OTTERPOOL PARK

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ENVIRONMENTAL STATEMENT

OP5 CHAPTER 8 **– CLIMATE CHANGE**

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March 2022

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Environmental Statement Volume 2: Main ES

Chapter 8: Climate Change

MARCH 2022

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8. Climate Change

8.1 Introduction

8.1.1 This chapter of the ES assesses the impact of construction and operation of the proposed Development with respect to Climate Change.

8.1.2 This chapter should be read in conjunction with Chapters 1-4 (the introductory chapters) and:

- Chapter 6: Air Quality;
- Chapter 7: Biodiversity;
- Chapter 10: Geology, Hydrogeology and Land Quality;
- Chapter 11: Human Health;
- Chapter 12: Landscape and Visual Impact;
- Chapter 15: Surface Water Resources and Flood Risk;
- Chapter 16: Transport; and
- Chapter 17: Waste and Resource Management.

8.1.3 It has also been prepared alongside and informed by Appendix 8.1: Carbon Calculations.

Relevant Aspects of the Proposed Development

8.1.4 A full description of the proposed Development is given in Chapter 4: The Site and the proposed Development. This Chapter presents the assessment of climate impacts associated with the worst-case carbon dioxide emissions and other greenhouse gases such as Methane, Nitrous oxide and others resulting from the construction and operation of the proposed Development, and is based on the current design with appropriate assumptions, aimed at worst-case and common standard of construction. The key aspects of the proposed Development that relate to impacts on climate are two-fold:

- Effects on future climate arising from whole life GHG emissions from construction and operation of the Development. This aspect considers effects of GHG emissions arising from the proposed Development on the climate, and the potential for GHG emission increases to affect the Government carbon reduction plan targets; and
- Vulnerability of the proposed Development to climate change (and impacts relevant to adaptation) – the resilience of the proposed Development to impacts resulting from a changing climate, including how the proposed Development design would take account of projected effects of climate change.

8.2 Assessment Methodology

Legislation, Policy and Guidance

8.2.1. This climate change impact assessment has been undertaken in accordance with current legislative and policy framework with respect to climate change. An outline of the legislation, policy and guidance relevant to the proposed Development at the national and local levels is provided below.

Legislation

8.2.2. Kyoto protocol Reference Manual: on accounting of emissions and assigned amount (Ref. 8.47) by the United Nations Framework Convention on Climate Change (UNFCCC), defines the seven key GHGs: Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur Hexafluoride (SF6), and Nitrogen Trifluoride (NF3); these key gases are to be expressed in terms of their equivalent global warming potential in mass of CO2e.

8.2.3. The Climate Change Act 2008 (2050 target amendment) (Ref. 8.1) sets the framework for the United Kingdom (UK) to achieve its long-term goals of reducing GHG. In June 2019, the Government amended the Climate Change Act 2008 to revise the 2050 greenhouse gas (GHG) target of an 80% reduction of GHG emissions compared to 1990 levels to a 100% reduction carbon target.

8.2.4. The Climate Change Act required that the pathway to achieving the previous 2050 carbon target was set out through five-year carbon budgets. The most recent carbon budget is the sixth (Ref. 8.11) which sets a cap on carbon emission levels between 2033 and 2035.

8.2.5. The Paris Agreement (Ref. 8.35) was adopted in 2015 and entered into force in November 2016. The Paris Agreement is an international climate agreement aiming to limit global temperature increase this century to less than 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. To achieve this aim, the Paris Agreement sets a target for net zero global carbon emissions in the second half of this century. The Paris Agreement was ratified and entered into force in the UK in November 2016. The Agreement additionally establishes a goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change.

8.2.6. COP26 was held in Glasgow in November 2021, the UK Government had reiterated some of its previous climate goals, such as achieving net zero emissions by 2050. Based on the 6th National Carbon Budget that states a 78% reduction in national emissions by 2035, the government at COP26 has expressed ambition that the UK's electricity system will run on clean, low-carbon, energy sources by 2035.

Policy

8.2.7. This assessment has been undertaken with regard to the National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2021). The NPPF identifies ways in which the challenge of climate change can be met by the planning system. Chapter 14 of the NPPF highlights that planning plays a key role in mitigating against climate change. The Policy also includes the requirements for local authorities to adopt proactive strategies to mitigate and adapt to climate change in line with the provisions and objectives of the Climate Change Act 2008 and co-operate to deliver strategic priorities which include climate change.

8.2.8. The assessment also considers relevant policies of the Kent Environment Strategy (2016), Folkestone & Hythe District Council Core Strategy (2022) (Ref. 8.5) and its

Places and Policies Local Plan (2020). We also respond to the new Folkestone & Hythe District Carbon Action Plan (2021) (Ref. 8.9).

8.2.9. The response to the various relevant policy requirements have been summarised within Table 8-1.

Table 8-1 Summary of Relevant Adopted Policies

Document	Policy	Summary of Requirements	Project Response
National Planning Policy Framework (NPPF) (Ref. 8.3)	Chapter 14	The NPPF states that 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. • Can help to reduce GHG 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.	A number of measures have been embedded in the design of the proposed Development to minimise the impacts arising from climate change and reduce GHG emissions during construction and operation. These are considered in detail in Section 8.4. As a result of the measures proposed, the proposed Development would benefit from reduced vulnerability to impacts arising from climate change. Among these embedded measures are: • Green Infrastructure Strategy (ES Appendix 4.11) to use sustainable drainage practices to reduce the risk of flooding while increase public amenity • Strategic Design Principles (ES Appendix 4.3) are intended to reduce the risk of overheating in structures
Net Zero Strategy: Build Back Greener (2021) (Ref 8.41)	Vision	In October 2021, the UK Government published its decarbonisation plan, and set out, for the first time, the plans to deliver its emissions targets of Net Zero in 2050 and a 78% reduction from 1990 baseline to 2035 across the economy sectors. The main sectors that are relevant to the proposed Development set out in the strategy are Power, Transport and Buildings.	Section 8.5 compares the construction and operational carbon emissions from the proposed Development with the relevant carbon budgets (3rd, 4th, 5th and 6th) and demonstrate that the emissions from the proposed Development would not have a significant adverse effect on the government's ability in achieving the carbon budgets. In summary, the proposed Development ability to align with the government strategy relies on: 1. Electrification of heating and transport and reliance on UK's grid rapid decarbonisation by 2035
The Carbon Plan: Delivering our Low Carbon Future (2011) (Ref. 8.3)	Vision	In 2011, the Government published an updated Carbon Plan setting out how the UK will achieve decarbonisation and make the transition to a low carbon economy. It sets this objective within a framework of mitigating and adapting to climate change and maintaining energy security in a way that minimises costs and maximises benefits to the economy. With regards	

Document	Policy	Summary of Requirements	Project Response
		to development, the Carbon Plan presents the UK Government's approach to promoting the delivery of low carbon, resilient and adaptive buildings and enabling sustainable transportation as positively contributing to these national carbon reduction targets. It also presents the Government's strategy for meeting all four carbon budgets for periods 2008-2012, 2013-2017, 2018-2022 and 2023-2027.	2. Minimising carbon emissions associated with construction, using low-carbon materials, low-carbon means of transport of materials and workers, and efficient construction methods. 3. Energy efficiency in buildings by requiring high standard of thermal insulation through advanced construction materials and methods, as well as efficient lighting and electrical appliances. 4. Reduce transport emissions by town planning and public infrastructure that encourages walking and cycling of short distances, and ease of use of local public transport. 5. Long distance travel is reliant heavily on HS1 line, with Westenhanger Station and Ebbsfleet station near the proposed Development, enabling fast travel in Kent, to Greater London Area, and to mainland Europe via the HS1 rail link.
The UK Climate Change Risk Assessment 2021 (CCRA3) (Ref. 8.28)	Section 1.2	Under the 2008 Climate Change Act, the UK government is required to publish a UK-wide CCRA every 5 years. The CCRA sets out the main priorities for adaptation in the UK under 5 key themes (Agriculture and Forestry, Business, Industries and Services, Health and Wellbeing, Natural Environment and Buildings and Infrastructure). The CCRA also reviews the evidence for 56 risks and opportunities of climate change in a UK context. The 6 key priority risks and opportunities identified in the UK CCRA 2017 Evidence Report include: • Flooding and coastal change risks to communities, businesses and infrastructure; • Risks to health, well-being and productivity from high temperatures; • Risk of shortages in the public water supply, and for agriculture, energy generation and industry;	Measures to increase the proposed Development's capacity to be resilient to the effects of climate change have been identified and are described within Section 8.4 of this Chapter. Embedded adaptation measures have been based on the latest UK CCRA. Statutory consultation bodies have been consulted by the relevant topics' specialists regarding these measures.

Document	Policy	Summary of Requirements	Project Response
		• Risks to natural capital, including terrestrial, coastal, marine and freshwater ecosystems, soils and biodiversity; • Risks to domestic and international food production and trade; and • New and emerging pests and diseases, and invasive non-native species, affecting people, plants and animals.	
Kent Environment Strategy: A Strategy for Environment, Health & Economy 2016 (Ref. 8.5)	Our challenges	The Kent Environment Strategy identifies climate change and energy consumption and generation as key challenges for the future. Kent has developed key themes and priorities for the county to achieve by 2030. Priorities include understanding risks and opportunities, energy use and emissions, building resilience to the impacts of environmental change and focusing on low carbon, environmental services and rural sectors. The key climate and carbon indicators and targets developed for the county are: • Reduce emissions across the county by 34% by 2020 from a 2012 baseline. This was achieved, with a 37% reduction by 2017. • More than 15% of energy generated in Kent to be from renewable sources by 2020 from a 2012 baseline. • Reduce the number of properties at risk from flooding. • To develop climate action plans by 2018.	A number of measures have been embedded in the design of the proposed Development to reduce GHG emissions during construction and operation. These are described in Section 8.4.
Kent and Medway Energy and Low Emissions Strategy 2020 (Ref. 8.27)	Meeting the Climate Change Challenge	By 2050, the 14 local authorities within the county of Kent aim to reduce emissions to net-zero and benefit from a competitive, innovative and resilient low carbon economy. Key targets include: • Set five-year carbon budgets and emission reduction pathways to 2050 for Kent and Medway, with significant reduction by 2030. • Ensure climate change, energy, air quality and environmental considerations are integrated into Local Plans, policies and developments, by developing a	A number of measures have been embedded in the design of the proposed Development to reduce GHG emissions during construction and operation. These are described in Section 8.4.

Document	Policy	Summary of Requirements	Project Response
		clean growth strategic planning policy and guidance framework. • Ensure buildings and infrastructure being constructed now are fit for the zero-carbon future, supporting low carbon travel, transport and digital connectivity. • Promoting sustainable transport and innovations in the transport sector. • Increase coverage of green infrastructure that store carbon, increases climate change resilience, improves air quality and increases biodiversity.	
Kent Environment Strategy Indicators December 2020 (Ref. 8.28)	Target and indicators	Kent County Council published the trends and performance to the targets, indicators and measures outlined in their 2016 Strategy. Key climate and carbon indicators are: • Reduce emissions across the county by 60% by 2030 from a 2005 baseline. A 39% reduction has been achieved up to 2018. • Over 50% of local wildlife sites will be in positive management by 2045, and 75% of freshwater SSSIs in favourable conditions. • Over 20,000 homes planned to be protected from flooding.	A number of measures have been embedded in the design of the proposed Development to reduce GHG emissions during construction and operation. Additionally, measures have been incorporated to minimise climate change vulnerability, for example heightened flood risk. These are described in Section 8.4.
F&HDC Core Strategy Review (2022) (Ref. 8.8)	Aim 2 of Strategic Need B. Strategic Need D	Aim 2 of Strategic Need B 'The challenge to enhance management and maintenance of natural and historic assets' Minimise local carbon emissions, maintain air quality, control pollutants and promote sustainable waste management - the aim states that local carbon emissions should be minimised, (good) air quality should be maintained and pollutants should be controlled. Aim 2 of Strategic Need D 'fosters high quality place-making with an emphasis on sustainable movement, buildings and green spaces' promoting strategic development following the principles of garden settlements, addressing climate change with the goal of creating new communities that are carbon neutral;	The impact on carbon emissions is presented in this Chapter. The effects on climate assessment appraises whether the proposed Development is likely to result in an unacceptable impact from GHG emissions. The risk of has been evaluated in Section 0. Section 8.4 has prompted the recommended application of a number of construction phase mitigation measures which would be delivered by the CoCP to ensure that climate change effects are minimised during construction. The Energy Strategy (Ref. 8.45) has assessed and adopted a number of low and zero carbon technologies for individual properties based on technological constraints, cost,

Document	Policy	Summary of Requirements	Project Response
			energy and carbon savings and future-proofing for the development lifetime.
F&HDC Places and Policies Local Plan (2020) (Ref. 8.9)	Policy HB1: Quality Places Through Design	F&HDC is committed all new developments in the county: • Make a positive contribution to its location and surroundings. • Facilitates circulation and ease of movement within the locality for all users. • Creates, enhances and integrates areas of public open space. • Does not lead to an adverse impact on the amenity of future occupiers. • Provides a clear definition between the public and private realm. • Complies with other relevant policies within the development plan.	• Otterpool Park is set to contribute significantly to its surroundings with upgrades of greenery, biodiversity, and amenities. • Otterpool emphasise on sustainable soft mobility (e.g. walking and cycling). • Otterpool Park development is phased to minimise the impact of development on amenity of future occupiers.
	Policy CC1 – Reducing Carbon Emissions	Planning applications for all major new build housing developments and new non-residential buildings of 1,000sqm or more gross floorspace will be required to reduce carbon emissions by a minimum of 10 per cent above the Target Emission Rate, as defined in the Building Regulations for England approved document L1A: Conservation of Fuel and Power in Dwellings. This should be through the use of on-site renewable and low-carbon energy technologies which could include an integrated system or site-wide solution involving the installation of a system that is not integrated within the new building.	• This Tier 1 application sets a commitment for Otterpool Park to a 45% carbon emissions reduction against current Building Regulation Standards (2013) for new homes. This exceeds the 31% carbon reduction target outlined in the Interim Future Home Standards for new homes (Ministry of Housing, Communities and Local Government, 2021). See Otterpool Park Energy Strategy.
	Policy CC2 – Sustainable Design and Construction	Policy elements relevant to this chapter comprise: 3. The development minimises energy demand through passive design and layout and landscape mitigation measures with an aspiration for new major residential developments to achieve zero carbon homes; 5. The development includes measures to adapt to climate change, such as the provision of green infrastructure, sustainable drainage systems (SuDS) in accordance with Policy CC3, suitable shading of	• Tier 1 Energy Strategy provides a framework for the path to net-zero carbon by 2030. The Tier 2 and Tier 3 level Energy Strategies will set out how the commitments in this Tier 1 Energy Strategy will be delivered or exceeded, and any further relevant measures that are identified in the development of these applications. • Green and blue infrastructure, as well as Sustainable drainage plan for the proposed

Document	Policy	Summary of Requirements	Project Response
		pedestrian routes and open spaces and drought resistant landscaping;	Development are planned and set out in Otterpool Park Strategic Design Principles
F&HDC Carbon Action Plan (2021)	-	Folkestone and Hythe District Council has committed to reducing its own carbon footprint to a net zero target by 2030.	Otterpool Park Development is committed to assist in the District Council efforts to carbon neutrality in its phased development. This includes reduced emissions in construction, and operational energy and transport.
KCC Net Zero action plan (2021)	Policy Actions Green Infrastructure Actions	Green Infrastructure • Embed net-zero targets within appropriate procurement contracts. • Develop net-zero design checklist for new build and significant redevelopment schemes. • Work with districts to secure a policy commitment to 20% biodiversity net gain in Kent. • Ensure relevant aspects of the KNP Kent Biodiversity Strategy are embedded within all relevant KCC services.	Otterpool Park Development is committed to assist in the County Council efforts to carbon neutrality in its phased development as set out in this chapter. While more than 8,000 new homes are planned which will constitute the majority of the region's expansion, the carbon impact is expected to be half or less of the expected regional carbon budget in its peak. Net-Zero targets are embedded in the design as set out in the Energy Strategy (Ref. 8.45), this includes: • Whole carbon assessment for non-domestic buildings • Calculation of embodied carbon to residential buildings The Transport Strategy includes: • The development shall be underpinned by a movement strategy which prioritises walking, cycling and access to public transport • All homes shall be within 800 metres/10 minutes' walk of a local neighbourhood centre with an aspiration that all homes are within 400 metres/5 minutes' walk of such facilities • Rail services will be prioritised

Document	Policy	Summary of Requirements	Project Response
Our Green Future 25 Year Plan (Ref. 8.8)	Chapter 6 – Policy 2 – Tackling climate change	The Green Future 25 year plan sets a commitment to continue to set an example, reducing our emissions from 1990 levels by at least 80% by 2050 and publishing the second sustainable and effective National Adaptation Programme in 2018.	The estimated GHG emissions arising from the proposed Development have been compared with UK carbon budgets (and the associated reduction targets, outlined in Table 8-6) and with the Kent GHG emissions presented within Section 8.5.

Guidance

8.2.10. A number of standards and non-statutory guidelines, which provide details of assessment methodologies and mitigation techniques, have been used to inform the assessment, including:

- Committee on Climate Change (CCC), 2017. Meeting Carbon Budgets: Closing the Policy Gap (Ref. 8.11).
- The National Adaptation Programme: Making the Country Resilient to a Changing Climate (Ref. 8.11).
- Environmental Impact Assessment Guide to: Assessing GHG Emissions and Evaluating their Significance 2017 (Ref. 8.12).
- Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation 2020 (Ref. 8.30).
- BS EN 15978:2011 Sustainability of Construction Works, Assessment of Environmental Performance of Buildings 2011 (Ref. 8.13).
- National Business, Energy and Industrial Strategy's (BEIS) UK Government GHG Conversion Factors for Company Reporting (Ref. 8.33)
- National Planning Practice Guidance (PPG) on Climate Change (2014 amended 2019) (Ref. 8.43)

Consultation and Scoping

Consultation

8.2.11. Table 8-2 provides a summary of the consultation undertaken for this chapter prior to and following the submission of the 2019 application (Y19/0257/ FH). The table summarises how the comments have been addressed in this chapter, where relevant.

Table 8-2 Summary of Consultation

Consultee/Contact/date	Summary of Consultee Issue	Outcome
KCC	The local area objectives should be considered in the assessment. Area Assessment – GHG emissions baseline data for the County of Kent and the wider South East region. In addition, Kent has been undertaking a Climate Change Risk	The following documents have been reviewed and taken into consideration for the climate assessment: • Kent Environment Strategy: A Strategy for Environment, Health & Economy, 2016 (Ref. 8.5). • Draft Kent State of Environment Report (Ref. 8.15).

Consultee/Contact/date	Summary of Consultee Issue	Outcome
	Assessment based on the Government 2017 CCRA. This has taken into account the emerging Nation Adaptation Plan, and when released the UKCP18 data. Kent is also developing an Energy and Low Emissions Strategy in partnership with all 12 Kent districts and Medway.	• Emissions data for Kent and South East.(Ref 8.42) • Kent Preparing for Climate Change: Review of activity – 2012 (Ref. 8.16). • Kent's Adaptation Plan 2011-2013 (Ref. 8.19). • Air quality data available from the Kent air website - www.kentair.org.uk.
Consultations since 2019	This mainly includes addressing the following LPA and key consultee comments to the previously submitted Outline Planning Application Otterpool Park (Y19/2057/FH)	
Kent County Council Response to Otterpool Park Outline Planning Application (July 2019)	The County Council recommends the applicant has a design-in approach to enhance landscape and community resilience against flooding, air and water pollution and other potential risks. The scale of this site presents the potential to deliver an exemplar scheme in terms of adaptation and mitigation of climate change impacts (examples provided).	Otterpool Park aims to achieve gains in biodiversity through open space allocation, maintaining green Infrastructure and introducing structure planting through: • Aiming to allocate 50% of the Otterpool Park area as green open space • Providing areas for productive land, allotments, and orchards. • Advocating the retention of woodlands and hedgerows. • Promotion of native species Promotion of pollinators. • Introducing additional planted areas through an advance planting programme, driven by the findings of the Landscape Impact assessments. • Means of promoting active travel are aimed primarily to enhance wellbeing and reduce air pollution. • These measures will help protect the Development from surface floods and also reduce significantly thee 'Urban Heat Island' effect, as well as provide residents with quality outdoor space
Kent County Council Response to Otterpool Park Outline Planning Application (July 2019)	Overall, the County Council considers that the applicant should further explore opportunities for adapting to climate change, heat, shade and water usage to ensure the development at Otterpool Park is environmentally sustainable.	• Since the application in 2019, the application had been strengthened in design for robust adaptation to climate change impacts, as the Green and Blue Infrastructure planned in Otterpool park. It has an important role in helping the proposed development integrate into the surrounding countryside and improve access to the countryside for wildlife. It serves to achieve: • Link new green spaces with surrounding open spaces to create a green, walkable framework. • Help the existing ecosystems to perform better, support the town's

Consultee/Contact/date	Summary of Consultee Issue	Outcome
		ability to adapt to changes such as more severe flooding. • Connect Otterpool Park with surrounding villages and communities, bringing a range of uses closer to local people and supplementing local amenity. • Use visual assessment knowledge to drive advance planting towards bio diversity net gains and productive land goals. • The Green Infrastructure, as well as flood mitigation and adaptation are described in specific detail in Chapter 15. • These measures contribute to the proposed Development adaptation and resilience to climate change by reducing heat stress, providing shade and limiting excessive water usage by growing local fauna that is native to the region.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Provide an estimate of the emissions associated with the construction workforce over the 19 year period, an assessment of significance, and measures that could minimise this impact.	The estimate of the total emissions associated with the construction workforce over the 19 year period is 6,400 TCO_2, its significance is considered 'low' as it constitutes only 1.2% of whole life carbon for the project. Measures to minimise it are detailed in Section 8.4
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Include an assessment of operational management and maintenance activities, and how emissions from these can be minimised.	Maintenance of materials as part of construction are included in the embodied carbon of materials. The operational maintenance activities could not be addressed at this preliminary stage of design as they vary greatly according to detailed design plans. They are assumed to be minor and therefore negligible compared to the overall project carbon impact, but a more detailed analysis will be done for each plot of the Development in further application steps.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Include human and ecological receptors (in addition to physical structures) in the climate change adaptation assessment, as there could be significant effects upon them; Update Table 8-25 and 8-26 with the additional receptors specified above.	This has now been added to the respective tables of climate adaptation, in Section 8.5.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Estimate the baseline emissions associated in the baseline condition, to allow a comparison with the proposed development.	Current uses in the planned site, such as: Westenhanger Castle, Brockhill Country Park, agricultural land, vehicle repair yard and other structures currently on site are considered, in terms of carbon emissions, to be negligible. Baseline emissions are

Consultee/Contact/date	Summary of Consultee Issue	Outcome
		presented as Kent and South East England current emissions and the proposed development is compared to current emissions in the region and how much will they increase. A net change increase in GHG therefore is considered to be any new emissions arising from the new development.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Clarify the future years being assessed in the climate change adaptation assessment; Clarify why the 2080s UKCP09 timescales have not been used.	The vulnerability of the proposed Development to climate change impacts have been reassessed in the current issue to reflect updates drawn from UCKP18. The timeframe assessed is up to 2050, with consideration of rough estimates up to the 2080s.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Clarify the purpose of Table 8-16, and how the demolition material can be reused.	This table (now Table 8-21) lists the amount of demolition material. A demolition survey is to be made on each specific structure on site and reuse opportunities to be assessed. These would include crushed material to be used as infill, and structural elements as rebar steel reused for the same propose.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Clarify why the largest embodied carbon from building materials is by far plastic, and whether aspects such as roads and path have been considered.	The embodied carbon assessment has been revised in this submission, and it has been found that the largest contributor is structural elements as concrete and steel, as well as asphalt.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Clarify where emissions factors for construction traffic have been derived from.	Emissions factors for construction traffic have been taken from Greenhouse gas reporting: conversion factors 2020 (Ref. 8.33).
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Clarify if the correct units have been used to assess construction traffic emissions.	Correct units have been used. The number of HGVs during the construction phased has been calculated in the Transport Strategy, emissions were calculated by the weight of material needed and an estimation of travel distances (200km) that is considered as worst-cast.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	How was the 6,466 tonnes of CO2e for construction plant derived, and how can this be minimised:	Construction plant associated emissions are calculated according to the UK Industry Performance Report (Ref. 8.38). This is a KPI of construction emissions in the UK and its correlation with overall budget.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	How were emissions associated with water derived?	Emissions associated with water use are based on project's construction cost estimation according to the UK Industry Performance Report (Ref. 8.38). This is a

Consultee/Contact/date	Summary of Consultee Issue	Outcome
		KPI of construction emissions in the UK and its correlation with overall budget.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Clarify why the emissions associated with gas was assessed, when the project description states this is not possible for the whole scheme to use gas?	The proposed Development is planned to provide all-electric homes, and natural gas for heating is assumed as an option to use only in the commercial and public buildings. It should be noted that domestic emissions have been calculated according to the Standard Assessment Procedure (SAP) methodology, in line with National Building Regulations (2013). This constitutes a certain worst-case scenario for operational emissions of the domestic buildings. The carbon factor used for electricity represent the grid carbon intensity of 2010, which has already decarbonised by about 50% to 2020, and is expected to reach zero emissions in the 2040's. Therefore, the carbon factor used to calculate emissions of the all-electric homes scenario is also representative of worst-case scenario, and it will not be different if gas will eventually be used in homes for heating.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Have the carbon emissions for operational energy been factored up to account for GHGs, and is this correct (given that the scheme will not be producing other types of GHG)?	Carbon emissions of operational energy are calculated in CO_2e and include all GHG emissions arising from operational use of buildings and transportation.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	The stated aspiration towards zero-carbon is welcomed (in line with good practice and emerging policy requirements elsewhere), although the Applicant should clarify whether this will apply to residential and non-residential uses and how much will be achieved through passive design and insulation measures.	The Energy Strategy (Ref. 8.45) presented provides the foundation for a path towards net zero carbon to be achieved. Otterpool Park currently commits to a 50% carbon reduction for both residential and non-residential properties, and this strategy highlights how this can be met and surpassed with a commitment to move towards net zero in the future. A 'fabric first' approach is being pursued with a commitment to 10% improvement on Fabric Energy Efficiency Standard (FEES) on current Building Regulations (2013) for new homes. The aspiration is to achieve carbon neutrality of the whole project, with all building types and uses. This could only be confirmed in later design stages. Passive design and insulation measures are to be incorporated into plans in later design stages, this design stage has only considered masterplanning considerations of net-zero elements, this includes features in the proposed

Consultee/Contact/date	Summary of Consultee Issue	Outcome
		Development such as placement of structures and transportation routes.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Table 8-23 describes carbon emissions from increased vehicle use per year. The numbers are questionable, as this shows no increase in emissions between 2032 and 2044 18,247tCO2e per year. The Applicant should clarify how this is calculated, and what assumptions have been taken into account with respect to cumulative schemes considered, potentially improving emissions standards and proportion of electric vehicles.	Operational transport related emissions are calculated from transport projection in the proposed Development and BEIS carbon factors for private vehicles and HGVs. It should be noted that in the Transport Strategy the construction traffic was combined with operational traffic and background traffic for assessment within the VISUM strategic model so could not be extracted separately for this analysis. HGV flows are predicted to be approximately similar in 2030 compared with the 2044, this is the reason there is no major increase in traffic emissions between the two periods.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Clarify why end of life emissions have not been included, and what measures could be incorporated to future proof this;	End of life emissions have been included in the current amended submission.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Provide a clear set of significance criteria against a measurable target, acknowledging IEMA's guidance that all emissions could be significant, but the assessment should be proportionate.	This chapter follow IEMA Guidance on GHG emissions (Ref. 8.36) and considers all emissions arising due to its construction and operation to be significant. Kent and Medway low emissions strategy has been formalised in December 2020. As first priority this document is recommending for the district council to set carbon emissions reduction pathways to 2030 and 2050. This is assumed to be published during 2022, and so expected to be added to the next stage of submission. Until then, the overall emissions attributed to the proposed Development are compared to the UK budget, to Kent's current emission rate and to the Tyndall Centre study of local carbon budget the Kent and Medway low emissions strategy will be based on. The proposed development attributed emissions are insignificant in the context of the National Budget, although it is a relatively large development, it is designed to be low carbon from conceptualisation, and as a housing development that provides needed homes in Kent, it is planned to achieve this with the minimum carbon requirements, per dwelling unit. In order to assess significance: • For the GHG assessment- several carbon budgets have been identified as relevant, this include the national and regional budgets, and these are

Consultee/Contact/date	Summary of Consultee Issue	Outcome
		compared to the proposed Development carbon impact. Climate Resilience- any climatic risk that is deemed probable for the region in the relevant forecasts has been identified as significant, but takes into consideration mitigation to determine whether the impact is significant or not.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Assess climate change resilience not just against disruption, but against the more serious impacts of damage and harm.	In this version, damage and harm have been included in the assessment of climate change resilience. This includes damage and harm to human and ecological receptors, and not only structures.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	How will the wind conditions at the site (particularly dangerous strong winds) be affected by climate change and will the scheme be suitable for long term use?	The latest UKCP18 states "An increase in near surface wind speeds over the UK for the second half of the 21st century for the winter season when more significant impacts of wind are experienced. This is accompanied by an increase in frequency of winter storms over the UK. However, the increase in wind speeds is modest compared to interannual variability for the PPE-15." In addition it states, *"No trend in the wind speed over the UK for the mean of the CMIP5-13."* This outlines that although there will be an increase it will only be a modest increase. Therefore, strong winds are not considered to represent a climate change risk to the proposed Development and have not been assessed as such.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Provide an Outline Climate Change Adaptation Plan that sets out the main considerations and how residence/adaptation details will be embedded into the reserved matters and ongoing facilities management;	The Climate vulnerability section sets out the main climatic threats to the built environment and human and ecological receptors in the proposed Development and details outline adaptation measures taken by the design team to reduce climatic risks. A separate Outline Climate change Adaptation Plan is not considered necessary as all measured are outlined in the design documents, as: • Strategic Design Principles; and • Green Infrastructure Strategy. An Outline Climate Change Adaptation Plan will be provided in Tier 2, and updated in Tier 3, and will set out the main considerations and details of how adaptation is to be embedded into the reserved matters and ongoing facilities management. The climatic risks assessed will be: • Higher Temperatures

Consultee/Contact/date	Summary of Consultee Issue	Outcome
		• More frequent flooding
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	Tables 8-25 and 8-26 require updating to take into account both the additional impacts of damage and/or harm as described above (above simply considering disruption). It is very much focussed on the hard engineered aspects, and doesn't adequately cover the softer landscaping and the users/occupants of the scheme. It is considered there is a therefore potential for significant effects that hasn't been adequately assessed in the EIA.	Table 8-26 and Table 8-28have been updated to take into account impacts of damage/harm/disadvantage arising from changing weather conditions such as long heatwaves, flooding events, and other impact of changing temperatures and flooding patterns to softer landscaping aspects and the health, wellbeing and productivity of users/occupations. This was done in light of the new UKCP18 which provides more detailed granular climatic projections to specific geographic areas of the UK.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	The applicant should clarify how they have achieved the conclusions that the cumulative effects of the scheme and surrounding schemes is 'minimal', and why they have not made an attempt to quantify this assessment	Quantification of effect has been revised in this version of the document. It is assessed against all UK budgets throughout its expected design lifetime, as well as current Kent County emissions rate and policy of future carbon reduction. IEMA guidance considers GHG assessment to be intrinsically cumulative – as the effect is not local there is no benefit in considering GHGs from other local developments and the "cumulative effect" is considered through context of national and regional totals.
Temple (on behalf of F&HDC) Interim Report Review of the ES, April 2019	There are many opportunities to better consider ways to reduced GHG emissions and better adapt to the changing climate. Recommended ones include: • Consideration of modular buildings to retain flexibility. Use of BIM to identify appropriate materials with lower embodied carbon. Construction traffic management plan. Use of consolidation centres for construction materials, and discussion with other cumulative schemes to maximise opportunities for reusing materials. • Outline Climate Change Adaptation Plan, with details of how specific measures will be taken forward to RMAs and managed by the facilities manager.	Measures to reduce GHG emissions are described in this ES, as well as the accompanying strategy documents to the application, as the Strategic Design Principles. This includes: • Robust insulation to reduce heat demand; • Optimising orientation and external shading of buildings; and • Low carbon construction methods and low carbon materials, including local sourcing to reduce transport.

Scoping

8.2.12. A previous EIA Scoping Opinion was obtained for the 2019 application, where relevant, the comments from this process have been incorporated within Table 8-3. For this amended application, a request for a Scoping Opinion was submitted to F&HDC in June 2020. This outlined the work that had been undertaken to date and sets out the proposed approach to the EIA. A Scoping Opinion was issued by F&HDC in July 2020. Table 8-3 provides a summary of the scoping opinion comments relevant to this chapter, and how they have been addressed.

8.2.13. Additionally, a Scoping Addendum was submitted on 5 October 2021 to outline key changes to the application. These comprised additional land in the north-west corner of the site for provision of the wastewater treatment works (WWTW), additional land for highway junction works at Newingreen Junction, minor amendments to clarify land ownership boundaries and a change in the assessment approach in relation to the future uses of Westenhanger Castle. A response was received from F&HDC on this Scoping Addendum as set out in Chapter 2: EIA Approach and Methodology. All relevant changes since the submission of the scoping report have been assessed in this ES.

Table 8-3 Summary of Scoping Opinion

Consultee/Contact	Summary Scoping Opinion Response	Location in the ES
Temple (on behalf of F&HDC)	The climate assessment will take into account information provided by Kent County Council regarding local area objectives, and GHG emission data for the Kent and wider South East England. The assessment should consider emissions from the existing baseline (i.e. all activities and traffic within the application site boundary), to provide a notional point against which to base the magnitude of change. This should inform conclusions regarding significance of GHG emissions, in line with IEMA guidance; it is currently stated that the Proposed Development's emissions will be assessed against the national UK budget only, but the assessment should apply the magnitude of GHG emissions changes to more local budgets and objectives. No methodology for evaluating that significance is given, but it would be helpful to categorise the level of impact.	The project baseline point in terms of local emissions is deemed negligible. As the proposed Development is set to be a large urban development, currently most of the land in the application site boundary of the plan is agricultural land, with scattered land uses of low intensity. It is therefore deemed that for the GHGs assessment for this large scale plan, it is necessary to look at the local/regional level, as this level will be set on regional carbon budgets in the future that can be compared to. Section 8.3 details the comparison against Kent current GHG emissions. Kent County has set out in December 2020 to publish Kent Carbon Budget which will include Kent specific carbon targets, currently (March 2022) this has not been published. The proposed Development's carbon impact of its life time is compared also against Tyndall Centre for Climate Change Research local carbon budgets (ref. 8.40) which has set specific carbon budgets (5 year periods starting from 2018) for Medway.
Temple (on behalf of F&HDC)	The proposed scope of the construction phase GHG emissions include embodied GHGs in construction materials, construction activities, water consumption, waste and transport. Give the location of the site and the scale of the workforce, it should also include the commutes of	Transportation of construction workers has been included in the construction phase emissions as detailed in Table 8-5. Maintenance of materials as part of construction are included in the embodied carbon of materials. It is not considered appropriate to assess the operational

Consultee/Contact	Summary Scoping Opinion Response	Location in the ES
	construction workers and/or any temporary accommodation required. The proposed scope of the operation phase GHG emissions include energy use, operational transport movements, and waste movement. It should also include maintenance activities for the proposed Development.	maintenance activities this outline stage of design as they vary greatly according to detailed design plans. They are assumed to be minor and therefore negligible compared to the overall project carbon impact, but a more detailed analysis will be done for each development are in further application steps.
Temple (on behalf of F&HDC)	GHG emissions from the decommissioning of the scheme have been scoped out due to the long lifespan of the Scheme, stated in this section to be 60 years (although this is given elsewhere in the Scoping Report as 100 years). This is agreed – although the assessment should include consideration of the potential for modular and reusable/reconfigurable buildings, meanwhile uses, and the adoption of circular economy principles which can reduce embodied carbon emissions notably,	Assessment of the potential for modular and reusable/reconfigurable buildings is part of the Otterpool Park Strategic Design Principles.
Temple (on behalf of F&HDC)	The assessment of climate change resilience and adaptation will use the UK Climate Projections 2018 to identify potential impacts on the proposed Development. This should consider human and ecological receptors as well as the effect on the building fabric. The forecast dates used should be appropriate for the lifespan of the proposed Development. Paragraph 8.5.5 should include the consideration of more climatic extremes on the site's landscaping and ecology. The assessment will be based on the IEMA (2020) Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation, which is the most up to date guidance.	Human and ecological receptors have been added to the assessment of climate change resilience and adaptation of the proposed Development.
Temple (on behalf of F&HDC)	As mentioned above, no methodology for the baseline for the GHG emissions assessment is given. The ES should make it clear whether there are any GHG emissions associated with current uses of the site.	Current uses on the site are considered negligible in terms of GHG emissions and had been assumed as zero. This is considered a worst-case scenario approach.
Temple (on behalf of F&HDC)	An assessment of the cumulative effect of local schemes on the global climate is not proposed in the 2020 Scoping Report. This is acceptable, however it would be useful to assess the cumulative effects of developments within Folkestone and Hythe, including	Comparison of the projected estimates to Kent County and South-East of England has been added. Folkestone and Hythe 'Emission reduction pathway' to 2050 to be published during 2022.

Consultee/Contact	Summary Scoping Opinion Response	Location in the ES
	the proposed Development, against emissions estimates for the Folkestone and Hythe District Council area.	
Temple (on behalf of F&HDC)	It is stated that no additional cumulative assessment for the climate adaptation and in combination assessment is required, as this topic will rely on cumulative assessments from other chapters. This approach is considered acceptable	Noted
Natural England, Sustainable Development Team	Climate Change Adaptation The England Biodiversity Strategy published by Defra establishes principles for the consideration of biodiversity and the effects of climate change. The ES should reflect these principles and identify how the development's effects on the natural environment will be influenced by climate change, and how ecological networks will be maintained. The NPPF requires that the planning system should contribute to the enhancement of the natural environment 'by establishing coherent ecological networks that are more resilient to current and future pressures' (NPPF Para 174), which should be demonstrated through the ES.	Effects of climate change on ecological receptors has been added to Section 8.5 Further details on climate change projected impact on ecology on site are in Chapter 7: Biodiversity.

8.2.14. Temple, on behalf of F&HDC, undertook a review of the Draft ES in December 2021. The topic specific comment and response is provided in Table 8-4.

Table 8-4 Comments on the Draft ES

Consultee	Comment	Response
Temple on behalf of F&HDC, 1 December 2021 Draft ES	There are several references in this chapter to PAS280 and the Infrastructure EIA Regulations. In our detailed review we would be looking to ensure that the climate change chapter is sufficient for an application made under the Town and Country Planning Act and appropriate for a predominantly residential development.	Reference to the Infrastructure EIA Regulations was in error, and has been amended. Reference to PAS2080 has been removed.

The Study Area

GHG Emissions

Construction

8.2.15. In relation to effects on climate, the extent of the study considered for the construction phase includes the embodied carbon of the materials used, emissions caused by the construction activities, waste materials and their associated transport, and the transportation of staff to site.

8.2.16. The study area comprises the application site boundary, the geographical area for the transport of waste and the transport of material resources during the construction. Therefore, the spatial coverage of the assessment of the construction phase is the Site boundary and the affected road network defined by the proposed Development's traffic model.

Operational

8.2.17. The study area for the operational phase comprises the application site boundary, and the roads in the vicinity of the site that were likely to be affected by changes in traffic movements as a result of the proposed Development. The roads identified and included in the traffic model have been used to assess GHG emissions, and have also informed the appraisal of the traffic, air quality and noise effects of the proposed Development.

Vulnerability to climate change

8.2.18. The study extent includes the physical infrastructure assets associated with the proposed Development (for example, earthworks, structures, buildings). In addition, the environmental receptors identified and scoped in within other topic chapters have also been considered where climate change has the potential to impact upon them.

8.2.19. Given its nature, the proposed Development is expected to have a design life of at least 60 years and would be maintained and upgraded as required, with expected lifetime to be a century or more. As such, decommissioning has been scoped out of the assessment of vulnerability.

Temporal Scope

8.2.20. The proposed Development would be constructed in a phased manner over a period of approximately 19 years, from 2023-2042. The Framework Masterplan (FM), projected to extend the construction phase to 2044, is also considered.

8.2.21. The 'operational phase' refers to the operation of the completed proposed Development from 2024 (first completed house construction) to fully operational proposed Development by 2042 and onwards.

Methodology for Establishing Baseline Conditions

Greenhouse Gases Emissions

8.2.22. Baseline conditions for effects on climate have been established through desk-top research. It was determined that the current land uses such as Westenhanger Castle, Brockhill Country Park, agricultural land, vehicle repair yard and other structures currently on site are few and relativity small scale in terms of their associated

emissions. The baseline for the carbon emissions is therefore zero emissions, which reflect a worst-case scenario approach.

8.2.23. Therefore, the GHG emissions currently associated with the uses of the proposed Development, i.e. agricultural land, vehicle repair yard. These uses are deemed insignificant in their emissions contribution and are considered as negligible.

Climate Resilience

8.2.24. Baseline condition for climate resilience are the current climatic conditions in this region of South-East England. These have been established through desk-top research of MET Office data. (Ref 8.48)

Forecasting the Future Baseline

8.2.25. The future baseline is the situation that would prevail should a proposed Development not proceed. The future baseline is further defined by the assessment scenario that the topic adheres to.

8.2.26. Future baseline conditions for effects on climate have been established through desk-top research, including transportation and energy and emissions projections.

8.2.27. UK Climate Projects (UKCP18) (Ref. 8.19) is a climate analysis tool, released in 2019, that provides probabilistic projections for the whole of the UK, at regional level and at local level. To identify the future changes to the climate baseline, the following factors have been identified and used in the assessment:

- The lifespan of the Development (including timescales for construction and operational life cycle stages).
- Climate trends associated with the UKCP high emissions scenario (50% probability) projection.

Defining the Sensitivity of resource

8.2.28. To determine the significance of environmental effects on climate, the assessment uses the specific criteria set out within IEMA (2020) guidance (Ref. 8.31), IEMA (2017) (Ref. 8.14) and DMRB LA 114 Climate (Ref. 8.24). The GHG emissions impact assessment and vulnerability of the proposed Development to climate change assessment use separate approaches as described within the sections that follow.

Methodology for Assessing Impacts

8.2.29. This section describes the methodology which has been used for the assessment of climate which may affect, or be affected by, the construction and operation of the proposed Development.

GHG Emissions

8.2.30. The assessment has reported the carbon footprint from the construction phase and for the operational design life of the proposed Development. In addition, the assessment has been carried out for the following time periods:

- 2024 – First occupation negligible
- 2030 – Construction peak year
- 2042 – Completion of the proposed Development.

8.2.31. The GHG emissions assessment has taken a project lifecycle approach to identify GHG emissions hot spots (i.e. emissions sources likely to generate the largest amount of GHG emissions), and correspondingly enables the identification of priority areas for

mitigation. This approach is consistent with the principles set out in IEMA guidance (Ref. 8.31).

8.2.32. There are no particular local or specific environmental receptors for GHG emissions in the same way that there are for other topic assessments. However, it has been possible to quantify the GHG emissions associated with the proposed Development in absolute terms, for example, tonnes of carbon dioxide equivalent (tCO_2e) from Chapter 17: Waste and Resource Management Chapter. This approach is commensurate with a worst-case scenario approach.

8.2.33. The GHG emissions impact assessment considers the significance of the proposed Developments contribution to UK GHG emissions and the Government's ability to achieve its carbon reduction targets to meet the relevant carbon budgets set by the Climate Change Act 2008 (as amended).

8.2.34. In line with the World Business Council for Sustainable Development (WBCSD) & World Resources Institute (WRI) GHG Protocol guidelines, the GHG assessment has been reported as tonnes of carbon dioxide equivalent (tCO2e) and has consider seven of the Kyoto Protocol gases. These have been included within the GHG calculations.

- Carbon dioxide (CO2);
- Methane (CH4)
- Nitrous oxide (N2O)
- Sulphur hexafluoride (SF6);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs);
- and Nitrogen Trifluoride (NF3).

8.2.35. Expected GHG emissions arising from the construction activities, embodied carbon in materials and operational emissions of the proposed Development have been quantified using a calculation-based methodology as per the following equation and aligned with the GHG Protocol (Ref: 8.32): Activity data x GHG emissions factor = GHG emissions

8.2.36. The scope of the GHG emissions assessment for the proposed Development is summarised in Table 8-5 and is consistent with the following principles set out in BS EN 15978 Sustainability of Construction Works – Assessment of Environmental Performance of Buildings – Calculation Method: 'Relevance – data used for the assessment has been selected and presented in Table 8-5:

- Completeness – the GHG emissions assessment is based on a life cycle (LC) approach.
- Consistency – consistent methodology and data sources for GHG emissions would be used to allow comparison of emissions over time.
- Accuracy – the quantification of the GHG emissions would neither over- nor under-estimate actual emissions, as far as can be judged. Also, uncertainties are reduced as far as reasonably practicable.
- Transparency – the outputs of the GHG emissions assessment would be available along with data sources and any relevant assumptions.'

8.2.37. As detailed above, the GHG emissions assessment has taken a life cycle assessment (LCA). A proportionate approach to estimating the principal contributing factors associated with GHG emissions has been taken. The proposed scope of the GHG

emissions assessment is summarised in Table 8-5 based on professional judgement. The approach has considered which factors are likely to be substantial in their carbon contribution and which are likely to be insignificant in terms of carbon contribution. Those factors which are likely to be substantial have been subject to a detailed assessment of their contribution, whilst those factors that are likely to be insignificant have been scoped out. This is consistent with the principles set out in BS EN 15978.

Table 8-5 Scope of the GHG Emissions Assessment for the proposed Development

Life Cycle Stage	Scoped In	Scoped out
Construction	• Construction products (embodied carbon). • Transport of construction materials from the factory gate to the construction site. • Transport of waste from the site to the waste management facilities or landfill sites. • Construction processes (including water). • Workers' commute. • Land use changes.	• Construction machinery manufacturing. • Current uses within application site boundary • Transport of construction plant equipment to and from site.
Operation	• Energy consumption and increase transport emission arising from the proposed Development, in the geographic region. • Maintenance, repair, replacement and refurbishment of construction materials.	• Operational water use. • Carbon sequestration from tree planting.
Post-operation/Decommissioning	• End of life of materials being used in construction of structures is included in their Life Cycle Analysis / Embodied carbon.	• End of life deconstruction, demolishing and decommissioning, transport and waste processing and disposal.

8.2.38. Potential impacts on the environment arising from GHG emissions would include construction emissions and operational emissions from the proposed Development including building energy use and traffic movements.

8.2.39. The estimated GHG emissions arising from the proposed Development have been compared with UK carbon budgets, outlined in Table 8-6, and with the Kent GHG emissions presented within Section 8.5.

8.2.40. The proposed Development is expected to be one of Kent and Medway's leading growth areas in housing and employment. Therefore, the significance of its carbon impact should be assessed on a national level in relation to it being a major growth area regionally and nationally.

Table 8-6 UK Carbon Reduction targets

Carbon Budget	Carbon Budget Level	Reduction Below 1990 Levels
3rd carbon budget (2018 - 2022)	2,544 $MtCO_2e$	37% by 2020
4th carbon budget (2023 - 2027)	1,950 $MtCO_2e$	51% by 2020
5th carbon budget (2028 - 2032)	1,725 $MtCO_2e$	57% by 2020
6th carbon budget (2033 – 2037)	965 $MtCO_2e$	78% by 2035

8.2.41. In Table 8-7 for indicative purposes, the carbon emissions impact of the proposed Development has also been compared to the local carbon budget study done by Tyndall Centre for Climate Change Research (Ref. 8.40), based on BEIS data for Kent County Council baseline. The official Kent & Medway Local Carbon budget is due to publish in 2022, and it is expected that future design stages will be compared to it.

Table 8-7 Kent & Medway Local Carbon Budgets (Ref. 8.40)

Carbon Budget Period	Recommended Carbon Budget (Mt CO2)
2023 - 2027	1.9
2028 - 2032	0.9
2033 - 2037	0.4
2038 - 2042	0.2
2043 - 2047	0.1
2048 - 2100	0.1

Construction

8.2.42. Estimated material quantities and types have been provided to calculate the embodied carbon of the construction material assets, giving its contribution to the overall construction carbon. The calculation of embodied carbon allowed the sum of the energy required in resource extraction, and any processing required prior to transport to the proposed Development for use, to be accounted for within the overall carbon baseline.

8.2.43. The emissions factors used have been selected from the Energy and Industrial Strategy's UK Government GHG Conversion Factors for Company Reporting (Ref. 8.33) and Inventory of Carbon and Energy (ICE) Database v3 (Ref 8.25).

8.2.44. Diagrammatic representation of the measure of embodied carbon in relation to material assets life cycle is illustrated in Figure 8-1.

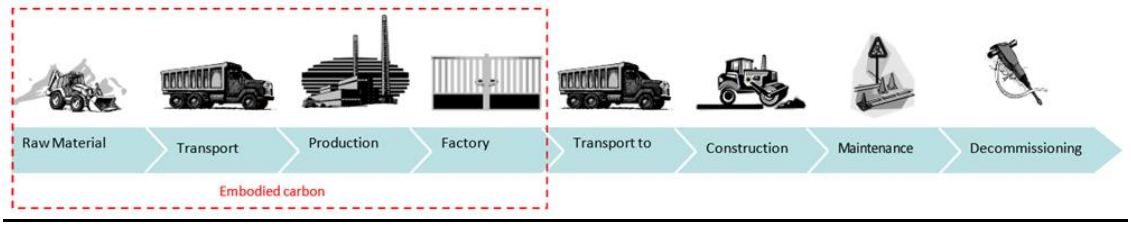

Figure 8-1 Diagrammatic representation of the measure of embodied carbon in relation to material assets life cycle

8.2.45. In addition to the calculation of embodied carbon, the emissions of construction activities are also considered and quantified. These included emissions associated with waste arisings and their transportation, water use, transportation of site workers and construction site energy and fuel usage for the duration of the construction phase.

8.2.46. The construction related emissions have been based on the construction and logistics information for the proposed Development. This includes information relating to specific land use / class across the entire proposed Development in terms of:

- Quantities (tonnes) of material resources;
- Type of material resources (e.g. concrete);
- Transport distances (km) of material resources- 200km for transport of materials and waste and 30km transport for construction workers (assumption based on professional judgement);
- Quantities (tonnes) of waste generated (both demolition and construction);
- GHG emissions factors (Ref 8.33);
- Overall carbon emissions of each design element and land use class; and
- Functional units (e.g. tCO2e per metre and year of design element and land use/class).

Operational

8.2.47. The operation stage assesses the operational energy and transport. For the transport calculation net variation is defined as the difference between the future baseline scenario without the proposed Development and with the proposed Development in the validated traffic model study area (the 'road user carbon'). As at least part of the GHG emissions associated with the operation of the proposed Development would have been displaced from other parts of the road network (e.g., road users), they are not considered additional to the UK GHG inventory. The traffic model study area is presented in the Transport Strategy.

8.2.48. Energy is assessed as the energy consumed during operation mainly including heating, lighting and other domestic uses. Non-domestic energy was assessed using typical KPIs based on floor areas.

Vulnerability of the proposed Development to climate change

8.2.49. The vulnerability of the proposed Development to climate change has been carried out in line with IEMA EIA Guidance (2020) (Ref. 8.31) and will be completed in liaison with project design team and the other EIA technical disciplines.

8.2.50. The following key terms and definitions relating to the vulnerability of the proposed Development to climate change assessment have been used:

- Climate hazard – a weather or climate related event which has potential to do harm to environmental or community receptors or assets, for example increased winter precipitation.
- Likelihood – probability and frequency of occurrence of the climate hazard.
- Climate change impact – an impact from a climate hazard which affects the ability of the receptor or asset to maintain its function or purpose.
- Consequence of impact– any effect on the receptor or asset as a result of the climate hazard having an impact.

8.2.51. A four-stage framework has been adopted for the operational assessment, which looks at the probability and consequence of the impact occurring to each receptor, leading to evaluation of the magnitude and significance of the effect.

8.2.52. The first stage has involved the assessment of climate effects on the proposed Development using its expected lifespan and the long-term life cycle stage (2100s) over which the baseline projections have been presented. UKCP18 (Ref. 8.39) provides probabilistic projections for the whole of the UK, at regional level and at local level. To identify the future changes to the climate baseline, the following factors have been identified and used in the assessment:

- The lifespan of the proposed Development of 60 years (including timescales for construction and operational life cycle stages); and
- Climate trends associated with the UKCP18 including overall different climatic conditions and extreme weather events.

8.2.53. The second stage has involved the identification of receptors which are vulnerable to climate change.

8.2.54. The third stage has involved the identification of the impacts (hazards and opportunities) for each receptor using the UKCP18 data, including the vulnerability of the proposed Development to both normal weather and extreme weather-related disaster scenarios.

8.2.55. The fourth stage has included an assessment of the identified impacts. Table 8-8 sets out the likelihood (probability and frequency) of an event occurring and Table 8-9 sets out the definition for the measure of consequence of impact of the climatic event on receptors, taken into account larger impact associated with climate change.

8.2.56. Potential negative impacts can be seasonal or on-going and could have physical effects (for example on structural elements such buildings and roads), or operational effects (for example on how buildings are operated during climate events).

Table 8-8 Likelihood categories

Likelihood Category	Description (probability and frequency of occurrence)
Very High	The event occurs multiple times during the lifetime of the proposed Development (60 years) - e.g. approximately annually, typically 60 events.
High	The event occurs several times during the lifetime of the proposed Development (60 years) - e.g. approximately once every 5 years, typically 12 events.
Medium	The event occurs limited times during the lifetime of the proposed Development (60 years) - e.g. approximately once every 15 years, typically 4 events.
Low	The event occurs during the lifetime of the proposed Development (60 years) - e.g. once in 60 years.
Very Low	The event may occur once during the lifetime of the proposed Development (60 years).

Table 8-9 Measure of consequence

Consequence of impact	Description
Very large adverse	• Regional level (or greater) disruption to infrastructure route(s) lasting more than 1 week; or • Disruption to the proposed Development lasting more than 1 week. • Very significant damage or harm to human and/or ecological systems
Large adverse	• Regional level (or greater) disruption to infrastructure route(s) lasting more than 1 day but less than 1 week; or • Disruption to the proposed Development lasting more than 1 day but less than 1 week. • Significant damage or harm to human and/or ecological systems
Moderate adverse	• Local level (or greater) disruption to infrastructure route(s) lasting more than 1 day but less than 1 week; or • Disruption to a section of the proposed Development lasting more than 1 day but less than 1 week. • Moderate damage or harm to human and/or ecological systems
Minor adverse	• Local level (or greater) disruption to infrastructure route(s) lasting less than 1 day; or • Disruption to a section of the proposed Development lasting less than 1 day. • Minor damage or harm to human and/or ecological systems
Negligible	• Disruption to an isolated section of the proposed Development lasting less than 1 day. • Negligible damage or harm to human and/or ecological systems

Significance criteria

8.2.57. To determine the significance of environmental effects on climate, the assessment uses the specific criteria set out within IEMA (2017) Guidance: Assessing Greenhouse Gas Emissions and Evaluating their Significance (Ref. 8.36) and IEMA (2020) Guidance for Climate Resilience (Ref. 8.31) and DMRB LA 114 Climate (Ref. 8.24). The GHG emissions impact assessment and vulnerability of the proposed Development to climate change assessment use separate approaches as described within the sections that follow.

GHG Emissions

8.2.58. GHG emissions from the proposed Development are quantified and expressed as tCO_2e per annum for 'Do Minimum' and 'Do Something' scenarios. The difference between the two scenarios is calculated to provide the evidence of the carbon impact of the proposed Development from its construction and operational phases, and this is assessed against the carbon budgets outlined in Table 8-7.

8.2.59. The global climate has been identified as the receptor for the purposes of the GHG emissions impact assessment. However, to enable significance evaluation of the estimated GHG emissions arising from the proposed Development, the UK GHG inventory and specifically the five-year UK national carbon budgets will be used as a proxy for the global climate. There is no standard definition for receptor sensitivity to GHG emissions set out in the IEMA (2017) GHG Guidance. The sensitivity of the receptor, the UK carbon budget (as a proxy for the global climate) has been defined as high. The rationale for this evaluation is as follows:

- Any additional GHG impacts could compromise the UK's ability to reduce its GHG emissions and therefore meet the future carbon budgets presented within Table 8-6; and
- The extreme importance of limiting global warming to below 2°C this century, as broadly asserted by the International Glasgow Climate Pact of 2021 and the Paris Agreement of 2015.

8.2.60. Due to the absence of any defined industry guidance for assessing the magnitude of GHG impacts in EIA, standard GHG accounting and reporting principles will be followed to assess impact magnitude. In GHG accounting, it is common practice to consider the exclusion of emission sources that are <1% of a given emissions inventory on the basis of a minimal contribution. The Department for Business, Energy & Industrial Strategy (BEIS) allows emissions sources of <1% contribution to be excluded from emission inventories, and these inventories can still be considered complete for verification purposes. This would therefore suggest that a development with emissions of <1% of the UK GHG inventory and relevant carbon budget would be minimal in its contribution to the wider national GHG emissions.

8.2.61. It should be considered that assessment of GHG impact of small, medium and large/national scale projects is still in its infancy. While the comparison set out in the paragraph above give indication of the project significance on the national level, we believe this does not give full indication of the magnitude, nor of the quality of the low-carbon design to achieve low carbon developments.

8.2.62. To create a more meaningful assessment of the GHG impact, the following have been considered:

- UK National Carbon Budgets (<1%)
- Kent County current emissions (<1%)
- Tyndall Centre for Climate Change Research regional carbon budgets for Kent & Medway (<1%).

8.2.63. IEMA guidance (Ref. 8.36) states that all GHG emissions have the potential to be significant and that the application of the standard EIA significance criteria is not considered to be appropriate for GHG emissions assessments. The significance has been concluded based on holistic consideration against both national and regional budgets.

Vulnerability to climate change

8.2.64. The significance of the risks identified in the assessment is based on the likelihood of a hazard having an impact on the Proposed Development, and the consequence of the impact. Details of the significance of effects are presented in Table 8-10.

Table 8-10 Effect Significance Matrix (IEMA Guidance Ref. 8.36)

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

Sensitivity Test

8.2.65. As set out in Chapter 2: EIA Approach and Methodology a sensitivity test has been undertaken in this chapter to account for the following:

- The transport modelling has been prepared on the basis of the Illustrative Accommodation Schedule (ES Appendix 4.4) and Illustrative Masterplan (ES Appendix 4.5). The quantum of development set out within the Illustrative Accommodation Schedule is lower than that for which approval is requested within the Development Specification (ES Appendix 4.1). This sensitivity test considers the increase in development quantum between these two scenarios.
- In addition, the sensitivity test accounts for the connection of a road in the proposed town centre (the additional link road). The base transport model did not include for the route to be connected for through traffic, however, the sensitivity test does allow for this connection as shown on the Development Area and Movement Corridor Parameter Plan (ES Appendix 4.2).

8.2.66. In order to confirm that the GHG emissions assessment is valid for the full quantum of development, for which approval is requested, sensitivity testing has been undertaken. The sensitivity test scenarios applied in this chapter comprise:

- **Scenario 2: Quantum for approval 2044 + Framework Masterplan:** This scenario accounts for the proposed Development quantum as set out in the Development Specification plus the anticipated Framework Masterplan area quantum as shown in the Illustrative Accommodation Schedule (10,000 homes and an additional school, although noting that the Development Specification quantum is higher for all uses apart from residential and education/community). It assumes build out will be completed in 2044.
- **Scenario 3: Quantum for approval 2030 + Framework Masterplan** - This scenario accounts for the proposed Development quantum as set out in the Development Specification plus the anticipated Framework Masterplan area quantum as shown in the Illustrative Accommodation Schedule at the construction peak, which is 2030 (10,000 homes and an additional school, although noting that the Developments Specification quantum is higher for all uses apart from residential and education/community).

8.2.67. The outputs of the sensitivity test are summarised in Table 8-11 and the full data provided in ES Appendix 8.1.

8.2.68. Scenario 1 (see Section 2.5) has not been considered in this sensitivity test because the quantum of development is lower than that in the main assessment, therefore, does not represent a worst-case scenario.

8.2.69. Scenario 2 leads to an increase in overall traffic flows across the road network of approximately 0.4% as compared to the with proposed Development scenario of the Illustrative Masterplan. This leads to an increase of transport related GHG of 2.73%, which is considered to be marginal for this stage.

8.2.70. Scenario 3 comprises the Development Specification traffic in the construction peak year of 2030. Scenario 3 leads to an increase in overall traffic flows across the road network of approximately 0.2% as compared to the 2030 with proposed development scenario of the Illustrative Masterplan. This leads to an increase of transport related GHG of 1.56%, which is also considered to be marginal.

8.2.71. Therefore in terms of GHG emissions and impacts on global climate, the emissions associated with Scenario 2 and 3 do not result in effects that are materially different to those resulting from the emissions associated with the Illustrative Masterplan. The conclusion still remains that the predicted GHG emissions of the proposed Development in 2030 and 2044 are **not significant**.

8.2.72. Therefore, in all scenarios for all receptors the sensitivity test concludes that the main assessment is considered to remain appropriate and robust.

Table 8-11 GHG emissions sensitivity test

Scenario	Illustrative Masterplan (TCO2/annum)	Sensitivity Test (TCO2/annum)	Increase (%)
Scenario 2 (2044, 10k)	213,502	219,487	2.73%
Scenario 3 (2030, 10k)	176,400	179,189	1.56%

Limitations and Assumptions

Limitations

GHG Assessment

8.2.73. The Climate change assessment has been based on the proposed Development proposals as described in Chapter 4 the Site and the Proposed Development. The assessment assumes that the proposed Development would be developed in accordance with this outline stage of planning. The assessment has been based upon the validity of the collated information. Specifically, the assessment of embodied carbon in materials has been undertaken based on a high-level material resource quantity, which were calculated prior to construction and only provides bulk estimates of material resources.

8.2.74. Whilst considered sufficient to inform the assessment, quantifications of materials required, and waste arisings forecast from the Project have been derived from the Building Research Establishment (BRE) key performance indicators and professional judgement. It has been assumed a preference for the retention and reuse of excavated materials (including uncontaminated minerals) over import of fill.

8.2.75. GHG emissions from the end of life stage of the proposed Development have been scoped out of the assessment due to the anticipated operational length of the Proposed Development.

Climate Resilience

8.2.76. The climate vulnerability assessment is inherently uncertain in relation to climate change projections and the variation of information available in relation to different climate hazards.

8.2.77. Climate projections are not predictions or forecasts but simulations of potential scenarios of future climate, under a range of hypothetical emissions scenarios and assumptions. Therefore, the UKCP18 presented within Section 8.3 cannot be treated as exact or factual, but projection options. They represent internally consistent representations of how the climate may evolve in response to a range of potential scenarios, and their reliability varies between climate variables. Furthermore, the projections do not go beyond 2100 and so weather extremes cannot be extrapolated beyond this period.

8.2.78. Climate resilience from the end-of-life stage of the proposed Development have been scoped out of the assessment due to the anticipated long operational length and the long time period of when the decommissioning will take place.

Assumptions

8.2.79. The Greenhouse Gases assessment was undertaken on the basis of the information available at the time of the assessment, based on professional judgement and evidence gathered through other environmental topic assessments, such as biodiversity, air quality, water, and the proposed Development design team.

8.2.80. The assessment of embodied carbon in materials was undertaken based on calculations of Chapter 17: Waste and Resource Management. This comprises waste from demolition material and construction waste. Assumptions on reuse of material and recycling stream are based on WRAP- Waste Management and Reprocessors, as described in the waste chapter and in the WRAP Report. The WRAP indicates the Baseline Wastage Rate and a 'Good' Wastage Rate. Transportation of waste related emissions are based on Chapter 16: Transport, which calculates HGV movements of waste to landfill, and waste to recycling centres.

8.2.81. Emissions factors for materials and fuel for plant were based on the closest emissions factor available for the material type. UK typical values were used where more specific information was not available.

8.2.82. Transportation and mode split assumptions:

- The mode split for work related trips is based on Census 2011 travel to work data for Shepway (the mid-layer Super Output Area (SOA) that represents the district of Folkestone & Hythe)
- For internal trips: Census travel to work data for trips made over distances up to 2km has been used. The distance of 2km is the shortest distance for which mode split information is presented within Census data. It is also approximately the distance from the centre of the Otterpool Park site to the nearest settlements outside the site boundary. It is therefore assumed that trips made up to 2km in distance are likely to be internal to the site, while trips that are over 2km in distance would be external to the site
- For external trips: Census travel to work data for trips made over distances greater than 2km was used.

8.2.83. The proposed Development is planned, at this stage, to provide all-electric homes, and natural gas for heating is assumed as an options in use only in the commercial and public buildings. It should be noted that domestic emissions have been calculated according to the SAP methodology, in line with National Building Regulations (2013). This constitutes a certain worst-case scenario for operational emissions of the domestic buildings. The carbon factor used for electricity represent the grid carbon intensity of 2010, which has already decarbonised by about 50% to 2020, and is expected to reach zero emissions in the 2040's. Therefore, the carbon factor used to calculate emissions of the all-electric homes scenario is also representative of worst-case scenario, and it will not be different if gas will eventually be used in homes for heating.

8.3 Baseline

Existing Baseline

GHG emissions

8.3.1. This section provides evidence of the existing GHG emissions within the study area and describes GHG emissions from the industry and commercial, domestic and transport sectors in the south east of England and Kent.

8.3.2. Current uses in the planned site, such as: Westenhanger Castle, Brockhill Country Park, agricultural land, vehicle repair yard and other structures currently on site are considered, in terms of carbon emissions, to be negligible.

8.3.3. Across the UK, the total GHG emissions from industry, commercial and domestic buildings and transport are presented as carbon dioxide equivalents (CO_2e). CO_2e is a quantity that describes, for a given amount of GHG emissions, the amount of CO_2 that would have the same global warming potential (GWP), when measured over a timescale of 100 years.

8.3.4. The UK GHG emissions have decreased in 2020 by 10.9% from 2019 (largely due to the COVID-19 Pandemic), and 40% from a baseline year 1990. In 2020, UK net CO_2 emissions were estimated at 326.1 million tonnes of CO_2e, and 30% of UK GHG emissions – of which 97.8 million tonnes of CO_2e - were from the transport sector.

8.3.5. According to the Climate Change Committee Sixth Carbon Budget – Buildings (Ref. 8.46) GHG emissions from buildings accounted for 17% of total UK emission. Direct emissions, resulting from use of fossil fuels (primarily gas) for heating, make up almost half of buildings GHG emissions. The other half is electricity related from lighting, heating cooling and other appliances. Residential GHG emissions account for 64% of buildings emissions which relates to some 332.8 million tonnes CO_2e in 2014.

8.3.6. Data, obtained from the Department for Business, Energy and Industrial Strategy (Ref. 8.20), show the emissions produced across the south east region and Kent for 2010-2018. These are presented within Table 8-12 and Table 8-13. They do not include the emissions created in the production of the fuels used.

Table 8-12 Total GHG emissions from the south east of England by source

Year	Estimated Quantities of Carbon (tonnes CO_2e per year)			
	Industry and Commercial Total	Domestic Total	Transport Total	Grand Total
2010	20,705,061,256	19,794,071,159	19,670,852,304	60,169,984,719
2011	18,484,165,052	17,333,977,502	19,437,980,164	55,256,122,718
2012	19,349,693,305	18,734,468,555	19,208,270,148	57,292,432,008
2013	18,238,841,436	18,277,305,423	18,946,605,096	55,462,751,955
2014	15,964,571,007	15,505,035,440	19,195,186,405	50,664,792,852
2015	14,421,303,177	15,031,514,898	19,829,507,981	49,282,326,056
2016	12,870,488,555	14,225,281,664	20,275,573,037	47,371,343,256
2017	12,119,219,067	13,286,607,869	20,152,076,429	45,557,903,365
2018	11,731,252,765	13,252,346,678	19,676,638,432	44,660,237,875
2019	9,426,412,670	12,973,305,267	18,650,065,354	41,049,783,291

Table 8-13 Total GHG emissions from Kent by source

Year	Estimated Quantities of Carbon (tonnes CO_2e per year)			
	Industry and Commercial Total	Domestic Total	Transport Total	Grand Total
2010	4,535,779,578	3,302,436,046	3,480,502,183	11,318,717,807
2011	4,065,878,314	2,891,342,457	3,488,539,621	10,445,760,392
2012	3,816,699,907	3,113,985,265	3,451,328,540	10,382,013,712
2013	3,597,671,403	3,034,286,144	3,373,345,236	10,005,302,783
2014	3,215,654,151	2,563,762,385	3,409,382,591	9,188,799,127
2015	2,832,946,835	2,507,620,265	3,548,545,949	8,889,113,049
2016	2,614,476,617	2,360,225,648	3,627,890,980	8,602,593,245
2017	2,500,374,863	2,214,875,959	3,618,523,761	8,333,774,583
2018	2,364,450,697	2,209,355,155	3,566,526,243	8,140,332,095
2019	1,852,848,677	2,167,543,419	3,303,546,041	7,323,938,137

8.3.7. Embodied carbon accounts for the carbon footprint of a material from extraction, manufacture, transportation, assembly, maintenance, replacement, deconstruction,

disposal and end of life aspects of the material. The UK construction industry is the largest consumer of natural resources with an average of over 400 million tonnes of raw materials consumed every year. This accounts for approximately 10% of the total UK carbon emissions. Therefore, approximately 40.38 million tonnes of CO_2 are attributed to the embodied carbon of construction materials.

Vulnerability of the site to climate change

8.3.8. A Local Climate Impact Profile (LCLIP) has been developed to assess the vulnerability of council services to severe weather events for Kent County Council (Ref. 8.21). The LCLIP for Kent was developed through a review of media stories in the local press over a 14-year period between 1996 and 2010. The LCLIP review found that Kent is already experiencing major weather events and that 52 highly significant events occurred over the 14-year LCLIP period. The most frequent impacts of these events were heavy rain and resultant flood events, heatwaves, droughts, freezing temperatures and snow as well as multiple storms.

8.3.9. Through the LCLIP, KCC has learnt that adequate data and information had not been collected to record the likely impacts. Consequently, and since 2012, KCC is utilising the Severe Weather Impacts Monitoring System (SWIMS) (Ref. 8.24). This is a decision-support tool enabling partners across Kent to record how they have been impacted by, and are responding to, severe weather events, as and when they occur.

8.3.10. A summary of the key findings from the Kent State of the Environment Report: Severe Weather Update provided in Table 8-14. these are events recorded between 2012-2020.

Table 8-14 Key findings from KCC Severe Weather Impacts Monitoring System (SWIMS)

Weather Event	KCC Findings
Heavy rainfall and flooding	A total of 11 heavy rain and flooding events were reported over the 8-year study period.
Extreme winter temperatures and precipitation	A total of 8 freezing events were noted. Impacts included 583 closures of roads over three events, full rail service suspensions and shortages in county grit levels.
Extreme summer temperatures and precipitation	Over 7 heatwave events were reported over the study period. Impacts reported included a 20- year low in the East Stour River's levels and road surfaces melting.

8.3.11. It has been found that in terms of financial damage of extreme weather events in Kent, flood events have the highest total cost of damage, whilst low temperature events have the highest average cost per event.

8.3.12. There has been a significant human influence on the observed warming in England's annual temperature since 1950. Statistical results from extreme value analysis suggest that the UK daily maximum and minimum temperature extremes have increased by just over 1°C since the 1950s, and that heavy seasonal and annual rainfall events have also increased. Across England, land temperature in the decade 2005 - 2014 was 1°C warmer than 1961-1990.

8.3.13. There has been a small observed increase in mean annual rainfall in recent decades. Between 1961-1990 and 1991-2010 mean annual rainfall increased by 3.2%.

However, this change is not statistically significant in the context of rainfall totals over the last century.

8.3.14. UK climate projection data is published by Defra via the UKCP18 data tool kit. The UKCP18 tool provides projections for a number of parameters from the 1990 baseline values. The 1990 baseline values for the key climate change adaptation parameters are presented in Table 8-15.

Table 8-15 Average climate change adaptation parameters in 1990 for KCC

Parameters	KCC Outputs
Mean air temperature at 1.5m (°C)	9.938
Mean maximum air temperature at 1.5m (°C)	13.848
Mean minimum air temperature at 1.5m (°C)	6.027
Temperature of the coolest day (°C)	-4.496
Temperature of the warmest day (°C)	30.701
Precipitation rate (mm/day)	1.664
Number of Rainy days in a year	85

8.3.15. Figure 8-2 shows precipitation means and temperature on monthly basis in the proposed Development region. The temperatures are highest on average in August, at around 18.9 °C, In December, the average temperature is 3.6 °C. The month with the highest number of rainy days is November (17.87 days), The month with the lowest number of rainy days is August (5.60 days).

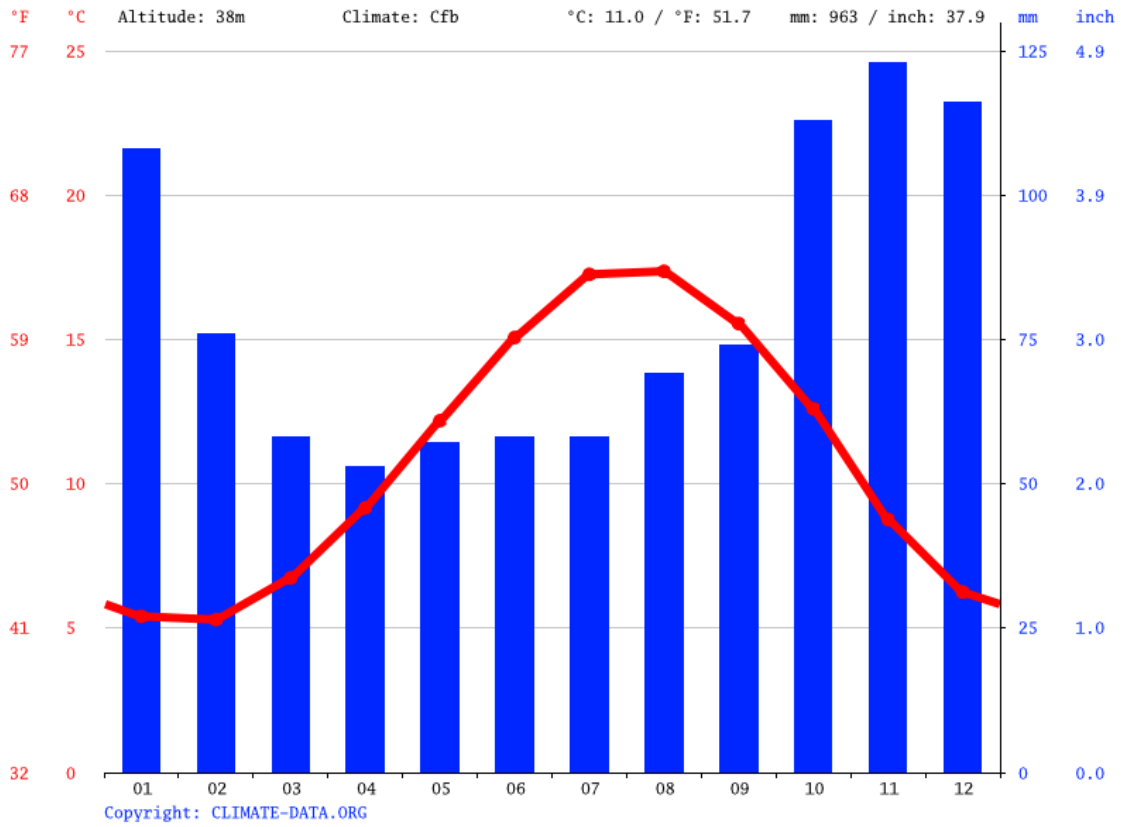

Figure 8-2 Monthly average temperature and average precipitation in Folkestone- 10km from proposed Development location

Future Baseline

8.3.16. The future baseline is the situation that would prevail should a proposed Development not proceed. The future baseline is further defined by the assessment scenario that the topic adheres to. The future baseline for climate change has identified the following.

Effects on climate (from GHG emissions)

8.3.17. The total GHG emissions without the proposed Development have been assessed within the traffic model as shown in the Traffic Strategy and presented in Table 8-16 below. Traffic data for 2022 is the current traffic emissions within the nodes assessed in the transport analysis.

Table 8-16 Total GHG emissions without the proposed Development within the traffic model study area by year

Year	Estimated Carbon Emissions (tCO_2e) per year	Percent Increase Over Previous Period
2023	187,257	
2030	209,303	12%
2042	229,619	9.7%
2044*	235,492	3%

* Framework Masterplan

Vulnerability of the proposed Development to climate change

8.3.18. It is predicted that climate change will increase the frequency and severity of some types of extreme weather events in England. UKCP18 Projections generally show that warmer, drier summers are more likely along with warmer, wetter winters. UKCP18 also shows data for 3 possible emissions scenarios: low, medium and high. These are the Intergovernmental Panel on Climate Change (IPCC) scenarios B1, A1B and A1FI respectively. The projections for the South East of England in the 2020s (2010-2039) in comparison to mean year 1990 baseline under a **high emissions** scenario suggest a central estimate of:

- An increase in winter mean temperature of 1.4ºC.
- An increase in summer mean temperature is 1.5ºC.
- An increase in summer mean daily maximum temperature is 2.0ºC.
- An increase in summer mean daily minimum temperature is 1.7ºC.
- No change in annual mean precipitation.
- A +7% change in winter mean precipitation.
- A -4% change in summer mean precipitation.

8.3.19. By the 2050s (2040-2069), the high emission central estimate (50% probability) provides the following projection:

- An increase in winter mean temperature of 2.5ºC.
- An increase in summer mean temperature is 3.1ºC.
- An increase in summer mean daily maximum temperature is 4.3ºC.
- An increase in summer mean daily minimum temperature is 3.4ºC.
- No change in annual mean precipitation.
- A 19% increase in winter mean precipitation.
- A 19% decrease in summer mean precipitation.

8.3.20. By the 2080s (2080-2099), the high emission central estimate (50% probability) provides the following projection:

- An increase in winter mean temperature of 3.5ºC.
- An increase in summer mean temperature is 4ºC.
- An increase in summer mean daily maximum temperature is 4.3ºC.
- An increase in summer mean daily minimum temperature is 3.4ºC.
- A 2% decrease in annual mean precipitation.
- A 26% increase in winter mean precipitation.
- A 28% decrease in summer mean precipitation.

8.3.21. No trend in the wind speed or frequency of strong winds over the UK for the mean projections model is forecasted.

8.3.22. Climate change is anticipated to increase peak rainstorm intensities resulting in potential for an increased frequency of flash flood events. However, there is also

potential for more frequent periods of drought, reducing the availability or reliability of surface and groundwater resources.

8.3.23. Using the UKCP by 2050 Kent and Medway are likely to see winter temperatures to be warmer by 2.0ºC, summers by 2.8ºC; winter rainfall is likely to increase by 14% and summer rainfall likely to decrease by 24%.

8.4 Design and Mitigation

8.4.1. The following section sets out:

- The embedded design measures, including good practice approaches, relied on in this assessment; and
- The potential significant effects remaining after the application of embedded design measures and good practice approaches, and any additional mitigation required to address these potential significant effects.

8.4.2. The potential significant effects prior to additional mitigation are identified in the Assessment Summary table.

8.4.3. Environmental considerations have influenced the proposed Development throughout the design development process, from early options assessment through to refinement of the Project design. An iterative process has facilitated design updates and improvements, informed by environmental assessment and input from the Project design teams, stakeholders and public consultation.

8.4.4. Impacts would be reduced by measures embedded into the design of the development, as well as by additional mitigation, and together these measures would act to avoid, reduce and mitigate effects. The measures have been summarised by whether they are embedded design measures, which are secured through the documents for approval, or additional mitigation secured, for example, by planning condition or legal agreement. Embedded measures are described as measures that form part of the design, developed through the iterative design process and good practice standard approaches and actions commonly used on development projects to avoid or reduce environmental impacts, typically applicable across the whole Development. Additional mitigation is described as any additional Development-specific measures needed to avoid, reduce or offset potential impacts that could otherwise result in effects considered significant in the context of the EIA Regulations.

Embedded Design Measures

Construction

Effects on Climate (from GHG emissions)

8.4.5. In line with the UK Governments carbon reduction plan, the design of the proposed Development aims to reduce GHG emissions as far as practicable in order to contribute to the UK's net reduction in carbon emissions. The following high-level options would be applied and developed when seeking to reduce GHG emissions during construction of the proposed Development:

- Step 1: Avoid and prevent: explore alternative lower carbon options to deliver the proposed Development's objectives.
- Step 2: Reduce: apply low carbon solutions (including technologies, materials and products) to minimise resource consumption during the construction, operation and at end-of-life; and construct efficiently: use techniques (e.g. during construction and operation) that reduce resource consumption over the life cycle of the proposed Development.

- Step 3: Remediate: after addressing steps 1 and 2, the proposed Development would identify, assess and integrate measures to further reduce carbon through onsite mitigation or off-site compensation/offsetting or sequestration. This is secured through the Energy Strategy (ES Appendix 4.9).

8.4.6. The Outline CoCP sets out that construction works would be carried out in accordance with the best practicable means, as described in Section 79 (9) of the Environmental Protection Act 1990, to reduce fumes or emissions. This would include all vehicle engines and plant motors to be switched off when not in use.

8.4.7. The following mitigation measures have been set out in the outline CoCP (ES Appendix 4.17) to be adopted where relevant:

- low carbon materials;
- low carbon construction methods;
- local supply chains;
- reuse opportunities;
- Efficient use of construction plant;
- Earlier connection to the grid;
- Good practice energy management on site;
- Onsite measurement, monitoring and targeting;
- Fuel efficient driving – freight;
- Fuel efficient driving – waste removal;
- Renewable Transport Fuel Obligation – freight and waste removal;
- Construction consolidation Selected projects;
- Sharing knowledge about alternative sustainable fuels;
- Reducing the transport of waste; and
- Fleet conversion to fuel efficient passenger vehicles.

8.4.8. The Outline CoCP (ES Appendix 4.17) sets out that a demolition survey is to be undertaken on each specific structure on site and reuse opportunities to be assessed. These may include crushed material to be used as infill, and structural elements as rebar steel reused for the same purpose.

Vulnerability of the proposed Development to climate change

8.4.9. The Outline CoCP (ES Appendix 4.17) sets out the following measures:

- While there is no specific projection of high wind speeds or intensity of storms from climate change, working conditions are to be assessed each day;
- Climatic conditions will be assessed on day-to-day basis, while identification of physical risks constantly observed and mitigated.
- The flooding risk of the construction site is to be considered, with mitigation and adaptation measures in place, for both workers and equipment.
- High temperature may hinder working conditions, if required workers resting areas will be provided.

8.4.10. The following measures have been embedded in the design of the proposed Development:

- Robust, low-carbon materials to be used for roads and pavements as secured through the Otterpool Park Strategic Design Principles.
- Projected heat stress of the next 30 years will be incorporated in the detailed structural design of domestic and non-domestic structures. With structures planned to be of moderate height and standard design of load bearing walls, opportunities for low carbon lean design structural elements would be investigated that will cut embodied carbon as well allow minute movement in structural elements. These measures are secured through Strategic Design Principles .
- Fill material to be appropriate to the climatic conditions projected, waste amounts have been projected on a worst-case scenario basis and the opportunities to further reduce waste will be explored in detailed planning. Secured through These measures are secured through Otterpool Park Outline Site Waste Management Plan.
- SuDS and drainage strategy to address issues of changes in ground water level. This has been addressed with planning of attenuation and wetlands, as well as conveyance swales. Further details can be found in the Green Infrastructure Strategy (ES Appendix 4.11) and Drainage Strategy (ES Appendix 15.1).
- Structural elements to be specified according to UKCP18 projections as secured through Otterpool Park Strategic Design Principles.
- Road markings to be designed against any changes in climatic conditions as secured through Otterpool Park Strategic Design Principles.
- Landscaping plan will address potential changes in growing regimes due to changing climates as secured through the Green Infrastructure Strategy (ES Appendix 4.11).

8.4.11. The vulnerability of the proposed Development to climate change and incorporation of appropriate adaptation measures into the project's design has been part of the design process. The risks associated with climate change have been part of the design team considerations, and that has been reflected in the proposed Development's design in Transport Strategy, number of units and materials. Climate considerations will be further addressed in the detailed design of buildings, including through measures such as use of appropriate materials and incorporation of adequate ventilation for future climates.

Operation

Effects on Climate (from GHG emissions)

8.4.12. To quantify the energy and GHG emissions reductions expected at the Proposed Development, the following design mitigation measures were incorporated into the modelling for the energy and carbon assessment included within the Energy Strategy Passive design including orientation and minimising solar gain:

- Improved building fabric and insulation beyond building regulations.
- Improved performance of glazing.
- Improved air tightness.
- Specification of water recycling, low-flow taps and showers.
- Provision of 100% low energy lighting.

- Low carbon heating.
- Renewable energy provision (solar photovoltaics).

8.4.13. An approach using the Energy Hierarchy of Be Lean (considering energy efficiency measures), Be Clean (assessing the potential for district heating) and Be Green (introduction of low and zero carbon energy generation) has been used against current Part L 2013 of Building Regulations.

8.4.14. The core commitments in the Energy Strategy are as follows:

- Otterpool Park will commit to a 50% carbon emission reduction for regulated energy for new buildings against current Building Regulation Standards (2013) and set the development on the path to a 67% carbon reduction in the medium term and zero carbon in the long term.
- Fabric First – including requiring a 10% improvement on the Building Regulations Fabric Energy Efficiency Standard using current building regulations (2013).
- All buildings will have low carbon electric heating in the form of Air Source Heat Pumps (ASHP) in the initial phases whilst ensuring flexibility for other low carbon heating technologies and fuels such as hydrogen in the future.
- The incorporation of renewable energy generation technology where feasible on all buildings with solar PV being the most viable technology in the initial phases.

8.4.15. Table 8-17 below details the CO_2e emission reduction from the energy hierarchy to achieve a 44.85% carbon reduction on current Building Regulations (2013).

Table 8-17 Carbon savings following energy hierarchy for the proposed Development

	Energy and Carbon Savings against Building Regulations Baseline			Energy and Carbon Savings Including Unregulated Energy		
	Tonnes Carbon (tCO2e/yr)	Carbon Savings (tCO2e/yr)	Savings (%)	Tonnes Carbon (tCO2e/yr)	Carbon Savings (tCO2e/yr)	Savings (%)
Building Regulations	26,466			42,960		
Be Lean (After Energy Efficiency)	17,222	9,245	34.93%	33,715	9,245	21.52%
Be Clean (After District Heating)	17,222	9,245	34.93%	33,715	9,245	21.52%
Be Green (After renewables)	14,596	11,871	44.85%	31,089	11,871	27.63%

8.4.16. In order to determine embedded design measures to reduce energy demand for heating, the Energy Strategy has considered a range of energy supply options including CHP, biomass heating, ground and water source heating for a site wide scheme alongside options that could be limited to a smaller cluster of dwellings such as sewer heat recovery and energy from food waste. However, none of the district heating options indicate a positive return on investment.

8.4.17. More innovative small-scale district energy option for sewage heat recovery or recovery of energy from the on-site Waste-Water Treatment Plant could provide heat

to selected customers to the west of the site. Due to the maturity of the technology its costs and performance are still uncertain, and any scheme would need more detailed assessment, to maximise the reduction of GHG emissions, before progressing further.

8.4.18. The Energy Strategy (Ref. 8.45) for the proposed Development has assessed a number of technologies based on technological constraints, cost, energy and carbon savings and future-proofing for the proposed Development lifetime. The preferred option would be to include solar photovoltaic cells within all suitable properties and also specify air source heat pump electric heating in the initial phases whilst remaining flexible for other forms of low carbon heating, such as hydrogen in the future.

8.4.19. Battery Storage, smart controls and electric vehicles will all be likely to be part of the proposed Development in the future. Pilot studies with monitoring and evaluation could be undertaken in the initial phases of the proposed Development in order to identify solutions that benefit most from these technologies and exploit the evolution of grid services and community involvement.

8.4.20. Smart energy will be integral to the transition to cleaner energy. Otterpool Park developments shall be equipped with smart metering and will positively inform how consumers interact with the grid. Through the research, trials and analysis of the evolving market, evidence will be developed on how Otterpool Park will embed the concepts. These concepts include the 'active home' or 'buildings as power stations', where occupants have the technology to integrate solar and storage technologies for heat, power or both.

8.4.21. In addition, carbon emissions arising from increased car use have been calculated based on the traffic model developed for the proposed Development, in combination with UK Government GHG conversion factor. The assessment results presented in Table 8-19 shows that peak emissions arising from increased car use would be from 2032. Due to lack of projections data, GHG emissions for 2032, 2044 and 2046 have been based on GHG emissions from 2030.

Table 8-18 Estimated Carbon Emissions from increased vehicles use per year

Year	Estimated Carbon Emissions (tonnes CO_2e per year)		
	Without proposed Development	With proposed Development	Increase in Transport GHG attributed to development
2017	187,257	N/A	378
2037	202,072	202,450	4,199
2044	229,619	247,866	18,247

Table 8-19 Total Estimated Carbon Emissions from increased vehicles use per period (calculations based on trips set out in the Transport Strategy)

Year	Estimated Carbon Emissions (tonnes CO_2e per period)			
	Without proposed Development	With proposed Development	Difference (Increase)	Increase in GHG attributed to development
2017 – 2021 (Pre-construction)	936,285	936,285	0%	-
2022 – 2030 (Early construction – Peak Construction)	2,042,413	2,055,073	1%	12,660
2031 -2042 (Peak Construction – completed development)	2,755,428	2,974,392	7%	218,964
proposed Development Total	5,734,126	5,965,750	4%	231,624
2042 – 2044 (Framework Masterplan)	459,238	495,732	7%	36,494
Total	**6,193,364**	**6,461,482**	**4%**	**268,118**

8.4.22. A comprehensive range of measures are suggested for the proposed Development to promote sustainable travel and vehicle choices, in addition to the provision of infrastructure in the form of walking and cycling routes and bus services and cycle storage. The suggested measures are set out in the Framework Travel Plan (ES Appendix 16.6), which is also submitted for information with the Application.

8.4.23. The proposed Development will need to provide for the future requirements for electric vehicles and give the flexibility to adapt to innovative transport solutions such as autonomous vehicles. The measures listed below are suggested as part of Transport Strategy (ES Appendix 16.5):

- Seek to develop an electric vehicle car club in conjunction with an operator.
- Seek to develop a rental bike scheme, including electric bikes.
- Provide passive provision for electric vehicle charging at all homes with allocated spaces as well as to on-street parking areas.
- Develop electric vehicle charging point strategy with provision in local centres, employment locations and the rail station.

Vulnerability of the proposed Development to climate change

8.4.24. Following identification of the future climate projections, the proposed Development receptors which are vulnerable to climate change during the construction have been

identified as the pavements and road surfaces, buildings, drainage, geotechnical conditions, signs, traffic signals and lighting, landscape, workforce, plant and equipment and user facilities. Human receptors, as human health and well being, as well as ecological receptors as biodiversity, are also included.

8.4.25. Mitigation and adaptation measures for the previous receptors to address climate change have been considered and have been embedded within the Development Specification, Strategic Design Principles, Parameter Plans and Strategy documents. One such example is the incorporation of Sustainable Drainage Systems (SuDS). The proposed Development would utilise SuDs to manage surface water in terms of both water quality and quantity, further information is provided in Chapter 15: Surface Water Resources and Flood Risk. SuDs would be designed to appropriate standards to safeguard the quality of the underlying groundwater regime. Appropriate green infrastructure spaces throughout the proposed Development would be determined in areas where infiltration rates and ground conditions are suitable for these features.

8.4.26. The proposals would ensure that greenfield (existing) discharge rates would not be exceeded during rainfall events up to a 1 in 100 (1%) annual probability including an allowance for climate change. Several infiltration areas have also been included in the design where the ground conditions are suitable. Swales, soakaways, permeable paving, rain gardens and green roofs would provide more localised surface water management. The site would aim to be an exemplar regarding the provision of SuDS and multi-functional green space, promoting Water Sensitive Urban Development (WSUD) principles, this is secured through the commitments in the GI Strategy. This would ensure that flood risk is mitigated during each development phase and cumulatively as the phases progress, whilst also reduce water demand and maximise overall environmental benefits. These measures are secured through the FRA and SWDS (ES Appendix 15.1) and through the mitigation set out in Chapter 15: Surface Water Resources and Flood Risk.

8.4.27. In addition, the proposed Development has been designed, as evidenced in Strategic Design Principles (ES Appendix 4.3) and the GI Strategy (ES Appendix 4.11), to be resilient to impacts arising from current weather events and climatic conditions and designed in accordance with current planning, design and engineering practice and codes (e.g. the Environment Agency's (EA) guidance on allowances for rainfall and flood probability due to climate change (Ref. 8.24), within the context of flood risk assessments).

8.4.28. National Planning Policy Framework, which sets out the government requirements for the management and reduction of flood risk in the land use planning process, requires the investigation of climate change on the proposed Development. Making an allowance for climate change in a flood risk assessment will help to minimise vulnerability and provide resilience to flooding and coastal change in the future.

8.4.29. The Flood Risk Assessment (FRA) indicated that up to 2115 the climate change allowance should be 20-40%, therefore a 40% climatic change allowance has been used in the calculations and will be included within the detailed flood storage design. Further detail is provided within the FRA (ES Appendix 15.1).

8.4.30. Making an allowance for climate change in the assessment for the proposed Development demonstrates the development is safe for its lifetime, without increasing flood risk elsewhere and where possible will provide betterment and reduce flood risk.

8.4.31. In order to provide protection to potential overland flows as a result of climate change, from rainfall run-off, or sewer surcharging, external levels would be arranged to direct overland flows away from buildings and towards positively drained areas to limit the

flooding potential to buildings. This measure is secured through the Surface Water Drainage Strategy (ES Appendix 15.1).

8.4.32. In addition, materials that would not deteriorate due to high temperatures would be selected during the detailed design stages as secured in the Strategic Design Principles (ES Appendix 4.3). This would avoid the deterioration for example of the pavement such as softening, deformation and cracking. Further detail is provided within Chapter 17: Waste and Resource Management.

8.4.33. A key feature of any 'Garden Town' development (for which the Otterpool Park application comprises a major component) is its inclusion of a rich Green Infrastructure (GI) and ability to maximise use of the natural environment for landscaping, biodiversity and recreational uses. The proposed Development has been planned as a holistic 'Green' development providing accessible routes between the residential setting, informal and formal sport, play spaces, food production areas, community space, work place and the wider surroundings (Ref. 8.37) as secured in the Development Specification and GI Strategy.

8.4.34. Allowances for climate change e.g. effects on planting have been identified and incorporated into the design, this includes the SuDS, water reuse, and other measures detailed in the GI Strategy. Longer vegetation growing seasons leading to a reduction in soil moisture and/or increased tree leaf coverage with an increased magnitude and frequency of storms events which could result in tree fall and increased maintenance and management requirements.

8.4.35. Parameter Plan OPM(P)4002, refines the hierarchy, structure and distribution of green infrastructure and open space across the site, including public realm and open space for leisure, sport and play. Existing GI typologies including high value hedgerows / trees and woodlands have guided the placement of proposed built Development parcels with a presumption towards vegetation retention where feasible.

Additional Mitigation

8.4.36. An iterative appraisal of the proposed Development taking into account the embedded design measures and good practice was undertaken to identify any potential significant effects that would require additional mitigation. The proposed Development, during both construction and operation, is not considered to have the potential to cause significant adverse effects related to climate change and therefore no additional mitigation measures have been identified.

8.4.37. However, production and implementation of measures set out within an Outline Climate Change Adaptation Plan is to be undertaken at the next tier to ensure that appropriate measures are embedded into the design. This would be secured by planning condition. Further information on the Outline Climate Change Adaptation Plan is set out below.

8.4.38. Once climate change risks and vulnerabilities have been assessed and preferred adaptation options have been identified and selected, a framework for implementation of adaptation action - strategy and action plan - can be established. To be effective, this framework would take into consideration the findings from the climate vulnerability assessment and be subject to public consultation and formal recognition by the relevant local authorities. The adaptation strategy is a reference document outlining the vision and direction of actions and their expected outcomes. Its accompanying

action plan sets out what needs to be done to transform the chosen adaptation options into actions.

8.4.39. The action plan sets out what needs to be done to turn the prioritised adaptation options into actions. An action plan could contain:

- Details of each action (and sub-actions, if applicable) and associated processes and synergies
- Roles and responsibilities in coordination and undertaking of actions
- Timeframe for implementation
- Estimation of human and financial resources needed and/or available funding schemes
- Indicators of success to be used for monitoring and evaluation

8.5 Assessment of Residual and Cumulative Effects

8.5.1. The following section sets out the residual effects following the implementation of the embedded measures and additional mitigation set out above.

Residual Effects from Construction

Effects on Climate (from GHG emissions)

8.5.2. For the construction phase, the material resources and waste assessments assume activities between 2023 and 2042. For the construction phase, with reference to the GHG emissions from materials resources and the transport of material resources and waste, the following years have been assessed:

- 2024 – First occupation;
- 2030 – Construction peak year, as set out in Chapter 2; and
- 2042 – Completion of the proposed Development.
- 2044 – Completion of Framework Masterplan

8.5.3. A summary of the maximum floorspace area for each land use type of the proposed Development is shown in Table 8-20.

Table 8-20 Summary of land use and planned floorspace

Land Use	Class / Description	Quantity (floorspace - GEA (m^2) unless otherwise specified)
Residential	Dwelling	Up to 8,500 dwelling units
Education and Community Facilities	Schools, nurseries, crèches, reserve school floorspace and/or Special Education Needs, health centres, place of worship, community centres.	Up to 67,000
Leisure	Sports pavilion and indoor sports hall	Up to 8,500
Mixed retail and related uses	Shops, professional services, restaurants, cafes, drinking establishments, hot food takeaways, offices, businesses	Up to 29,000
Hotel	Hotel	Up to 8,000
Employment	Commercial business space in hubs, commercial business park, light industrial business park.	Up to 87,500
Total		Up to 200,000

8.5.4. Waste benchmarking data used from the BRE SmartWaste and the WRAP wastage rates quantities of construction and demolition waste arising from the proposed Development and material resources required have been estimated in Table 8-21 below. A full description of the methodology is given in Chapter 17: Waste and Resource Management. Table 8-21 provides the results of estimations of construction waste arising from the proposed Development. These values have been used to calculate embodied carbon emissions and HGV carbon emissions.

Table 8-21 Estimated construction waste arising (from Chapter 17: Materials and Resource Management) from the proposed Development

Material Type	Waste Arisings (tonnes)
Bricks	11,801
Tiles and Ceramics	785
Concrete	18,769
Inert	44,327
Insulation materials (non hazardous)	783
Metals	2,307
Packaging materials	3,949
Plasterboard / Gypsum	4,911
Binders	163
Plastic (excluding packaging waste)	2,631
Timber	12,733
Floor coverings (soft)	123
Electrical and electronic equipment (non hazardous)	61
Furniture	29
Canteen/Office/Adhoc waste	1,534
Liquids	124
Oils	10
Bituminous mixtures (non hazardous e.g. asphalt)	1,369
Hazardous waste	1,063
Other waste	4,121
Mixed construction and/or demolition waste	43,299
TOTAL	154,893

8.5.5. Table 8-22 presents the weight of materials anticipated to be required for the proposed Development. These values have been calculated using the wastage rates of key construction materials and the waste arisings anticipated for the proposed Development (as set out in Table 8-21). The wastage rates and the average carbon conversion factors for electrical and electronic equipment, furniture, liquids and canteen / office / ad-hoc waste have not been defined due to lack of information at this stage. Therefore, Table 8-22 has not included the embodied carbon of these material resources. The estimated embodied carbon from hazardous material resources, other material resources and mixed construction material resources have been calculated using the average carbon conversion factor for the key construction material resources (Ref. 8.23).

Table 8-22 Estimated material resources required for the proposed Development and embodied carbon emissions

Materials Stream	Estimated Quantities of materials (tonnes)	Conversion Factor (kgCO2e/kg)	Carbon (Tonnes)
Bricks	59,007	0.24	14,162
Tiles and ceramics	9,816	0.7	6,871
Concrete	469,213	0.107	50,206
Inert	443,270	0.0052	2,305
Insulation materials (non-hazardous)	5,223	1.86	9,714
Metals	76,892	2.03	156,091
Packaging materials	15,794	2.015	31,825
Plasterboard / gypsum	21,826	0.39	8,512
Binders	3,267	0.74	2,418
Plastic (excluding packaging waste)	26,309	3.31	87,083
Timber	127,325	0.72	91,674
Floor coverings (soft)	1,231	3.9	4,802
Electrical and electronic equipment (non-hazardous)	2,020	1	2,020
Furniture	2,946	1.75	5,155
Canteen / office / ad-hoc waste	6,135	2.1	12,884
Liquids	2,489	0.8	1,991
Oils	207	3.47844	722
Bituminous mixtures (Non-hazardous (e.g. asphalt))	27,376	0.086	2,354
Hazardous waste	11,811	1.33	15,765
Other waste	45,794	1.39	63,653
Mixed construction and/or demolition waste	481,099	1.39	668,727
TOTAL	1,839,051		1,238,935

8.5.6. Based on the estimated quantities of material resources required and forecasted waste arisings from the construction phase, the potential number of traffic movements have been estimated and presented in Table 8-23 below.

8.5.7. The estimated carbon emissions have been calculated using carbon emissions factors of 0.0017 and 0.0011 TCO_2e/km (Ref. 8.32) for a fully loaded HGV and unloaded HGV respectively to account two-way trips of HGVs. Given the current stage of design it is not known where materials will be procured from, it has been assumed for the purposes of the assessment that all material resources transported by road would be approximately 100 km per trip to the proposed Development and that all waste arisings would be transported around 30 km per trip from the proposed Development. These factors and distance have been applied to the bulk weights set out in Table 8-21 and Table 8-22. This has been calculated as a worst-case scenario whilst the measures set out in Chapter 17: Waste and Resource Management seek to reduce this as far as practicable.

Table 8-23 Estimated traffic movements of material resources and waste from the construction of the proposed Development

Material	Carbon Emissions of Materials Transport (TCO2e)	Carbon Emissions of Waste Transport (TCO2e)	Total (TCO2e)
Bricks	1061.8	20.8	1082.6
Tiles and Ceramics	132.6	1.6	134.2
Concrete	8206.6	36.7	8243.3
Inert	7974.4	86.6	8061.0
Insulation materials (non hazardous)	1912.2	382.2	2294.4
Metals	1383.5	9.4	1392.8
Packaging materials	213.2	32.6	245.8
Plasterboard / Gypsum	392.7	47.1	439.8
Binders	44.2	0.7	44.9
Plastic (excluding packaging waste)	355.3	28.4	383.7
Timber (17 02 01)	1718.0	322.6	2040.6
Floor coverings (soft)	16.7	0.5	17.2
Electrical and electronic equipment (non hazardous)	27.5	0.3	27.8
Furniture	39.8	0.2	39.9
Canteen/Office/Adhoc waste	83.0	6.2	89.2

Material	Carbon Emissions of Materials Transport (TCO2e)	Carbon Emissions of Waste Transport (TCO2e)	Total (TCO2e)
Liquids	33.7	0.8	34.5
Oils	3.1	0.2	3.3
Bituminous mixtures (non hazardous e.g. asphalt)	369.6	5.6	375.1
Hazardous waste*	159.5	4.4	163.9
Other waste	618.1	19.5	637.7
Mixed construction and/or demolition waste	6491.3	129.2	6620.5
Total	31236.5	1135.6	32372.0

8.5.8. The carbon output from plant and equipment utilised throughout the construction phase has been calculated in line with the key performance indicator from the UK Industry Performance Report published in 2018 (ref 8.38) and is estimated to be around 6,466 tonnes of CO_2e from the proposed Development and around 7,458 tonnes of CO_2e from the proposed Development including the Framework Masterplan. This is calculated based on KPI taking into account project estimated budget and estimated working weeks.

8.5.9. The carbon output from water usage throughout the construction phase has also been calculated in line with the key performance indicator from the UK Industry Performance Report published in 2018 and is estimated to be around 103 tonnes of CO_2e. Table 8-24 summarises the combined construction carbon emissions.

Table 8-24 Summary of construction phase carbon emissions

Material Type	Total Estimated Carbon Quantities (tonnes CO_2e)
Material resources (embodied carbon)	1,238,935
Materials (% of total)	96.7%
Transport of material resources and waste	32,372
Plant and equipment	7,458
Transport of workers to site during construction phase	2,433
Water	103
Total	1,281,301

8.5.10. The overall peak-year carbon impact of the proposed Development is presented in Table 8-25.

Table 8-25 Overall Annual Average Carbon Emissions of the proposed Development

Phase	Construction	TCO2e/yr
Construction	Per year (19 years)	64,065
Operational	Energy	31,089
	Transport	36,494
Total		131,648

8.5.11. The carbon assessment has indicated that the proposed Development would result in life-cycle emissions of averaged 125,879 tonnes of CO_2e per year. This makes up 0.0025% of the 3rd budget (2,544 million tonnes of CO_2e) and 0.034% of the 4th and 5th carbon budget (3,675 million tonnes of CO_2e),and will approximately make up 0.065% of the 6th carbon budget (2033-2037), which will still fall during the construction phase.

8.5.12. These figures are less than 0.1% of the UK national carbon budgets until 2035, and represent 0.36% of Kent County current surface carbon emission rate.

8.5.13. It is expected that in 2022 Kent County Council will publish official local carbon budgets, that Otterpool Park could assess impact in comparison to them. Based on preliminary study by the Tyndall Centre for Climate Change Research in collaboration with the University of Manchester, Kent & Medway carbon budget, during peak construction phase (2023-2035) the proposed development will constitute approximately 33% to a maximum of 50% of the Kent & Medway Local Carbon Budget. After peak construction phase and until completion of the proposed Development (2030-2042) the proposed development will constitute approximately 17.5% of the remaining local budgets (0.2-0.3Mt CO2 per year). With grid decarbonisation expected during the 2040's, net zero should be achieved during this time period until 2050. It is important to note this represents a worst-case scenario, in practice, the proposed Development actual emissions during construction and operation are expected to be significantly lower. This indicates that the proposed Development will not hinder the UK Government and the Kent County Council effort to achieve Net Zero, as even worst-case emissions are projected to be well within the national and regional carbon budgets.

8.5.14. The emissions arising from the proposed Development are plotted against Tyndall Medway Pathway Projections in Figure 8-3.

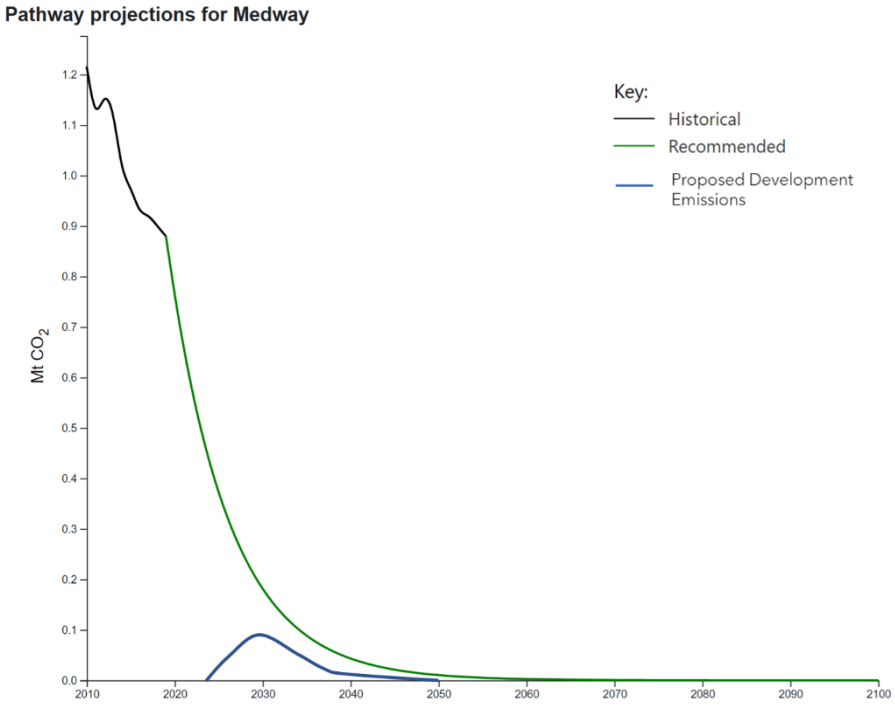

Figure 8-3 Diagrammatic representation of the measure of embodied carbon in relation

8.5.15. It is concluded that the construction phase of the proposed Development would not have a significant adverse effect on the government's ability to achieve the carbon budgets. It will also be in line with Kent & Medway's carbon plan to decarbonise.

8.5.16. It should be noted that this projection represents a worst-case scenario. For example, this assessment projects that from peak construction in 2030 towards the end of the construction phase in 2040, the proposed Development will represent about half of Kent County Council carbon allowance. This might be expected from a project of the scale of the proposed Development, but it should be noted emissions are expected to be lower than indicated through implementation of low carbon materials and construction practices that will become common practice by the time of peak construction, and even lower as the proposed Development design will seek to incorporate even lower carbon measures throughout the design and construction process.

8.5.17. In addition, the embodied carbon emissions from materials are estimated to be 1,884,869 tonnes of CO_2e. When compared to the 10% contribution from construction material resources to the annual UK emissions, this only contributes 0.19%.

8.5.18. Mitigation measures for effects on climate consist of strategic approaches that drive reduction across all lifecycle stages and encouraging carbon reduction behaviours with those specific to the separate lifecycle stages.

8.5.19. It is considered that the construction phase effects of the proposed Development, from whole construction operations, will be **Not Significant** on climate, due to the relatively low quantity of emissions in comparison to overall emissions for construction as

presented above. The Code of Construction Practice (CoCP) is set to ensure that climate change effects are minimised during construction.

Vulnerability of the proposed Development to climate change

8.5.20. The proposed Development has the potential to be vulnerable to a range of climate change effects, including an increased frequency and severity of prolonged and/or heavy precipitation events, prolonged droughts and heatwaves, a greater frequency of very hot days, and an increased risk of storms. Warmer temperatures may also mean that the risks associated with ice and snow would decrease over time. Retaining the ability to respond to these events would remain important.

8.5.21. The vulnerability of the proposed Development to climate during the construction phase has been outlined in Table 8-26 below.

8.5.22. With the mitigation detailed in Section 8.4, the residual effects for construction are expected to be **Not Significant**.

Table 8-26 Vulnerability of the proposed Development to climate during the construction phase

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
Pavements and road surfaces	Design of foundations	An increase in winter precipitation or a decrease in summer precipitation would result in a change in ground water level and soil moisture. In addition, it has the potential to generate larger ground movement.	Robust, low-carbon materials to be used for roads and pavements	Very High	Negligible	**Not significant**
	Materials specification and construction details	An increase in extreme temperatures has the potential to put the proposed Development at risk from a greater degree of surface failure or deterioration. For example, for concrete pavements, thermal gradients have the potential to create uneven internal stresses which can then give rise to curling or warping, sometimes called hogging, of the slabs. These can be compounded by loading from passing traffic.		Very High	Negligible	**Not significant**
		Large changes in temperature have the potential to generate thermal contraction and expansion of the slabs which, if not taken into consideration at the design stage, can generate unacceptably large longitudinal internal stresses and excessive movements at joints.		Very High	Negligible	**Not significant**
	Construction – laying surface dressing, micro-surfacing and other temperature susceptible materials	During extended periods of hot, sunny conditions, asphalt can remain workable for a considerable time, making it difficult to maintain profile during compaction.		Very High	Negligible	**Not significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
Buildings	Thermal actions (loads)	An increase in extreme temperatures may require the use of more expensive components like joints, bearings, paint systems etc. Also, greater care would be required to set the gaps, to ensure that movement does not cause a problem.	Projected heat stress of the next 30 years will be incorporated in the detailed structural design of domestic and non-domestic structures. With structures planned to be of moderate height and standard design of load bearing walls, opportunities for low carbon lean design structural elements would be investigated that will cut embodied carbon as well allow minute movement in structural elements.	Very High	Negligible	**Not Significant**
	Wind actions (loads)	An increase in wind speed has the potential to increase risk of disruption to construction work (unable to operate in high winds).	While there is no specific projection of high wind speeds or intensity of storms from climate change, working conditions are to be assessed each day, according to the	Medium	Negligible	**Not Significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
			CPP (Construction Phase Plan).			
	Increased thermal range giving rise to increased earth pressures for buildings	An increase in mean temperatures and extreme temperatures has the potential to lead to the requirement of stronger fill material and therefore increasing the quantities of excavated material becoming waste.	Fill material to be appropriate to the climatic conditions projected, waste amounts have been projected on a worst-case scenario basis and the opportunities to further reduce waste will be explored in detailed planning.	Very High	Negligible	**Not Significant**
	Surface water drainage systems, cross-culvert, road-edge drainage, attenuation outfalls and drainage ditches	An increase in winter precipitation and a decrease in summer precipitation has the potential to change the ground water level. This could mean that additional drainage and stronger materials would be required.	SuDS and drainage strategy to address issues of changes in ground water level. This has been addressed with planning of attenuation and wetlands, as well as conveyance swales. Further details can be found in the GI Infrastructure Strategy and	Very High	Negligible	**Not Significant**
	Stability of earthworks	Increased precipitation could increase risk to the earthworks stability resulting in the requirement of fill materials that are less susceptible to moisture		Very High	Negligible	**Not Significant**
	Earthworks compaction	An increase in extreme temperature and a decrease in summer precipitation has the potential to lead to reduction in soil moisture. Risks to compaction relate to the need for		Very High	Negligible	**Not Significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
		greater compaction effort being required with potential increased costs, delays etc.	Drainage Strategy (ES Appendix 15.1).			
	Stability	An increase in extreme precipitation and wind speed has the potential to create wind loading risks for the signs, traffic signals (temporary and fixed) and lighting.	Structural elements to be specified according to UKCP18 projections.	Medium	Negligible	**Not Significant**
Drainage	Road markings design and specification	An increase in winter precipitation and extreme precipitation has the potential to alter the performance of the road markings.	None required. Road markings to be designed against any changes in climatic conditions.	Very High	Negligible	**Not Significant**
Geotechnical conditions	Planting	An increase in mean temperature and a decrease in summer precipitation has the potential to lead to longer growing season and a reduction in soil moisture.	Landscaping plan will address potential changes in growing regimes due to changing climates.	Very High	Negligible	**Not Significant**
	Workforce	An increase in projected mean daily rainfall, especially in winter months could result increase safety risk of slips, trips and falls to construction workers.	Climatic conditions will be assessed on day-to-day basis, while identification of physical risks constantly observed and mitigated.	Very High	Negligible	**Not Significant**
Signs, traffic signals, lighting	Construction site	An increase in projected mean daily rainfall, especially in winter months could potentially result in the construction site flooding, excavations flooding during construction	CPP to consider flooding risk of the construction site, with mitigation and	Very High	Negligible	**Not Significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
		phase. Site roads may also become impassable through flooding.	adaptation measures in place.			
	Construction activities	Under extreme temperatures, certain construction activities may be required to be undertaken at night to keep project build to schedule. This will incur higher programme costs (e.g. labour and illumination).	High temperature may hinder working conditions, this will be addressed in workers resting areas and other measures in the CPP.	Very High	Negligible	**Not Significant**
Landscape	Plant and equipment	Water ingress to critical equipment, including traction power distribution sites, leading to signalling or other electronic equipment failures, requiring switch off or, possibly causing damage.	Flooding risks to equipment will be addressed through mitigation and adaptation measures.	Very High	Negligible	**Not Significant**

Residual Effects from Operation

Effects on Climate (from GHG emissions)

8.5.23. The Energy Strategy (Ref. 8.45) indicates that the proposed Development would result in emissions of approximately 25,320 tonnes CO_2 per year once built.

8.5.24. When compared to the total estimated carbon from the domestic sector in the south east (14,145,475,671 tonnes CO_2e in 2016) and in Kent (2,347,185,380 tonnes CO_2e in 2016), these only contribute 0.27% and 0.32% respectively to the south east domestic emissions and 1.6% and 1.91% respectively to the Kent County domestic emissions.

8.5.25. The transport model has indicated that the proposed Development would result in emissions of approximately 36,494 tonnes of CO_2e from the increase in traffic volume due to the proposed Development from 2024 until 2044.

Table 8-27 Operational Transport Carbon Emissions

Year	Estimated Carbon Emissions (tonnes CO_2e per year)	
	Without proposed Development	With proposed Development
2017	187,257	N/A
2023	202,072	N/A (under construction)
2029	209,303	213,502
2032	229,619	247,866
2044	229,619	247,866

Vulnerability of the proposed Development to climate change

8.5.26. When taking into the account the design intended to reduce vulnerability to floods and heatwave, and given the incorporated mitigation measures outlined above, the vulnerability of the proposed Development to climate change effects during the operational phase are assessed overall as '**Not Significant'**. A summary of results is provided in Table 8-28.

Table 8-28 Vulnerability of the proposed Development to climate during the operational phase

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
Pavements and road surfaces	Roads	Pavement has a typical design life of 40 years and could therefore be affected by changes in climate. An increase in mean daily rainfall rates has the potential to alter the moisture content of soils. This could lead to ground movements, soil settlement as well as expansion and contraction.	Robust, low-carbon materials to be used for roads and pavements	Very high	Negligible	**Not Significant**
		An increase in the frequency and intensity of storm events may discourage the use of non-motorised user facilities (e.g cycle paths, etc) to complete journeys. This may lead to more road users than projected.	This has been addressed fully in the Transport Assessment (ES Appendix 16.5) for the proposed Development. The built area is avoiding the floodplain, and road bridges over the East Stour are to prevent roads and cycling ways to be blocked during rain events.	Very high	Negligible	**Not Significant**
		For concrete roads, thermal gradients have the potential to create uneven intern stresses which could then give rise to curling or warping, sometimes called hogging, or the slabs. These could be compounded by loading from passing traffic.	Up to date road construction, and identification of possible failure points, including alternative routes	Very high	Negligible	**Not Significant**
	Pavement Surface	Large changes in temperature have the potential to generate thermal contraction and expansion of the pavement surfaces which, if not taken into consideration at the design stage, could generate	Robust, low-carbon materials to be used for roads and pavements	Very high	Negligible	**Not Significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
		unacceptably large longitudinal internal stresses and excessive movements at joints.				
		Large changes in temperature have the potential to generate thermal contraction and expansion leading to cracks in the pavement affecting pedestrians.	Robust, low-carbon materials to be used for roads and pavements	Very high	Negligible	**Not Significant**
		An increase in heavy rain could potentially lead to flooding and closures and diversions of footpaths.	Drainage, SuDS and GI Strategy to address this issue	Very high	Negligible	**Not Significant**
		The newly laid surfacing layers of a pavement may also maintain temperatures after opening to traffic that are high enough to allow excessive rutting and the rapid embedment of any chippings, with the latter again causing a reduction of texture depth.	Robust, low-carbon materials to be used for roads and pavements	Very high	Negligible	**Not Significant**
Buildings	Residential	Increases in temperature have the potential risk of thermal actions (loads) applied to buildings (e.g. leading to joint and bearing failure). Some buildings have the potential to fail to operate within original design parameters. This could induce failures meaning additional works would then be required to strengthen them.	Structural design of buildings will consider effects of heat as described in the Strategic Design Principles	Very high	Negligible	**Not Significant**
		Increases in precipitation rates could lead to premature deterioration rates for joints,		Very high	Negligible	**Not Significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
		bearings, surfaces and external fabric of the house.				
		An increase in the frequency and intensity of storms have the potential to cause increased loads on building structures and lead to collapse.		Very high	Negligible	**Not Significant**
		An increase in mean temperatures and increased humidity levels has the potential to lead to an increased need for maintenances for the building fabric and discomfort for the resident (overheating and reduced ventilation).		Very high	Negligible	**Not Significant**
		Increased precipitation has the potential to lead to isolated flooding (flood damage, damp, mould).		Very high	Negligible	**Not Significant**
		Increased drought could lead to the subsidence in the buildings.		Very high	Negligible	**Not Significant**
	Earth pressures used in design affected by change in ground water level	An increase in winter precipitation and a decrease in summer precipitation has the potential to change the ground water level.	SuDS and drainage strategy to address issues of changes in ground water level. This has been addressed with planning of attenuation and wetlands, as well as conveyance swales. Further details can be found in the GI Infrastructure Strategy and Drainage Strategy (ES Appendix 15.1).	Very High	Negligible	**Not Significant**
	Foundation settlement	Increase in winter precipitation and decrease in summer precipitation has the	The impact of rapidly Changing groundwater level due to climate	Very High	Negligible	**Not Significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
	affected by change in ground water level	potential to change the ground water level..	change will incur more robust foundation			
	Design for increased scour risk for foundations	An increase in extreme precipitation has the potential to lead to flooding.	Drainage strategy addresses issues of ground stability and eliminates risks associated with this, including future maintenance	Very High	Negligible	**Not Significant**
Drainage	Design of buildings drainage	An increase in extreme precipitation has the potential to lead to the requirement of additional drainage, larger components and more extensive works.		Very High	Negligible	**Not Significant**
Geotechnics	Surface water drainage systems, cross-culvert, road-edge drainage, attenuation outfalls and drainage ditches	An increase in winter precipitation and a decrease in summer precipitation has the potential to change the ground water level. This could mean that additional drainage and stronger materials would be required.	Robust materials and structural design to be taking into account effects of future climate	Very High	Negligible	**Not Significant**
	Stability of earthworks	Increased precipitation could increase risk to the earthworks stability resulting in the requirement of fill materials that are less susceptible to moisture	Biodiversity plan is enhancement of biodiversity through identification of key habitats that may be threatened by climate change	Very High	Negligible	**Not Significant**
Signage, signals, lighting columns and	Signs and signals	An increase in the frequency and intensity of storm events could reduce the design life of a number of key assets such as signage, lighting, road surface and road markings. This could increase	Robust materials for signs, signals and road markings to be used.	Very high	Negligible	**Not Significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
overhead power lines		maintenance costs over the lifespan of the road.				
	Signs	An increase in wind speed and in frequency of extreme wind events has the potential to affect the stability of the signs, which have a design life of 25 years.		Very high	Negligible	**Not Significant**
	Lighting columns and overhead power lines	An increase in wind speed and in frequency of extreme wind events has the potential to affect the stability of the lamp posts and overhead power lines.		Very high	Negligible	**Not Significant**
	Road markings	Increase in precipitation and temperature have the potential to weather road markings and change performance.		Very high	Negligible	**Not Significant**
Landscape	Landscape Design	A decrease in mean rain fall may lead to drought tolerant trees becoming more prevalent. This may cause a change in the landscape character of the area.	Biodiversity action plan (ES Appendix 7.20) identifies key possible issues of habitat alteration and propose mitigation measures	Very high	Negligible	**Not Significant**
		An increase in mean temperature and precipitation may alter the growing characteristics such as soil properties and length of growing season. This may impact the species identified as part of the landscape strategy and thus alter the character of the landscape.		Very high	Negligible	**Not Significant**
		An increase in precipitation and flooding has the potential to destroy plants in higher flood risk areas.		Very high	Negligible	**Not Significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
		An increase in frequency and intensity of heavy rainfall and flooding events could cause temporary flooding of public open spaces and public realm areas.	Drainage strategy has addressed issues of flooding of open spaces	Very high	Negligible	**Not Significant**
		Increased wind speed could lead to the loss of valued landscape features and green space, also potentially opening up new views of the proposed Development that were previously shielded.	None required	Very high	Negligible	**Not Significant**
Water	Continuity of water supplies	Increased risk of household water supply interruptions during droughts and from burst pipes in cold weather.	Robust piping to reduce risk of leakage and digital equipment to monitor them	Very high	Negligible	**Not Significant**
Air Quality	Pollutants	Hotter and drier / drought conditions could increase concentrations and mobility of certain air pollutants such as ozone and PM2.5/10.	Air quality assessment addressed this issue and provided guidance to design	Very high	Negligible	**Not Significant**
Ecology	Habitat and wildlife	An increase in mean temperatures may exceed thresholds for certain habitats and species identified for relocation and enhancement as part of the environmental Masterplan.	Biodiversity plan identifies key possible issues of habitat alteration and propose mitigation measures	Very high	Negligible	**Not Significant**
Finance	Insurance	As the risk of flooding increases, the flooding of particular sites may become a repeated occurrence rather than an exceptional event. This would lead to a higher premium for all land holders and homeowners nationally and locally as well as potentially lead to the loss of insurance for at risk buildings.	Drainage, SuDS and GI Strategy to address these issues and eliminate financial risks	Very high	Negligible	**Not Significant**

Receptor	Aspect	Potential effect to proposed Development (Impact)	Embedded Design Measures	Likelihood Category	Consequence of Impact	Significance
Human Health	Increased Heat	An increase in summer average temperature and the number of days above 30°C could cause overheating in living spaces and make outdoors stay and active transport inconvenient. This was taken into design consideration of the landscaping, providing tree cover for shade, and will be an integral part of the design of buildings for passive cooling methods such as ventilation and insulation.	Overheating is addressed fully in the Strategic Design Principles, homes should be well ventilated and made of conducting materials to eliminate risk of overheating	Very High	Negligible	**Not Significant**
	Changing Precipitation Regime	Southern England is expected to experience slightly increase in overall precipitation with an increase of intensity of rainy days. This is expected to raise the likelihood of surface flooding events and has been taken into design consideration, this could be seen in the floods strategy and Green Infrastructure	Drainage, SuDS and GI Strategy to address issues of increase in precipitation and intensity of rainy days	Very High	Negligible	**Not Significant**

Cumulative Effects

Greenhouse Gas Emissions

8.5.27. Cumulative impacts could also occur due to the proposed Development in combination with other existing and/or approved development. The effects of all GHG emissions are essentially cumulative. The excess of emissions from human activities contributes to the overall effect on climate in the UK, not only local emissions. For this reason, the impact of the proposed Development has been considered in the context of overall GHG emissions from the UK. By comparing the estimated Proposed Development's GHG emissions with UK carbon budgets, as per the methodology stated in IEMA Guidance (Ref. 8.36). should also be noted that the traffic data used in the assessment of GHG emissions already accounts for traffic generated by other planned or reasonably foreseeable major local developments.

Vulnerability to Climate Change

8.5.28. The cumulative effects from climate conditions changing of the proposed Development is mainly of floods becoming more severe due to extensive development in Otterpool park and developments around it. This is assessed at the Flood Risk Assessment and Drainage Strategy, and it is considered that the cumulative effect on climate change receptors would be **Not Significant**.

8.6 Monitoring

8.6.1. No monitoring requirements have been identified relevant to the climate topic, however, monitoring within the other topic chapters will be relevant to this chapter.

8.7 Assessment Summary

8.7.1. An assessment has been undertaken of the effects of the proposed Development on climate and the vulnerability of the proposed Development to climate change during the construction and operational phases.

8.7.2. The proposed Development is committed to reducing GHG emissions from proposed Development activities by implementing the hierarchy for GHG emissions (avoid and/or prevent, reduce, remediate).

8.7.3. The carbon assessment has indicated that the proposed Development would make up 0.0021% of the 3rd carbon budget and 0.021% of the 4th and 5th carbon budgets. In addition, the carbon output from the materials is estimated to be 0.19% of the annual UK emissions from construction materials.

8.7.4. The Energy Strategy (Ref. 8.45) indicates that the proposed Development would contribute between 0.27% and 0.32% to the south east domestic emissions and between 1.6% and 1.91% to the Kent domestic emissions. In addition, the transport model has indicated that the proposed Development carbon emissions would make up 0.00034% of the 4th and 5th carbon budgets. The 6th carbo budget (2033-2037) is in the period after peak construction (2030) and therefore most emissions will be in the scope of the previous budgets.

8.7.5. It is concluded that the construction and operational phases of the proposed Development would not have a significant adverse effect on the government's ability in achieving the carbon budgets and therefore are anticipated to be **Not Significant**.

8.7.6. The vulnerability to the changing climatic condition expected, as higher temperatures and stronger flooding events, etc. and their effect on workers and worksite during construction, as well as materials and dwellers wellbeing during operation has been assessed and mitigation measures have been set out to lessen their effect. It is

therefore deemed that climate change impacts on the proposed Development to be **Not Significant**.

8.7.7. Table 8-29 provides an assessment summary with respect to climate change, including the potential significant effect with embedded design measures in place, and additional measures required to reach the residual significance of effect.

Table 8-29 Assessment Summary

Receptor	Embedded Design Measures	Potential Significant Effect (pre-mitigation)?	Phase	Additional Mitigation	Mitigation Delivery Mechanism	Residual Effect Significance
Greenhouse Gas Emissions						
Global climate	In order to reduce capital carbon (construction carbon) commitments are: • Whole carbon assessment for non-domestic buildings • Assessment of embodied carbon to residential buildings • Low carbon construction methods and low carbon materials, including local sourcing to reduce transport as set out in the Outline CoCP (ES Appendix 4.17). • Completion of a demolition survey as secured through the Outline CoCP (ES Appendix 4.17). Iterative process of opportunities seizing to reduce operational energy and carbon as secured through the Energy Statement, including: • A 'fabric first' approach is being pursued with a commitment to 45% improvement on Fabric Energy Efficiency Standard (FEES) on current Building Regulations (2013) for new homes • At this Outline Energy Strategy stage there is a commitment to install solar PV technology on all buildings where feasible, with a review of suitable technologies, such as solar thermal and	Construction GHG emissions = Not Significant	Construction	No additional mitigation required.	N/A	**Not Significant**

Receptor	Embedded Design Measures	Potential Significant Effect (pre-mitigation)?	Phase	Additional Mitigation	Mitigation Delivery Mechanism	Residual Effect Significance
	energy storage options undertaken for Tier 2 and Tier 3 planning applications, taking account of evolving technologies, viability, and policy.					
Global climate	• Robust plan to reduce carbon emissions arising from operational energy and transport: • The proposed Development is planned to provide all-electric homes. • The development shall be underpinned by a movement strategy which prioritises walking, cycling and access to public transport • All homes shall be within 800 metres/10 minutes' walk of a local neighbourhood centre with an aspiration that all homes are within 400 metres/5 minutes' walk of such facilities • Rail services will be prioritised, and access to train stations made convenient with walking and cycling network • As secured through the Transport Strategy: • Seek to develop an electric vehicle car club in conjunction with an operator. • Seek to develop a rental bike scheme, including electric bikes. • Provide passive provision for electric vehicle charging at all homes with allocated spaces as well as to on-street parking areas.	Operational GHG emissions = Not Significant	Operation	No additional mitigation required	N/A	**Not Significant**

Receptor	Embedded Design Measures	Potential Significant Effect (pre-mitigation)?	Phase	Additional Mitigation	Mitigation Delivery Mechanism	Residual Effect Significance
	• Develop electric vehicle charging point strategy with provision in local centres, employment locations and the rail station.					
Vulnerability to Climate Change						
Pavements and road surfaces	Measures will be taken to keep soil. Where practicable, any surpluses or permanently displaced soils would be used to reinstate soils with profiles thicker than the original. In addition, the following aspects would further reduce the proposed Development's vulnerability to climate change: • Foundation strength would be increased to reduce the risk of failure caused by increased winter precipitation, by evaluating the moisture regime. Foundations would incorporate hydraulically bound materials or the use of reinforcement such as geotextiles; • The Contractor would ensure appropriate measures are implemented and, as appropriate, additional measures to ensure the resilience of the proposed mitigation of impacts during extreme weather events. For example, avoidance of storing construction materials in floodplains and dampening of soils and stockpiles; and The concrete would be laid in accordance with best practice and relevant standards.	Changes in ground water level and soil moisture. Surface failure or deterioration. Making it difficult to maintain profile during compaction = **Not Significant**	Construction	Implementation of measures set out within an Outline Climate Change Adaptation Plan, to be developed at the next tier.	Planning condition	**Not Significant**

Receptor	Embedded Design Measures	Potential Significant Effect (pre-mitigation)?	Phase	Additional Mitigation	Mitigation Delivery Mechanism	Residual Effect Significance
Buildings	Timing of construction activities will be part of the construction plan taking into account climatic conditions.	More expensive components may be required due to thermal actions. Need to reschedule of works to specific times of the year = **Not Significant**	Construction	Implementation of measures set out within an Outline Climate Change Adaptation Plan, to be developed at the next tier.	Planning condition	
Drainage	Robust drainage plan	Larger ground movement and heave requiring additional drainage **= Not Significant**	Operation	Implementation of measures set out within an Outline Climate Change Adaptation Plan, to be developed at the next tier.	Planning condition	
Geotechnical conditions	Measures to keep soil	Risk to the earthwork's stability and compaction = **Not Significant**	Construction	Implementation of measures set out within an Outline Climate Change Adaptation Plan, to be developed at the next tier.	Planning condition	
Signs, traffic signals and lighting	None (wind was not identified as a significant climatic risk for the region)	Wind loading risks for the signs, traffic signals (temporary and fixed) and lighting = **Not Significant**	Operation	Implementation of measures set out within an Outline Climate Change Adaptation Plan,	Planning condition	

Receptor	Embedded Design Measures	Potential Significant Effect (pre-mitigation)?	Phase	Additional Mitigation	Mitigation Delivery Mechanism	Residual Effect Significance
				to be developed at the next tier.		
Landscape	Landscaping operations will consider implications of changing precipitation regime	Longer growing season and a reduction in soil moisture = **Not Significant**	Operation	Implementation of measures set out within an Outline Climate Change Adaptation Plan, to be developed at the next tier.	Planning condition	
User facilities	Comprehensive Construction Safety plan to take into account climatic risks	Safety risk of slips, trips and falls to construction workers. Flooding. Higher programme costs. Damage to plant and equipment due to water ingress = **Not Significant**	Construction	Implementation of measures set out within an Outline Climate Change Adaptation Plan, to be developed at the next tier.	Planning condition	
Pavements and road surfaces	Mitigation measures would have been embedded at design and construction stages to control this risk, see Table 8-27	Alteration of moisture content of soils, thermal contraction and expansion of the pavement surfaces and flooding = **Not Significant**	Operation	Implementation of measures set out within an Outline Climate Change Adaptation Plan, to be developed at the next design stage.	Planning condition	**Not Significant**
Buildings		Thermal actions applied to buildings deterioration of joints, bearings, surfaces and external fabric of the houses, collapse, flooding	Operation			

Receptor	Embedded Design Measures	Potential Significant Effect (pre-mitigation)?	Phase	Additional Mitigation	Mitigation Delivery Mechanism	Residual Effect Significance
		and discomfort to residents = **Not Significant**				
Drainage		Flooding **= Not Significant**	Operation			
Geotechnics		Collapse of embankments and changes in species that could be grown in soils = **Not Significant**	Operation			
Signage, signals, lighting columns and overhead power lines		Reduced design life of assets increasing maintenance costs. Stability of signs, lamp post and overhead power lines = **Not Significant**	Operation			
Landscape		Change in the landscape character of the area. Alterations in length of growing season. Flooding and loss of valued landscape features and green space = **Not Significant**	Operation			
Water		Increased risk of household water supply interruptions during droughts and from burst pipes in cold weather = **Not Significant**	Operation			

Receptor	Embedded Design Measures	Potential Significant Effect (pre-mitigation)?	Phase	Additional Mitigation	Mitigation Delivery Mechanism	Residual Effect Significance
Air Quality		Increase mobility and concentrations of pollutants = **Not Significant**	Operation			
Ecology		Changes in thresholds for relocation of species = Not Significant	Operation			
Finance		Premiums to land holders and homeowners due to risk of flooding = **Not Significant**	Operation			
Human Health and Wellbeing	Mitigation measures such as sustainable design of houses, GI strategy to make public areas reachable and pleasant to encourage stay	Extreme flood events and prolonged heatwaves could have impact on overall health, productivity and mental health = **Not Significant**	Operation	Implementation of measures set out within an Outline Climate Change Adaptation Plan, to be developed at the next design stage.	Planning condition	**Not Significant**

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