14 CLIMATE CHANGE

Introduction

14.1 This chapter of the ES assesses the likely significant effects of the Development on climate change ('Greenhouse Gas (GHG) Emissions Assessment'), and the likely significant effects of climate change on the Development ('Climate Change Resilience and Adaptation Assessment').

14.2 As each assessment has different methodologies, baseline conditions, potential impacts and mitigation measures, this chapter will present the GHG Emissions Assessment and Climate Change Resilience and Adaptation assessments separately. This chapter is structured as follows:

- **Introduction and Policy Context** – introduces the chapter, presents the policy, and legislation relevant to the assessments;
- **Part 1: GHG Emissions Assessment** – sets out the methodology, baseline and considers the activities associated with the Development with the potential to emit GHG emissions and the mitigation measures implemented to reduce these emissions; and
- **Part 2: Climate Change Resilience and Adaptation** – sets out the methodology, baseline and reviews the outcomes of a high-level climate risk and resilience assessment undertaken for the Development and the mitigation measures implemented to increase climate resilience; and
- **References**.

14.3 The chapter has been prepared by Stantec UK Ltd (see Appendix 1.2 Statement of Expertise).

Policy Context

National Planning Policy Framework[i]

14.4 Climate change is one of the core planning principles which the National Planning Policy Framework (NPPF) expects plan-making and decision-taking to underpin. The NPPF recognises that planning plays a key role in minimising vulnerability, providing resilience and managing the risks associated with climate change.

14.5 Paragraph 150 states that new development should be planned for in ways that:

> *"a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas*

> *which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green and blue infrastructure; and*
> *b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards."*

14.6 Paragraph 8 defines three overriding objectives for achieving sustainable development. The environmental objective includes "*mitigating and adapting to climate change*".

Planning Practice Guidance[ii]

14.7 The Planning Practice Guidance (PPG) is intended to be read alongside the NPPF and provides guidance on a range of planning issues. The PPG, in relation to climate change, advises how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change.

14.8 Paragraph 004 Reference ID: 6-004-20140612 provides guidance on how adaptation and mitigation approaches should be integrated as follows:

> *"When [preparing Local Plans and] taking planning decisions local planning authorities should pay particular attention to integrating adaptation and mitigation approaches and looking for 'win-win' solutions that will support sustainable development. This could be achieved in a variety of ways, for example:*
>
> - *by maximising summer cooling through natural ventilation in buildings and avoiding solar gain;*
> - *through district heating networks that include tri-generation (combined cooling, heat and power); or*
> - *through the provision of multi-functional green infrastructure, which can reduce urban heat islands, manage flooding and help species adapt to climate change - as well as contributing to a pleasant environment which encourages people to walk and cycle. Local planning authorities should be aware of and avoid the risk of maladaptation (adaptation that could become more harmful than helpful). For example, designing buildings to maximise solar gain in winter without thinking through the implications for overheating in summer."*

14.9 Paragraph: 005 Reference ID: 6-005-20140306 provides guidance on dealing with the uncertainty of climate risks when promoting adaptation in particular developments:

> *"The impact of climate change needs to be taken into account in a realistic way. In doing so, local planning authorities will want to consider:*
>
> - *identifying no or low cost responses to climate risks that also*

deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity;
- *building in flexibility to allow future adaptation if it is needed, such as setting back new development from rivers so that it does not make it harder to improve flood defences in future; and*
- *the potential vulnerability of a development to climate change risk over its whole lifetime"*

14.10 Paragraph: 007 Reference ID: 6-007-20140306 discusses how local planning authorities can identify appropriate mitigation measures in plan-making:

"Every area will have different challenges and opportunities for reducing carbon emissions from new development such as homes, businesses, energy, transport and agricultural related development.

- *…The distribution and design of new development and the potential for servicing sites through sustainable transport solutions, are particularly important considerations that affect transport emissions. Sustainability appraisal should be used to test different spatial options in plans on emissions.*
- *Different sectors may have different options for mitigation. For example, measures for reducing emissions in agricultural related development include anaerobic digestion, improved slurry and manure storage and improvements to buildings. In more energy intensive sectors, energy efficiency and generation of renewable energy can make a significant contribution to emissions reduction."*

14.11 Local development plans identify the need for housing over the plan period, including the amount and location of sites for new developments. In accordance with the NPPF, local development plans need to consider carbon emissions throughout the process of selecting suitable sites for development and the number of houses that will be built in each location. A Sustainability Appraisal (SA) is required to assess the impact of building new houses on climate change and through adopting the local plan, the LPA has accepted the impact of new housing developments on climate change through their potential to release GHGs.

Future Homes Standard

14.12 Following the Spring Statement from Her Majesty's Treasury[iii], a Future Homes Standard will likely be coming forward and introduced by 2025. The standard will ensure future-proofing new build homes with low carbon heating and world-leading levels of energy efficiency. The standard will build on the Prime Minister's Industrial Strategy Grand Challenge mission to at least halve the energy use of new buildings by 2030[iv].

Local Planning Policy

Cherwell District Council Local Plan 2011 – 2031

14.13 The Cherwell District Council (CDC) Local Plan includes Policy ESD 1: Mitigating and Adapting to Climate Change. The policy states that developments will include measures such as reducing the need to travel by car, encouraging sustainable travel modes, reducing carbon emissions through resource efficiency and promotion of renewable and low carbon energy use. The policy also requires new development to demonstrate the design is resilient to climate change including the use of passive solar design for heating and cooling, sustainable drainage methods and the provision of green infrastructure.

14.14 Other relevant polices include:

- Policy ESD 2: Energy Hierarchy and Allowable Solutions
- Policy ESD 3: Sustainable Construction
- Policy ESD 5: Renewable Energy
- Policy ESD 6: Sustainable Flood Risk Management

14.15 The strategic allocation Policy Bicester 1: North West Bicester Eco-Town, which the Development forms part of, sets out the expectation of zero carbon developments.

14.16 The Local Plan has been subject to a Sustainability Appraisal and Strategic Environmental Assessment (SA/SEA) as required by law. The purpose of the SA and SEA process is to appraise the social, environmental and economic effects of a plan from the outset so that planning decisions are made that contribute to achieving sustainable development. The policies within the Local Plan, including strategic allocation Policy Bicester 1, was assessed against SA objectives that included GHG emissions and climatic factors. The Development has therefore been subject to an appraisal of potential GHG emissions and been allocated on the basis that any GHG emissions generated by the Proposed Development are outweighed against the benefit the Development brings in respect of the other sustainability objectives. This gives credence that the macro consideration of GHG emissions has been considered within the planning process.

CDC Climate Change Emergency

14.17 CDC declared a climate emergency in July 2019, committing it to ensure its own operations and activities are zero carbon by 2030. The declaration also laid out the goal - with the

support of residents, businesses and other organisations - of achieving net zero for the wider district by 2030. CDC have since published a Climate Action Framework[v] in October 2020 which describes how CDC will achieve net zero.

14.18 Additionally, Oxfordshire County Council (OCC) have declared a climate emergency and CDC and OCC are working together to meet their commitments.

Legislative Context

Climate Change Act 2008[vi]

14.19 The Climate Change Act (CCA) 2008 established the context for government action, providing a legally binding framework for the UK to reduce GHG emissions and build the UK's ability to adapt to climate change. The CCA 2008 requires the Government to compile a Climate Change Risk Assessment every 5 years and develop a National Adaptation Programme to address risks and opportunities from climate change.

14.20 In July 2019, an amendment was made to change the target of net UK carbon emissions for the year 2050 from 80% to 100% lower than the 1990 baseline.

14.21 To reduce carbon emissions, the UK government has set legally binding carbon budgets, capping the amount of GHGs emitted in the UK over 5-year periods.

14.22 The Committee on Climate Change (CCC) published its recommendation on the level of the 6th carbon budget for the period 2033-37, in December 2020 however the Government has not yet imposed this budget into law. This recommended carbon budget is the first budget to consider the consider the UKs net zero target by 2050 with a trajectory that is consistent with the Paris Agreement.

PART 1: GHG Emissions Assessment

14.23 This section presents the assessment of the impact the Development will have upon climate change.

Assessment Methodology

14.24 There is no nationally adopted method for assessing climate change within EIA and therefore the assessment approach draws upon IEMA guidance[vii]. IEMA guidance emphasises the need

for proportionality in the context of national, sector and local GHG emissions. The guidance recognises that qualitative assessments are acceptable, particularly where mitigation measures are agreed early on in the design stage. Mitigation measures that are embedded in the design of the Development in relation to reducing GHGs are outlined in this chapter.

Consultation

14.25 CDC issued their EIA Scoping Opinion on the 22nd December 2020. Comments regarding climate change within the ES are set out below:

> *"Whilst reference is made to compliance with the Building Regulations in force at the time and reference is made to policy requirements, the specific requirement through Policy Bicester 1 is for a 'true zero carbon' development. It is expected that this requirement be included within the assessment of this topic."*

14.26 The requirement for achieving net zero is considered within this chapter as part of the assessment of GHG emissions from purchased electricity (Scope 2).

Study Area

14.27 The GHG Emissions Assessment study area includes the Site and extends to include activities that occur beyond the Site boundary, such as the generation of electricity off site. As GHG impacts are global and cumulative with all other sources of emissions, no specific geographical study area is defined for this assessment as the system is global.

Assessment

14.28 The goal of this assessment is to identify the GHG emissions generated during the construction and operation of the Development and the mitigation measures that will seek to reduce these emissions.

14.29 The scope of emissions within the assessment align with the World Business Council for Sustainable Development (WBCSD) / World Resources Institute (WRI) Greenhouse Gas Protocol[viii], and British Standards Institution (BSI) PAS 2070[ix] methodology and considers the construction and operation stages of the Development. The WRI GHG Protocol categorises direct and indirect emissions into three broad scopes:

- Scope 1: all direct GHG emissions;
- Scope 2: indirect GHG emissions from consumption of purchased energy, such as electricity, heat or steam; and

- Scope 3: all other indirect emissions not covered in Scope 2 that occur in the value chain of the Development, such as the extraction and production of purchased materials and fuels, waste disposal, etc.

14.30 The GHG emissions assessment has been based on the assumption that construction works will commence in 2022, with completion in 2027.

14.31 IEMA guidance emphasises that a proportionate and appropriate assessment should be undertaken to inform decision making. The sources of emissions that are considered within this assessment, in line with IEMA Guidance, are discussed below.

Emissions Scoped in to the Assessment

14.32 The GHG Emissions Assessment evaluates the following potential sources of GHG emissions from the construction and operation of the Development. These are outlined in Table 14.1 below and have been assessed qualitatively.

Table 14.1: GHG Emission Sources and Scope of GHG Emission Assessment

Development Stage	GHG Protocol	Activity Assessed
Baseline	Scope 1	A qualitative review of the current land use of the Site. It is difficult to calculate GHG emissions in a way that is proportionate as detailed information would be required to assess these emissions quantitatively, such as specific information on farming activities, use of fertilisers and soil moisture content. Therefore a qualitative review has been undertaken.
	Scope 2	There are no existing buildings on Site therefore there are no scope 2 emissions for the baseline scenario.
Construction	Scope 1	A qualitative description of the emissions likely to arise from the combustion of fuels in transport, vehicle, plants and equipment used for the demolition and construction of the Development (e.g. enabling activities).
	Scope 2	A qualitative review of the emissions associated with electricity needed for plant and welfare facilities.
	Scope 3	A qualitative description of the embodied carbon of the Development. The exact materials and quantities to be used during the demolition and construction of proposed buildings is not known as this stage.
Operation	Scope 1	A qualitative review of emissions associated with directly burning fossil fuels on site, such as heating in proposed buildings, and vehicle trips generated by the Site A qualitative description of the carbon sequestration associated with landscaping and green infrastructure. As carbon sequestration is dependent on several factors including rate of tree growth and management regime, it is considered proportionate to undertake a qualitative evaluation.
	Scope 2	A qualitative description of emissions associated with purchased electricity from the national grid during operation of the Development.
	Scope 3	A qualitative description of the emissions associated with waste disposal and water supply and treatment.

14.33 Due to the nature of the Development (residential led, mixed-use), it has not been designed with a fixed lifetime and therefore the end-of-life stage is difficult to define. Emissions

associated with the end-of-life stage of the Development are therefore scoped out of the assessment due to proportionality.

Data Sources

14.34 A high-level review of existing land use and associated activities on the Site has been undertaken to identify sources of baseline GHG emissions. This includes a review of Chapter 6 Transport and Access and Chapter 7 Air Quality and the supporting appendices.

14.35 Chapter 5 Construction Methodology and Phasing and the parameter plans in Figures 3.1 to 3.3 have been reviewed to identify GHG emissions from the construction and operation of the Development, along with the Sustainability and Energy Statement for the Development.

Determining Significance

Identification and Sensitivity of Receptors

14.36 GHG emissions have a global effect rather than directly affecting specific local receptors to which levels of sensitivity can be assigned. The global climate has therefore been treated as a single receptor. Given the global scale and severe consequences of climate change and limited recoverability, the receptor sensitivity is considered to be high.

Determining Magnitude of Change

14.37 The magnitude of change has been considered as the change experienced from the baseline conditions at the sensitive receptor and has been considered on a scale of large, medium, small or negligible.

14.38 Table 14.2 provides definitions for each scale of magnitude used within this assessment. The definitions are based on IEMA guidance and will be determined by professional judgement.

Table 14.2: Definition of Magnitude of Change

Magnitude	Definition
Major	A substantial change considered to be on a national scale.
Moderate	A moderate change considered to be on a regional scale.
Minor	A small change considered to be on a local scale.
Negligible	Very little change from baseline conditions and considered to be beneath level of perception.

Determining Level of Effect

14.39 There is an absence of significance criteria or defined threshold for determining the significance of effects resulting from GHG emissions in EIA. IEMA guidance does not propose changes to the significance criteria used in the EIA process (Chapter 2 of this ES). IEMA guidance identifies three underlying principles to inform the assessment of significance and conclude that:

- all projects create GHG emissions that contribute to climate change
- climate change has the potential to lead to significant environmental effects
- there is a GHG emission budget that defines a level of dangerous climate change whereby any GHG emission within that budget can be considered as significant.

14.40 Therefore, in the absence of any significance criteria or a defined threshold, IEMA recommends that all GHG emissions might be considered as significant and that the EIA should ensure the project addresses their occurrence through mitigation. Due to the subjectivity of defining the magnitude of significance (i.e. major, moderate, minor, negligible) for GHG assessments, significance has been determined by professional judgement in the context of sectoral, local or national carbon budgets, as recommended by IEMA.

14.41 The level of effect attributed has been assessed based on the magnitude of change due to the Development and the evaluation of the sensitivity of the affected receptor.

Table 14.3: Significance of Effects

MAGNITUDE	SENSITIVITY
	High
Major	Major
Moderate	Major to Moderate
Minor	Moderate to Minor
Negligible	Negligible

Cumulative Effects

14.42 Chapter 2 sets out the approach to identifying existing and approved developments for cumulative assessment within this ES. The global concentration of GHGs in the atmosphere, rather than the flow of emissions, is what causes effects on climate change and therefore all cumulative sources are relevant. This has been taken into account in the GHG emissions assessment through defining the high sensitivity of the global climate as a receptor and through the consideration of emissions in the context of UK emissions.

Limitations and Assumptions

14.43 The assessment has been based on parameters for the Development, therefore the project information that has informed the GHG assessment is broad and, where referenced, based on assumptions.

14.44 This qualitative assessment provides a high level overview of the likely significant effects of GHG emissions on the Development. Given the outline nature of the application, specific GHG emissions data is not available within this ES.

Baseline Conditions

The Site

14.45 The existing Site conditions are outlined in Chapter 3. The agricultural use of the Site produces GHG emissions associated with livestock, crop fertilisation, soil based emissions from disturbing soils, waste produced as a result of farming processes, and other activities.

14.46 Within the Site there are hedgerows and trees on the boundaries of the Site, as well as two distinct areas of woodland within the Site. These features are likely to sequester small amounts of carbon.

The Surrounding Area

14.47 The total emissions for the UK over the last two carbon budgets[x] are shown in Table 14.4 below. Both budgets were met, culminating in a 31% reduction below 1990 carbon emissions. In 2018 emissions were 43% below 1990 levels[xi].

Table 14.4: 2008-2017 UK Carbon Budgets

UK Budget	Carbon budget level	Reduction below 1990 levels	UK Emissions
1st carbon budget (2008 to 2012)	3,018 MtCO2e	25%	2,982 $MtCO_2e$
2nd carbon budget (2013 to 2017)	2,782 MtCO2e	31%	2,398 $MtCO_2e$

14.48 The carbon dioxide emissions for CDC in 2018[xii] are presented in Table 14.5 below. Transport was the greatest source of emissions and land use and forestry sequestrated 12.5 ktCO2, which is reflected in the total emissions for CDC.

Table 14.5: Cherwell CO_2 estimates for 2018

Cherwell CO_2 estimates ($ktCO_2$)				
Industry and Commercial Total	Domestic Total	Transport Total	Land Use, Land Use Change and Forestry	**Grand Total**
345.3	227.1	669.0	-12.5	**1,228.9**

Future Baseline

14.49 If the Site is not developed, the amount of GHG emissions emitted will remain at the current levels. As the patches of woodland continue to mature, their ability to sequester carbon may marginally increase. However, due to the limited size of these woodland areas, this is likely to be a negligible change.

UK Carbon Budgets

14.50 The UK Carbon Budgets for the next 12 years are set out below in Table 14.6. The carbon budgets are legally binding and UK GHG emissions will need to be reduced to meet them. The Committee for Climate Change (CCC) provided their recommendation for 6th carbon budget, for the period 2033-37, in December 2020[xiii] however the Government has not yet imposed this budget into law.

Table 14.6: UK Carbon Budgets for 2018-2032

Budget	Carbon budget level	Reduction below 1990 levels
3rd carbon budget (2018 to 2022)	2,544 $MtCO_2e$	37% by 2020
4th carbon budget (2023 to 2027)	1,950 $MtCO_2e$	51% by 2025
5th carbon budget (2028 to 2032)	1,725 $MtCO_2e$	57% by 2030
6th carbon budget recommendation (2033—37)	965 $MtCO_2e$	78% by 2035

Decarbonisation of Grid

14.51 As a direct result of the rapid decarbonisation of the national electricity Grid, GHG emissions from developments will inherently decrease over the next 10 years. This is an outcome of the continued uptake of renewable energies and the decline of coal-fired power stations. The increasing share of low carbon, renewable energy sources with a corresponding decrease in the use of fossil fuels, is termed "decarbonisation". Therefore, the emissions per unit of electricity generated (grams of carbon dioxide per kilowatt hour) is reducing. This is seen as a vital step in meeting the emissions reductions target set by the CCA 2008.

14.52 For new developments, the energy supply from the Grid that is used to power homes and

businesses is increasingly becoming cleaner and greener, thereby reducing the GHG emissions associated with energy use at the Development.

Electric Vehicles

14.53 Vehicle electrification has been rising in the UK Government's agenda over recent years, as electric vehicles (EVs) play a key role in delivering the zero emissions strategy and in proliferating power intensive EV charging infrastructure. This has been supported by targets and policy initiatives, including the publication of the Road to Zero Strategy[xiv] which sets out its ambition to reduce emissions from vehicles on UK roads and promote the uptake of zero emissions vehicles.

14.54 In March 2020, the Electric Vehicles and Infrastructure paper[xv] was published, which outlined how the infrastructure for EVs have been planned for and what incentives are available to encourage growth.

14.55 In November 2020, the Government announced the end of sale of petrol and diesel cars and vans and some forms of hybrid vehicles by 2030 to increase the uptake of EVs and reduce transport GHG emissions.

Likely Significant Effects

Construction Phase

14.56 The below sections provide a qualitative description of the anticipated GHG emissions arising during the construction period of the Development.

Scope 1 Emissions

14.57 The main sources of direct GHG emissions during construction relate to the burning of fossil fuels during the transportation of building materials and waste by Heavy Goods Vehicles (HGV) to and from the Site. Further sources of GHG emissions include the burning of fossil fuels on Site to power the plant engines and equipment.

14.58 Construction of the Development would result in a land use change of the Site from predominantly agricultural to a built urban development, which will comprise of sealed surfaces and open space. Following completion of the Development, all land will be removed from agricultural use. Therefore, GHG emissions associated with the agricultural use of the Site will no longer be generated and will be replaced by the operational GHG emissions of the

Development, as discussed below.

14.59 The woodland areas on the Site currently act as land carbon sinks which naturally sequesters and stores carbon. These woodland areas are being retained where possible and will therefore continue to sequester and store carbon.

14.60 The direct Scope 1 GHG emissions from construction activities, without mitigation, is considered to be a temporary minor adverse impact and therefore Not Significant.

Scope 2 Emissions

14.61 The temporary construction office, welfare facilities and lighting on the Site will require electricity purchased from the National Grid. This will result in indirect GHG emissions generated from the burning of fossil fuels to deliver electricity to the Site.

14.62 The indirect GHG emissions from construction activities, without mitigation, is considered to be a temporary minor adverse impact and therefore Not Significant.

Scope 3 Emissions

14.63 Construction of the Development will cause an increase in indirect GHG emissions including from, for example, embodied carbon and emissions from processing waste.

14.64 Embodied carbon emissions are a result of extracting raw materials, processing them, assembling them into usable products and transporting them to Site for use in the construction of the Development. It is noted that a large proportion of GHG emissions from a development may be accounted for within Scope 3 embodied carbon. The embodied carbon associated with the Development will be heavily influenced by the type and amount of material required to construct the Development. Extraction and production processes can be carbon intensive, particularly for materials such as concrete. It is noted that the embodied carbon associated with the Development is also heavily influenced by available materials and supply chains in the local and wider areas.

14.65 Construction waste will need to be transported and treated, either through landfill or recycling methods. This will result in GHG emissions, although these will inevitably be in the control of the organisation that manages these processes.

14.66 With consideration of the above, scope 3 emissions from the Development are considered to

be noticeable on a local scale, with the potential to be noticeable on a wider regional scale due to the several activities associated with purchased materials and their embodied carbon. Therefore, there is likely to be an indirect, temporary moderate adverse effect which is considered to be Significant, without mitigation. Recommended mitigation measures are outlined below in paragraph 14.77.

Completed Development

Scope 1 Emissions

14.67 There is potential for GHG emissions to be generated if fossil fuels are burnt directly on the Site. The completed Development will generate an increase in traffic volumes through the Site and along the local transport network thereby generating GHG emissions from burning fossil fuels through road transport. As the Development is residential, it would generate a limited number of HGV movements. The Development is located in proximity to existing sustainable transport facilities that are within walking distance of proposed residents, with pedestrian and cycling routes that connect to local facilities. The provision of pedestrian and cycle routes reduces the need to rely on cars and therefore reduces GHG emissions associated from transport during operation.

14.68 There is potential for carbon sequestration associated with the Development and the green infrastructure strategy during operation, as shown on the green infrastructure parameter plan (Figure 3.2). This relates to the land use changes from agricultural land to the creation of new habitats, and the retention and enhancement of existing habitats.

14.69 With the consideration of the above GHG sources, scope 1 emissions during operation are considered to be noticeable on a local scale. The direct Scope 1 GHG emissions during operation of the Development, without mitigation, are considered to be a minor adverse effect and therefore Not Significant.

Scope 2 Emissions

14.70 Scope 2 emissions arise from purchased electricity from the National Grid for electric heating, powering appliances and maintaining lighting on the proposed road network. In accordance with CDC Local Plan and the Site allocation, the Development will be a true net zero carbon development. This means that the Development will target no net CO_2 emissions relating to all energy use from buildings over a year. Therefore, no Scope 2 emissions are expected during the operation of the Development.

14.71 The indirect Scope 2 emissions from the Development therefore have a negligible impact and

are Not Significant.

Scope 3 Emissions

14.72 During operation, indirect Scope 3 emissions will result from, for example, the disposal of waste and the provision and treatment of water supplies. Emissions resulting from the treatment of both waste and water will be managed by the relevant companies (such as Thames Water). It is anticipated that emissions will reduce over time as these companies are legally required to align with the CCA.

14.73 The Development will incorporate water efficiency measures and target the higher water efficiency standard outlined in Building Regulations Part G[xvi], which is 110 litres/person/day, as required by CDC policy.

14.74 The Development will provide recycling facilities in accordance with CDC policy, enabling users to recycle and reduce the volume of waste sent to landfill. In turn this will reduce the amount of GHG emissions associated with waste.

14.75 The indirect Scope 3 GHG emissions during operation of the Development, without mitigation, are considered to be a minor adverse effect and therefore Not Significant.

Mitigation Measures

Construction Phase

14.76 A Construction Environmental Management Plan (CEMP) will be secured through a suitably worded planning condition. The CEMP should include several mitigation measures covering transport, materials, waste and air quality during construction. Measures that will reduce GHG emissions during construction include, for example, no unnecessary idling of engines, maintenance of plant equipment to check they are operating optimally and efficient use of materials to reduce waste.

14.77 Other recommended measures include procuring locally sourced materials, and requiring suppliers to report on annual Scope 1 and 2 GHG emissions. The CEMP should also outline the management arrangements to reduce road vehicle trips, seek to reduce the number and length of construction related transport movements, and seek to reduce GHG emissions from vehicle movements through training and best construction and logistics practice.

14.78 It is recommended that a Site Waste Management Plan (SWMP) is prepared prior to the

commencement of construction, although this is no longer a legal requirement. The SWMP will be secured through a suitably worded planning condition. The SWMP will aid the management, procurement and delivery of materials to support material usage optimisation and minimisation of waste quantities. This will reduce the need for offsite waste management, limit the number of vehicle movements required during site preparation and will result in a reduction of GHG emissions associated with transport, waste and material use during construction.

Completed Development

Transport

14.79 A Residential Travel Plan, submitted with the planning application for the Development, details a series of "soft" (non-physical) measures to encourage greater use of sustainable modes of transport, such as marketing information, financial incentives, and user groups. This will reduce Scope 1 GHG emissions associated with transport during the Development's operation.

14.80 In addition, cycle parking will be provided in line with the CDC's Residential Design Guide SPD (2018). This provision will be confirmed in detail at the RMA.

Energy Efficiency

14.81 Mitigation measures to reduce energy demand that will help to enable net zero carbon from energy will be brought forward at detailed design for each reserved matters application (RMA). The selection of a 'grid' plot layout and alignment of building location can take advantage of the prevailing winds will help to facilitate air movement and enhance natural ventilation. Building orientations may be optimised to take advantage of south-facing aspects for passive solar gains, and positioning of taller buildings to the north of the Site can help avoid overshadowing. This will help reduce the energy demand required to heat the buildings during the winter, thereby reducing GHG emissions associated with electricity purchased from the National Grid.

14.82 Each plot will seek to adopt a "fabric first" approach to building design (enhancing the performance of the components and materials that make up the building fabric itself, such as improving insulation and reducing cold bridging), before considering the use of mechanical or electrical services systems and renewable/low carbon technologies.

14.83 Measures will be adopted in the detailed design of buildings to reduce energy demands, use energy more efficiently and, where possible, adapt to the predicted impacts of climate change.

These measures can be split into 'passive' and 'active' measures. Passive measures are design features which can include building orientation, appropriate internal layouts and building fabric selection, that inherently reduce the buildings' energy requirements. Active measures are building services design features that will increase the efficiency of the energy used, and therefore also reduce the energy demand requirements. A combination of 'passive' and 'active' measures will result in well insulated, air-tight buildings with appropriate and efficient building services.

14.84 An Outline Energy Statement (Stantec, 2021) has been prepared and submitted with the planning application for the Development and provides further information on design principles that will reduce energy demand.

14.85 It is also noted that, following the Spring Statement from Her Majesty's Treasury[xvii], a Future Homes Standard will likely be coming forward and introduced by 2025. The standard will ensure future-proofing new build homes with low carbon heating and world-leading levels of energy efficiency. The standard will build on the Prime Minister's Industrial Strategy Grand Challenge mission to at least halve the energy use of new buildings by 2030.

Low and/or Zero Carbon Technologies

14.86 The Outline Energy Statement (Stantec, 2021) reviews the suitability of renewable, low and/or zero technologies on Site. The following renewable and low carbon opportunities could be used on-Site to generate energy:

- Photovoltaic (PV) systems could be installed on suitable south facing roof spaces. Frame-mounted systems can be used on flat roofs to optimise performance.
- Solar water heating (or solar thermal) could also be installed on suitable south facing roof spaces to supply a portion of buildings' heat demands. However, this would compete with PV for roof space;
- The use of wastewater and air heat recovery technology could be implemented in all buildings, subject to further viability assessment;
- Connection to the low carbon heat network for hot water and space heating; and
- Air source heat pumps could be installed in suitable buildings to provide space heating and/ or hot water. This technology would support an electric led heating strategy from 2025. External condensers need carefully positioning to avoid visual/ noise disturbance. Widespread use throughout the Site is only suitable with spare electrical network capacity due to the impact on peak demand loadings.

14.87 The use of renewable or low carbon generation will help reduce GHG emissions associated

with energy use on Site. The implementation of these technologies will be considered and confirmed at the detailed design stage and secured by a suitably worded planning condition.

Residual Effects

Construction Phase

14.88 The assessment identified minor to moderate adverse effects resulting from construction GHG emissions. It is considered that the Development addresses construction GHG emissions through the embedded and further mitigation outlined above. The Development will still emit GHG emissions despite mitigation so the residual effect of the Development on climate change during construction is considered to be temporary **minor adverse** and **Not Significant**. However, as stated in the methodology, GHG impacts are cumulative. It should be noted that the SA/SEA of the Local Plan gives consideration to GHG emissions and accepts the impact of GHGs from the Development.

Completed Development

14.89 The assessment identified negligible to minor adverse effects resulting from operational GHG emissions. Several mitigation measures are embedded into the design of the Development including true net zero building design, along with further measures that will be brought forward at detailed design. GHG emissions are also expected to reduce over time with the increased use of EVs over petrol or diesel vehicles. It is therefore considered that the Development addresses operational GHG emissions. The residual effect of the Development on climate change during operation is considered to be permanent **minor adverse**, and **Not Significant**. It should be noted that the SA/SEA of the Local Plan gives consideration to GHG emissions and accepts the impact of GHGs from the Development.

Cumulative Effects

14.90 As stated in the methodology, the global concentration of GHGs in the atmosphere, rather than the flow of emissions, is what causes effects on climate change and therefore all cumulative sources are relevant. This has been taken into account in the assessment through defining the high sensitivity of the global climate as a receptor and through the consideration of emissions in the context of UK emissions. Therefore, the level of effect and significance resulting from GHG emissions remains as that reported above and is considered to be minor and Not Significant.

Part 2: Climate Change Resilience and Adaptation

14.91 This section presents the outcome of the assessment on the impact of climate change upon the Development.

Assessment Methodology

14.92 There is no nationally adopted method for assessing climate change within EIA and therefore the assessment approach draws upon IEMA guidance[xviii].

Consultation

14.93 CDC adopted their EIA Scoping Opinion on the 22nd December 2020. No comments were received in relation to the climate resilience and adaptation assessment.

Study Area

14.94 The climate change resilience and adaptation assessment utilises the UK Climate Change Projections 2018 (UKCP18), produced by the UK Met Office[xix], for the 25 km grid cell within which the Site is located (462500 212500), although the area of influence for potential climate vulnerability impacts is expected to be limited to the Site and the immediate area around this. The 25 km probabilistic projections have been used to show a broad range of outcomes for the study area.

Data Sources

14.95 IEMA guidance recommends that the climatic baseline should consider extremes in short-term weather events, such as heatwaves; long-term climatic variability, such as seasonal changes in precipitation; and average climate norms, such as ambient temperature.

14.96 The current climatic baseline has been defined by historic climate conditions and the prevailing conditions at the time of the assessment using data provided by the Met Office[xx].

14.97 The future climate conditions, identified as part of the emerging baseline, have been defined by UKCP18 and a literature review of relevant publications. UKCP18 builds upon previous projections to provide information on how the climate of the UK may change over the rest of this century. UKCP18 uses Representative Concentration Pathways (RCPs) to develop projections and consider factors such as economic activity, population growth and land use change, which will result in a different range of global mean temperature increases until 2100.

14.98 RCP8.5 is the most conservative, highest-impact scenario, which reflects an average increase

in global mean surface temperature compared to the pre-industrial period of 4.3˚C by 2081-2100. This is considered the most appropriate scenario for assessing the impact of climate change on the Development due to the uncertainties that exist around climate projections. A review of the following data from these projections has been undertaken:

- Average Summer Precipitation (% change);
- Average Winter Precipitation (% change);
- Average Annual Precipitation (% change);
- Maximum Average Summer Temperature;
- Minimum Average Winter Temperature; and
- Annual Mean Temperature.

14.99 The projections (Appendix 14.1) show the potential change in temperature or precipitation above or below the observed temperature/precipitation for 1981-2000.

14.100 It should be noted that Site is inland and over 120 km from the sea, therefore future sea level rise has not been considered within this assessment.

14.101 To assess the impacts of climate change on the Development within the context of specific disciplines, a review of Chapter 6 Transport and Access, Chapter 7 Air Quality, Chapter 9 Landscape & Visual Impact, Chapter 10 Biodiversity, Chapter 12 Population and Human Health and Chapter 13 Water Resources and Flood Risk and the supporting appendices has been undertaken.

Assessment Approach

14.102 In accordance with IEMA guidance, the vulnerability and resilience of the Development to climate change has been identified by undertaking a risk assessment that includes:

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

14.103 The risk assessment considers the likelihood of a hazard occurring that could result in an impact on sensitive receptors. In addition, the magnitude of effects on the Development will depend on the severity of the consequence of the impact, and the vulnerability of the receptor itself. The definitions of these terms can therefore be summarised as follows:

- **Hazard** is an effect of climate change which has the potential to cause an impact on

sensitive receptors associated with the Development;

- **Magnitude** is the likelihood of impact occurring and the consequence of the impact of a hazard; and
- **Vulnerability** is the degree to which receptors are susceptible to adverse impacts and is influenced by sensitivity, adaptive capacity, and exposure to climate hazards.

14.104 IEMA guidance recommends that the climatic baseline should consider extremes in short-term weather events, such as heatwaves; long-term climatic variability, such as seasonal changes in precipitation; and average climate norms, such as ambient temperature.

14.105 The temporal scope of the assessment has been based on the assumption that construction works are anticipated to commence on Site in 2022, and last for approximately five years with completion in 2027, as outlined in Chapter 5. The post-construction stage will run up to 2100, as this is the last date available in the UKCP18 data.

Determining Significance

Identification of Receptors

14.106 Receptors that may be affected by climate change have been identified with consideration of both extreme weather events and gradual climatic changes in the study area for the Development. In accordance with IEMA guidance, receptors have been assessed against their vulnerability which is defined as follows:

- **High Vulnerability**: directly dependent on existing / prevailing climatic factors and reliant on these specific existing climate conditions continuing in future or, only able to tolerate a very limited variation in climate conditions;
- **Moderate Vulnerability**: receptor is dependent on some climatic factors but able to tolerate a range of conditions (e.g. a species which has a wide geographic range across the entire UK but is not found in southern Spain); and
- **Low Vulnerability**: climate factors have little influence on receptors.

14.107 Table 14.7 outlines the moderate and high vulnerability receptors included in this assessment and their vulnerability to climate change.

Table 14.7: Receptor Vulnerability

Receptor	Vulnerability	Reasoning
Construction stage		
Construction Workers	Moderate	It is assumed that construction workers will be of working age and healthy enough to work, and therefore able to tolerate some change to climate.
Construction Equipment	Moderate	Construction equipment is not directly dependent on climatic factors, but could be affected by some changes to climate.
Existing Ecology, Landscaping and Planting	Moderate	Species identified within and surrounding the Site (see Chapter 10 for details) have widespread geographical ranges and the Site is not within the edge of their range.
Land Stability	Moderate	Earthworks during demolition and construction may expose soil and leave it vulnerable to erosion.
Post-completion stage		
Future users of the site (residents, employees, students)	Moderate to High	Some future users of the Site will be more vulnerable to climate change than others, depending on a range of factors such as age (children, young people and the elderly) and existing poor health.
Infrastructure including buildings and roads	Moderate	Infrastructure across the Development ranges in value. Critical infrastructure, such as energy and water pipes/cables are considered to be of moderate vulnerability given that it can tolerate some changes in climate but is critical for the operation of the Development.
Ecology, Landscaping and Planting	Moderate	Species identified within and surrounding the Site (see Chapter 10 for details) have widespread geographical ranges and the Site is not within the edge of their range.
Land Stability	Moderate	Land stability is of concern primarily on slopes and embankments and depends on a range of factors including current groundwater levels, soil composition and soil condition.

Magnitude of Change

14.108 The magnitude of change depends on a combination of the probability of an effect occurring over the time period of the Development and the consequence to the receptors affected, as set out in IEMA guidance.

14.109 The climate resilience assessment provides a high level summary of the magnitude of hazards that have been identified through defining the current and emerging climatic baseline. As per IEMA guidance, the magnitude assigned to the effect also considers embedded mitigation measures which would reduce the probability or the consequence of the effect and therefore the overall magnitude.

Defining Significance

14.110 There is an absence of significance criteria for determining the significance of effects resulting

from climate change. IEMA guidance states that receptor vulnerability and uncertainties must be considered. Significance has therefore been determined by IEMA guidance and professional judgement. Effects determined to be moderate or greater are considered significant in EIA terms.

Limitations and Assumptions

14.111 Scientific evidence shows that our climate is changing. However, there are significant uncertainties in the magnitude, frequency and spatial occurrence within the climate projections utilised in this assessment. The projections are dependent on future global GHG emissions and, while several different scenarios are provided, it cannot be reliably predicted which (if any) emission scenario will occur over the next 80 years[xxi]. As a result, RCP8.5, the highest emission scenario, is considered most appropriate for this assessment to provide a conservative projection.

14.112 Additionally, projections after the 2040s increasingly diverge between scenarios and provide greater confidence for long-term climate averages than extreme events. For example, there is greater confidence around changes in temperature than there is in relation to wind. Levels of confidence and certainty are considered when assessing the likelihood and consequence of climate hazards.

Baseline Conditions

UK Observations

14.113 Observed climate changes over the UK include:

- The most recent decade (2009-2018) has been on average 0.3°C warmer than the 1981-2010 average and 0.9 °C warmer than 1961-1990. All of the top ten warmest years have occurred since 2002[xxii];
- In the past few decades there has been an increase in annual average rainfall over the UK. However, natural variations are also seen in the longer observational record[xxiii];
- The period since 2000 accounts for two-thirds of hot-day records, and close to half of wet-day records, in monthly, seasonal and annual observations since 1910[xxiv];
- The frequency of severe autumn and winter wind storms increased between 1950 and 2003[xxv], although storminess in recent decades is not unusual in the context of longer European records dating back to the early 20th century[xxvi]; and
- Widespread and substantial snow events have occurred in 2018, 2013, 2010 and 2009, but their number and severity have generally declined since the 1960s[xxvii].

Regional Observations

14.114 Historic climate averages during the period 1981-2010 for the closest climate station to the Site (Oxford), obtained from the Met Office website[xxviii], indicates the following:

- Average annual maximum temperature was 14.6°C;
- Warmest month on average was July (mean maximum temperatures of 22.7°C);
- Coldest month on average was January (mean minimum temperature of 7.6°C);
- Average total annual rainfall was 659.7 mm;
- Wettest month on average was May (average monthly rainfall of 57.1 mm); and
- Driest month on average was February (average monthly rainfall of 42.5 mm).

Future Baseline

14.115 Figures 14.1 – 14.6 in Appendix 14.1 show the grid square projections for average summer, winter and annual precipitation, maximum average summer temperature, minimum average winter temperature and annual mean temperature. A summary of the projections is provided below. This is supported by data extracted from the probabilistic projections which is presented in Appendix 14.1, a summary of which is provided in Table 14.8.

Table 14.8: Summary of 50th Percentile Climate Projections for 25 km grid square 462500 212500 using baseline 1981-2000 scenario RCP 8.5

Date	Climate Variable at 50th Percentile					
	Mean air temperature anomaly at 1.5 m (Â°C)	Annual Precipitation rate anomaly (%)	Maximum Summer air temperature anomaly at 1.5 m (Â°C)	Average Summer Precipitation rate anomaly (%)	Minimum Winter air temperature anomaly at 1.5 m (Â°C)	Average Winter Precipitation rate anomaly (%)
2022	0.80	1.67	1.07	-7.27	0.61	11.91
2027	0.94	1.35	1.68	-7.29	0.73	5.01
2050	1.87	-0.52	2.70	-24.63	1.58	10.60
2075	3.24	1.24	4.87	-31.35	2.78	25.13
2099	5.01	-5.50	7.82	-46.31419	4.18	28.64

14.116 The projections show an almost continuous increase in annual average temperature over the next 80 years. Annual precipitation is shown to vary year on year, with some years being dryer or wetter than previous years.

14.117 The projections suggest that summers will become warmer and drier, with an expected increase in maximum summer temperatures and overall decline in summer precipitation. Natural variations may mean that some cooler and/or wet summers will occur.

14.118 Winters may become milder and wetter, with an overall increase in both minimum winter temperature and winter precipitation. Natural variations may mean that some cold and/or dry winters may still occur.

14.119 In the UK, the heaviest snowfalls tend to occur when the air temperature is between zero and 2°C[xxix]. There is less certainty in the magnitude of change to snow occurrence and amount, although climate models do show a downward trend in both falling and lying snow over time.

Extreme Weather Events

Heatwaves

14.120 A heatwave is an extended period of hot weather relative to the expected conditions of the area at that time of year, which may be accompanied by high humidity. For the UK, the Met Office defines a heatwave as "*when a location records a period of at least three consecutive days with daily maximum temperatures meeting or exceeding the heatwave temperature threshold*"[xxx]. The threshold varies by county and have been calculated using the 1981-2010 climatology of daily maximum temperature at the mid-point of the meteorological summer (15 July), which for the Site (Oxfordshire) is 27ºC.

14.121 Research has found that the likelihood of heatwave events in the UK is about 10 times higher due to climate change[xxxi]. As discussed above, the maximum summer air temperature and annual average air temperature is expected to increase over the next 80 years, which could result in more intense and more frequent heatwaves.

Low Rainfall and Drought

14.122 Droughts are natural events which occur when a period of low rainfall creates a shortage of water. There is no single definition of drought, although the Environment Agency (EA) identifies three main types that may occur together or separately:

- **Environmental Drought**: shortage of rainfall causing a detrimental impact on the environment e.g. reduced river flows and/or low groundwater levels;
- **Agricultural Drought**: crop production or farming practises such as spray irrigation is constrained by a shortage of rainfall; and
- **Water Supply Drought**: shortage of rainfall is affecting human water supply.

14.123 The UKCP18 projections show a trend toward drier summers on average, although the uncertainties of these are wide ranging. Research on the influence of climate change on

drought in the UK is limited and given that several different factors influence droughts (meteorological, hydrological, and societal), it is challenging to identify whether drought events will become more common and prolonged in the future.

Heavier Rainfall

14.124 Heavy rainfall that may lead to flooding is hard to predict in the long term. A study has shown that an extended period of extreme winter rainfall in the UK is now about seven times more likely due to human-induced climate change[xxxii], although the largest changes in heavy rainfall since 1961 have occurred in Scotland and northern England.

14.125 The climate projections for the Site show there will be an increase in average winter precipitation (Figure 14.1). There is also a pattern of larger increases in winter precipitation over central England toward 2100.

14.126 While projections indicate a trend that summers will become drier toward the end of the century, there is also evidence that summer rainfall events may become more intense when they do occur.

Storms and High Winds

14.127 Projections of future wind and storm occurrence and intensity are uncertain and confidence in projections is low. Research has shown that there are no compelling trends in maximum gust speeds over the last four decades[xxxiii] and therefore there is no evidence that link climate change and storms.

14.128 UKCP18 identifies an increase in near surface wind speed over the UK in 2050-2100 for the winter season, which is accompanied by an increase in frequency of winter storms over the UK[xxxiv]. However, the increase in wind speeds is modest compared to natural variability from month to month and season to season.

14.129 Due to the little evidence that storms may increase in frequency or severity as a result of climate change, likely significant effects resulting from storms and high winds are scoped out of further assessment.

Likely Significant Effects

Construction Phase

14.130 The baseline evolution shows that the likely changes in average climate norms over the

construction period are relatively small compared to the later years of the study period. The anticipated increase of average annual temperature and decrease in average annual precipitation between 2022 and 2027 is unlikely to adversely affect construction workers or equipment. Predicted seasonal changes are also relatively small over this time period and are unlikely to cause significant adverse effects.

14.131 Climate hazards have the potential to disrupt or delay construction programme due to unsafe conditions for workers and potential damage to equipment or works. The risk of climate hazards, for example from heatwaves or periods of heavy precipitation may increase during the construction period however it is expected that these will be managed through standard construction and health and safety practices, such as securing material/equipment and not undertaking works during periods of extreme rainfall. The effect of climate change on the Development during the construction phase is therefore likely to be negligible. The impact of climate change on the Development during construction is therefore considered to be Not Significant.

Completed Development

14.132 Table 14.9 outlines the potential significant effects from climate on the identified receptors within the Development. Minor effects have been identified on future users of the Site as a result of increased frequency and intensity of heatwaves and a Minor effect on habitats, planting and landscaping as a result of more intense and frequent droughts. These effects are Not Significant. Moderate adverse effects were identified in relation to heavy rainfall and flooding, as identified in Chapter 13, which are assessed as Significant.

Table 14.9: Likely Significant Effects of Climate Change on the Development During Operation

Climate Condition / Hazard	Receptor	Receptor Vulnerability	Potential Impact (with embedded mitigation)	Significance
Long Term Changes to Climate Norms	Future Users of the Site	Moderate to High	Increased temperatures and drier summers may affect human behaviour with, for example, an increase in outdoor activity. The Development includes a network of open spaces, including footpaths, recreational cycle routes and areas for informal recreation. The design of the Development and open spaces considers creating shade and allowing throughflow of air to allow for cooling and reduce risk of overheating.	Negligible
	Infrastructure	Moderate	Infrastructure may require more maintenance and repair as changes to climatic norms may cause increased stress on, for example, below ground cables and pipes. This will be managed at the detailed design stage, where risk assessments will be undertaken to manage risks from future climate change in accordance with nationally accepted standards and guidance.	Negligible
	Ecology, Landscaping and Planting	Moderate	Warmer, drier summers and milder wetter winters are likely to have a long term impact on species' ranges, potentially causing flora and fauna to relocate to more tolerable climate conditions. The changes in annual and seasonal averages may also impact the timing of seasonal biological activities, such as migrating birds. Chapter 10 identifies that important habitat and species present are generally considered to be widespread and the Site is not near the edge of their ranges.	Negligible
Heatwaves	Future Users of the Site	Moderate to High	Increased frequency and intensity of heatwaves may adversely impact human health by increasing the risk of mortality and morbidity due to heat[xxxv]. Embedded mitigation in the design of the Development, for example the provision of open space should promote healthy lifestyles for all members of the community and provide evaporative cooling at night. This will help to reduce the risk of building overheating and maintain thermal comfort during periods of extreme heat.	Minor adverse
	Infrastructure	Moderate	Extremes in temperatures have the potential to damage infrastructure, for example causing tarmac to soften, melt and be more susceptible to damage. As a result, additional maintenance and emergency repairs may be required. This will be managed at the detailed design stage, where risk assessments will be undertaken to manage risks from future climate change in accordance with nationally accepted standards and guidance.	Negligible
	Ecology, Landscaping and Planting	Moderate	Increased frequency of extreme weather events such as heatwaves could change the type and structure of existing and proposed vegetation.	Minor adverse
Low Rainfall and Drought	Future Users of the Site	Moderate to High	Periods of low rainfall and drought have the potential to adversely affect public water supply. Water companies have a statutory duty to maintain a secure water supply during a drought and to produce Water Resources Management Plans (WRMP), which consider climate change and drought.	Negligible

Climate Condition / Hazard	Receptor	Receptor Vulnerability	Potential Impact (with embedded mitigation)	Significance
	Infrastructure	Moderate	Reduction in rainfall could cause soil moisture deficits, which may affect soil stability. This may increase risk of damage to infrastructure. This will be managed at the detailed design stage, where risk assessments will be undertaken to manage risks from future climate change in accordance with nationally accepted standards and guidance.	Negligible
	Ecology, Landscaping and Planting	Moderate	Increased frequency of low rainfall and droughts combined with higher average temperatures may adversely impact the productivity, function and structure of ecosystem services by, for example, causing an increase in erosion as soils and substrates dry out.	Minor
	Land Stability	Moderate	Consideration of land stability with regards to the foundations of structures and buildings is taken into account during the detailed design stages. The design of will be designed in accordance with UK standards for the soil type and condition found on Site.	Negligible
Heavy Rainfall and Flooding	Future Users of the Site	Moderate to High	Flooding has the potential to isolate future users of the Site, disrupt service provision, damage homes and increase risk to human health. Chapter 13 Water Resources and Flood Risk assesses the likely significant effects of flood risk and states that there will be a moderate adverse effect without additional mitigation.	Moderate Adverse
	Infrastructure	Moderate	Increased precipitation during the winter and more intense rainfall events are likely to increase flood risk and surface water run-off. This could prevent the use of and/or damage infrastructure and also adversely affect water quality Chapter 13 Water Resources and Flood Risk assesses the likely significant effects of flood risk and states that there will be a moderate adverse effect without additional mitigation. A summary of embedded mitigation with regards to flood risk and drainage is provided below, further details are outlined in Chapter 13 and the FRA (Appendix 13.1): • All 'most vulnerable' built development will be located within Flood Zone 1 and outside of the climate change Flood Zone 3 (for further details see FRA in Appendix 13.1); and • The finished floor levels will be set to a minimum of 150 mm above surrounding ground levels.	Moderate Adverse
	Ecology, Landscaping and Planting	Moderate	Flooding has the potential to damage planting and habitats on Site. As stated in Chapter 13 Water Resources and Flood Risk effects are expected to be moderate adverse without additional mitigation.	Moderate Adverse
	Land Stability	Moderate	The impact of heavy rainfall events and flooding may lead to an increased risk of slope and embankment instability. As the Site is largely on flat terrain, and the residential Development is not anticipated to include steep slopes or embankments, there is limited potential for landslide events. Furthermore, the FRA which accompanies Chapter 13 Water Resources and Flood Risk outlines how climate change is embedded within the flood risk mitigation measures and drainage design. Consideration of land stability with regards to the foundations of structures and buildings is taken into account during the detailed design stages. The design of	Negligible

Climate Condition / Hazard	Receptor	Receptor Vulnerability	Potential Impact (with embedded mitigation)	Significance
			foundations and drainage will take into consideration the ground conditions and any sensitive clay soils with higher swell potential, and will be designed in accordance with UK standards for the soil type and condition found on Site.	

Mitigation Measures

Construction Phase

14.133 Mitigation measures during the construction stage should be secured through a CEMP via a suitably worded planning condition. The CEMP will include several measures covering transport, waste, air quality, materials, water quality and health and safety for workers.

Completed Development

Landscape and Planting

14.134 The landscape and planting strategy, which will be developed at the detailed design stage, should seek to improve the climate resilience of the Development through the following measures:

- Planting should aim to be structurally diverse and include a range of pollen and nectar rich species that flower throughout the year and aim to maximise species diversity to strengthen the ecological network;
- Provision of woodland planting that will provide evaporative cooling at night, helping to reduce the heat island effect, and provide passive shading;
- The planting strategy should consider the selection of native plant and tree species that are deemed suitable for future climate conditions, including being tolerant to higher temperatures and drought; and
- The planting scheme should consider reducing the risk of soil erosion and help retain topsoil by providing a protective barrier from direct rainfall. The plant roots help stabilise the soil.

14.135 It is anticipated that a Landscape and Ecological Management Plan (LEMP). will be prepared for subsequent Reserved Matters applications on the Site. This should be secured through an appropriately worded planning condition. The LEMP would set out measures for ongoing management, maintenance and monitoring of habitats on Site. This would increase the long-term resilience of habitats and species within the Site and managing areas that may be affected by droughts.

Flood Risk and Surface Water Drainage

14.136 A SuDS-based drainage strategy will be in place during the completed development phase to

mitigate increased runoff rates and volumes from the Development. The SuDS have been adequately sized to account for climate change and to provide attenuation storage in line with planning policy and LLFA requirements.

Water Use

14.137 At detailed design, measures to reduce water demand and increase water efficiency in line with Building Regulations Part G will be considered to further increase resilience to droughts. The Development will accord with the North West Bicester WCS, aspiring to achieve BREEAM excellent standard for residential buildings, and a design standard to set home water demand to 105l/p/. The measures to achieve this will be secured through planning conditions and developed at reserved matters stage. These measures may include:

- Dual flush toilets - to reduce water consumption
- Leak detection systems
- Flow control devices - to reduce the flow rate of kitchen sink and bathroom basin taps
- Installing pulsed water meters with pulsed output and fitting sub-meters – to reduce the energy demands associated with water heating
- Using water-efficient appliances (e.g. those with an 'A' or 'B' rating as defined by the European Water Label).

Residual Effects

Construction Phase

14.138 The construction residual effects of climate change on the Development are judged to be negligible and Not Significant.

Completed Development

14.139 The minor adverse effect on human health as a result of the increased likelihood and frequency of heatwaves has been mitigated as far as possible with embedded mitigation. Mitigating these effects further is reliant on aspects outside the scope of the Development, such as increasing the resilience of health services and availability of emergency services. Therefore, these effects remain as minor adverse, which is considered to be Not Significant.

14.140 Potential minor adverse effects to ecology, landscaping and planting resulting from droughts and storms would be managed through the implementation of the LEMP and planting strategy.

The likely effect is therefore considered to be negligible and Not Significant.

14.141 The residual effect of heavy rainfall and flooding on receptors within the completed development would reduce to minor adverse which is assessed as significant, as detailed in Chapter 13 Water Resources and Flood Risk.

14.142 All other effects remain as negligible and Not Significant.

Cumulative Effects

14.143 No cumulative effects are anticipated on the basis that climate change resilience and adaptation effects and impacts are specific to the Development and will not result in impacts to neighbouring development or sensitive receptors. Cumulative effects are therefore negligible and Not Significant.

14.144 There is, however, potential for in-combination climate change effects to exacerbate other environmental effects identified in other topic chapters without mitigation. There is a need to deliver a co-ordinated approach to the climate change mitigation measures to provide climate resilience within the Development. It is considered that, with the implementation of embedded mitigation measures outlined within the assessment section of this chapter and careful consideration of further climate change mitigation and adaptation measures at the detailed design stages, the effects identified within the topic chapters will not be exacerbated as a result of climate change. In-combination effects are therefore negligible and Not Significant.

Summary

14.145 In accordance with the EIA Regulations and Institute of Environmental Management and Assessment (IEMA) guidance, the climate change assessment considers the likely significant environmental effects in relation to the impact of the Development on climate change (potential to emit greenhouse gasses (GHGs)) and the impact of climate change on the Development. There is no nationally adopted method for assessing climate change within EIA and therefore the assessment approach draws upon IEMA guidance.

GHG Emission Assessment

14.146 The GHG assessment utilises the World Business Council for Sustainable Development (WBCSD) / World Resources Institute (WRI) Greenhouse Gas Protocol, the British Standards Institution (BSI) PAS 2070 methodology and IEMA guidance.

14.147 The baseline conditions of the Site result in GHG emission from agricultural use. Existing hedgerows and two areas of woodland within the Site are likely to sequester small amounts of carbon.

14.148 During construction of the Development, GHG emission sources include enabling activities, combustion of fuels in vehicles, plants and equipment, as well as emissions associated with electricity needed for plant and welfare facilities. The assessment identified minor to moderate adverse effects resulting from construction GHG emissions without mitigation. With the implementation of a CEMP the residual effect of the Development on climate change during construction is considered to be temporary minor adverse and Not Significant.

14.149 During operation, direct GHG emissions will arise from transport movements as well as indirect GHG emissions from activates not undertaken within the Site, such as processing waste or provision and treatment of water supplies. The Development embeds several mitigation measures and will target net zero carbon. This means the Development will target no net carbon dioxide emissions relating to energy use from buildings. The assessment identified negligible to minor adverse effects resulting from operational GHG emissions.

14.150 Further mitigation measures such as the implementation of a Residential Travel Plan and specific energy efficiency measures that will be brought forward at detailed design and secured through planning conditions will reduce GHG emissions associated with the operation of the Development. GHG emissions are also expected to reduce over time with the increased use of EVs over petrol or diesel vehicles in line with Government policies and targets. It is therefore considered that the Development addresses operational GHG emissions. The residual effect of the Development on climate change during operation is considered to be permanent minor adverse, and Not Significant.

14.151 It should be noted that the SA/SEA of the Local Plan gives consideration to GHG emissions and accepts the impact of GHGs from the Development.

Climate Change Resilience and Adaptation

14.152 The climate change resilience and adaptation assessment has been undertaken with due regard to IEMA guidance.

14.153 UK Climate Projections (UKCP18) from the Met Office were used to establish evolving baseline climate conditions up to 2099. It is expected that the Site may experience warmer, drier summers and milder, wetter winters, along with an increase in frequency and intensity of extreme weather events such as droughts or heatwaves.

14.154 It is expected that risks from climate hazards during construction will be managed through standard construction and health and safety practices, such as securing material/equipment and not undertaking works during periods of extreme rainfall. The effect of climate change on the Development during the construction phase is therefore likely to be negligible and Not Significant.

14.155 During operation, minor adverse effects were identified on future users of the Development as a result of increased frequency and intensity of heatwaves and a minor adverse effect on habitats, planting and landscaping as a result of more intense and frequent droughts without mitigation. Moderate adverse effects were also identified as a result of heavy rainfall and flood risk without mitigation.

14.156 It is recommended that a CEMP, a LEMP and water efficiency measures are implemented at the appropriate stages of detailed design. With this mitigation in place, it is anticipated that the minor adverse effect on habitats, planting and landscaping will reduce to negligible, however effect on human health will remain as minor adverse. These effects are considered Not Significant.

14.157 A SuDS-based drainage strategy that accounts for climate change reduces flood risk effects to minor adverse, which is assessed as significant (see Chapter 13).

14.158 Table 14.10 contains a summary of the likely significant effects of the Development.

Table 14.10: Table of Significance – Climate Change

Potential Effect	Nature of Effect (Permanent/ Temporary)	Significance (Major/Moderate/Minor) (Beneficial/Adverse /Negligible)	Mitigation / Enhancement Measures	Geographical Importance*							Residual Effects (Major/Moderate/Minor) (Beneficial/Adverse /Negligible)
				I	UK	E	R	C	B	L	
Construction											
Scope 1 Emissions (direct emissions from combustion of fuels on site)	Temporary	Minor Adverse	Implementation of a CEMP							✓	Minor Adverse
Scope 2 Emissions (indirect emissions from purchased electricity)	Temporary	Minor Adverse	Implementation of a CEMP							✓	Minor Adverse
Scope 3 Emissions (indirect emissions from embodied carbon from purchased materials)	Temporary	Moderate Adverse	Implementation of a CEMP and SWMP				✓				Minor Adverse
Disruption to construction programme or to worker health as a result of climate change	Temporary	Negligible	Implementation of a CEMP							✓	Negligible
Completed Development											
Scope 1 Emissions (direct emissions from transport and gas emissions)	Permanent	Minor Adverse	Implementation of a Travel Plan							✓	Minor Adverse
Scope 2 Emissions (indirect emissions from purchased electricity)	Permanent	Negligible	Energy efficiency measures and renewable/low carbon technology to be confirmed at detailed design							✓	Negligible
Scope 3 Emissions (indirect emissions from waste and water management and supply)	Permanent	Minor Adverse	Water efficiency measures to be secured at detailed design							✓	Minor Adverse
Long term changes to climate norms	Permanent	Negligible	None							✓	Negligible
Heatwaves	Permanent	Negligible (infrastructure) Minor Adverse (future users, ecology, landscaping and planting)	Implementation of a LEMP							✓	Negligible (infrastructure, ecology, landscaping and planting) Minor Adverse (future users)

Potential Effect	Nature of Effect (Permanent/ Temporary)	Significance (Major/Moderate/Minor) (Beneficial/Adverse /Negligible)	Mitigation / Enhancement Measures	Geographical Importance*							Residual Effects (Major/Moderate/Minor) (Beneficial/Adverse /Negligible)
				I	UK	E	R	C	B	L	
Low Rainfall and Drought	Permanent	Negligible (future users, infrastructure, land stability) Minor Adverse (ecology, landscaping and planting)	Implementation of a LEMP Water efficiency measures to be confirmed at detailed design							✓	Negligible
Heavy Rainfall and Flooding	Permanent	Moderate Adverse (future users, infrastructure, ecology, landscaping and planting) Negligible (land stability)	SuDS							✓	Minor Adverse (future users, infrastructure, ecology, landscaping and planting) Negligible (land stability)
Cumulative Effects											
Construction											
GHGs	Temporary	Minor Adverse	Implementation of a CEMP							✓	Minor Adverse
Climate Resilience	N/A	N/A	N/A								N/A
Completed Development											
GHGs	Permanent	Minor Adverse	Energy and water efficiency measures and renewable/low carbon technology to be confirmed at detailed design							✓	Minor Adverse
Climate Resilience	N/A	N/A	N/A								N/A

*** Geographical Level of Importance**

I = International; UK = United Kingdom; E = England; R = Regional; C = County; B = Borough; L = Local

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