the transport sector and continuous decarbonisation of the national electricity grid are expected to further reduce the annual emissions of the Proposed Development at the operational stages.

Table L8.1: Summary table

Receptor	Potential Effect	Potential mitigation measures to be considered at Reserved Matters	Residual Effect
During construction			
Global climate	Increase in carbon emissions in the atmosphere	• Key materials extracted as part of the enabling works to be re-used and/or recycled in accordance with the waste hierarchy giving priority to on-site uses where practical. • Use of energy-efficient construction plant and machinery. • Deployment of right size generators. • Reuse/recycling targets for the construction activities set at the outset. • Preference for local suppliers (within the Arun district) to shorten the supply chain and reduce its associated environmental footprint coupled with prioritisation of responsibly sourced goods and services where feasible whilst maximising the proportion of recycled content within materials used in construction. • Monitoring of energy, water and waste data during the construction stage to encourage transparency and accountability. • All waste generated during construction to be diverted from landfill (where technically feasible). All waste materials during the construction phase to be managed in accordance with a Project Waste Management Plan and Outline Construction Environmental Management Plan and in accordance with all applicable waste legislation and the recommendations of West Sussex County Council as the local Waste Authority. • Exploration of the potential for low carbon construction materials and techniques – such as timber frame and offsite manufacture – which can help reduce the embodied impact of construction.	Minor adverse (Insignificant)
During operation			
Global climate	Increase in carbon emissions in the atmosphere	• Installation of smart meters and/or sub-meters to monitor operational consumption more accurately. • Production of a Framework Travel Plan to set out all relevant targets/measures	Minor adverse (Insignificant)

Receptor	Potential Effect	Potential mitigation measures to be considered at Reserved Matters	Residual Effect
		in relation to encouraging more sustainable travel patterns and identify future monitoring and management arrangements. • Suitable space for waste storage and management facilities to be factored into the design to enable adequate waste segregation for optimal collection and subsequent treatment.	

M8.o

Abbreviations & Definitions

Abbreviations

- 1 Environmental Impact Assessment (EIA)
- 2 Greenhouse gas (GHG) emissions
- 3 UK Climate Change Risk Assessment (CCRA)
- 4 National Adaptation Programme (NAP)
- 5 Committee on Climate Change (CCC)
- 6 National Planning Policy Framework (NPPF)
- 7 National Planning Practice Guidance (PPG)
- 8 Arun District Council (ADC)
- 9 Department for Business, Energy & Industrial Strategy (BEIS)
- 10 Building life cycle assessment (LCA)
- 11 International Finance Corporation (IFC)
- 12 UK Climate Projections (UKCP)
- 13 Heavy goods vehicles (HGV): > 3.5t gross vehicle weight
- 14 Any other vehicles (non-HGV): <3.5t gross vehicle weight
- 15 Solar photovoltaics (PV)
- 16 CIBSE Technical Memorandum (TM)
- 17 Outline Ecological Management Plan (OEMP)
- 18 Carbon (CO₂) emissions
- 19 Nitrogen dioxide (NO₂)
- 20 Particulate matters (PM)

Definitions

- 21 **Scope 1 emissions:** direct emissions from owned or controlled sources
- 22 **Scope 2 emissions:** indirect emissions from the generation of purchased energy
- 23 **Scope 3 emissions:** all indirect emissions (not included in scope 2) that occur in the value chain, including both upstream and downstream emissions.
- 24 **Climate change mitigation:** measures implemented in the design of the Proposed Development to avoid, prevent, reduce or offset GHG emissions.
- 25 **Primary / inherent / embedded design mitigation:** modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project, and do not require additional action to be taken. This type of mitigation encompasses design principles and solutions which have been 'embedded' or 'built in' the Proposed Development design to minimise climate-related risks.
- 26 **Secondary / additional mitigation:** actions that will require further activity in order to achieve the anticipated outcome. These may be imposed as part of the planning consent, or through inclusion in the ES. This type of mitigation refers to measures that require

additional action beyond the core function of the development, which can be proposed at any point within the EIA process, including during the decision-making process.

- 27 **Tertiary / inexorable mitigation:** actions that are required regardless of the EIA process such as measures imposed by other existing legislative requirements and/or standard sectorial practices.
- 28 **Climate change resilience & adaptation:** measures implemented to future-proof the Proposed Development and adapt to the anticipated impacts of a changing climate.
- 29 **Precautionary Principle / Approach:** a principle in policy-making which stipulates that if there is a threat or risk of serious or irreversible damage to human health or the environment, precautionary actions must be taken even if there is lack of full certainty surrounding the issue.
- 30 **Embodied carbon:** the total carbon emissions generated to produce a built asset. It is often defined as the carbon emissions associated with energy consumption (embodied energy) and chemical processes during the extraction, manufacture, transportation, assembly, replacement and deconstruction of construction materials or products.
- 31 **OneClick LCA database:** a life cycle metrics software tailored to the construction industry designed to help developers understand their embodied carbon emissions and acquire insights to help them reduce cost, carbon and material use in construction.
- 32 **Regulated carbon emissions:** emissions associated with the regulated energy uses, i.e. uses that are inherent in the design of a building and, therefore, relate to the 'quality' of the building itself.
- 33 **Unregulated carbon emissions:** emissions associated with unregulated energy uses within a building including small power electricity use, such as IT equipment, plug in devices and catering facilities.

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