Chapter Twenty ◆ Greenhouse Gas and Climate Change

INTRODUCTION

20.1 This chapter of the ES assesses the nature and magnitude of greenhouse gas (GHG) emissions, which will arise from the Proposed Development during construction and in operation, and the impact of this contribution to climate change. The vulnerability of the Proposed Development to the effects of climate change has also been considered.

~~20.1~~ This chapter was originally published in December 2020 but has since been updated (July 2021) to reflect the notification of the Swanscombe Peninsula as a SSSI, and respond to clarifications raised by Relevant Representations. These included further details on the GHG emission scopes and corrections to align with other documents submitted, in particular the area schedule.

20.2

20.3 The chapter starts with information common to both climate change mitigation (reducing GHG emissions) and climate change adaptation:

- EIA Scoping & Consultation
- Relevant law, policy and guidance

20.4 The methodology and assessment of effects is then presented in the following two parts:

- **Part A: GHG Emissions** – assessment of the nature and magnitude of GHG emissions likely to arise as a result of the Proposed Development in line with the 2017 *Institute of Environmental Management and Assessment (IEMA) guide to assessing GHG emissions and evaluating their significance*[1]. The scope of GHG emissions includes both the construction (materials, site transport, site processes, end-of-life) and operational phases (maintenance of built assets, energy, water, transport). Assessment of each source of GHG emissions includes defining a significance criteria, review of the existing baseline conditions, assessment of the effects resulting from the Proposed Development and identifying mitigation measures to reduce these emissions to minimise any adverse effects on climate change.

- **Part B: Climate Change Adaptation and Resilience** – focusing on the vulnerability of the Proposed Development to risks arising from a changing climate, in line with the *2020 IEMA guide to Climate Change Resilience and Adaptation*[2]. The risk assessment includes a review of existing baseline conditions, identification and evaluation of risks

[1] *IEMA. (2017). IEMA EIA Guide to: Assessing GHG Emissions and Evaluating their Significance.* [redacted]

[2] *IEMA. (2020). IEMA EIA Guide to: Climate Change Resilience and Adaptation.* [redacted]

and proposed mitigation measures to minimise the risk of any adverse effects arising from climate change.

20.5 The extent to which climate exacerbates or ameliorates the effects of the Proposed Development on the environment (i.e. 'in-combination' climate effects) have been assessed within each ES technical chapter under the 'climate change' sub-heading, in line with the IEMA (2020) guidance. The effects of the Proposed Development on various environmental receptors has been assessed, then these effects have been re-assessed taking into account climate change.

20.6 The GHG and Climate Change ES Chapter is supported by the following three appendices:

- **Appendix 20.1: PEIR consultation comments –** This appendix summarises the comments made during the consultation process with detailed responses; and
- **Appendix 20.2: GHG calculation inputs –** This appendix summarises the inputs that went into the GHG emissions calculation process.
- **Appendix 20.3: Energy Strategy (document reference 6.2.20.3) –** This appendix outlines the energy strategy for the Proposed Development.

EIA scoping

20.7 The Applicant submitted an EIA Scoping Report under Regulation 10 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, to the Planning Inspectorate on 15 June 2020. This set out the proposed approach to assessing GHGs and climate change in relation to the Proposed Development.

20.8 The EIA Scoping Opinion was received in July 2020 from the Planning Inspectorate, and further comments were received in August 2020 from other statutory consultees. All comments received from the Planning Inspectorate have been given thorough consideration and have been addressed in the assessment within this ES chapter.

20.9 The 2020 Scoping Opinion comments and responses are summarised in Table 20.1.

Table 20.1 Summary of Scoping Opinion comments and responses

Consultee	Topic	Scoping opinion comments	Response
Planning Inspectorate	GHG emissions	There are a number of gases that are considered Greenhouse Gas (GHG) Emissions. The Scoping Report does not define which	The ES chapter takes into account the greenhouse gases included in the Kyoto Protocol[3] (i.e. carbon dioxide, methane, nitrous oxide,

[3] *United Nations. (1997). Kyoto Protocol to the United Nations Framework Convention on Climate Change. h*[redacted]

Consultee	Topic	Scoping opinion comments	Response
		GHG emissions will be assessed in the ES Chapter. The ES should assess GHGs where they are likely to cause significant effects, and these should be named in the ES to understand the extent of the assessment.	hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride). These are reported in mass of carbon dioxide equivalent (CO_2e) which is the standard unit for reporting, as defined in the GHG Protocol (2001). This takes into account all greenhouse gases by expressing them in terms of their relative global warming potential compared to carbon dioxide (CO_2).
Planning Inspectorate	Land use change and levelling	The Proposed Development includes land remediation works, terrain re-modelling and landscape works and planting which have potential to increase or reduce (e.g. though increased sequestration) GHG emissions. These works are not included in the potential construction emissions in the Scoping Report. The ES should characterise and include an assessment of climate change impacts these works where significant effects are likely to occur.	An assessment of GHG emissions associated with land use change has been included as part of the 'Beyond Building Life cycle' stage (stage D). Carbon sequestration/emissions associated with current habitats on the Project Site have been compared to the carbon sequestration/ emissions associated with habitats on the Proposed Development. See paragraph 20.51 and 20.56 for the baseline and future baseline assumptions, and paragraph 20.68 for the effects on GHG emissions resulting from the Proposed Development.
Planning Inspectorate	Area schedules and building typology benchmarks	In the approach and methodology for the GHG Emissions and Climate Change Chapter, the estimated emissions are anticipated to be based on 'area schedules' and 'benchmarks for building typologies' but it is not defined what these benchmarks will be used for	Where GHG emissions are quantitatively assessed in the ES, clear methodology has been set out describing how estimated emissions are calculated. (Refer to Appendix 20.2 for calculation inputs, including area schedules and benchmarks.)

Consultee	Topic	Scoping opinion comments	Response
		or what the area schedules are. The ES should provide a clear methodology as to how emissions are estimated to inform the assessment.	
Planning Inspectorate	Uncertainties with predicted GHG Emissions and worst-case scenario	The Scoping Report identifies that there may be uncertainty and inaccuracy when estimating the GHG emissions associated with the Proposed Development due to estimations being based on area schedules and benchmarks for building typologies and due to the bespoke nature of some of the proposed infrastructure. Additionally, it is acknowledged that estimating where site users will arrive from may be difficult and therefore compromise accuracy of estimations. The ES should address the uncertainty using a worst-case scenario in terms of benchmarks for building typologies, area schedules and estimating the distanced travelled by site users during operation to ensure that uncertainty and inaccuracy does not undermine the assessment. Effort should be made to agree the approach with the relevant consultation bodies.	This has been acknowledged. We have used the worst-case scenario when using benchmarks, area schedules and estimating distance travelled by site users. See paragraphs 20.46 to 20.48 *Limitations and assumptions* for details.
Planning Inspectorate	Impacts – disruption to construction, supply and maintenance and stress on structures from	Extreme weather as a result of climate change has potential to cause disruption and to cause stress on structures; these impacts are not considered in the Scoping Report. The ES should include the impacts in the climate	The likely effects of climate change, including extreme weather, on the Proposed Development have been assessed in *Part B Climate change adaptation and resilience* of this ES chapter. Table 20.25 summarises the

Consultee	Topic	Scoping opinion comments	Response
	extreme temperatures	change assessment where significant effects are likely to occur.	climate risks considered and Table 20.26 summarises the mitigation measures for risks rated as medium or above.
Planning Inspectorate	Cross-referencing	Impacts from the Flood Risk Assessment and the Transport Assessment have potential to overlap with impacts identified in the GHG and Climate Change Chapter. It should be clear within the ES how the outcomes of any related assessments have informed the Chapter assessment and appropriate cross-referencing should be made to other relevant aspect Chapters explaining the nature of the interaction and where potential impacts are assessed.	We have consulted with the transport consultants and water consultants regarding cross over. We have cross-referenced to other ES chapters within this chapter where appropriate.
Planning Inspectorate	Coastal Change	The National Policy Statement for Ports requires coastal development includes an assessment of coastal change (erosion, landslips, inundation and accretion). Please see the comments against item 4.6.12. *Marine Ecology & Biodiversity - Item 4.6.12:* *The Scoping Report proposes to embed the assessment of likely significant effects of coastal processes in the marine ecology and water resources and flood risk aspect chapters. The Scoping Report does not provide a baseline or methodology for the assessment of coastal processes, for example, sediment type, erosion and deposition are not defined*	An assessment of sedimentation and accretion has been carried out and has been appended to ES Chapter 16: Water Resources and Flood Risk (Document Reference 6.1.17). Due to the nature of the Project Site, an assessment of landslips is not relevant. Inundation has been assessed in ES Chapter 16: Water Resources and Flood Risk (Document Reference 6.1.17) and Flood Risk Assessment (Appendix 17.1, Document Reference 6.2.17.1). Significant effects of coastal processes is addressed in ES Chapter 13: Marine Ecology & Biodiversity (Document Reference 6.1.13).

Consultee	Topic	Scoping opinion comments	Response
		and impacts to coastal stability are not considered. The Inspectorate considers that the impacts and effects associated with changes to coastal processes from the Proposed Development may be considerable. Accordingly, the Inspectorate requests that the ES include a separate aspect chapter assessing coastal processes. This is a position that is also identified as being necessary by the Marine Management Organisation (MMO) in their consultation response.	
Environment Agency	Tidal change	Tidal The recently updated flood risk assessment climate change allowances for sea level rise - UKCP18-was published on 17th Dec 2019.	UKCP18 sea level rise has been taken into account in ES Chapter 16: Water Resources and Flood Risk (Document Reference 6.1.17) and in the Flood Risk Assessment (Appendix 17.1, Document Reference 6.2.17.1). It has also been taken into account in *Part B: Climate change adaptation and resilience* of this ES chapter. Table 20.25 summarises the climate risks considered and Table 20.26 summarises the mitigation measures for risks rated as medium or above.
Environment Agency	Future Modelling	The applicant should be aware that they may need to carry out further climate change modelling, if, post submission, the Inspector sees fit to ask for this in the light of any new EA climate change guidance for fluvial and rainfall being published during the examination period (Paras 4.36 to 4.47 of	Noted. ES Chapter 16: Water Resources and Flood Risk (Document Reference 6.1.17) and in the Flood Risk Assessment (Appendix 17.1, Document Reference 6.2.17.1) take into account the latest climate change guidance. If further guidance is made available during the examination period,

Consultee	Topic	Scoping opinion comments	Response
		the NPS.)	sensitivity tests will be undertaken to assess the impact on the development proposals and flood and storm water mitigation measures being proposed.

Consultation

20.10 A public consultation was held between July and September 2020 (Planning Act 2008, s.42), which resulted in responses from various stakeholders, including Kent County Council, Gravesham Borough Council, Ebbsfleet Development Corporation and the Environment Agency. Comments relevant to greenhouse gases and climate change with responses from the Proposed Development are captured in Appendix 20.1.

RELEVANT LAW, POLICY AND GUIDANCE

Global

20.11 The Paris Agreement 2015[4] is a global framework agreed at COP 21 in Paris, on 12 December 2015. Parties to the United Nations Framework Convention on Climate Change (UNFCCC**)** reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement requires all Parties to put forward commitments through "nationally determined contributions" (NDCs) and to strengthen these commitments in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts. There will also be a global stocktake every 5 years to assess the collective progress towards achieving the purpose of the agreement and to inform further individual actions by Parties.

UK Law

20.12 Table 20.2 provides a summary of the key pieces of UK law relating to GHG emissions and climate change adaptation.

[4] *United Nations Framework Convention on Climate Change. Paris Agreement 2015.*

Table 20.2: Table containing the key pieces of UK law relating to climate change.

Law	Description
UK Climate Change Act 2008 (2050 Target Amendment)[5]	This Act originally required the UK to reduce carbon emissions by at least 80% by 2050 from a 1990 baseline. On 27th June 2019, the UK Government increased the ambition to 100% reduction in carbon emissions by 2050. This is in line with the recommendations set out in the report by the Committee on Climate Change (CCC) in May 2017: *Net Zero - The UK's contribution to stopping global warming*[6] The Climate Change Committee (CCC) is an independent, statutory body established under the Climate Change Act 2008 to monitor and advise on carbon budgets and preparing for climate change. Section 56 of the Act requires the UK Government to undertake a climate change risk assessment on a five-yearly cycle, with the subsequent development of an adaption programme to deliver resilience against these risks.
Infrastructure Planning (Environmental Impact Assessment) Regulations 2017[7]	The 2014 EU EIA Directive was transposed into UK law through the 2017 Infrastructure Planning (EIA) Regulations (herein referred to as the EIA Regulations 2017), which replaced the 2009 version. This update means that there is now a specific requirement to consider GHG emissions and climate change adaptation in the EIA process. The EIA Regulations 2017 state that the Environmental Statement should include: '*a description of the likely significant effects of the development on the environment resulting from, inter alia… (f) the impact of the project on climate (for example the nature and magnitude of GHG emissions) and the vulnerability of the project to climate change*'.
Climate Change and Sustainable Energy Act 2006[8]	The Climate Change and Sustainable Energy Act 2006 aims to boost the number of heat and electricity microgeneration installations in the United Kingdom, so helping to cut carbon emissions and reduce fuel poverty. For the purpose of the Act, microgeneration technologies include biomass, biofuels, fuel cells, photovoltaics, water (including wave

[5] *Stationary Office. The Climate Change Act 2008 (2050 Target Amendment) Order 2019.* *https://www.legislation.gov.uk/ukdsi/2019/9780111187654*

[6] *Committee on Climate Change (2019). Net Zero – The UK's contribution to stopping global warming.* [redacted].

[7] *Stationary Office. The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. https://www.legislation.gov.uk/uksi/2017/572/contents/made*

[8] *Stationary Office. Climate Change and Sustainable Energy Act 2006.* *https://www.legislation.gov.uk/ukpga/2006/19/contents*

Law	Description
	power and tidal power), wind power, solar power, geothermal sources and combined heat and power systems.

National policy

20.13 Table 20.3 provides a summary of the key pieces of national policy relating to GHG emissions and climate change adaptation and resilience.

Table 20.3: Table detailing national policy relating to climate change.

Policy	Description
National Policy Statements (NPS)[9]	National Policy Statements set out the government's policies to deliver Nationally Significant Infrastructure Projects (NSIPs) in England. There is no NPS for business and commercial NSIP projects such as the Proposed Development. However, to the extent that a substantial component of the London Resort comprises transport infrastructure, this chapter has regard to the National Networks NPS, including: • Environmental and social impacts (NPS paragraphs 3.2 to 3.5); • Emissions (NPS paragraphs 3.6 - 3.8) • Sustainable transport (3.15 to 3.18) • Criteria for "good design" for national network infrastructure (NPS paragraphs 4.28 – 4.35); • Climate change adaptation (NPS paragraphs 4.36 – 4.47); • Carbon emissions (NPS paragraphs 5.16 – 5.19); • Coastal change (NPS paragraphs 5.67 – 5.80); • Flood risk (NPS paragraphs 5.90 – 5.115). Regard has also been had to the NSP for Ports (January 2012) including: • Climate change mitigation (NPS paragraphs 4.12.1 – 4.12.10); and

[9] *Department for Transport. National networks national policy statement.* *https://www.gov.uk/government/speeches/national-networks-national-policy-statement*

Policy	Description
	• Climate change adaptation (NPS paragraphs 4.13.1 – 4.13.15)
National Planning Policy Framework (NPPF) (2019)[10]	Although this is not directly applicable to NSIPs, section 14 of the NPPF 2019 focuses on meeting the challenge of climate change, flooding and coastal change. As part of this, new developments should be planned 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 greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.
Clean Growth Strategy 2017[11]	The Clean Growth Strategy 2017 outlines how the UK government intend to grow national income whilst cutting GHG emissions. The strategy focuses on the following six areas: • Improving Business and Industry Efficiency and Supporting Clean Growth; • Improving Our Homes; • Accelerating the Shift to Low Carbon Transport; • Delivering Clean, Smart, Flexible Power; • Enhancing the Benefits and Value of Our Natural Resources; and • Leading in the Public Sector.

Local policy

[10] *Ministry of Housing, Communities & Local Government. (2019). National Planning Policy Framework.* *https://www.gov.uk/government/publications/national-planning-policy-framework--2*

[11] *HM Government. Clean Growth Strategy 2017.* *https://www.gov.uk/government/publications/clean-growth-strategy*

20.14 Table 20.4 provides a summary of key local policy relating to GHG emissions and climate change adaptation and resilience.

Table 20.4: Table detailing relevant local policy relating to climate change.

Policy	Description
Kent and Medway Energy and Low Emissions Strategy 2020[12]	Kent County Council recognised the UK climate emergency at a County Council meeting on 23 May 2019. In response to declaring a climate emergency, Kent County Council have prepared the Kent and Medway Energy and Low Emissions Strategy, working with Medway Council and all 12 district and borough councils. This strategy sets out how the county will achieve net-zero emissions, reduce fuel poverty and eliminate poor air quality, whilst supporting clean, sustainable economic growth.
Kent and Medway Climate Change Risk and Impact Assessment 2020[13]	The Kent and Medway Climate Change Risk and Impact Assessment was published in June 2020. This document sets out the likely risks and impacts of climate change in Kent and Medway. Sector summaries have also been provided for the agricultural, industry, natural environment, people and the built environment, transport and utilities sectors.
Kent Environment Strategy 2016[14]	Theme 2 of the Kent Environment Strategy focuses on '*making best use of existing resources, avoiding or minimising impacts*'. Within this theme there is a section on '*energy use and emissions*', which outlines Kent's current energy consumption and GHG emissions, as well as commitments. Subsequently, reducing the usage of resources and wasting less provides the focus for priority 6 of Theme 2, which is to '*improve our resource efficiency such as energy, water and land*'.
Essex County Council Adapting to Climate Change Action Plan[15]	This action plan highlights the types of severe climatic events that Essex could face in the future and the impact these could have on services. It provides each type of event a risk score (based on impact x likelihood) and sets out measures that Essex County

[12] *Kent County Council. Kent and Medway Energy and Low Emissions Strategy.* *https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/environmental-policies/kent-and-medway-energy-and-low-emissions-strategy*

[13] *Kent County Council. (2020). Kent Climate Change Risk and Impact Assessment.* *https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/environmental-policies/kents-changing-climate*

[14] *Kent County Council. (2016). Kent Environment Strategy.* *https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/environmental-policies/kent-environment-strategy*

[15] *Essex County Council. (2011). Adapting to Climate Change Action Plan.* *https://www.essex.gov.uk/adapting-climate-change*

Policy	Description
	Council can take both now and over the next ten years to adapt and build resilience to these types of event.
Dartford Borough Council Core Strategy 2011[16]	The Dartford Borough Council Core Strategy 2011 includes the following policies relating to GHG emissions and climate change adaptation: • Policy CS 14: Green Space; • policy CS 23: Minimising Carbon Emissions; • policy CS 24: Flood Risk; • policy CS 25: Water Management.
Dartford Borough Council New Local Plan: Preferred Options 2020[17]	A Preferred Options public consultation held in January – February 2020, setting out emerging proposals of the new Dartford Borough Council Local Plan. Section H focuses on 'Renewable Energy and Water Management', stating the following: *'The Council recognises the serious impact of climate change and that we are facing a climate emergency. It welcomes the Government's commitment to meet the Intergovernmental Panel on Climate Change target to cut greenhouse gas emissions to net zero by 2050 but aspires to see the effects of climate change tackled earlier than either the 2050 national target or the 2030 date proposed by some . It is committed to increasing efforts to work with highways partners to reduce car use and provide solutions to prioritise pedestrians, cyclists and calmer, safer traffic. The policies in the Local Plan review will seek to minimise carbon emissions and address climate change by:* • *Locating new development in areas well served by facilities and public transport, including Fastrack, to reduce the use of private cars;* • *seeking improved train and bus services, as well as improved walking and cycling routes;*

[16] *Dartford Borough Council. (2011). Core Strategy. https://www.dartford.gov.uk/by-category/environment-and-planning2/new-planning-homepage/planning-policy/adopted-plans#:~:text=The%20Core%20Strategy%20(2011)%20Document,and%20jobs%20will%20be%20created.*
[17] *Dartford Borough Council. (2020). New Local Plan: Preferred Options. https://www.dartford.gov.uk/by-category/environment-and-planning2/new-planning-homepage/planning-policy/new-local-plan*

Policy	Description
	• *requiring the design of development to minimise the need for the regulation of internal temperatures and energy consumption;* • *supporting the provision of decentralised energy and heating facilities and renewable and low carbon energy schemes and technologies;* • *encouraging the use of electric vehicles;* • *protecting and increasing greenspace in both the urban and rural area;* • *protecting and enhancing tree planting;* • *protecting the borough from risks of flooding including enabling the implementation of the TE2100 plan; and* • *aiming for resilience from the future impacts of climate change'.* Whilst this is not currently adopted policy, it represents the direction that Dartford Borough Council are heading in regarding climate change related policy.
Dartford Development Policies Plan 2017[18]	The Dartford Development Policies Plan contains includes the following policies relating to climate change: • Policy DP5: Environmental and Amenity Protection; • Policy DP6: Sustainable Residential Locations; • Policy DP11: Sustainable Technology and Construction; • Policy DP22: Green Belt in the Borough; • Policy DP23: Protected Local Green Space; • Policy DP24: Open Space; and • Policy DP25: Nature Conservation and Enhancement.

[18] *Dartford Borough Council. (2017). Dartford Development*

Policy	Description
Gravesham Local Plan Core Strategy 2014[19]	Policy CS18: Climate Change of the Gravesham Local Plan Core Strategy 2014 covers the following topics: • Flood risk; • water quality; • sustainable drainage and surface water runoff; • water demand management; • carbon reduction.
Gravesham Borough Council Climate Emergency[20]	On 25 June 2019 the Council declared that there was a climate emergency and pledged to do what is possible within its powers and resources to make Gravesham Borough Council carbon neutral by 2030.
Thurrock Local Development Framework Core Strategy and Policies for Management of Development (as amended) 2015[21]	The following two Core Strategy Thematic Policies relate to climate change: • CSTP25: Addressing Climate Change • CSTP26: Renewable or Low-Carbon Energy Generation. Additionally, the following two Policies for Management of Development relate to climate change • PMD12: Sustainable Buildings; • PMD13: Decentralised, Renewable and Low Carbon Energy Generation; • PMD14: Carbon Neutral Development.
Ebbsfleet Development Corporation Ebbsfleet Implementation	Delivery Theme 6 of the Ebbsfleet Implementation Framework focuses on '*resilient & sustainable systems'*. This delivery theme includes the following three objectives:

[19] *Gravesham Borough Council. (2014). Local Plan Core Strategy.* *https://www.gravesham.gov.uk/home/planning-and-building/local-plan/gravesham-local-plan-core-strategy*

[20] *Gravesham Borough Council. (2019). Climate Change Motion.* *http://democracy.gravesham.gov.uk/documents/s56626/Report%20-%20Climate%20Change%20Emergency.pdf*

[21] *Thurrock Council. (2015) Local Development Framework Core Strategy and Policies for Management of Development (as amended).* *https://www.thurrock.gov.uk/core-strategy-local-plan/about-core-strategy*

Policy	Description
Framework 2017[22]	• *'Identify innovative approaches and new and emerging technology to reduce carbon and to improve the efficiency of urban systems.* • *Ensure homes and infrastructure are future proofed to be responsive to everybody's individual and collective needs now and into the future.* • *Develop a 'Garden Grid' to enhance the sustainability and resilience of Ebbsfleet by improving air quality and management of the urban water cycle.'*

Guidance

20.15 Table 20.5 provides a summary of guidance documents relating to the inclusion of GHG emissions and climate change adaptation and resilience in EIA.

Table 20.5: Table detailing guidance documents relevant to the inclusion of climate change in EIA.

Guidance	Description
IEMA EIA Guide to: Assessing GHG Emissions and Evaluating their Significance (2017)[1]	IEMA published this guidance in response to the inclusion of climate change in the EIA Regulations 2017. This guidance states that: *'a good practice approach to EIA will see GHG emissions scoped into the assessment and thus estimated, reported and mitigated as part of the project's undertakings. This approach should follow for all projects regardless of whether there is a net increase or decrease in GHG emissions relating to the works.'* The guidance provides the following justification for scoping in a GHG emissions assessment: • *'All projects create GHG emissions that contribute to climate change;* • *climate change has the potential to lead to significant environmental effects; and* • *there is a GHG emission budget that defines a level of dangerous climate change whereby any GHG emissions within that budget can be considered as significant.'*

[22] *Ebbsfleet Development Corporation. (2017). Ebbsfleet Implementation Framework.*

Guidance	Description
	Based on these principles, the guidance states that: *'it might be considered that all GHG emissions are significant and an EIA should ensure the project addresses their occurrence by taking mitigation action.'*
RICS Whole Life Carbon Assessment for the Built Environment (2017)[23]	The purpose of this RICS guidance is to standardise whole life carbon assessment and enhance consistency in outputs by providing specific practical guidance for the interpretation and implementation of the methodology in BS EN 15978:2011.
BS EN 15978:2011 Sustainability of Construction Works – Assessment of Environmental Performance of Buildings – Calculation Method[24]	The purpose of this Standard is to provide a consistent framework for the assessment of lifecycle GHG emissions associated with new and existing buildings. This follows a modular approach, breaking down the lifecycle of the development into the product stage, the construction stage, the in-use stage, the end of life stage and elements beyond the building lifecycle.
PAS 2080:2016 Carbon Management in Infrastructure[25]	This Standard follows the same principles as BS EN 15978:2011 outlined above but applies them to the assessment of carbon associated with infrastructure projects.
IEMA EIA Guide to: Climate Change Resilience and Adaptation (2020)[26]	This document acts as a revision to the IEMA guidance on Climate Resilience and Adaptation in EIA (2015) and reflects lessons learnt from emerging practice. It provides a framework for the effective consideration of climate change resilience and adaptation in the EIA process.
ISO 14090:2019 Adaptation to Climate Change – Principles, Requirements and	The main purpose of this Standard is to provide organisations and projects with a consistent, structured and pragmatic approach to prevent or minimise the harm that climate change could cause and also to take advantage of opportunities.

[23] *RICS. (2017). RICS Whole Life Carbon Assessment for the Built Environment.*

[redacted]

[24] *BSI. (2011). BS EN 15978:2011 Sustainability of Construction Works – Assessment of Environmental Performance of Buildings – Calculation Method.*

[redacted]

[25] *BSI. (2016). PAS 2080: 2016 Carbon Management in Infrastructure.*

[redacted]

[26] *IEMA. (2020). IEMA EIA Guide to: Climate Change Resilience and Adaptation.*

[redacted]

Guidance	Description
Guidelines[27]	
Mayor of London Whole Life-Cycle Carbon Assessments Guidance (2020)[28]	This guidance document explains how to prepare a whole life carbon assessment. The document is intended for anyone involved in, or with an interest in developing whole life carbon assessments, including planning applicants, developers, designers, energy consultants and local authority officials.
London Energy Transformation Initiative (LETI) Embodied Carbon Primer (2020)[29]	The LETI Embodied Carbon Primer offers guidance to those interested in exploring embodied carbon in more detail. There is lack of knowledge in the built environment industry surrounding embodied carbon reduction strategies and calculations. Therefore, LETI has produced the primer to support project teams to design buildings that deliver ambitious embodied carbon reduction.

PART A: GHG EMISSIONS

Methodology and data sources

20.16 There is currently no standard methodology for quantifying GHG emissions within the EIA process. IEMA (2017)[1] instead advocates flexibility and proportionality related to the development under assessment.

20.17 The decision to include or exclude a source of GHG emissions is primarily based on the relative contribution of a GHG emissions source to the total GHG emissions over the lifecycle of the Proposed Development. Consideration of opportunities for design and construction decisions to significantly influence GHG emissions reductions and the availability of published benchmarks and certainty over future technologies and scenarios to meaningfully estimate the GHG emissions has also been taken into account.

20.18 A 'Rochdale Envelope' approach has been taken for this DCO application; consequently, the application will be based on a series of parameters rather than detailed information for the Proposed Development. ~~In particular, there is a lack of information available for what will be included within Gate 1 and Gate 2.~~

~~20.18 Therefore, the applicant was unable to estimate embodied carbon associated with these areas of the Proposed Development. However, whilst these are not currently accounted for, the intention it is assess these areas when sufficient detail is available.~~

[27] *ISO. (2019). ISO 14090:2019 Adaptation to Climate Change – Principles, Requirements and Guidelines.* [redacted]

[28] *Mayor of London. (2020). Whole Life-Cycle Carbon Assessments Guidance. https://www.london.gov.uk/sites/default/files/wlc_guidance_april_2020.pdf*

[29] *London Energy Transformation Initiative (LETI). (2020). Embodied Carbon Primer.* [redacted]

20.19 Where possible a quantitative approach has been taken to assessing GHG emissions associated with the Proposed Development using industry benchmarks. However, where there are information limitations, a qualitative approach has been taken based on professional judgement, in line with the IEMA (2017)[1] guidance.

20.20 In particular, there is limited information on the following at this stage, as well as limited appropriate industry benchmarks due to the bespoke nature of these components, therefore it is proposed to update the assessment to include these when a meaningful estimate can be undertaken:

- Gate 1 and Gate 2 contents beyond the gross area and indicative artist impressions
- Sitewide civil engineering works (including infrastructure and earthworks)

~~20.19~~20.21 It is recognised the above results in an underestimation of the embodied carbon associated with construction at this stage. In recognition, the criteria set for determining magnitude of impact (Table 20.6) is based on relative reductions against a baseline rather than absolute magnitude ensuring carbon reductions will be targeted in line with best practice once detailed estimates of the total GHG emissions can be calculated.

~~20.20 For the purposes of the assessment, the development has been split up into lifecycle stages, as per BS EN 15978 Sustainability of Construction Works - Assessment of Environmental Performance of Buildings - Calculation Method ('BS EN 15978'), as shown in Figure 20.1.~~

Field Code Changed

20.22 For the purposes of the assessment, the development has been split up into lifecycle stages, as per BS EN 15978[24] Sustainability of Construction Works - Assessment of Environmental Performance of Buildings - Calculation Method ('BS EN 15978'), as shown in Figure 20.1.

~~20.21~~20.23 The scope of the assessment includes GHG emissions that occur as a result of works within the Order Limits. The spatial scope therefore depends on the source of GHG emissions being assessed. For instance, the spatial scope of GHG emissions associated with transport includes the area covered by the in ES Chapter 9: Traffic and Transport.

20.24 It is noted that the lifecycle assessment method outlined in BS EN 15978[24] applies to buildings only. However, this also falls in line with the methodology outlined in PAS 2080:2016 Carbon Management in Infrastructure ('PAS 2080:2016')[25]. Therefore, it has been deemed appropriate to utilise the methods set out in BS EN 15978[24].

~~20.22~~

~~20.23~~20.25 All GHG emissions are expressed in mass of carbon dioxide equivalent (CO_2e) which is the standard unit for reporting, as defined in the GHG Protocol (2001)[30].

[30] *World Resources Institute. (2001). The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard*[redacted].

This takes into account all greenhouse gases by expressing them in terms of their relative global warming potential compared to carbon dioxide (CO_2). This takes into account GHGs included in the Kyoto Protocol[3] (i.e. carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride).

Construction

~~20.24~~20.26 In line with Figure 20.1, the construction phase shall take into account the following sources of GHG emissions:

- **A1-A3 Product stage:** GHG emissions associated with the material extraction, transportation and manufacturing of construction products.
- **A4-A5 Construction process stage:** GHG emissions associated with product delivery to site and the installation process.
- **C1-C5 End of Life Stage and D Beyond Building Life cycle:** GHG emissions associated with the demolition and disassembly of the Proposed Development, as well as the exploration of circular economy principles. GHG emissions and absorptions associated with different types of existing and proposed land use and natural capital have been included under Stage D as supplementary information beyond the standard life cycle assessment stages defined by EN 15978:2011[24].

Operation

~~20.25~~20.27 In line with Figure 20.1, the operation phase of the assessment shall take into account the following sources of GHG emissions:

- **B1-B5 In-use stage:** This use stage captures GHG emissions associated with the operation of the built asset over its entire lifecycle, from practical completion to the end of its service life.
- **B6-B7 Operational carbon:** GHG emissions associated with the energy use of building-integrated systems and water consumption over the lifecycle of the building.

~~20.26~~20.28 Additionally, this assessment considers operational transport emissions, which is not included in Figure 20.1. Operational transport emissions are considered due to the significant role these play in the UK's overall GHG emissions. Surface transport is the largest emitting source of GHG emissions in the UK, accounting for 24% of 2019 emissions according to the Committee on Climate Change (2020)[31].

[31] *Committee on Climate Change. (2020). Reducing UK Emissions Progress Report to Parliament.*

~~20.27~~20.29 Trip generation data has been provided by the transport consultants for the years 2020 (baseline), 2024 (opening of Gate 1), 2029 (opening of Gate 2) and 2038 (maturity). This data has then been extrapolated over the design life of the Proposed Development and relevant GHG emissions factors have been applied using the BEIS Greenhouse gas reporting: conversion factors 2020[32].

20.30 GHG emissions associated with land use change may either have a positive or negative effect on the overall GHG emissions associated with the Proposed Development. Typically, GHG emissions associated with land use change make up a small proportion of total GHG emissions compared to construction, operation and transport for this type of brownfield development. However, an assessment of GHG emissions associated with land use change has been included in the 'C1-C5 End of Life Stage and D Beyond Building Life Cycle' stage for the purposes of this ES Chapter.

20.31 Other operational GHG emissions considered but not included in the assessment are summarised as follows. These will be further reviewed as part of the carbon management strategy to be developed at the next stage.

- **Operational waste** – Waste accounted for 6% of UK GHG emissions in 2018[33] therefore it is unlikely to account for a significant portion of the total GHG emissions for the Proposed Development. As such, emissions have not been included in the GHG assessment. Instead, the focus of impact reduction is on reducing the volume of waste and maximising diversion of recyclable and organic waste from landfill, which will minimise GHG emissions associated with waste. Reference should be made to *Chapter 19 Waste and Materials* of the Environmental Statement and its supporting appendices for details. Further commitments on resource efficiency can be found in the *Outline Sustainability Strategy* (Document Reference: 7.7).
- **Embodied carbon of materials and products for the building operation** – Not influenced by the design and construction therefore considered disproportionate to estimate this now as details of the operations (e.g. retail, food and beverage, etc.) are unknown at this stage. This will be covered by any future operational carbon reporting requirements by LRCH.
- **Operational deliveries via river** – Refer to *Chapter 10 River Transport* of the Environmental Statement (Document Reference: 6.1.10) and the appended Marine Operations Concept Plan. Frequency of these movements are yet to be confirmed due to the quantity of consumables required during the operational stages of the project being unknown at this time. However, these are expected to

[32] *Department for Business, Energy & Industrial Strategy. Greenhouse gas reporting: conversion factors 2020.* https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

[33] [redacted]

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be limited by the capacity of the associated terminal facilities therefore associated GHG emissions are not scoped in.

- **Operational deliveries via train** – Refer to *Environmental Statement Appendix 9.1 Transport Assessment: Appendix TA-AE Delivery and Servicing Plan (Document Reference: 6.2.9.1).* Deliveries via train is not currently a core component of the delivery and servicing strategy therefore associated GHG emissions are not scoped in.
- **Air travel by visitors** – Not currently quantified with limited influence. However, opportunities to encourage alternative travel means will be considered as part of future operational strategies.
- **Refrigerant leaks** – no building design, and therefore building services strategy, has taken place since a 'Rochdale Envelope' approach has been adopted for the DCO application. This will be considered as part of the commitment to undertake whole life carbon assessments (BS EN15978:2011 Module B1 Use) and overall carbon reductions targeted as part of the design development process.

Study period

~~20.28~~20.32 The study period for the quantitative construction phase assessment for the areas outside of Gate 1 and Gate 2 is 2022-2024, therefore construction phase embodied carbon has been spread over a three-year period. The areas within Gate 1 and Gate 2 have been assessed qualitatively from 2022 to 2029, when Gate 2 is expected to open.

~~20.29~~20.33 An assessment period of 60 years has been used for the operational phase, as per the principles outlined in BS EN 15978:2011[24]. This is based on the typical expected service life of a non-residential building, aligned with available Life Cycle Assessment databases. The total estimated GHG emissions have been estimated to 60 years after the completion of Gate 1 in 2024, as this is the date in which the majority of the Proposed Development becomes operational.

Significance criteria

~~20.30~~20.34 GHG emissions arising from the construction and operation of the Proposed Development are considered the key impact, with the principal receptor being atmospheric GHG concentrations. The consequence of the impact is increasing the levels of atmospheric GHG emissions towards its environmental limit, triggering subsequence effects on the global climate system.

~~20.31~~20.35 In the absence of an industry-wide agreed approach to defining the significance criteria and GHG emissions thresholds at the local development site scale, IEMA (2017)[1].

guidance has been adopted. This highlights three over-arching principles which show all GHG emissions are potentially significant:

- GHG emissions from all projects will contribute to climate change, the largest inter-related cumulative environmental effect;
- Consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive; and
- GHG emissions have a combined environmental effect that is approaching a significantly defined environmental limit.

Magnitude of impact

~~20.32~~20.36 Whilst it is recognised that the cumulative impact of GHG emissions arising from global human activity is Major adverse, the contribution from individual developments at national and local level has been defined using professional judgement. It is assumed that any GHG emissions would be adverse.

20.37 Due to the nature of different sources of GHG emissions associated with the Proposed Development, a different scale for determining magnitude of effects has been set for each of the different life cycle sources of GHG emissions aligned with industry best practice sustainability and carbon reduction for each source. ~~.~~ Since the criteria is relative to the design development, it will guarantee a certain level of reduction as more detailed carbon assessments can be undertaken. Absolute KPIs will be developed as part of the Sustainability Framework, as committed to in Section 5 of the Outline Sustainability Strategy.

~~20.33~~20.38 Table 20.6 outlines the criteria used to determine impact magnitude for construction stage embodied carbon (lifecycle stage A1-A5).

Table 20.6: Criteria for determining impact magnitude for construction stage embodied carbon (GHG emissions associated with lifecycle stage A1-A5 for product and construction).

Magnitude of impact	Criteria for assessing impact
Major	There is no commitment made to reducing construction stage embodied carbon.
Moderate	There is a commitment made to measure and reduce construction stage embodied carbon by 10% compared to the business as usual baseline.
Minor	There is a commitment made to develop a pathway to reduce construction stage embodied carbon by 40% compared to a business as usual baseline for all buildings and key infrastructure.

Magnitude of impact	Criteria for assessing impact
	This is based on the World Green Building Council target for 2030 (WGBC, 2019[34]).
Negligible	There is a commitment made to reduce construction stage embodied carbon upfront and offset any residual embodied carbon.

~~20.34~~20.39 Table 20.7 outlines the criteria used for determining life cycle embodied carbon (GHG emissions associated with life cycle stage B1-B5 in use, C1-C4 end-of-life and D beyond the life cycle). These criteria have been developed with reference to the Greater London Authority (GLA) Circular Economy Statement Guidance (GLA, 2020)[35]. Whilst it is acknowledged that the Proposed Development is not within Greater London, the GLA are the first planning authority in the UK to develop planning policy and guidance on circular economy, therefore it can be considered a reasonable benchmark to adopt as best practice.

Table 20.7: Criteria for determining magnitude for life cycle embodied carbon (GHG emissions associated with life cycle stage B1-B5 in use, C1-C4 end-of-life and D beyond the life cycle).

Magnitude of impact	Criteria for assessing impact
Major	There is no commitment made to reducing life cycle embodied carbon (business as usual).
Moderate	There is a commitment made to preparing a Draft Circular Economy Statement in line with the GLA guidance[35].
Minor	There is a commitment made to prepare a Pioneering Circular Economy Statement in line with the GLA guidance[35] and set targets for reduction.
Negligible	There is a commitment made to prepare a pathway to achieving annual net zero embodied carbon in operation, either through circular economy principles or offsetting.

~~20.35~~20.40 Table 20.8 outlines the criteria for determining impact magnitude for GHG emissions associated with operational energy consumption (lifecycle stage B6). These criteria have been developed with reference to key pieces of legislation and guidance.

[34] *World Green Building Council. (2019). Bringing Embodied Carbon Upfront.* [redacted]*t*

[35] *Greater London Authority. (2020). Circular Economy Statement Guidance.* *https://www.london.gov.uk/sites/default/files/ggbd_circular_economy_statement_guidance_2020_web.pdf*

Table 20.8: Criteria for determining impact magnitude for GHG emissions associated with operational energy consumption (lifecycle stage B6).

Magnitude of impact	Criteria for assessing impact
Major	GHG emissions associated with operational energy do not reach net zero before 2050, therefore do not meet the requirements of the amended UK Climate Change Act 2008.
Moderate	GHG emissions associated with operational energy reach net zero by 2050, in line with the amended UK Climate Change Act 2008.
Minor	GHG emissions associated with operational energy reach net zero by 2030, in line with the World Green Building Council target for buildings (WGBC, 2020[36]) and IPCC publications on staying below 1.5 ºC of global warming (IPCC, 2018[37]).
Negligible	GHG emissions associated with operational energy are net zero from the start of operation.

~~20.36~~20.41 Table 20.9 shows the criteria used for determining impact magnitude for GHG emissions associated with operational water consumption (lifecycle stage B7).

Table 20.9: Criteria for determining impact magnitude for GHG emissions associated with operational water consumption (lifecycle stage B7).

Magnitude of impact	Criteria for assessing impact
Major	Business as usual i.e. no reduction in water consumption against a notional baseline.
Moderate	0-25% improvement against notional baseline for water consumption associated with buildings. Best practice water efficiency for other water uses.
Minor	Greater than 25% improvement against notional baseline for water consumption associated with buildings, equivalent to the minimum standard for BREEAM Outstanding[38]. Best practice water efficiency for other water uses.
Negligible	GHG emissions associated with operational water consumption are net zero from the start of operation.

[36] *World Green Building Council. (2020). The Net Zero Carbon Buildings Commitment.*

[37] *Intergovernmental Panel on Climate Change. (2018). Special Report: Global Warming of 1.5 ºC.*

[38] *BRE. (2018). BREEAM UK New Construction.*

~~20.37~~20.42 Table 20.10 shows the criteria used for determining impact magnitude for GHG emissions associated with operational transport.

Table 20.10 Criteria for determining impact magnitude for GHG emissions associated with operational transport.

Magnitude of impact	Criteria for assessing impact
Major	No measures are in place to encourage visitors and staff to use public transport and active travel to get to the Proposed Development. No measures are in place to decarbonise deliveries, on-site fleet vehicles and public transport options to the Project Site.
Moderate	There are some measures in place to encourage visitors and staff to use public transport and active travel to get to the Proposed Development. Some measures are in place to decarbonise deliveries, on-site fleet vehicles and public transport options to the Project Site.
Minor	There are strong measures in place to encourage visitors and staff to use public transport and active travel to get to the Proposed Development. Strong measures are in place to decarbonise deliveries, on-site fleet vehicles and public transport options to the Project Site.
Negligible	All journeys made to the Proposed Development are made by public transport or active travel. Strong measures are in place to decarbonise deliveries and public transport options to the Project Site. All on-site fleet vehicles are net zero carbon.

Receptor sensitivity

~~20.38~~20.43 Sensitivity is defined by taking into consideration the value, vulnerability and reversibility of the receptor. With regard to the atmospheric GHG concentrations, sensitivity is considered Very High based on the following conclusions:

- Value of the resource - the atmosphere and its role in regulating the global climate is of high ecological, social and economic value and underpins life on the planet therefore is of global critical value;

- Vulnerability - is recognised by the Paris Agreement (2015)[4] that the GHG concentrations in the atmosphere are already approaching its environmental limit and the effects of climate change are already evident; and

- Reversibility of the effect – climate change is considered irreversible, with a delayed effect in any actions or technologies employed to reduce concentrations of GHG emissions already in the atmosphere.

Impact significance

~~20.39~~20.44 The significance of an environmental impact is determined by the interaction of magnitude and sensitivity. As receptor sensitivity is considered 'Very High' in all circumstances, significance is determined based on the magnitude of effects identified. The Impact Significance Matrix is set out in Table 20.11. Effects above Moderate ~~and major effects~~ are considered significant in EIA terms.

Table 20.11: Impact significance matrix.

		Magnitude of effects				
		No change	~~Major~~Negligible	~~Moderate~~ Minor	~~Minor~~Moderate	~~Negligible~~Major
Receptor sensitivity	Very H~~H~~igh	Neutral	~~Major~~Slight	Moderate	~~Minor~~Large	~~Negligible~~Very Large

Scenarios

~~20.40~~20.45 The following testing scenarios will be considered within this chapter:

- Existing Project Site (current baseline);
- Existing Project Site (future baseline);
- Existing Project Site (current baseline) with Proposed Development; and
- Existing Project Site (current baseline) with Proposed Development and mitigation measures.

Limitations and assumptions

~~20.41~~20.46 The main limitation associated with the assessment is that there is limited detailed information around land use and material quantities for the Proposed Development due to the 'Rochdale Envelope' approach that's been taken. This is particularly the case within Gate 1 and Gate 2 of the Proposed Development. Therefore, assumptions have been made where appropriate and a qualitative approach has been taken where there is a lack of information available. All assumptions and calculation inputs are stated in Appendix 20.2.

~~20.42~~20.47 When calculating GHG emissions associated with the baseline scenario and the construction and operation of the Proposed Development, appropriate energy and carbon benchmarks have been used based on floor area and building use. Whilst these

benchmarks provide an initial estimate of the scale of GHG emissions associated with the Proposed Development, they represent typical buildings only and the accuracy is limited due to variations between buildings, including geography, construction processes and construction materials used, and continual improvement in the construction industry to reduce GHG emissions through design and specification. However, this is considered the best available method of estimating GHG emissions given the information available at this early stage of the project. Additionally, where there is uncertainty, the worst-case scenario has been taken. Where benchmarks have been used, these have been defined and the source has clearly been stated (See Appendix 20.2).

~~20.43~~20.48 For the assessment of operational transport emissions, assumptions have been made on the likely reasonable worst-case distance of travel for users of the Proposed Development. As it is difficult to gain an accurate picture of where site users will actually arrive from due to user behaviour, there is uncertainty in the estimations provided.

Baseline conditions

Current baseline

~~20.44~~20.49 In line with IEMA (2017)[1] guidance, the baseline for the Proposed Development is defined as the current GHG emissions arising from activities and infrastructure within the order limits of the Project Site for the assessment year (2020). Table 20.12 provides a summary of the current land uses by area for the Project Site. Typical electricity and fossil-thermal benchmarks taken from the Chartered Institution of Building Services Engineers (CIBSE) Technical Memorandum 46 (TM46)[39] have been applied to the current land uses, as outlined in ES Chapter 7: Land-use and socio-economic effects. The BEIS Greenhouse Gas Reporting: Conversion Factors 2020[32] for gas and grid electricity have then been applied to these figures in order to provide an estimate of annual GHG emissions from the Project Site for the assessment year (2020). GHG emissions figures are based on the current building occupancy rates.

Table 20.12: Current baseline GHG emissions calculation.

Land use type	Total Area (m^2 NIA)	Occupied Area (m^2 NIA)	CIBSE TM46 building type	Estimated electricity and fossil usage for assessment year (2020) (kWh/y)	Estimated GHG emissions for assessment year (2020) (tCO_{2e}/y)

[39] *CIBSE. (2008). TM46: Energy Benchmarks.* [redacted]

Retail, store or showroom	700	700	General retail	115,500	28
Industrial/ manufacturing	11,000	8,200	Workshop	1,763,000	376
Light industrial	7,400	5,500	Workshop	1,182,500	252
Storage	48,600	33,700	Storage facility	6,571,500	1,406
Offices	1,300	1,300	General office	279,500	62
Total	**69,100**	**49,400**	**N/A**	**9,912,000**	**2,124**

~~20.45~~20.50 The transport consultants have provided data on the total arrivals and departures from the existing building on the Project Site for cars and ordinary goods vehicles (OGVs) for the baseline (2020) year). For cars, the total arrivals are 777,632 and the total departures are 759,467. For OGVs, the total arrivals are 65,524 and the total departures is 61,631. The assumed distance for car journeys was 31.87km, based on Department for Transport National Travel Survey 2019[40]. The assumed distance for OGV journeys was 180km, which is the furthest point in the South-Eastern England region. The relevant BEIS Greenhouse Gas Reporting: Conversion Factors 2020[32] has then been applied to the distance figures. For cars, the 'petrol' 'average car' value has been used, while for OGVs a 50% laden average diesel have been used, both representing the worst-case scenario. Based on this approach, GHG emissions associated with car journeys were estimated to be 8,494 tCO_{2e} and GHG emissions associated with OGV journeys were estimated to be 19,001 tCO_{2e}. Therefore, total GHG emissions associated with transport to and from the Proposed Development for the baseline (2020) year are 27,496 tCO_{2e}.

~~20.46~~20.51 The ecologists have provided a breakdown of habitat types by area of the Project Site. The Natural England Carbon Storage by Habitat[41] report has been used to provide carbon factors that estimate the carbon sequestration/emissions associated with each habitat type. Based on this, it is estimated that 597 tCO_{2e} are sequestered on the Project Site for the baseline (2020) year. This value is only indicative as there is limited published guidelines on calculation carbon sequestration/emissions associated with land use change at a project site scale.

Future baseline

~~20.47~~20.52 The future baseline represents the scenario without the Proposed Development and the current land-use of the existing Project Site remains the same over the study

[40] *Department for Transport. (2019). National Travel Survey: Trips, stages, distance and time spent travelling. https://www.gov.uk/government/statistical-data-sets/nts04-purpose-of-trips#trips-stages-distance-and-time-spent-travelling*

[41] *Natural England. (2012). Carbon Storage by Habitat. Review of the evidence of the impacts of management decisions and condition of carbon stores and sources (NERR043).*

period. Figure 20.2 shows the estimated annual operational energy GHG emissions for the land uses currently on the Project Site for a 60-year period from 2020. Relevant BEIS carbon factors[42][32] have been applied for each year over the 60-year study period, which include transmission and distribution losses. GHG emissions values are based on 100% building occupancy to reflect the worst-case scenario. This shows that GHG emissions associated with current land uses on the Project Site will become less intensive in the future as the carbon electricity grid decarbonises with the phase out of fossil fuels in favour of more renewable energy sources. Annual GHG emissions reduce to 1,718 tCO_{2e}/y in 2050, a reduction from 2,125 tCO_{2e}/y in 2020. Beyond 2050 the annual emissions remain at 1,718 tCO_{2e}/y as BEIS projections assume near zero carbon for grid electricity by 2050 before plateauing in their projections to 2100. Since the carbon factor for gas remains constant and this is assumed to be the dominant energy use in existing building stock for heating and hot water, the majority of the remaining GHG emissions can be attributed to gas consumption.

~~20.48~~20.53 Figure 20.3 shows the cumulative operational energy GHG emissions associated with the current land uses on the Project Site over a 60-year period. Total cumulative emissions over the 60-year period are estimated to be 110,885 tCO2e.

~~20.49~~20.54 As well as operational GHG emissions, it may be assumed as a worst-case scenario that the buildings on the Project Site would be replaced at some point during the 60-year lifecycle of the Proposed Development. If this were the case, then there would be embodied carbon emissions associated with the construction and operation of the new buildings. If the current buildings on the Project Site were to be replaced with buildings on a like-for-like basis, then embodied GHG emissions associated with raw materials, construction, deliver & transport and use (maintenance) would be between 44,707 tCO2e and 54,642 tCO2e, allowing for potential efficiencies in modern construction processes and materials.

~~20.50~~20.55 GHG emissions associated with car and OGV trips for the current buildings on the Site have been extrapolated over the 60-year lifecycle. GHG emissions associated with cars travelling to and from the Project Site are estimated to be 254,832 tCO_{2e} and GHG emissions associated with OGVs travelling to and from the Project Site are estimated to be 570,044 tCO_{2e}. Therefore, the total estimated GHG emissions associated with transport to and from the Project Site over the 60-year lifecycle is 834,876 tCO_{2e}. The UK Government announced the end to sales of new petrol and diesel cars by 2030 on 18 November 2020, however, there will still be existing petrol and diesel cars on the road beyond this point. Therefore, in order to take into account this uncertainty, it has been assumed that there will be emissions associated with vehicles up to 2050, by which point the UK Government is targeting net zero emissions~~This figure takes into account the UK Government's target for net zero emissions by 2050~~[3]. ~~The electrification of the boat fleet~~

[42] [redacted]
https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal#history

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~~has not been taken into account up to 2050 to take~~This accounts for a reasonable ~~into account the~~ worst-case scenario.

~~20.51~~20.56 As per the current baseline, carbon factors from the Natural England Carbon Storage by Habitat[41] report have been applied by habitat type. The baseline (2020) figure has then been extrapolated over the 60-year lifecycle. Based on this, it is estimated that 35,319 tCO_{2e} would be sequestered over the 60-year period if the Project Site were land uses to remain unchanged. This value is only indicative at this stage as there is limited published guidelines on calculation carbon sequestration/emissions associated with land use change.

~~20.52~~20.57 In total, estimated life cycle GHG emissions associated with the future baseline scenario are between 1,058,199 tCO2e and 1,069,282 tCO2e, excluding carbon sequestration from green infrastructure. When green infrastructure is taken into account, estimated lifecycle GHG emissions associated with the future baseline scenario are between 1,022,880 tCO2e and 1,033,963 tCO2e.

~~20.53~~20.58 A summary of the assumptions and limitations that have been made when calculating estimated GHG emissions figures can be found in Appendix 20.2.

Potential significant environmental effects of the Proposed Development

Construction effects

Construction stage embodied carbon (GHG emissions associated with lifecycle stage A1-A5 for product and construction)

~~20.54~~20.59 Embodied carbon associated with the Proposed Development has been estimated by applying an appropriate embodied carbon benchmark based on floor area and the building typologies. Embodied carbon benchmarks have been taken from the Atkins Carbon Critical Tool[43], WRAP Embodied Carbon Database[44] and the University of Washington Embodied Carbon Benchmark Study[45]. These are considered the best available publicly available benchmarks at present. With consistent embodied carbon calculation scopes and reporting still an evolving topic across the industry, limited alternatives are available. A summary of the assumptions that have been made when calculating estimated GHG emissions figures can be found in Appendix 20.2.

~~20.55~~20.60 The total embodied carbon associated with the construction, operation and demolition of buildings outside Gate 1 and Gate 2 has been calculated to be between

[43] *Carbon Critical Tool, Atkins cited: Methodology to calculate embodied carbon of materials, RICS (2012).*
[44] *Waste and Resource Action Plan (WRAP). Embodied Carbon Database.*
[45] *The Carbon Leadership Forum, University of Washington. (2017). Embodied Carbon Benchmark Study.*

~~500,358~~707,949 tCO_2e and ~~759,389~~1,080,110 tCO_2e, allowing for variations from the benchmarks for material and construction efficiencies. Figure 20.4 breaks this figure down into the raw material, construction, delivery & transportation of materials, use (maintenance) and demolition lifecycle stages for a worst-case scenario.

~~20.56~~20.61 For the worst-case scenario, a total of ~~493,126~~638,784 tCO_2e can be attributed to the raw material phase (A1-A3), ~~4,500~~31,393 tCO_2e to the construction phase (A5) and ~~1,014~~38,327 tCO_2e the delivery & transportation phase (A4). These figures are spread out over a three-year construction period prior to the opening of Gate 1 in 2024.

~~20.57~~20.62 Embodied carbon associated with the construction of hard landscaping has been calculated separately. There is to be an estimated 344,780 m^3 of hard landscaping outside of Gate 1 and Gate 2. The embodied carbon benchmark for 'Asphalt (85mm) over prepared sub-base' has been applied to this from the Building Research Establishment (BRE) Green Guide[46]. The total estimated embodied carbon associated with the construction of hard landscaping is 1~~2~~5,515 tCO_2e.

~~20.58~~20.63 Therefore, the total estimated embodied carbon associated with the construction of buildings and hard landscaping outside of Gate 1 and Gate 2 for the worst case scenario is estimated to be~~between 525,873 tCO_2e and ~~784,904~~1,095,625 tCO_2e.

~~20.59~~20.64 It should be noted that the embodied carbon values presented do not account for the construction of buildings and attractions within Gate 1 and Gate 2 and sitewide civil engineering and infrastructure works due to limited information available for these areas at this stage prior to detailed design. Therefore, the embodied carbon associated with the Proposed Development will be ~~much~~ greater ~~than the values provided~~once a meaningful estimate of these components can be undertaken.

~~20.60~~20.65 Based on the criteria set out in Table 20.6, magnitude is considered to be Major as no commitments have been made to reducing construction stage embodied carbon. As sensitivity is deemed to be Very High, effect significance is deemed to be Very Large~~Major~~ Adverse.

Life cycle embodied carbon (GHG emissions associated with life cycle stage B1-B5 in use, C1-C4 end-of-life and D beyond the life cycle)

~~20.61~~20.66 Embodied GHG emissions associated with the use (maintenance) phase of the Proposed Development ~~are~~ is estimated to be ~~19,962~~333,278 tCO_2e (worst case scenario), as shown in Figure 20.4. This is broken down over the 60-year lifecycle of the Proposed Development at points where it is assumed that buildings and attractions will need to be maintained or replaced.

[46] *Building Research Establishment. Green Guide 2008 Ratings.*

[redacted]

~~20.62~~20.67 GHG emissions associated with the demolition (C1-C4) of the Proposed Development are estimated to be ~~3,033~~38,327 tCO_2e (worst case scenario), as shown in Figure 20.4.

~~20.63~~20.68 The ecologists have provided a breakdown of habitat categories by area for the Proposed Development. As per the current baseline, carbon factors from the Natural England Carbon Storage by Habitat[41] report have been applied to the habitat areas. These figures have then been extrapolated over the 60-year lifecycle of the Proposed Development. Based on this, it is estimated that 16,409 tCO2e would be sequestered over the 60-year period if the Proposed Development were to go ahead, which is a reduction of 18,910 tCO2e compared to the future baseline scenario. This value is only indicative at this stage as there is limited published guidelines on calculation carbon sequestration/emissions associated with land use change.

~~20.64~~20.69 Based on the criteria set out in Table 20.7, magnitude is considered to be Major as no commitments have been made to reducing life cycle embodied carbon. As sensitivity is deemed to be Very High, effect significance is deemed to be Very Large~~Major~~ Adverse.

Significance

~~20.65~~20.70 The significance rating attributed to the identified construction phase effects relating to GHG emissions are outlined in Table 20.13.

Table 20.13: Summary of sensitivity, magnitude and significance ratings attributed to the identified construction phase effects.

Receptor	Sensitivity	Magnitude of change/ impact	Effect significance
Construction stage embodied carbon	Very High	Major	Very Large~~Major~~ A~~a~~dverse (Significant)
Life cycle embodied carbon	Very High	Major	Very Large~~Major~~ A~~a~~dverse (Significant)

Operational effects

GHG emissions associated with operational energy consumption (lifecycle stage B6)

~~20.66~~20.71 The Proposed Development has a target of achieving net zero energy emissions during operation, in line with the UK Green Building Council definition[47], which states the following:

~~20.67~~20.72 *"When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy*

[47] *UKGBC. (2019). Net Zero Carbon Buildings: A Framework Definition.* [redacted]

efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset."

~~20.68~~20.73 The following steps (in order of priority) are set out by the UKGBC:

- Establish a net zero scope by targeting either net zero carbon in either construction or in operational energy. This sets the boundaries for an analysis of carbon emissions and provides guidance on which carbon emissions need to be considered.

- Reduce operational energy use (demand and consumption) as a priority and before all other measures. In-use energy consumption should be calculated and publicly disclosed on an annual basis.

- Increase renewable energy supply through first prioritising the use of on-site renewable generation and/or additionally through the use of off-site renewable generation

- Offset any remaining carbon using a recognised carbon offsetting framework and publicly disclose the level of offsetting used on an annual basis.

~~20.69~~20.74 An Energy Strategy (Appendix 20.3, Document Reference 6.2.20.3) has been developed for the Proposed Development that assesses energy demand, carries out an options appraisal for heating and cooling options and assesses options for on-site and off-site renewable energy generation.

~~20.70~~20.75 An energy demand assessment has been undertaken as part of the Energy Strategy. This estimates energy demand for the Proposed Development relating to heat demand, cooling demand, power demand and electric vehicle (EV) load demand.

~~20.71~~20.76 As part of the Energy Strategy, an options appraisal was undertaken to determine the best heat and cooling provision options for achieving the net-zero carbon emissions goal. Figure 20.5 compares the GHG emissions associated with each of the options over on an annual basis, calculated using BEIS GHG conversion factors[42~~32~~].

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~~20.72~~20.77 The two preferred options from this appraisal were as follows:

- Decentralised heating through individual building air source heat pumps (ASHPs) and decentralised cooling through individual building air cooled chillers; or

- Centralised ASHPs and gas boilers in a district heating network and water cooled (with cooling towers) centralised chillers in a district cooling network.

~~20.73~~20.78 In line with the UKGBC framework on targeting net zero carbon in operations, the Energy Strategy has undertaken an assessment of renewable energy potential across the Proposed Development.

~~20.74~~20.79 Within this study, the deployment of onsite solar PV panels on available roof space has been assessed on the basis of using monocrystalline 360W / 400W panels. A review of available roof space was undertaken in collaboration with the architect in order to quantify useable roof area across the Resort. Through this exercise it was identified that up to 84,000 m2 of PV panels could be accommodated across the Resort. It was estimated that an annual electricity generation of 13,920 MWh could be achieved through an installed solar PV capacity of 13.3 MWp, as detailed in the Energy Strategy (Appendix 20.3, Document Reference 6.2.20.3).

~~20.75~~20.80 An overview of overall operational carbon emissions over a 60-year project life are presented in Figure 20.6. A breakdown of carbon emissions associated with heating, cooling, and Principal Development power demands is provided, along with the carbon benefit achieved through the use of on-site solar PV. The use of on-site solar results in a total reduction in lifetime carbon emissions of around 44,800 tCO_2e, resulting in an overall lifetime carbon impact of 522,270 tCO_2e, as detailed in the Energy Strategy (Appendix 20.3, Document Reference 6.2.20.3).

~~20.76~~20.81 As per the Energy Strategy (Appendix 20.3, Document Reference 6.2.20.3), any remaining GHG emissions following the implementation of GHG emissions reduction measures shall be offset either using off-site renewable generation or carbon offsetting certificates, meaning that the Proposed Development will be net zero carbon for operational energy, in line with the UKGBC net zero carbon definition.

~~20.77~~20.82 Based on the criteria set out in Table 20.8, magnitude is considered to be Negligible as GHG emissions associated with operational energy are net zero from the start of operation. Sensitivity is deemed to be Very High, therefore significance is deemed to be Slight Adverse~~Negligible~~ (non-significant).

GHG emissions associated with operational water consumption (lifecycle stage B7)

~~20.78~~20.83 Total water demand has been calculated for a fully operational site on an average day to be ~~6,570~~6,801 m^3/day at the Kent Project Site and 11 m^3/day at the Essex Project Site (~~6,581~~ 6,812m^3/day total).

~~20.79~~20.84 These figures account for a 25% decrease in water demand compared to a notional business as usual baseline, which has been achieved as a result of the following embedded mitigation measures:

- 105 litres per person per day maximum achieved through design for residential buildings;
- Efficient fittings and fixtures;
- Greywater recycling for toilet flushing in key buildings where viable~~; and~~
- Recycling of water in Gate areas for rides; and~~.~~

- Onsite waste water treatment plant, which will recycle waste water and re-use for irrigation on-site

20.85 Reference should be made to the Utilities Statement (Ddocument Rreference: 7.6) for more information on the assumptions behind the total water demand estimates outlined above.

~~20.80~~20.86 The BEIS Greenhouse Gas Reporting: Conversion Factors 2020[32] states that the carbon factor for water supply in the UK is 0.344 kg CO_2e per m^3 of water supplied. Based on this, GHG emissions attributed to water demand of the Proposed Development on an average day are 2.340~~26008~~ tCO_2e per day at the Kent Project Site and 0.00~~4378~~ tCO_2e per day at the Essex Project Site (2.344~~2,263.86~~ t~~kg~~ CO_2e per day in total).

20.87 This means that GHG emissions attributed to water demand of the Proposed Development will be 854~~25~~ tCO_2e per year for the Kent Project Site and 1 tCO_2e per year for the Essex Project Site (855~~26~~ tCO_2e per year in total).

~~20.81~~20.88 Over the 60-year lifecycle of the Proposed Development, GHG emissions associated with water demand are estimated to be 51,236 tCO_2e for the Kent Project Site and 83 tCO_2e for the Essex Project Site (51,319 tCO_2e in total over the 60-year project lifecycle).

~~20.82~~20.89 Based on the criteria set out in Table 20.9, magnitude is considered to be Minor because it is proposed that there will be a 25% improvement against notional baseline for water consumption associated with buildings and best practice water efficiency for other water uses. As sensitivity is deemed to be Very High, effect significance is deemed to be Moderate~~Minor~~ Adverse.

Operational transport emissions

~~20.83~~20.90 An assessment of GHG emissions associated with operational transport has been carried out for private cars, coaches, buses, trains, the Thames Clipper, delivery vehicles and on-site fleet vehicles. Some modes have been assessed quantitively whilst others have been assessed qualitatively depending on available data. In line with ES Chapter 9: Land Transport (Document Reference 6.1.9), GHG emissions have been estimated for the following three assessment years: 2024~~3~~5 (1 year after opening of Gate 1), 202~~1~~9 (opening of Gate 2) and 2038 (maturity).

~~20.84~~20.91 GHG emissions associated with private cars travelling to the Proposed Development has been estimated by applying an emissions factor to trip number and distance figures provided by the transport consultants. Distance travelled has been broken down on a local authority level, with a blanket mode share having been applied to the total annual arrivals/departures based on the car park accumulation on the 85th percentile day (which is the same assumptions as the transport assessment work). BEIS Greenhouse Gas Reporting: Conversion Factors 2020[32] have been used and the 'petrol'

'average car' value has been used. GHG emissions from private cars for the three assessment years are as follows:

- 20245 (1 year after opening of Gate 1) – 41,063 tCO_{2e} per year
- 2029 (opening of Gate 2) – 64,155 tCO_{2e} per year
- 2038 (maturity) – 86,498 tCO_{2e} per year

~~20.85~~20.92 When these figures are extrapolated over the 60-year lifecycle, GHG emissions associated with private cars travelling to and from the Proposed Development are estimated to be 1,779,619 tCO_{2e}. This figure takes into account the UK Government's target for net zero emissions by 2050[3]. The UK Government announced the end to sales of new petrol and diesel cars by 2030 on 18 November 2020, however, there will still be existing petrol and diesel cars on the road beyond this point. Therefore, in order to take into account this uncertainty, it has been assumed that there will be emissions associated with vehicles up to 2050, by which point the UK Government is targeting net zero emissions[3]. This accounts for a reasonable worst-case scenario.~~The electrification of private cars has not been taken into account up to 2050 to take into account the worst-case scenario. Whilst the Government announced the end to sales of new petrol and diesel cars by 2030 on 18 November 2020, existing petrol and diesel cars would still be in circulation until their end of life.~~

~~20.86~~20.93 As with private vehicles, GHG emissions associated with coaches have been calculated by applying the relevant BEIS[32] emissions factor to trip number and distance figures for the three assessment years. The Resort is proposed to provide 200 coach parking spaces, of which it has been assumed that approximately 100 spaces will be used on average, across all day types and assessment years. Coach services will operate from locations dependant on future demand, and this is likely to vary on a day-to-day basis depending on the trip purpose (school trip, large private group, organised event). As such, it is difficult to provide specific origins and thus distances, though it can be assumed to primarily be large cities/towns. In order to provide an estimate of GHG emissions, a mean distance of UK local authorities from the Proposed Development has been used, this being 211km. It has been assumed that an average coach capacity is 49 passengers. Estimated GHG emissions from coach journeys for the three assessment years is as follows:

- 20245 (1 year after opening of Gate 1) – 20,620 tCO_{2e} per year
- 2029 (opening of Gate 2) – 20,620 tCO_{2e} per year
- 2038 (maturity) – 20,620 tCO_{2e} per year

~~20.87~~20.94 When these figures are extrapolated over the 60-year lifecycle, GHG emissions associated with coaches travelling to and from the Proposed Development are estimated to be 515,492 tCO_{2e}. As with private vehicles, ~~T~~this figure takes into account the UK

Government's target for net zero emissions by 2050[3]. The electrification of the coach fleet has not been taken into account up to 2050 to take into account the worst-case scenario.

~~20.88~~20.95 There is going to be an electric shuttle bus service (the 'people mover') that runs between Ebbsfleet International railway station, the pier and the London Resort entrance. Due to the fact that there isn't a BEIS[32] emissions factor available for electric buses, the emissions factor for electric van 'class III (1.74 to 3.5 tonnes) has been used as the closest alternative. Estimated GHG emissions associated with shuttle bus journeys are as follows:

- 2024~~4~~5 (1 year after opening of Gate 1) – 7.8 tCO_{2e} per year
- 2029 (opening of Gate 2) – 9.7 tCO_{2e} per year
- 2038 (maturity) – 14.3 tCO_{2e} per year

~~20.89~~20.96 When these figures are extrapolated over the 60-year lifecycle, GHG emissions associated with bus travel is estimated to be 290 tCO2e. As with private vehicles, ~~T~~this figure takes into account the UK Government's target for net zero emissions by 2050[5].

~~20.90~~20.97 There is likely to be an increase in demand on local bus networks as a result of the Proposed Development. The relevant BEIS[32] emissions factor has been applied to the number of trips expected ('average local bus'). The number of trips has been broken down by origin district (i.e. Thurrock, Bexley, Medway, Dartford, Gravesham or Sevenoaks), with the furthest point in that district being used as the worst-case scenario. Estimated GHG emissions from bus journeys are as follows:

- 2025~~4~~ (1 year after opening of Gate 1) – 3,646 tCO_{2e} per year
- 2029 (opening of Gate 2) – 5,161 tCO_{2e} per year
- 2038 (maturity) – 5,783 tCO_{2e} per year

~~20.91~~20.98 When these figures are extrapolated over the 60-year lifecycle, GHG emissions associated with bus travel is estimated to be 130,424 tCO2e. As with private vehicles, t~~T~~his figure takes into account the UK Government's target for net zero emissions by 2050[5]. The electrification / hybridisation of the bus fleet has not been taken into account up to 2050 to take into account the worst-case scenario.

~~20.92~~20.99 At this stage discussions are ongoing regarding train travel to the Proposed Development. There are existing stations close to the Proposed Development (Greenhithe, Swanscombe, Northfleet and Ebbsfleet International). There is potentially going to be an increase in the number of train services to Ebbsfleet International or an increase in the length of trains for existing services, leading to an increase in GHG emissions associated with trains stopping at this station. However, GHG emissions associated with this increase in train capacity are likely to be far lower than a scenario where visitors arrived via private car rather than by train.

~~20.93~~20.100 As a part of the Proposed Development there are to be Uber boat by Thames Clipper services running from central London and Tilbury to the Resort. The relevant BEIS[32] emissions factor has been applied to the distance and number of trips expected. It has been assumed that the capacity of each boat is 400 based on current Thames Clipper boats. Estimated GHG emissions from boat journeys for the three assessment years are as follows:

- 2024~~3~~5 (1 year after opening of Gate 1) – 6,754 tCO_{2e} per year
- 2029 (opening of Gate 2) – 6,754 tCO_{2e} per year
- 2038 (maturity) – 6,754 tCO_{2e} per year

~~20.94~~20.101 When these figures are extrapolated over the 60-year lifecycle, GHG emissions associated with boats travelling to and from the Proposed Development are estimated to be 168,841 tCO_{2e}. As with private vehicles, ~~T~~this figure takes into account the UK Government's target for net zero emissions by 2050[3]. The electrification / hybridisation of the boat fleet has not been taken into account up to 2050 to take into account the worst-case scenario.

~~20.95~~20.102 Data has been derived on trips made by delivery and service vehicles to the Proposed Development. It has been calculated that that there will be 9,447 delivery and service vehicle trips in each of the three assessment years. It is difficult to determine how far delivery and service vehicles will travel per journey as the distance will vary depending on what is being delivered. However, as per the Outline Sustainability Strategy, there will be a preference for local supply chains to support the operations of the Proposed Development. Therefore, it has been assumed that the starting point for deliveries will be from within the South East region of the England. As a worst-case scenario, the furthest point of the South East region has been selected, which is 180km from the Proposed Development. Based on this, estimated GHG emissions from deliveries for the three assessment years are as follows:

- 2024~~3~~5 (1 year after opening of Gate 1) – 2,823~~420~~ tCO_{2e} per year
- 2029 (opening of Gate 2) – 2,823~~420~~ tCO_{2e} per year
- 2038 (maturity) – 2,823~~420~~ tCO_{2e} per year

~~20.96~~20.103 When these figures are extrapolated over the 60-year lifecycle, GHG emissions associated with delivery vehicles travelling to and from the Proposed Development are estimated to be 70,584~~10,504~~ tCO_{2e}. This figure takes into account the UK Government's target for net zero emissions by 2050[3]. As with private vehicles, ~~T~~the electrification of the delivery vehicle~~van~~ fleet has not been taken into account up to 2050 to take into account the worst-case scenario.

~~20.97~~20.104 At this stage there is no data available for the distance travelled by on-site fleet vehicles. However, GHG emissions associated with these vehicles are likely to be minor compared to other forms of transport (e.g. private cars). Additionally, there is a commitment for all on-site fleet vehicles to be electric, thereby reducing associated GHG emissions further.

~~20.98~~20.105 Based on the criteria set out in Table 20.10, magnitude is considered to be Moderate as it is proposed that there will be some measures in place to encourage visitors and staff to use public transport and active travel to get to the Proposed Development. Some measures will also be in place to decarbonise deliveries, on-site fleet vehicles and public transport options to the Project Site. As sensitivity is deemed to be Very High, effect significance is deemed to be Large~~Moderate~~ Adverse.

Significance

~~20.99~~20.106 The significance rating attributed to the identified operation phase effects relating to GHG emissions are outlined in Table 20.14.

Table 20.14: Summary of sensitivity, magnitude and significance ratings attributed to the identified operation phase effects.

Receptor	Sensitivity	Magnitude of change/ impact	Effect significance
Operational energy emissions	Very High	Negligible	Slight~~Negligible~~ (Not Significant)
Operational water emissions	Very High	Minor	Moderate~~Minor~~ A~~a~~dverse (~~Not~~ Significant)
Operational transport emissions	Very High	Moderate	Large~~Moderate~~ A~~a~~dverse (Significant)

Whole life GHG emissions comparison

~~20.100~~20.107 It is not possible to get an accurate overall whole life GHG emissions figure for the Proposed Development at this stage as there is limited detailed information due to due to the 'Rochdale Envelope' approach that has been taken and the fact that some GHG emission sources have been assessed qualitatively. However, Table 20.15 provides an early indicative comparison between the future baseline scenario (existing site without the proposed Development) and the Proposed Development over a 60-year period for a sense of scale. It should be caveated that the construction and lifecycle embodied carbon phases for the Proposed Development do not account for Gate 1 and Gate 2 or civil engineering and infrastructure works, therefore these figures will be significantly higher in reality. However, the whole life GHG emissions have otherwise been estimated to be a reasonable worst-case scenario based on available data at this stage, as set out in this

Chapter.

Table 20.15 Comparison of lifecycle GHG emissions for the Proposed Development compared to the future baseline scenario (60-year study period)

GHG Emission Source	Future Baseline (tCO2e)	Proposed Development (tCO2e)
Construction and life cycle embodied carbon	44,707 to 54,642	~~525,873~~723,464 to ~~784,904~~1,095,625
Operational energy	110,885	~~Zero once offset (~~522,270 ~~excluding~~ (Zero once offset)~~offsetting)~~
Operational water	Data not available	~~826~~51,319
Operational transport – private cars	254,832	1,779,619
Operational transport – coaches	N/A – no coaches operate specifically for existing functions on the Project Site.	515,492
Operational transport – shuttle bus	N/A – no shuttle bus exists on the Project Site	290
Operational transport – local buses	Data not available	130,424
Operational transport – trains	Data not available	Data not available
Operational transport – boats	N/A - no boats operate specifically for existing functions on the Project Site.	168,841
Operational transport – delivery and service vehicles	570,044	~~10,504~~70,584
Operational transport – on-site fleet vehicles	Data not available	Data not available
Total (including operational energy prior to offsetting)	980,468 to 990,403	~~3,131,869~~3,962,303 to ~~3,559,741~~4,334,464
Land use change (carbon sequestration)	-35,319	-16,409

20.108 ~~As a comparison point and t~~To provide a sense of scale, Table 20.16 outlines the UK's national carbon budgets (Climate Change Committee, 2021[48]). It should be noted that a direct comparison between the total estimated GHG emissions from the proposed development and the national budgets is not possible due to differing timeframes (60-year study period for the Proposed Developed versus 5-year budget periods) and scope.

[48] [redacted]

In particular, embodied carbon associated with construction products are accounted for at source therefore the carbon associated with raw material supply, transport and manufacturing may occur outside of the UK. However, a simplistic comparison on 4.3MtCO2e from the Proposed Development over 60-years (upper estimate) is <0.1% of the sum of the 4th, 5th and 6th UK carbon budget.

Table 20.16 Summary of national carbon budgets for the UK (Climate Change Committee, 2021)

Budget	Carbon budget level	Reduction below 1990 levels
1st carbon budget (2008 to 2012)	3,018 MtCO2e	25%
2nd carbon budget (2013 to 2017)	2,782 MtCO2e	31%
3rd carbon budget (2018 to 2022)	2,544 MtCO2e	37% by 2020
4th carbon budget (2023 to 2027)	1,950 MtCO2e	51% by 2025
5th carbon budget (2028 to 2032)	1,725 MtCO2e	57% by 2030
6th carbon budget (2033 to 2037)	965 MtCO2e	78% by 2035

Proposed mitigation

Construction effects

~~20.101~~20.109 Mitigation measures proposed during construction are detailed in Table 20.1~~76~~.

Table 20.1~~76~~: Construction phase mitigation [opportunities].

Mitigation measures [opportunities]	Responsibility/ mechanism for implementation	Timing
Construction stage embodied carbon		
A whole life carbon assessment will be undertaken for each building to identify opportunities to reduce embodied carbon through design, material specification and construction processes. As per the Outline Sustainability Strategy (Document Reference 7.7)	Include in design team brief and contractor tender requirements.	Detailed Design Stage
Appropriate KPIs will be developed to measure and report on material efficiency and circularity. As per the Outline Sustainability Strategy (Document Reference 7.7)	Include in design team brief and contractor tender requirements.	Detailed Design Stage
Materials used for hard landscaping and street furniture will explore opportunities for high recycled content and bio-based materials. As per the Outline Sustainability	Include in design team brief and contractor tender requirements.	Detailed Design Stage

Mitigation measures [opportunities]	Responsibility/ mechanism for implementation	Timing
Strategy (Document Reference 7.7)		
Innovations in materials will form part of the designer's brief for any rides and attractions. As per the Outline Sustainability Strategy (Document Reference 7.7)	Include in design team brief and contractor tender requirements.	Detailed Design Stage
Movement of construction materials and waste via the River Thames, rather than via road. As per the Outline Construction Method Statement (Appendix 3.1, Document Reference 6.2.3.1)	Include contractor tender requirements.	Construction Stage
On-site soil washing to be utilised to allow reuse of material from the Project Site, rather than importing soil from elsewhere. As per the Outline Construction Method Statement (Appendix 3.1, Document Reference 6.2.3.1).	Include in design team brief and contractor tender requirements.	Detailed Design and Construction Stage
Life cycle embodied carbon		
A Circular Economy strategy will be developed for the project to identify opportunities to minimise new virgin material demand during construction, minimise resource demand during the operational life arising from repair, refurbishment and replacement, and maximise material recovery at the end of life. As per the Outline Sustainability Strategy (Document Reference 7.7)	Include in design team brief and contractor tender requirements.	Detailed Design Stage
Buildings will be designed to be flexible and adaptable to stay relevant and in-use for their full design life.	Include in design team brief and contractor tender requirements.	Detailed Design Stage
A sustainable procurement policy will be developed to actively encourage ongoing elimination of waste at source, for example packaging and food waste. As per the Outline Sustainability Strategy (Document Reference 7.7)	Implemented by London Resort.	Operation Stage
Circular economy principles have been included in the Site Waste Management Plan (SWMP) for the Proposed Development (Appendix 19.2, Document Reference 6.2.19.2)	Include in design team brief and contractor tender requirements.	Detailed Design Stage
Circular economy principles have been	Implemented by London	Operation Stage

Mitigation measures [opportunities]	Responsibility/ mechanism for implementation	Timing
included in the Outline Operational Waste Management Plan (OWMP) for the Proposed Development (Appendix 19.1, Document Reference 6.2.19.1).	Resort.	

Operation effects

~~20.102~~20.110 Mitigation measures proposed during the Resort in operation are detailed in Table 20.1~~8~~~~7~~.

Table 20.1~~8~~~~7~~: Operation phase mitigation opportunities.

Mitigation opportunities	Responsibility/ mechanism for implementation	Timing
Operational energy emissions		
Application of the 'lean, clean, green, seen' energy hierarchy to prioritise carbon reductions through passive design principles. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Detailed Design Stage
Energy efficiency design standards beyond Building Regulations to achieve reductions in carbon emissions of 15% for non-residential buildings and 10% for residential buildings beyond the Part L 2013 baseline. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Alignment with the UK Green Building Council Net Zero Carbon Buildings definition and reporting framework. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Site-wide 'clean and green' energy infrastructure to support the net zero operational carbon target, as per the Energy Strategy (Appendix 20.3, Document Reference 6.2.20.3).	Include in design team brief and contractor tender requirements.	Design Stage
100% reliance on electricity for heating and cooling, with gas for top-up and back-up for resilience only, as per the Energy Strategy (Appendix 20.3, Document Reference 6.2.20.3) and the Outline Sustainability	Include in design team brief and contractor tender requirements.	Design Stage

Mitigation opportunities	Responsibility/ mechanism for implementation	Timing
Strategy (Document Reference 7.7).		
Electric vehicle charging infrastructure in the car parks, as per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Energy efficient external lighting with smart controls, as per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Energy efficient AV infrastructure for outdoor events, as per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Deployment of technologies to support innovation in energy efficiency for the design of rides and attractions, as per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Operational water emissions		
All residential buildings will be designed for a maximum water consumption of 105 litres per person per day or less. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
All non-residential buildings will be designed for at least the BREEAM ~~Excellent~~ Outstanding standard for water efficiency (25% improvement over a notional building). This will be achieved through best practice water efficient fixtures and fittings. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Grey water harvesting shall be utilised for toilet flushing in key buildings where viable. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Preference will be given to drought tolerant soft landscaping which requires minimal irrigation after establishment, as per the Landscape Strategy (Appendix 11.7, Document Reference 6.2.11.7).	Include in design team brief and contractor tender requirements.	Design Stage
Opportunities for recycled water sources for public realm maintenance and irrigation during prolonged dry periods will be	Include in design team brief and contractor tender requirements.	Design Stage

Mitigation opportunities	Responsibility/ mechanism for implementation	Timing
considered. As per the Outline Sustainability Strategy (Document Reference 7.7).		
Water conservation best practice and closed loop systems will be explored for rides and attractions involving water. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Operational transport emissions		
New transport interchanges for rail, ferry, coaches, taxis and cars. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Park and Glide boat service running from Tilbury on the north bank of the River Thames. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Improved cycling and walking routes across the Peninsula. As per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Smart ticketing and travel plans to encourage public transport use. As per the Public Transport Strategy (LR-DC-WSP-REP-835.0) and the Outline Sustainability Strategy (Document Reference 7.7).	Implemented by London Resort.	Operation Stage
Electric vehicle charging infrastructure, as per the Outline Sustainability Strategy (Document Reference 7.7).	Include in design team brief and contractor tender requirements.	Design Stage
Use of the River Thames for operational waste, rather than via road, as per the Outline Operational Waste Management Plan (Appendix 19.1, Document Reference 6.2.19.1).	Implemented by London Resort.	Use Stage

Residual environmental effects

Construction effects

~~20.103~~20.111 Table 20.1~~98~~ summarises the residual construction effects relating to GHG emissions once mitigation measures have been taken into account.

Table 20.198 Summary of residual construction effects

Receptor	Sensitivity	Magnitude of change/ impact	Effect significance
Construction stage embodied carbon	Very High	Moderate	LargeModerate Adverse (Significant)
Life cycle embodied carbon	Very High	Moderate	LargeModerate Adverse (Significant)

20.10420.112 Effects associated with construction stage embodied carbon and life cycle embodied carbon have been deemed to be 'LargeModerate Adverse', which means that effects are significant. This aligns with the World Green Building Council report, Bringing Embodied Carbon Upfront[34] which highlights the fact that embodied carbon contributes around 11% of global carbon emissions and has historically been largely overlooked. Recent emerging industry guidance, such as the LETI Embodied Carbon Primer[29], Mayor of London Whole Life-Cycle Carbon Assessments Guidance[28] and RIBA 2030 Climate Challenge[49] reinforce the need to reduce construction embodied carbon by setting transitional targets towards net zero embodied carbon. Opportunities to reduce construction stage embodied carbon relative to the business-as-usual benchmarks used in estimating the embodied carbon will continue to be explored as the design develops and appropriate reduction targets put in place prior to further design development.

Table 20.2019 Summary of residual operation effects

Receptor	Sensitivity	Magnitude of change/ impact	Effect significance
Operational energy emissions	Very High	Negligible	SlightNegligible (Not Significant)
Operational water emissions	Very High	Minor	ModerateMinor Adverse (Not Significant)
Operational transport emissions	Very High	Minor	ModerateMinor Adverse ((Not Significant)

Cumulative, in-combination and transboundary effects

20.10520.113 Unlike other environmental effects discussed in the ES that have a direct or indirect effect on the Project Site and local area, effects from GHG emissions are not localised but contribute to the global atmospheric concentration of greenhouse gases and consequently contribute to the global climate change effect. Therefore, assessing emissions from the Proposed Development in terms of combined effects with other nearby developments is extraneous and immaterial in terms of localised effects. The

[49] *RIBA (2019) RIBA 2030 Climate Challenge,* [redacted]

Proposed Development should be viewed, rather, in the context of developments and construction projects globally as it contributes to a global climatic effect. As there are GHG emissions associated with almost all new developments globally and that we are approaching a global climate tipping point, it may be stated that cumulative effects are significant.

PART B: CLIMATE CHANGE ADAPTATION AND RESILIENCE

Methodology and data sources

~~20.106~~20.114 This part of the chapter provides a high-level review of the vulnerability of the Proposed Development to climate change. The assessment methodology takes into account the recommendations set out in the IEMA EIA Guide to: Climate Change Resilience and Adaptation (2020)[26] and has been adapted to ensure the assessment is proportionate to the Proposed Development.

~~20.107~~20.115 There are two key strands to assessing climate change adaptation issues within EIA, which need separate treatment:

- The risks of changes in the climate to the project (i.e. the resilience or conversely the vulnerability of a project to future climate changes). This is best suited to a Risk Assessment type process rather than a traditional EIA 'determination of significance'. A climate risk assessment has been carried out as part of this climate change and resilience ES chapter.

- The extent to which climate exacerbates or ameliorates the effects of the Proposed Development on the environment (i.e. 'in-combination' climate effects). In line with the IEMA (2020)[26] guidance, this has been analysed within each ES technical chapter and uses the significance criteria from the respective chapter. The effects of the Proposed Development on various environmental receptors has been assessed, then these effects have been re-assessed taking into account climate change.

~~20.108~~20.116 It is acknowledged that the majority of the Site has been designated as a Site of Specific Scientific Interest (SSSI) and this designation has been considered through the assessment of climate change related risks. The main climate change related risks associated with the SSSI designation relate to effects on ecology and biodiversity. These 'in-combination' effects have been assessed through Environmental Statement Chapter 12 - Terrestrial and freshwater ecology and biodiversity.

Risk assessment

~~20.109~~20.117 This climate change resilience risk assessment has been undertaken in line with the IEMA (2020)[26] guidance. As per the IEMA (2020)[26] guidance, the methodology has

been adapted from the C40 Cities Climate Change Risk Assessment Guidance (2018)[50], the Public Infrastructure Engineering Vulnerability Committee (PIEVC) Climate Risk Assessment Methodology (2015)[51] and the criteria used by Highways England in EIA projects[52]. Risk has been assessed based on the probability of an event occurring and severity of consequences as a result of that event occurring.

Probability

~~20.110~~20.118 Table 20.2~~10~~ summarises the criteria utilised to determine the likelihood rating for an effect. The project lifetime includes both the construction and operation stages. The project lifetime is considered to be 60 years.

Table 20.2~~10~~: Criteria used to determine likelihood.

Score	Description (probability and frequency of occurrence)
1	The event occurs very rarely during the lifetime of the projects (60 years). For example, once every 60 years (1 event).
2	The event occurs limited number of times during the lifetime of the project (60 years). For example, once every 20 years (3 events).
3	The event occurs regularly during the lifetime of the project (60 years) For example, once every 5 years (12 events).
4	The event occurs frequently during lifetime of the project (60 years). For example, once every two years (30 events).
5	The event occurs multiple times during the lifetime of the project (60 years). For example, annually (60 events).

Consequence

~~20.111~~20.119 Table 20.2~~1~~ summarises the criteria used to determine the consequence rating for an effect.

Table 20.2~~1~~: Criteria used to determine consequence.

Score	Description
1	Very low but measurable effect on site users and the Proposed Development itself. No change in capacity of the Proposed Development.
2	Low but measurable effect on site users and the Proposed Development itself. No change in capacity of the Proposed Development.

[50] *C40 Cities. (2018). Climate Change Risk Assessment Guidance.* [redacted]

[51] *Public Infrastructure Engineering Vulnerability Committee (PIEVC). (2015). Climate Risk Assessment Methodology.* [redacted]

[52] *Highways England. Design Manual for Roads and Bridges Sustainability & Environmental Appraisal.* [redacted]

3	Moderate effect on site users and the Proposed Development itself. Occasional Loss of Some Capacity
4	Moderate effect on site users and the Proposed Development itself. Moderate Loss of Some Capacity
5	Moderate effect on site users and the Proposed Development itself. Loss of Capacity and Loss of Some Function
6	Major effect on site users and the Proposed Development itself. Critical Loss of Function
7	Extreme effect on site users and the Proposed Development itself. Loss of Asset

Risk rating

~~20.112~~20.120 Table 20.2~~3~~2 summarises the matrix used to determine the risk rating, determined based on probability of the event occurring and the consequences as a result of the event occurring.

Table 20.2~~3~~2: Risk rating determined based on the likelihood and consequence scores.

	Probability					
Consequence		**1**	**2**	**3**	**4**	**5**
	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25
	6	6	12	18	24	30
	7	7	14	21	28	35

	Low risk
	Medium risk
	High risk

Limitations and assumptions

~~20.113~~20.121 The main uncertainty regarding the climate change adaptation assessment surrounds the climate change projections that the Proposed Development is assessed against. Climate change projections are presented using a set of scenarios that capture the relationships between human choices, emissions, concentrations and temperature change. Some scenarios are consistent with continued dependence on fossil fuels, while others are associated with deliberate actions to reduce GHG emissions. Therefore, climate change projections contain inherent uncertainty, reflecting the uncertainty associated with quantifying human activities (including technological change) and their influence on climate.

Baseline conditions

Current baseline

~~20.114~~20.122 Table 20.2~~43~~ provides a summary of current climatic conditions for the South of England for 2019 taken from the Met Office[53]. The warmest month on average was July and the coolest month on average was January. The wettest month on average was October and the driest month on average was April. The month with the most hours of sunlight on average was August and the month with the least hours of sunlight on average was November.

Table 20.2~~43~~ Summary of current climatic conditions for the South of England for 2019 taken from Met Office data.

Month	Max temperature (degrees C)	Min temperature (degrees C)	Rain (mm)	Sun (hours)
January	7.6	2.0	33.2	56.4
February	12.4	3.3	34.2	120.2
March	13.1	5.8	49.6	119.0
April	15.8	5.7	12.8	170.1
May	18.6	8.4	36.0	176.3
June	21.8	11.9	81.8	170.1
July	25.5	14.9	50.8	194.5
August	25.2	14.1	33.6	201.2
September	21.2	11.8	63.0	156.8
October	15.5	8.6	92.8	74.0
November	10.3	4.3	74.8	51.3
December	10.2	4.0	89.6	56.2

Future baseline

~~20.115~~20.123 The UK Climate Projections 2018 (UKCP18)[54] provide the most up-to-date assessment of how the climate of the UK may change over the 21st century. UKCP18 uses Representative Concentration Pathways (RCPs). These are named according to the concentration of greenhouse gas modelled to occur in the atmosphere in 2100. There are four RCPs available in the UKCP18 climate projections: 2.6, 4.5, 6.0 and 8.5. In line with the IEMA (2020)[26] guidance, RCP 8.5 has been used, which represents the most conservative, highest-impact scenario. Table 20.2~~54~~ summarises the projected mean summer and winter mean temperature and precipitation changes up to the 2090s for RCP 8.5. In line with the NPS for National Networks[9], the Proposed Development has been assessed against the 50th percentile probability level.

[53] *Met Office. (2020). Historic station data. https://www.metoffice.gov.uk/research/climate/maps-and-data/historic-station-data*

[54] *Met Office. (2018). UK Climate Projections 2018 (UKCP18). https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index*

Table 20.254: UKCP18 data for the South East of the UK under RCP 8.5.

Season	Variation	Time period	5th percentile	10th percentile	50th percentile	90th percentile	95th percentile
Winter	**Mean temperature (degrees C)**	2030s	-0.1	0.1	0.9	1.8	2
		2050s	0.2	0.5	1.7	2.9	3.3
		2070s	0.4	0.9	2.5	4.2	4.8
		2090s	1	1.5	3.6	5.8	6.4
	Mean precipitation (%)	2030s	-9	-5	8	23	27
		2050s	-10	-5	13	34	40
		2070s	-12	-5	20	49	58
		2090s	-10	-3	27	63	75
Summer	**Mean temperature (degrees C)**	2030s	0.1	0.4	1.3	2.4	2.6
		2050s	0.8	1.1	2.5	4	4.4
		2070s	1.2	1.8	3.9	6.1	9.5
		2090s	2.2	2.9	5.8	8.7	9.5
	Mean precipitation (%)	2030s	-36	-30	-9	13	19
		2050s	-55	-48	-22	5	14
		2070s	-69	-61	-30	1	9
		2090s	-85	-77	-41	-3	7

Temperature

~~20.116~~20.124 UKCP18 projections show that there is more warming in the summer than in the winter. In summer there is a pronounced north/south contrast, with greater increases in maximum summer temperatures over the southern UK compared to northern Scotland.

Precipitation

~~20.117~~20.125 Rainfall patterns across the UK are not uniform and vary on seasonal and regional scales and will continue to vary in the future. While UKCP18 projections show a clear shift to higher probability levels of dry summers, they also suggest that the likelihood of individual wet summers reduces only slightly. The projections show a pattern of larger increases in winter precipitation over southern and central England and some coastal regions towards the end of the century. Summer rainfall reductions tend to be largest in the south of England.

Sea level rise

~~20.118~~20.126 According to UKCP18 projections, global sea level has risen over the 20th century and will continue to rise over the coming centuries. The amount of sea level rise depends on the location around the UK and increases with higher emissions scenarios. There is likely to be a greater amount of sea level rise in the south of the UK than the north of the UK. Sea level rise over the coming centuries may affect tidal characteristics substantially (including tidal range).

Snow

~~20.119~~20.127 According to UKCP18 projections, for the period 2061-2080, under a high emissions scenario (RCP8.5), the regional (12km) and local (2.2km) projections show a decrease in both falling and lying snow across the UK relative to the 1981-2000 baseline. In general, the decreases are smaller in both falling and lying snow in mountainous regions (e.g. Scottish Highlands) than in low-lying regions (e.g. southern England).

Wind

~~20.120~~20.128 There are no compelling trends in storminess, as determined by maximum gust speeds, from the UK wind network over the last four decades. UKCP18 projections over the UK show 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 effects 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 inter-annual variability.

~~20.121~~20.129 Winds associated with major storm events can be some of the most damaging and disruptive events for the UK with implications for property, power networks, road and rail transport and aviation.

Identification and Evaluation of Risks

~~20.122~~20.130 Table 20.2~~65~~ summarises the climate change risks for the Proposed Development which have been assessed using a probability rating based on Table 20.20 and a consequence rating based on Table 20.21. Climate change risks are based on those identified in the C40 Cities Climate Change Risk Assessment Guidance (2018)[50].

Table 20.2~~65~~: Summary of climate risk ratings based on probability rating and consequence rating

Risk	Is it relevant for the Proposed Development?	Probability rating	Consequence rating	Risk rating	Mitigation needed?
Rainstorm	Yes	5	1	5	No
Monsoon	No	N/A	N/A	N/A	N/A
Heavy snow	Yes	3	2	6	No
Fog	Yes	2	2	4	No
Hail	Yes	3	2	6	No
Severe wind	Yes	3	3	9	Yes

Risk	Is it relevant for the Proposed Development?	Probability rating	Consequence rating	Risk rating	Mitigation needed?
Tornado	No	N/A	N/A	N/A	N/A
Hurricane	No	N/A	N/A	N/A	N/A
Extratropical cyclone	Yes	3	4	12	Yes
Tropical storm	No	N/A	N/A	N/A	N/A
Storm surge	Yes	1	5	5	
Lightening / thunderstorm	Yes	4	1	4	No
Extreme winter conditions	Yes	3	3	9	Yes
Cold wave	Yes	3	3	9	Yes
Extreme cold days	Yes	3	4	12	Yes
Heat wave	Yes	4	5	2016	Yes
Extreme hot days	Yes	4	4	16	Yes
Drought	Yes	3	4	12	Yes
Forest fire	No	N/A	N/A	N/A	N/A
Land fire	No	N/A	N/A	N/A	N/A
Flash / surface flood	Yes	2	6	12	Yes
River flood	Yes	2	6	12	N/A
Coastal flood	Yes	4	6	24	Yes
Groundwater flood	Yes	1	6	6	No
Permanent inundation	No	N/A	N/A	N/A	N/A
Saltwater intrusion	Yes	1	5	5	No
Ocean acidification	No	N/A	N/A	N/A	N/A
Landslide	No	N/A	N/A	N/A	N/A
Avalanche	No	N/A	N/A	N/A	N/A
Rock fall	No	N/A	N/A	N/A	N/A
Subsidence	Yes	1	6	6	No
Water-borne disease	Yes	1	6	6	No
Vector-borne disease	Yes	1	6	6	No
Air-borne	Yes	1	6	6	No

Risk	Is it relevant for the Proposed Development?	Probability rating	Consequence rating	Risk rating	Mitigation needed?
disease					
Insect infestation	Yes	1	4	4	No

Mitigation measures

~~20.123~~20.131 Table 20.2~~76~~ provides a summary of mitigation measures that will be implemented where appropriate to reduce climate change risks. Mitigation measures have been be identified for risks with a rating of 7 or higher (medium risk rating or higher).

Table 20.2~~76~~ Summary of mitigation measures for risks rated as 'medium' or above.

Risk	Mitigation measure	Responsibility/ mechanism for implementation	Timing
Severe wind	A climate change resilience workshop will form part of every building design briefing, as per the Outline Sustainability Strategy (Document Reference 7.7). The structural design of the buildings and attractions are to be resilient to high winds. External planting (e.g. trees) shall be put in place to reduce wind speeds, as per the Landscape Strategy (Appendix 11.7, Document Reference 6.2.11.7).	Include in design team brief and contractor tender requirements.	Detailed Design Stage
Extra tropical storm	A climate change resilience workshop will form part of every building design briefing, as per the Outline Sustainability Strategy (Document Reference 7.7). A Surface Water and Drainage Strategy (Appendix 17.2, Document Reference 6.2.17.2) and Flood Risk Assessment (Appendix 17.1, Document Reference 6.2.17.1) have been carried out for the Proposed Development that	Include in design team brief and contractor tender requirements.	Detailed Design Stage

Risk	Mitigation measure	Responsibility/ mechanism for implementation	Timing
	consider the effects of climate change. The structural design of the buildings and attractions are to be resilient to high winds. External planting (e.g. trees) shall be put in place to reduce wind speeds, as per the Landscape Strategy (Appendix 17.1, Document Reference 6.2.11.7).		
Extreme winter conditions Cold wave Extreme cold days	A climate change resilience workshop will form part of every building design briefing, as per the Outline Sustainability Strategy (Document Reference 7.7). A thermal comfort modelling exercise that takes into account the likely effects of climate change through future weather data is to be completed for each building included in the Proposed Development. As per the Outline Sustainability Strategy (Document Reference 7.7). Strategic provision of shelter against extreme weather events such as heat waves and heavy rainfall.	Include in design team brief and contractor tender requirements.	Detailed Design Stage
Heat wave Extreme hot days	A climate change resilience workshop will form part of every building design briefing, as per the Outline Sustainability Strategy (Document Reference 7.7). A thermal comfort modelling exercise that takes into account the likely effects of climate change through future weather data is to be completed for each building included in the Proposed Development. As per the Outline	Include in design team brief and contractor tender requirements.	Detailed Design Stage

Risk	Mitigation measure	Responsibility/ mechanism for implementation	Timing
	Sustainability Strategy (Document Reference 7.7). Building design will adopt the principles of the cooling hierarchy to reduce the reliance on air conditioning in future. As per the Outline Sustainability Strategy (Document Reference 7.7). Incorporating green and blue infrastructure to help alleviate the urban heat island effect during heat waves, as per the Landscape Strategy (Appendix 11.7, Document Reference 6.1.11.7). Strategic provision of shelter against extreme weather events such as heat waves and heavy rainfall.		
Drought	A climate change resilience workshop will form part of every building design briefing, as per the Outline Sustainability Strategy (Document Reference 7.7). The Proposed Development includes the following water saving measures, as per the Outline Sustainability Strategy (Document Reference 7.7): • Efficient fittings and fixtures; • Greywater recycling for toilet flushing in buildings where viable; • Recycling of water Gate areas for rides; ~~and~~ • Low water demand landscape for the main hotel areas (outside of the gates) which require minimal irrigation after the establishment period; ~~.~~	Include in design team brief and contractor tender requirements.	Detailed Design Stage

Risk	Mitigation measure	Responsibility/ mechanism for implementation	Timing
	• Rainwater harvesting for landscape irrigation and other non-potable water uses; • SMART metering for the early identification of leakage; and • Management of stress on external networks (where required and viable) through on-site storage. • Onsite waste water treatment plant, which will recycle waste water and re-use for irrigation on-site ~~Options for utilising treated sewage effluent recycled from the on-site wastewater treatment facility shall additionally be considered at future design stages.~~		
Flash/surface flood River flooding Coastal flood	A climate change resilience workshop will form part of every building design briefing, as per the Outline Sustainability Strategy (Document Reference 7.7). Chapter 17: Water Resources and Flood Risk considers the effects of climate change on flooding, as well as the Surface Water and Drainage Strategy (Appendix 17.2, Document Reference 6.2.17.2) and Flood Risk Assessment (Appendix 17.1, Document Reference 6.2.17.1). As detailed in the Flood Risk Assessment, the following criteria forms the basis of the flood management strategy: • All development uses across the Project Site	Include in design team brief and contractor tender requirements.	Detailed Design Stage

Risk	Mitigation measure	Responsibility/ mechanism for implementation	Timing
	protected to the year 2070 as a minimum; • More vulnerable uses (sleeping accommodation, safe refuge areas), highly vulnerable (telecommunications installations) and essential infrastructure (required to function and operate during a flood) protected for 100 years; and • Less Vulnerable, Water Compatible and other essential infrastructure (not required to function and operate during a flood) protected for 60 years (2090).		

Residual effects

~~20.124~~20.132 Table 20.2~~87~~ provides a summary of the residual effects of climate change on the Proposed Development for risks that were rated as 'medium' or above once mitigation measures have been taken into account. As with Table 20.22, risks have been assessed using a probability rating based on Table 20.20 and a consequence rating based on Table 20.21.

Table 20.2~~87~~ Summary of residual risks ratings based on probability and consequence taking into account mitigation measures

Risk	Probability rating	Consequence rating	Risk rating
Rainstorm	5	1	5
Heavy snow	3	2	6
Fog	2	2	4
Hail	3	2	6
Severe wind	3	2	6
Extra tropical storm	3	2	6
Storm surge	1	5	5
Lightening/thunderstorm	4	1	4

Risk	Probability rating	Consequence rating	Risk rating
Extreme winder conditions	3~~2~~	2	6~~4~~
Cold wave	3~~2~~	2	6~~4~~
Extreme cold days	3~~2~~	2	6~~4~~
Heat wave	4~~3~~	4~~2~~	16~~6~~
Extreme hot days	4~~3~~	3~~2~~	12~~6~~
Drought	3~~1~~	4	12~~4~~
Flash/surface flood	2~~1~~	4~~6~~	8~~6~~
River flooding	2~~1~~	4~~6~~	8~~6~~
Coastal flood	4~~1~~	4~~6~~	16~~6~~
Groundwater flood	1	6	6
Saltwater intrusion	1	5	5
Subsidence	1	6	6
Water-borne disease	1	6	6
Vector-borne disease	1	6	6
Air-borne disease	1	6	6
Insect infestation	1	4	4

Cumulative, in-combination and transboundary effects

20.133 Due to the nature of effects relating to climate change on the Proposed Development, the majority of risks identified will not increase or decrease when taking into account in-combination cumulative effects (i.e. effects of the Proposed Development alongside the effects of identified cumulative developments). The only identified climate risk which may be affected as a result of the identified cumulative developments is drought. As more developments are built out in the surrounding area, water supply is likely to become increasingly strained, meaning that drought conditions are increasingly likely. However, with the identified mitigation measures in place for the Proposed Development, the effects are not likely to be significant.

SUMMARY AND CONCLUSIONS

Scope of the assessment

~~20.125~~20.134 This chapter is presented in two parts:

- **Part A: GHG Emissions** – assessment of the nature and magnitude of GHG emissions likely to arise as a result of the Proposed Development during both the construction and operational phases, and proposed measures to reduce these emissions to minimise its contribution to climate change.

- **Part B: Climate Change Adaptation and Resilience** – focusing on the vulnerability of the Proposed Development to risks arising from a changing climate, and proposed measures to reduce these risks.

Part A: GHG Emissions

Environmental effects

Construction

~~20.126~~20.135 The significance of effects related to construction stage embodied carbon was deemed to be Major Adverse prior to the implementation of mitigation measures.

~~20.127~~20.136 The significance of effects related to life cycle embodied carbon was deemed to be Major Adverse prior to the implementation of mitigation measures.

Operation

~~20.128~~20.137 The significance of effects related to GHG emissions associated with operational energy was deemed to be Negligible with embedded mitigation measures included.

~~20.129~~20.138 The significance of effects related to GHG emissions associated with operational water consumption was deemed to be Minor Adverse with embedded mitigation measures included.

~~20.130~~20.139 The significance of effects related to GHG emissions associated with operational transport was deemed to be Moderate Adverse with embedded mitigation measures included.

Mitigation

~~20.131~~20.140 A range of mitigation measures have been put in place to reduce lifecycle GHG emissions associated with the Proposed Development.

Residual environmental effects

Construction effects

~~20.132~~20.141 Table 20.2~~98~~ summarises the residual construction effects relating to GHG emissions once mitigation measures have been taken into account.

Table 20.2~~98~~ Summary of residual construction effects

Receptor	Sensitivity	Magnitude of change/ impact	Effect significance
Construction stage embodied carbon	Very High	Moderate	~~Moderate~~ Large Adverse (Significant)
Life cycle embodied carbon	Very High	Moderate	~~Moderate~~ Large Adverse (Significant)

~~20.133~~20.142 Effects associated with construction stage embodied carbon and life cycle embodied carbon have been deemed to be 'Moderate Adverse', which means that effects are significant. As discussed in paragraph 20.109, there is industry recognition of the significance of embodied carbon associated with current practices, with emerging guidance to stimulate the development of solutions to deliver transitional targets towards net zero embodied carbon. These will be explored as part of the detailed design development and appropriate reduction targets put in place to further reduce the residual effects where practical.

Operation effects

~~20.134~~20.143 Table 20.30~~29~~ summarises the residual operation effects relating to GHG emissions once mitigation measures have been taken into account.

Table 20.30~~29~~ Summary of residual operation effects

Receptor	Sensitivity	Magnitude of change/ impact	Effect significance
Operational energy emissions	Very High	Negligible	~~Negligible~~ Slight (Not Significant)
Operational water emissions	Very High	Minor	~~Minor Adverse~~Moderate (Not Significant)
Operational transport emissions	Very High	Minor	~~Minor Adverse~~Moderate (Not Significant)

Part B: Climate Change Adaptation and Resilience

Identification and Evaluation of Risks

~~20.135~~20.144 A set of climate change risks to the Proposed Development were identified using the C40 Cities Climate Change Risk Assessment Guidance[50]. Climate change risks were then assessed for the Proposed Development based on the probability of an event occurring and the consequence of that event occurring.

Mitigation measures

~~20.136~~20.145 Mitigation measures have been identified for risks with a rating of 7 or higher (medium risk rating) based on the assessment of probability and consequence.

Residual effects

~~20.137~~20.146 With appropriate mitigation measures in place, the risk rating for all climate change risks relating to the Proposed Development have been reduced to low risk.