8. CLIMATE CHANGE

Introduction

8.1 This chapter of the ES assesses the likely significant effects of the Development on the environment in respect of Climate Change. It has been prepared by Barton Wilmore Institute of Environmental Management and Assessment (IEMA) EIA Quality Mark registrants.

Legislative and Policy Framework

National Legislation

8.2 This chapter assesses the effects of the proposed scheme in relation to climate change, in line with the requirements of the 2017 EIA Regulations (as amended):

> *"The EIA must identify, describe and assess in an appropriate manner, in light of each individual case, the direct and indirect significant effects of the proposed development on climate."*[1]
>
> *"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 greenhouse gas emissions) and the vulnerability of the project to climate change"*[2].

Climate Change and Sustainable Energy Act

8.3 The Climate Change and Sustainable Energy Act (2006) is an Act of Parliament which aims to boost the number of heat and electricity microgeneration installations in the United Kingdom, helping to cut carbon emissions and reduce fuel poverty. It gives powers to the UK Government to require certain organisations to report on how they are adapting to climate change through the Adaptation Reporting Power.

8.4 The Act provides that the government must set and meet national targets for the number of installed microgeneration systems and informs that the government must promote community energy projects. Local planning authorities may influence the success of community energy schemes through making planning permission for certain developments conditional on the use of such schemes.

[1] S.I. 2017 No. 571: Part 1; 4(2)(C)
[2] S.I. 2017 No. 571: Schedule 4; 5(f)

Climate Change Act 2008 and UK Carbon Plan 2011

8.5 Further to the Climate Change and Sustainable Energy Act (2006), the Climate Change Act (2008) sets a legally binding target for reducing greenhouse gas (GHG) emissions, in particular carbon dioxide (CO_2), by at least 80% (on 1990 levels) by the year 2050 in the United Kingdom (UK), and a requirement that domestic emissions are reduced by no less than 3% each year.

8.6 In setting these targets, the Act established the Committee for Climate Change (CCC), which is responsible for setting binding interim targets for the Government over five-year periods. In May 2019, the CCC recommend a new emissions target for the UK: a 100% reduction ('net zero') in greenhouse gases by 2050. This change is legislation mandating a 100% reduction in CO_2 emissions by 2050 was approved by the House of Commons on 24th June 2019 and the House of Lords on 26th June 2019.

8.7 The government's plans for achieving the emissions reductions it has committed to, including actions and incremental five-year milestones, are set-out in the UK Carbon Plan[3] which includes an interim target of 34% reduction in CO_2 emissions on 1990 levels by the year 2029[i].

The Clean Growth Strategy

In October 2017, the UK Government published its Clean Growth Strategy (CGS)[ii] setting out ambitious policies and proposals, through to 2032 and beyond, to reduce emissions across the economy and promote clean growth. The CGS provides an 'ambitious' blueprint for Britain's low carbon future, outlining how investment in green energy goes hand – in – hand with economic growth and industrial, commercial and residential strategies. Core to the strategy are actions that will cut emissions, increase efficiency and lower the amount consumers and business spent on energy. The CGS six key areas that together are responsible for 100% of the UK's carbon emissions. These are:

1. Improving business and industry efficiency (25% of UK emissions): Improving business and industry efficiency, improving energy productivity and commercial building standards, delivering industrial energy efficiency, investing in industrial innovation;
2. Accelerating the shift to low-carbon transport (24% of UK emissions): Accelerating the shift to low – carbon transport, supporting the take – up of ultra – low emission vehicles, developing electric vehicle charging network, shifting freight from road to rail and innovation in Connected and Autonomous Vehicles and electric batteries;

3. Improving our homes (13% of UK emissions): Improving our homes, upgrading energy efficiency across a million homes, strengthening building standards, rolling out het networks, phasing out of high carbon heating;
4. Enhancing the benefits and value of our natural resources (15% of UK emissions): Enhancing the benefits and value of our natural resources, supporting agriculture, a new network of forests, zero avoidable waste by 2050, managing emissions from landfill;
5. Leading the public sector (2% of UK emissions): Leading in the public sector, setting a voluntary 30 percent public sector carbon reduction target by 2020 and funding for energy efficiency improvements in England; and
6. Delivering clean, smart, flexible power (21% of UK emissions): Delivering clean, smart, flexible power, phasing – out of coal, developing new ways of balancing the grid through electricity storage and demand response.

25 Year Environment Plan

8.8 Building on the proposals set out in the CGS, the UK outlined its plans to improve the environment in 'A Green Future: Our 25 Year Plan to Improve the Environment' (2018)[iii]. The 25 Year Environment Plan was published in January 2018 and sets out the UK's approach to deliver on our ambition to leave our environment in a better state than we inherited, and to fully seize the opportunities of clean growth. At a glance, the key proponents of the 25 Year Plan are:

- **Embedding an 'environment net gain' principle for development, including housing and infrastructure:** reforming developer contributions and tariffs to limit environmental damage and secure investment in natural capital.
- **Clean Air:** meeting legally binding targets to reduce emissions of five damaging air pollutants; this should halve the effects of air pollution on health by 2030 and maintaining the continuous improvement in industrial emissions by building on existing good practice and the successful regulatory framework.
- **Reducing the risks of harm from environmental hazards**: We will reduce the risk of harm to people, the environment and the economy from natural hazards including flooding, drought and coastal erosion.
- **Increasing resource efficiency and reducing pollution and waste**: achieving zero avoidable waste by 2050 and eliminating avoidable plastic waste by 2042 and reducing food chain emissions and wastage as well as improving the management of residual waste.
- **Using resources from nature more sustainably and efficiently:** ensure that resources from nature, such as timber, are used more sustainably and efficiently.

- **Enhancing beauty, heritage and engagement with the natural environment:** making sure that there are high quality, accessible, natural spaces close to where people live and work, particularly in urban areas, and encouraging more people to spend time in them to benefit their health and wellbeing.
- **Mitigating and adapting to climate change:** We will take all possible action to mitigate climate change, while adapting to reduce its impact.

8.9 At the time of writing, The Environment Bill is to be considered by a Public Bill Committee. The Environment Bill in its current form legislates that the Secretary of State must prepare an environmental improvement plan, with the aim to significantly improving the natural environment. The current environmental improvement plan is "A green future: out 25 year plan to improve the environment", which as outlined above seeks to holistically tackle specific environmental issues and the wider climate change challenge.

National Planning Policy Framework and Planning Practice Guidance

8.10 The National Planning Policy Framework (NPPF)[iv] which was revised in February 2019 requires developments to "*take a proactive approach to mitigating and adapting to climate change.*" Section 14 of the NPPF 'Meeting the challenge of climate change, flooding and coastal change' emphasises the planning system's pivotal role in sustainable development through "*minimising vulnerability and improve resilience to the impacts of climate change*". Paragraph 149 of the NPPF states:

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

8.11 One of the NPPF's 12 core planning principles is to encourage the effective use of land by reusing land that has been previously developed (paragraphs 17 and 111). The use of Brownfield land helps to regenerate derelict sites and remediate land contaminated by previous uses. It can also help to protect the environment by minimising the use of Greenfield sites for development. The re – use of previously developed land provides a desirable and sustainable approach for accommodating future growth; as such sites are often located close to existing services and facilities. This can help to increase the likelihood of people choosing more sustainable modes of transport, such as walking, cycling or public transport, thereby

helping to reduce carbon emissions and the negative effects of climate change.

8.12 National Planning Practice Guidance (PPG)[v] was published in June 2014 and recognises that the planning system can "*increase resilience to climate change impact through the location, mix and design of development*". The guidance advises how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change.

8.13 Paragraph 005 of the PPG puts forwards recommendations for Local Planning Authorities 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 the future; and
- The potential vulnerability of a development to climate change risk over its whole lifetime.

8.14 The PPG on climate change (Paragraph 007) also recognises that every area will have different challenges and opportunities for reducing carbon emissions from new development such as homes, businesses, energy, transport and agricultural related development:

- Robust evaluation of future emissions will require consideration of different emission sources, likely trends taking into account requirements set in national legislation, and a range of development scenarios;
- The distribution of new development and the potential for servicing sites through sustainable transport solutions, are particularly important considerations that affect transport emissions; and
- Different sectors may have different options for mitigation. For example, measures for reducing emissions in agricultural related development include anaerobic digestion, improve 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.

8.15 Further detailed guidance is also provided with regards to specific considerations for climate change. For example, the PPG companion document to the NPPF sets out the required approach to climate change for the assessment of flood risk. It provides recommendations for sensitivity ranges and allowances for future increases in rainfall, sea levels, river flows and tidal effects such as wind speed and wave height. For example, paragraphs 155 and 156 of

the NPPF state:

> *"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.*
>
> *Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards."*

Regional and Local Planning Policy

The Adopted London Plan: London's Response to Climate Change[vi]

8.16 The London Plan supports the Mayor of London's strategies for tackling climate change, particularly in relation to the built environment. Chapter 5: London's Response to Climate Change provides a comprehensive suite of policies to support delivery of the Mayor's vision for London set out in the London Plan, in particular that London should be:

> *'**A City that becomes a world leader in improving the environment** locally and globally, taking the lead in tackling climate change…'*

8.17 Policies particularly relevant to this Chapter include:

- Policy 5.2: Minimising Carbon Dioxide Emissions. Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the Be lean; Be Clean; Be Green hierarchy, whilst also including detailed energy assessments.

- Policy 5.3: Sustainable Design and Construction. The highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime.

- Policy 5.7: Renewable Energy. Major development proposals should provide a reduction in expected carbon dioxide emission through the use of on-site renewable energy generation, where feasible.

- Policy 5.9: Overheating and Cooling. The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation.

- Policy 5.10: Urban Greening. Promotion and supporting urban greening, such as new planting in the public realm.

- Policy 5.13: Sustainable Drainage. Development should utilises sustainable urban drainage systems (SuDS) unless there are practical reasons for not doing so.

Zero Carbon London: a 1.5°c Compatible Plan[vii]:

8.18 The Mayor of London has committed to some of the most ambitious plans to tackle climate change in the world. In line with the International Panel of Climate Change's (IPCC) Special Report: Global Warming of 1.5°c[viii], the Mayor's London Environment Strategy and the actionable Plan provides a pathway for London to become a 'zero carbon' city by 2050. In doing so, it sets out the actions the Mayor will take, within his powers, to get there as soon as possible.

8.19 The Plan recognises that there is no singular pathway to achieving a zero carbon London. Instead, four scenarios are presented which rely on a different mix of technologies:

1. Decentralised energy: focuses on heat networks;
2. High electrification: heat pumps dominates (electric heating);
3. Decarbonised gas: Hydrogen replaces gas in the gas grid. Relies on carbon capture and storage; and
4. Patchwork: combination of heat pumps, heat networks and a partial hydrogen network.

8.20 In understanding the different pathways, the Plan is able to set an ambitious goal in line with the IPCC recommendations. This will see London reduce its emissions by 60% on 1990 levels by 2030, and by nearly 80% by 2040. In order to achieve this, the key messages are as follows:

1. 'We urgently need to increase the number of buildings retrofitted with energy efficiency measures';
2. 'Strong national government policy and programmes are needed to get London's buildings to the required levels of energy efficiency';
3. 'London's path towards net zero carbon relies on continued grid decarbonisation and

more ambitious national governmental action';

4. 'Any increase in London's energy demands should be offset by energy efficiency deployment and increasing use of smart technology to smooth peaks in demand';
5. 'Costs associated with grid updates should be manageable';
6. 'Government must decide which low carbon heat pathway the UK will take by mid 2020s at the latest';
7. 'Each different energy system pathway has its own pros and cons. However, costs may be similar and business as usual is not the cheapest option'; and
8. 'Decarbonising transport and increasing use of active and public transport remains a key objective for London'.

The Intend to Publish Version of the London Plan 2019[ix]

8.21 The Mayor of London published a new version of the Intend to Publish London Plan in December 2019 which provides a Spatial Development Strategy for Greater London. Whilst it has not been formally adopted, it is a relevant policy consideration and therefore the policies which are relevant to this Chapter are set out below. In developing the Plan, the Mayor paid particular regard to climate change and the consequences of climate change in order to promote the improvement of the environment in Greater London.

- Policy GG6: Increasing efficiency and resilience;
- Policy G1: Green Infrastructure;
- Policy S11: Improving Air Quality;
- Policy S12: Minimising greenhouse gas emissions;
- Policy S14: Minimising heat risk;
- Policy SI12: Flood Risk Management; and
- Policy T1: Strategic approach to Transport.

Core Strategy – Waltham Forest Local Plan 2012[x]

8.22 The Core Strategy is the key planning document for LBWF, setting out the overarching framework of policies for the region. In particular, the policies seek to maximise the benefits of regeneration whilst protecting the places and space the community values most. The Core Strategy policies relevant to this Chapter, include:

- Policy CS4 – Minimising and adapting to climate change;
- Policy CS5 – Enhancing green infrastructure and biodiversity;
- Policy CS7 – Developing sustainable transport;

- Policy CS15 – Well designed buildings, places and spaces.

Waltham Forest Draft Local Plan 2020-2035[xi]

8.23 Waltham Forest Council have a new Draft Local Plan which is currently at the public consultation stage and released in July 2019. The plan contains Development Management policies that are used to determine planning applications, and provides a planning framework for the period of 2020-2035.

8.24 Chapter 18 of the Draft Local Plan sets out the strategic objective of 'building resilience through addressing sustainability, efficient waste management and the effects of climate change through all stages in the development process'. The Draft Local Plan acknowledges that the Borough has the lowest emission per capita in Greater London, with 2.4 tonnes of C02 emitted per resident each year in the Borough. The aggregate breakdown of this is described in more detail in the Baseline Conditions for the Site. The Borough has achieved 34.7% reductions in C02 emissions from 2005 to 2017, with the breakdown of current C02 emissions as follows: Homes – 48%; Transport – 29%; Commercial and Industrial Sector – 23%. Applicable Policies are detailed below.

- Policy 90: A Zero Carbon Borough. Waltham Forest will minimise greenhouse gas emissions, reduce the Borough's carbon footprint and maximise energy efficiency within developments.
- Policy 91: Decentralised and Renewable Energy.
- Policy 92: Sustainable Design and Construction.
- Policy 93: Air Pollution.
- Policy 94: Water.
- Policy 95: Contaminated Land.
- Policy 96: Managing Flood Risk.

Guidance

Building Regulations

8.25 As of 2015, the Code for Sustainable Homes was withdrawn and merged into the Buildings Regulations. The Buildings Regulations, specifically Approved Document Part L; 'Conservation of Fuel and Power', determine the energy efficiency and carbon emission standards required by new buildings. Part L addresses controls for:

- insulation values of buildings elements;
- the allowable area of windows, doors and other opening;
- the air permeability of the structure;
- the heating efficiency of boilers;
- hot water storage and lighting;
- mechanical ventilation and air conditioning systems;
- space heating controls;
- airtightness testing of larger buildings;
- solar emission; and
- requirements for Carbon Index ratings.

8.26 As of 2016, the government implemented a 'Zero carbon homes policy' in a bid towards improving the fabric energy and efficiency performance of modern buildings. This proposal allows developers to have some flexibility in the way that they seek to off-set some of the carbon emissions through investing in off-site carbon reduction schemes, though the emphasis is on applying a 'fabric first approach'.

Institute of Environmental Management and Assessment (IEMA): Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation[xii]

8.27 The Guide to Climate Change Resilience and Adaptation (June 2020) provides an updated framework for the effective consideration of climate change resilience and adaption in the EIA process in line with the UK Town and Country Planning (EIA) Regulations (2017). This document is a revision of the 2015 IEMA guidance on Climate Change Resilience and Adaption in EIA and reflects lessons learnt from emerging practice.

8.28 A step by step method presented within this guidance is set out below and has been incorporated within this Chapter:

- Step 0 – Building climate resilience into the project by considering incorporating resilience during the designs stage and by identifying appropriate mitigation measures;
- Step 1 – Scoping for the EIA; e.g. identify the climate change projections for use in the assessment and identify key climatic variables relevant to the project;
- Step 2 – Defining the future (climate) baseline; define future conditions using selected climate change projections (i.e. increase in rainfall, increase in mean summer temperature and wind strength);
- Step 3 – Identifying and determining sensitivity of receptors;
- Step 4 – Reviewing and determining magnitude of the effect; consider probability and

consequence to determine the magnitude of the effect;
- Step 5 – Determination of significance;
- Step 6 – Developing additional adaptation / EIA mitigation measures;
- Step 7 (Development permitted) – Monitoring and adaptive management by implementing mitigation measures.

8.29 EIA Reports produced in line with this guidance are to be proportionate in their approach and not include superfluous assessment that does not address likely material issues.

IEMA Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance[xiii]

8.30 IEMA published this guidance (referred to hereafter to as IEMA GHG Guidance) to complement the guidance above, and seeks to assist practitioners with addressing greenhouse gas (GHG) emissions assessment and mitigation in statutory and non – statutory EIA. The guidance indicates that a 'good practice' approach is advocated where GHG emissions are always considered and reported but at varying degrees of detail depending on the project.

8.31 The guidance sets out there are a number of different assessment methods available for measuring and quantifying the GHG emissions associated with the built environment, ranging from general guidance to form standards for the use of an EIA. The Guidance recognising that *'qualitative assessments are acceptable, for example: where data is unavailable or where mitigation measures are agreed early on in the design phase with design and engineering teams'*.

UK Greenhouse Gas Statistics

8.32 The Department for Business, Energy & Industrial Strategy (BEIS)[xiv] reports on energy and emissions projections by source, and reports on local and regional GHG emissions. This has allowed the collection of baseline data for the period 2005-2018 for the Local Authority of Waltham, as well as London and Nationally.

Assessment Methodology

General Approach

8.33 'Climate' is generally understood to mean the weather conditions prevailing over a long period of time and climate change refers to changes in recorded long term climate trends. As a topic for the assessment within EIA, climate change is relatively new. Guidance is evolving and

there is no prescribed way in which climate change should be incorporated into an ES, however, some guidance has been prepared by IEMA, discussed further below, which sets out the two main approaches that can be taken to determine a project's climate change impact. These involve identifying:

- The vulnerability of the Development to climate change; and
- The direct and indirect influence on the Development on climate change.

8.34 The vulnerability of the Development to climate change considers effects on the Development as a receptor (this is referred to in IEMA Guidance as Climate Change Resilience and Adaptation). A high level climate change risk and resilience assessment has been undertaken to identify the potential risks of climate change on the Development and to high design measures to increase its resilience and adaptation to climate hazards, such as extreme hot and cold weather, intense rainfall, high winds and storm events.

8.35 Direct and indirect effects consider effects on environmental receptors as a result of the Development. The GHG Protocol[xv] defines direct and indirect emissions as follows:

- Direct GHG emissions are emissions from sources that are owned or controlled by the operator. Examples include vehicular emissions, plant use (such as generators) and independent onsite energy generation (oil, gas and diesel);
- Indirect GHG emissions are emissions that are a consequence of the construction of operational activities of the Development but are a result of procurement and / or activities controlled by another entity. Examples include energy generation and the manufacture of materials (known as 'embodied' carbon).

8.36 This chapter provides a quantitative, assumptions – based assessment of the direct effects of vehicular GHG emissions, in particular CO_2 during operations. This includes:

- Direct sources of vehicular and plant emissions of CO2 during construction;
- Direct sources of CO2 arising from vehicles, plant use and function during operation;
- Indirect sources of embodied carbon contained within building materials during construction; and
- Indirect sources arising from generation and consumption during operations.

8.37 In lieu of a prescribed methodology, IEMA guidance on Climate Change Resilience and Adaptation (2020) has been prepared to assist practitioners with the effective consideration "*of both climate change resilience and adaptation in the EIA process*". The guidance stresses

that climate change should be an integrated consideration within the EIA, by undertaking an assessment that is "*proportional to the evidence base available to support any assessment*" and focusses on impacts "*specific to project*".

Scope of Assessment

8.38 The following assessments are considered in terms of the Development. Accordingly, this Climate Change Chapter assesses the effects of climate change on the Development and the effects of the Development on climate change by:

- Establishing the existing baseline conditions (2020);
- Determining future baseline conditions by reviewing climatic projections (including identifying sensitive receptors);
- Assessing of the likely significant effects of the Development (alone and cumulatively) on the established baseline and future conditions; and
- Identification of mitigation measures and following the identification of residual effects.

8.39 The scope of this assessment was agreed with LBWF in the Scoping Opinion (Appendix 2.2) received on the 31st July 2020.

Temporal Scope

8.40 The assessment assumes the Development will be fully operational from 2025. In considering future climate change scenarios, managing climate change resilience and adaption, the IEMA guidance (2020) recommends the use of the UK Climate Projections (UKCP) Website (Met Office, 2018). The latest UKCP is UKCP18 which provides updated observations and climate change projections out to 2100 in the UK. Therefore, this assessment assumes projections for the 2100 as the most far-reaching projection and is considered to be appropriate for the design life of the Development.

Spatial Scope

8.41 The data available to allow an assessment of greenhouse gas emissions from vehicle movements associated with the Development is limited to the study area of the Transport Assessment and the same traffic data has been used as for the Noise and Air Quality assessments within this ES. The Development is anticipated to be fully operational in 2025, with first occupations expected in 2024. Therefore, this chapter is aligned with the Noise and Air Quality chapter in assessing vehicular emissions from 2024. This allows a worst – case

assessment of effects at the local scale. Given that climate change is a global issue, a qualitative assessment of the Development's effects is also made at the global scale.

Determining Significance

8.42 There is currently no industry – wide agreed threshold of carbon emissions which, if exceeded, can be defined as significant or potentially significant. The 2017 IEMA Guidance acknowledges that all emissions could lead to cumulatively significant effects.

8.43 The IEMA Guidance (2017) notes that the cumulative impact of carbon emissions arising from global human activity is considered *major* however, the contribution from individual developments, such as the Development in this ES, could be considered *negligible / low* in the context of the UK's emissions since, in isolation, the quantity of carbon emissions from an individual development is likely to have limited potential to significantly increase atmospheric carbon emissions towards global environmental targets.

8.44 In general EIA practice, the sensitivity of a receptor is typically defined by taking into consideration the vulnerability, value and recoverability of the receptor. With regard to the atmospheric carbon concentrations, the overall sensitivity of receptors is not used to assess significance in this instance.

8.45 An assessment of the significance of effect for the Development's vulnerability to climate changes is provided qualitatively with the most significant risks and opportunities for the project identified using professional judgement. The criteria for identifying the vulnerability of a receptor is outlined in Chapter 2 EIA Methodology of this ES and for the purposes of this Chapter, the sensitivity to change of receptors is considered as high. This view has been taken given the longevity of the life span of the Development and in consideration with the uncertainty of the projected pathway of climate change. A conclusion is drawn as to whether climate changes to likely to lead a significant impact on the Development or not.

Assessing Whole Life Cycle (WLC) Carbon

8.46 Chapmanbdsp have conducted a Whole Life Cycle (WLC) assessment in support of the planning application. The WLC demonstrates the full picture of the project carbon emissions resulting from materials extraction, construction and then, operation. A full summary of the stages of the life cycle and analysis scope is provided in Table 8.1 below.

Table 8.1 WLC Assessment Methodology & Scope

Life Cycle Stage	Analysis Scope
A1-A3 Construction Materials	Raw material supply (A1) includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also taken into account. Transport impacts (A2) include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.
A4 Transportation to Site	A4 includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.
A5 Construction / Installation process	A5 covers the exhaust emissions resulting from using energy during the site operations, the environmental impacts of production processes of fuel and energy and water as well as handling of waste until the end-of-waste state
B4 Material replacement	The environmental impacts of material replacements (B4) includes environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation and production of the replacing new material as well as the impacts from manufacturing the replacing material as well as handling of waste until the end-of-waste state.
B6 Energy Use	The considered use phase energy consumption (B6) impacts include exhaust emissions from any building level energy production as well as the environmental impacts of production processes of fuel and externally produced energy. Energy transmission losses are also taken into account.
C1-C4 Deconstruction	The impacts of deconstruction include impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally,deconstruction impacts includeemissions caused by waste energy recovery.
D External impacts/ end-of-life benefits	The external benefits include emission benefits from recycling recyclable building waste. Benefits for re-used or recycled material types include positive impact of replacing virgin based material with recycled material and benefits for materials that can be recovered for energy cover positive impact for replacing other energy streams based on average impacts of energy production.

Assessing Operational Vehicle Greenhouse Emissions

8.47 The assessment of carbon emissions and the evaluation of their significance is set out in IEMA Guidance (2017). The receptor for the assessment is the global atmosphere; the impacts of GHG emissions, in terms of their contribution to climate change, are global and cumulative in nature, with every tonne contributing to impacts on natural and human systems. The potential impacts of the Development, therefore, contribute to this global issue.

8.48 The climate change impact is assessed as the difference between the carbon emissions associated with the baseline and that associated with the fully completed Development. The study area for carbon emissions assessment is defined by the red line Site boundary and the

transport network assessed in the Transport Assessment (refer to Volume 2 of this ES). This transport network assessment is also utilised for the Air Quality Chapter (Chapter 6) of this ES.

8.49 The baseline conditions of the Site were based on the trip rates and existing published data sets (see Table 8.1). The baseline for the Site is defined as the current carbon emissions arising from vehicles in the study area. In terms of transport-related emissions, whilst forecasting can be carried out to project potential increases in traffic flows, and, by inference, the impact on C02 levels, the impact of technological changes is harder to infer. This includes the introduction and uptake of electric vehicles. Hence, the assessments broadly assume no impacts in terms of this, other than assumptions which are inherent in the Emissions Factors Toolkit (EFT V9.0)[xvi] utilised for the assessment. The updated EFT utilises updated data sets on Fleet Composition and information from the Transport for London and Mayor of London's Transport Strategy. Therefore, the assessments utilise best practice assumptions, but still represent a worst case assumption of climate change impacts.

Traffic flow data

8.50 24-hour, Average Annual Daily Traffic (AADT) flows (Appendix 8.1) were provided by WSP for the following scenarios:

- Baseline (2020);
- 'Do-minimum' (2024) (Baseline + growth + committed developments); and
- 'Do-something' (2024) (Baseline + growth + committed development + the Development).

8.51 Traffic data has been provided for 2024 as the projected opening year of the Development. Chapter 5 Construction Methodology & Phasing shows that it would be complete by 2025. Fleet composition was provided utilising the baseline split of Heavy Duty Vehicles (HDV) and Light Duty Vehicles (LDV) for Forest Road (A503) and Fulbourne Road (B160).

8.52 As per Appendix 8.1, mean vehicle speeds for the links used in the assessment were estimated based on maximum permitted speeds in the area and analysis of the road network (32kph based on the 20mph speed limit). In the absence of pre-defined distances for vehicles, the most recent UK average journey distance is defined by the National Travel Survey[xvii] provided by the Department for Transport as 10.9km (6.8 miles).

Vehicle Emissions Factors

8.53 An indicative assessment of emissions factors for $C0_2$ was determined for each scenario using the traffic data (appendix 8.1) and DEFRA's EFT (V9.0).

8.54 Assumptions of the inputs used in the carbon modelling are provided in Table 8.2 and details provided at Appendix 8.1.

Table 8.2 Traffic Data Assumptions

Opening Year of Development	**2024 'Do-minimum'**		**2024 'Do-something'**	
24 hour Average Annual Daily Traffic (AADT) of the Development*	LDV	29,570	LDV	30,137
	HDV	383	HDV	409
	Total:	**29,953**	**Total**	**30,546**
Link Length	10.9km			
Road Type	London			
Average Vehicle Speed**	20mph / 32kph			
* Trips are two way ** based on the posted speed limit of the roads surrounding the Development				

8.55 The fleet composition for the operational phase was taken from baseline fleet projection and predicted changes in fleet composition owing to the projected development uses. The road type utilised was 'London – Inner' to reflect the urban nature of the Site. The assessment presents a worst-case scenario as it does not consider the use of public transport, including a potential reduction in vehicular trips. The breakdown of emissions for conventional vehicle types includes conventional vehicle categories and does allow for, with some degree of uncertainty, the likely phasing of alternative (electric) vehicles as previously discussed.

Significance Criteria

8.56 In the absence of any significance criteria or a defined threshold, it might be considered that all carbon emissions are significant and beneficial effects only arise if there is a net loss in carbon and emissions. As per the IEMA Guidelines, when evaluating significance, all new GHG emissions contribute to a significant negative environmental effect. The significance of a project's emissions should be based on its net impact, which may be positive or negative, EIA should ensure an assessment addresses the occurrence of GHGs by taking mitigating action. Whilst there is no single preferred method to evaluate significance of effects given this topic is emerging within EIA, the approach to determining the significance of effects has applied available guidance, standard industry practice and profession judgement. The impacts have therefore been defined as either negligible (beneficial) or minor, moderate or major as set out in Table 8.3.

Table 8.3 Emissions Significance Criteria (Local Level)

Effect Significance	Description of Criteria Emissions from Road Traffic (C02)
Negligible	Emissions are equal to the emissions predicated in the 2025 'Do-minimum' scenario.
Minor	An increase in emissions predicated in the 2030 'Do-minimum' scenario, but less than 1% of total emissions from LBWF's current traffic-related emissions.
Moderate	An increase in emissions predicated in the 2030 'Do-minimum' scenario, but less than 2% of total emissions from LBWF's current traffic-related emissions.
Major	An increase in emissions predicated in the 2030 'Do-minimum' scenario, but less than 5% of total emissions from LBWF's current traffic-related emissions.

Assessing Resilience to Climate Change

8.57 To ensure climate change adaptation is assessed, this chapter draws on recognised climate change projections, existing guidance and emerging good practice as well as relevant information presented in the ES and documents, which form part of the planning application to ensure that appropriate project mitigation and risk management is included in the Development design. In particular, this chapter draws upon the findings of Chapter 7 Noise and Vibration, Chapter 6 Air Quality and the Transport Assessment.

8.58 A comprehensive flood risk assessment (FRA) has been carried out, in consultation with LBWF, to assess the vulnerability of the Development to all possible types of flooding. The assessment followed technical guidance within the NPPF and examined flood risks at the existing baseline level and at the future baseline for the lifetime of the Development, taking into account projected climate change impacts for all sources of flooding.

8.59 A Preliminary Ecological Appraisal (PEA) has been carried out by Aspect Ecology which accompanies the planning application. The appraisal provides an assessment of potential ecological impacts associated with the Development and evaluates the importance of the habitats and species present on the Site.

8.60 The PEA was then utilised for the purposes of calculating a biodiversity metric for the Site which is also submitted alongside the planning application. Furthermore, as a number of biodiversity-related European designations are located within the site surrounds, Aspect Ecology also conducted a Habitats Regulations Assessment (HRA) under the Conservation of Habitats and Species Regulations 2017 (as amended).

8.61 In doing so, the HRA analysed a number of pathways in which the Development may have a potential impact on the European Designations, including:

- Recreational pressure;

- Air pollution;
- Urbanisation;
- Water pollution;
- Hydrological changes;
- Invasive species; and
- Spread of disease.

Identifying Climate Change Projections

8.62 The current projections, 'UKCP18', released in November 2018, are now the most up to date climate change projections available. The Met Office states that UKCP18 provides a valid assessment of the UK's future climate over land, but that when considering decisions that are sensitive to projected future changes in summer rainfall, additional information should also be used. In line with IEMA Guidance, this Chapter utilises climate projections using the 'worst case scenario' of future weather projections, and therefore Representative Concentration Pathway (RCP) 8.5 scenarios are used. This worst case scenario assumes a 'business-as-usual' pathway through a combination of assumptions about high population levels, relatively slow income growth with modest rates of technological change and energy intensity improvements, leading in the long term to high energy demand and GHG emissions in absence of climate change policies[xviii].

8.63 Taking into account the nature and location of the Development, the following climate related parameters are also considered to have the potential to impact upon the operation of the Development:

- Wind (speed, direction and gustiness);
- Temperature; and
- Precipitation.

Assessment of Likely Significant Effects

8.64 The resilience of the Development to climate change impacts is qualitatively assessed, based on professional expertise and judgement, with quantitative evidence where appropriate.

8.65 A high value receptor that has very little resilience to changes in climatic conditions should be considered more likely to be significantly affected than a high value receptor which is more resilient to changes in climatic conditions. If there is uncertainty about how a receptor will adapt to a changing climate, then a precautionary approach should be employed (IEMA,

2015). Therefore, receptors have been assumed to have a high sensitivity to the changing climate.

Limitations and Assumptions

8.66 The following assumptions and limitations that apply to this assessment have been set out in this section.

8.67 This assessment of climate change and greenhouse gas emissions is based on available best practice information.

8.68 The construction phase of the Development is planned to begin in 2021 and be fully completed by 2025, with the climate unlikely to change significantly between the submission of the planning application and commencement of construction in 2021. For this reason, climate change adaptation and resilience during the construction phase has been scoped out of this assessment.

8.69 The decommissioning phase is not considered due to the long design life of the assets and given that emissions with the end of the life of this type of asset are relatively small and therefore unlikely to be significant.

8.70 The initial modelling of carbon emissions for vehicles during operations is illustrative as real – time carbon emissions associated with the Development are not available, thus informing early design discussions and decision making is based on limiting carbon emissions of the Development from the outset.

8.71 The UKCP18 climate change projections are not climate change predictions as they include a degree of uncertainty. As stated in the UKCP18 Science Overview Report[xix].

> *"While the global and regional projections of future climate use the latest climate models and are diverse they cannot cover all potential future climate outcomes out to 2100 (or beyond in the case of sea level)…"*

8.72 The 21st century projections presented in this report are produced for the Representative Concentration Pathways (RCP)[4] climate change scenarios. The results are therefore subject to any inherent limitations of the assumed emissions scenarios including:

> *"The probabilities represent the relative strength of evidence*

[4] Established by the Intergovernmental Panel on Climate Change (IPCC).

supporting different plausible outcomes for UK climate, based on the climate models, physical insight, observational evidence and statistical methodology used to produce them. However, they may not capture all possible future outcomes, because, for example, some potential influences on future climate are not yet understood well enough to be included in climate models."

8.73 The following receptors identified in other ES topic chapters and other supporting documents, and considered potentially sensitive to climate change:

- **Chapter 7: Noise and Vibration:** higher temperatures can alter the behaviour of noise sensitive receptors which can increase their exposure to noise.
- **Chapter 6: Air Quality:** An increase in temperature can lead to increased surface ozone, allowing more $N0_X$ to convert to nitrogen dioxide ($N0_2$), which may worsen local air quality conditions;
- **Flood Risk (FRA):** recommended 'Contingency Allowances' for Climate Change are guided by the Environment Agency. Considerations include fluvial flooding, groundwater, surface water runoff generation and overland flow, including flood risk receptors (people, property and infrastructure that may be at risk from any flooding, including the Development, any off-site properties and existing sewers). The FRA is to be found at Appendix 8.2.
- **Biodiversity:** There are potential threats to species both on the Site and to proximate European Sites.

Consultation

8.74 The consultation process is set out in Chapter 2, no additional consultation has taken place in relation to climate change. In the Scoping Opinion for the Development (Appendix 2.2), LBWF confirmed the requirement to assess the impact of the Development on Climate Change as part of the EIA process.

Baseline Conditions

Current Climate Conditions

8.75 This section summarises current climate conditions for the local area based on historic weather data and information about extreme weather events. The information presented below presents average weather conditions along with exceptional weather occurrences. To maintain relevance to current weather trends the displayed information has been calculated using data collected over the past two decades. There are approximately seven climate

stations serving the Greater London area. The climate profile is taken from closest available data source to the Site, located at Greenwich Park, approximately 12km to the south[xx].

8.76 Regionally, the climate is warm and temperate with a significant rainfall all-year-round. The climate here is classified as 'Ocean Atlantic' (Cfb) by the Köppen-Geiger system; '*these climates are dominated all year round by the polar front, leading to changeable, often overcast weather. Summers are mild due to cool ocean currents, although hotter, stable weather patterns can set in for periods of time. Winters are milder than other climates in similar latitudes, but usually very cloudy'*.

8.77 In a year, the average rainfall is 557.4 mm (52% less than the mean annual UK rainfall). The driest month is July (an average of 34.6 mm). Most of the precipitation here falls in October, averaging 61.1 mm.

8.78 The average annual temperature is 15.3 °C. With an average of 23.4 °C, July is the warmest month. January is the coldest month, with temperatures averaging 8.1 °C.

Current Baseline GHG Emissions for the Region

8.79 The current GHG emissions at the Borough Level are provided in Table 8.4. A breakdown of total GHG emissions from the three main sources for LBWF are provided over the period of 2005-2018 utilising the most recent data set. The Per Capita Emissions (tonnes) is compared against London and the UK average in Figure 8.1.

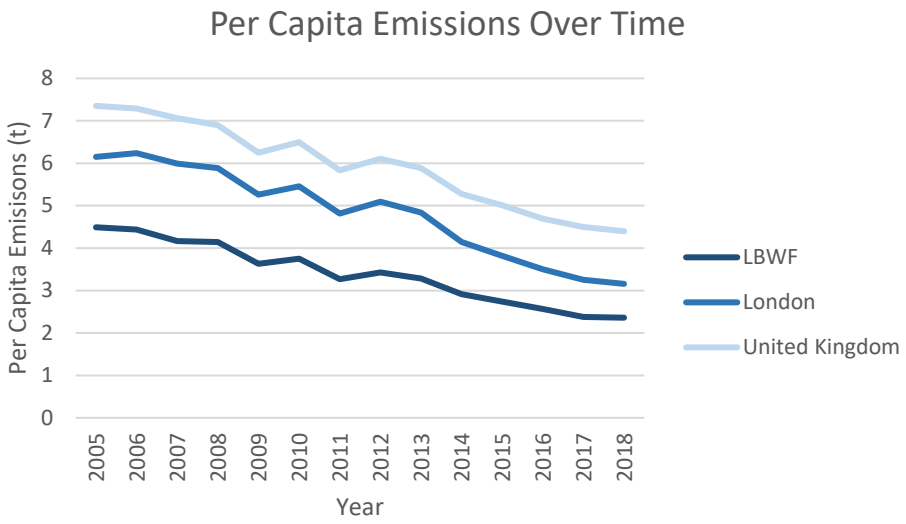
Table 8.4 GHG Emissions within LBWF 2005-2018

Year	Industry and Commercial Total (kt C02)	Domestic Total (kt C02)	Transport Total (kt C02)	Grand Total (C02)	Population ('000s, mid-year estimate)	Per Capita Emisisons (t)
2005	285.9	496.0	235.8	1,018.3	226.7	4.5
2006	306.2	490.8	225.9	1,025.5	230.7	4.4
2007	276.5	477.5	228.1	982.5	235.7	4.2
2008	307.7	483.0	211.2	1,002.2	242.1	4.1
2009	257.8	436.7	206.5	901.2	248.1	3.6
2010	279.9	466.9	206.5	953.5	254.0	3.8
2011	243.4	410.9	194.7	849.1	259.7	3.3
2012	256.5	442.5	199.9	898.9	262.5	3.4
2013	241.8	433.9	196.4	872.1	265.7	3.3
2014	204.9	364.3	207.1	779.4	267.8	2.9
2015	187.0	354.0	200.3	741.2	270.7	2.7
2016	164.0	336.7	203.5	704.1	274.2	2.6
2017	147.4	313.1	195.4	655.6	275.5	2.4
2018	149.2	312.8	191.3	653.0	276.7	2.4

8.80 Overall, carbon emissions have steadily declined within LBWF over the period 2005 to 2018. There has been a downward trend in the contribution of each of the three main sources of emissions, with Industry and Commercial being the largest percentage decrease, at 52% over the thirteen year period. This has led to a resultant decrease in the per capita emissions for LBWF where a 53% reduction has been seen over the time period.

8.81 Emissions from transport related sources have continued to fall from 2005-2018. The figure for 2018 is utilised for assessing the significance of predicted transport-related emissions arising from the operational phase of the Development.

Figure 8.1 Capita Intensity For LBWF, London and the United Kingdom



8.82 Figure 8.1 shows the $C0_2$ per capita emissions of LBWF compared against the benchmarks of London and the UK. The per capita figure is helpful in demonstrating the average impact on carbon dioxide emissions per person, by dividing the total carbon emissions by the total population. Figure 8.1 also shows that at the local, regional and national scale, per capita emissions have steadily fallen over the thirteen-year time period. It can be seen that LBWF has a lower per capita emissions than London and the UK. In 2018, the per capita emissions for LBWF was 25% less than that of London, and 45% less than the UK average.

8.83 London has the lowest $C0_2$ per capita emissions of any region due to the urban nature of the transport system, a high population density and its lower level of large industrial facilities than other regions[xxi].

Air Quality

8.84 LBWF has declared the entire borough an AQMA for exceedances of the annual mean nitrogen dioxide (NO_2) and daily mean particulate matter (PM_{10}) objectives.

8.85 The LBWF produced an Air Quality Action Plan outlining actions to tackle poor air quality that they will deliver between 2018-2023. The actions in the plan have been grouped into six categories that have been listed below:

1. Reducing emissions from developments and buildings;
2. Increasing of both public health and air quality awareness;
3. Reducing emissions from delivery services and freight;
4. Reducing emissions from the council's own vehicles;

5. Engaging in localised solutions; and
6. The use of cleaner transport.

8.86 Furthermore, the Greater London Authority has also designated Air Quality Focus Areas (AQFAs) which are pollution hotspots where there is a potential for high human exposure and therefore, air quality issues are most acute. The Site is not within any of the AQFAs.

Ecology

8.87 The Site comprises a Homebase home improvement store which is dominated by a single building and hardstanding, along with a small number of additional buildings, trees, ornamental planting and amenity grassland. Dense scrub and trees are located at the south eastern and eastern boundaries.

8.88 The buildings and hardstanding support a limited range of common and widespread floral species and are inherently of negligible ecological value and therefore do not form important ecological features. In addition, invasive species found on site are considered to be detrimental to ecology at the site level.

8.89 Surveying of faunal species on the Site have not recorded the presence of any protected or notable species, with low roosting potential for bats, mammals, birds and invertebrate species associated with urban habitats.

Noise

8.90 In summary, the noise climate at the Site and within the surrounding area is principally influenced by local road traffic noise (see Chapter 7 Noise).

Future Climate Conditions (up to 2100)

Temperatures

8.91 The central estimate of increase in mean annual temperature is 4.3ºC; it is very unlikely to be less than 2.1ºC and is very unlikely to be more than 6.2ºC. The central estimate of increase in winter mean temperature is 3.6ºC; it is very unlikely to be less than 1ºC and very unlikely to be more than 6.4ºC. The central estimate of increases in summer mean temperature is 5.7 ºC; it is very unlikely to be less than 2.2ºC and very unlikely to be more than 9.4ºC.

Precipitation

8.92 Winter rainfall is projected to increase and summer rainfall is most likely to decrease. The central estimate of change in winter mean precipitation is 24%; it is very unlikely to be less than -9% and is very unlikely to be more than 65%. The central estimate of change in summer mean precipitation is -40%; it is very unlikely to be less than -84% and is very unlikely to be more than 8%.

8.93 With respect to the continued validity of UKCP18 projections for summer rainfall (see above), whilst the full range of summer rainfall outcomes from UKCP18 are considered to remain valid in informing planning decisions, rainfall patterns across the UK are not consistent and will vary dependent on seasonal and regional scales and will continue to vary in the future (Met Office, 2019)[xxii].

Wind speed and storms

8.94 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. Calm periods with little wind, particularly over prolonged periods, can affect air quality whilst winds from a particular direction can be a critical factor in the spread of pathogens. Both of these cases are also examples where the combination of factors such as wind, temperature and precipitation can exacerbate their impacts (e.g. air quality issues tend to be worse under conditions of light winds and higher temperatures; pathogen spread can require wind, temperature and precipitation conditions to be favourable) (Met Office, 2019[xxiii]).

8.95 Changes in wind speeds are not currently available at the regional level and there remains considerable uncertainty in the projections, with respect to wind speed. However, there are small changes in projected wind speed (Met Office, 2019). Across the UK, near surface wind speeds are expected to increase in the second half of the 21st century with winter months experiencing more significant impacts of winds (Met Office, 2019). This is accompanied by an increase in frequency of winter storms over the UK. However, the increase in wind speeds is projected to be modest. There are no compelling trends in storminess as determined by maximum gust speeds from the UK wind network over the last four decades[xxiv].

Summary

16.1 The London region, where the Site is located, is set to experience hotter, drier summers and milder, wetter winters. With winter precipitation and the number of heavy rain days projected to increase, flooding events may be more likely and occur on a more frequent basis.

Conversely, summer precipitation is expected to decrease. Coupled with a central estimate of summer temperatures increasing by 5.7ºC, the area may experience an overall reduction in water resources. Whilst there are large uncertainties in the frequency and intensity of storms increasing under climate change, wind speeds are expected to increase slightly as well.

Likely Significant Effects

Construction Phase

Vehicle Movements

8.96 The Development will have an impact on climate change due to carbon emissions during construction as well as operation. During the construction phase, there may be some emissions of CO_2 from construction traffic accessing the Site, non-road mobile machinery and small generators temporarily used to power machinery and equipment on-site. However, these emissions will be infrequent and temporary occurring between 2021 and 2025. These are highly unlikely to make a significant contribution to the overall UK GHG emissions though they will lead to a net increase in carbon in the short term due to the nature of the operations.

8.97 Carbon emissions associated with construction are relatively small when compared with the total user carbon emissions over the study period. As detailed in Chapter 5 Construction Methodology & Phasing of this ES, daily construction vehicle movements are anticipated to be up to 20 LDVs and 30 HDVs per day. During this construction phase, the current operation of the Site as a home improvement store will cease. Therefore, upon consideration of the baseline traffic flows for the Site (See Appendix 8.1), there is likely to be a negligible overall effect on the climate from construction vehicle emissions when compared to the baseline of the Site. The transportation of materials to the Site is analysed through the WLC assessment conducted and submitted as part of the planning application and is to be found at Appendix 8.3.

Whole Life Cycle Analysis

8.98 In terms of the demolition process, it is expected that the Development will minimise the amount of waste material emanating from the Site. In addition, the Development will divert significant proportions of its construction waste from landfill and ensure that it follows best practice measures wherever possible. This will be achieved by sorting waste at source and sending as much as possible to be recycled, using techniques such as, cut and fill to minimise the volume of waste material and using recycled materials within the construction where feasible.

8.99 A Resource Management Plan will be prepared to enhance construction resource efficiency and secured by planning condition, with current aspirations of 70% of non-demolition material by volume diverted from landfill and up to 80% of demolition material by volume to be diverted from landfill.

8.100 In order to reduce embodied carbon and subsequent waste generation, whilst embedding circular economy principles, the following has been considered:

- Targeting the use of low-embodied carbon precast concrete bricks that would have nearly 50% reduction in embodied carbon when compared to the traditional clay brick;
- The team is working to achieve highly efficient spans that reduce construction material demand and is considering the use of ground-granulated blast-furnace slag (GGBS) to replace a part of the cement content within the concrete; and
- The concepts of designing for adaptability, disassembly, re-use and recycling will be kept being promoted within the team as the design progresses.

8.101 GGBS (Ground Granulated Blast-furnace Slag) is a cementitious material whose main use is in concrete and is a by-product from the blast-furnaces used to make iron. This can be a very effective strategy to reduce the concrete embodied carbon. The current concrete mix uses 25% of GGBS cement replacement. This proposed cement substitution can have an impact of approximately 18% reduction in the concrete embodied carbon.

8.102 The façade is composed of masonry brick supported by concrete frame and a Structural Framing System (SFS). Typically, a similar façade shows more than 40% savings on embodied carbon when compared to a precast brick panel façade. Furthermore, the use of SFS compared to traditional brick façade results in significantly fewer lorry deliveries.

8.103 The Tables below provides two scenarios for the results of embodied carbon assessments utilising the life-cycle modules detailed in Table 8.1. Table 8.5 utilises the current status of the electrical grid for calculation of B6 (operational energy), whilst Table 8.6 applies predicted grid decarbonisation when assessing B6 (operational energy). Table 8.5 is therefore, a worst-case scenario.

Table 8.5 Embodied Carbon Results assuming current grid status

	Module A1-A5 (Product Sourcing and construction stages)	Module B1-B5 (Use Stages)	Module B6-B7 (Operational energy)	Module C1-C4 (Deconstruction)	Module D (External Impacts / End-of-life benefits)
Total KG C02e	23,669,560	8,198,986	40,624,087	993,997	-10,969,105
Total Kg Co2e/M^{2}GIA	481.9	166.9	827.1	20.2	-223.3

Table 8.6 Embodied Carbon Results assuming predicted grid decarbonisation

	Module A1-A5 (Product Sourcing and construction stages)	Module B1-B5 (Use Stages)	Module B6-B7 (Operational energy)	Module C1-C4 (Deconstruction)	Module D (External Impacts / End-of-life benefits)
Total KG C02e	23,669,560	8,198,986	11,588,461	993,997	-10,969,105
Total Kg Co2e/M^{2}GIA	481.9	166.9	236.0	20.2	-223.3

8.104 As can be seen through a comparison of Table 8.4 and 8.5, the embodied carbon results from Module B6-B7 (Operational Energy) are greatly reduced upon assumption of the electricity grid decarbonising over the lifetime of the Development. The current WLC assessment, albeit based on a number on assumptions, shows that the project meets the GLA WLC benchmark for residential developments (900-1000 kg CO_2e/m2 GIA) and currently even falls within the Aspirational WLC benchmark for Stages A1-A5 (construction materials, transportation to Site and construction/installation processes.)

8.105 In line with IEMA guidance recognising that all emissions are potentially significant in nature, these construction effects are also significant at the local scale, and are considered not significant at the global scale.

Operational Phase

Vehicular Emissions

8.106 The impacts of carbon emissions arising from the operational stage of the completed Development are identified as having a contribution to climate change.

8.107 The Development will lead to a minor increase in road traffic on the local road network. The AADT flow associated with the Development is 30,456 vehicle trips per day (30,047 LDV and 409 HDV). The 'do-minimum' scenario without the Development has an AADT flow of 29,953

vehicle trips per day (29,570 LDV and 383 HDV). In total, the anticipated operational emissions for traffic will be 17,140 kilos of C02 per year (KgC02/yr), whilst the 'do-minimum' scenario is anticipated to generate 16,759kgC02/yr in 2025. With regards to traffic emissions, the completed Development is anticipated to result in an increase of 381KgC02/yr as a result of vehicular emissions locally.

8.108 This increase in vehicular emissions locally would, for disciplines other than climate change, be classified as a negligible effect. However as previously discussed, given that best practice acknowledges that all emissions are potentially all significant, the effect is assessed to be minor-adverse locally. In line with the significance criteria outlined in Table 8.2, the increase in operational vehicle emissions for the Development would be 0.002% of the Borough's annual traffic emissions for the year. Globally, the increase in emissions is not considered as significant.

Other sources of operational emissions

8.109 Other sources of operational emissions have been considered holistically in the life cycle assessment of embodied carbon and are discussed above.

Climate Change Adaptation

8.110 This section provides an assessment of the main potential risks presented by a changing climate to the Development, with a particular focus on the increased frequency of extreme weather events.

Temperature

8.111 At this stage of design, it is not clear that the direct effect of the Development on ecological and human receptor would alter substantially as a result. With the projected trend to warmer conditions, a rise in temperature has the potential to impact on habitat which in turn may affect the behaviour of bird interest, while changes in temperature could affect the composition and growth rates of plant communities and invertebrates and habitats. As previously discussed, rises in temperature also create risks to health, well-being and productivity.

8.112 In addition, green and biodiverse finishes will be implemented across the Development at roof and ground level. These areas will contribute to reducing the urban heat island effect by removing heat from the air and reducing the temperature of the roof surfaces and surrounding

air, positively impacting the Development. Trees and vegetation at ground level will provide shaded areas improving occupant comfort which can also help to manage ground moisture levels to help prevent damage occurring to the building via soil shrinkage.

8.113 Overheating assessments have been conducted for the purposes of the Energy Strategy submitted as part of the planning application and is to be found at Appendix 8.4. It is recognised that rising temperatures could lead to increasing use of open windows in order to prevent overheating of the residential units in the future. This has resultant impacts on ambient noise levels inside the residential units. The overheating assessment reports that 98% of bedrooms in all blocks and 84% of living rooms and kitchens pass the overheating criteria. Those rooms which did not pass the preliminary overheating assessment will be fitted with a peak lopping cooling coil which will temper the fresh air supply delivered via the mechanical ventilation with heat recovery (MVHR) system into all the bedrooms and living spaces, thus cooling the units without being exposed to above-threshold noise levels.

Wind

8.114 Over the lifetime of the Development, UKCP18 shows the change in wind speeds and storms is limited to well within the limits of current inter-annual variability. Therefore, no effects are anticipated.

Biodiversity

8.115 As outlined, the Site supports a limited range of common and widespread floral species and are inherently of negligible ecological value and therefore do not form important ecological features. In addition, invasive species found on site are considered to be detrimental to ecology at the site level.

8.116 Changes in precipitation and temperature could potentially affect the future of bird assemblages, particularly when taking changes in habitat into consideration. Biodiversity net gain will be delivered as part of the Development (Refer to Biodiversity Metric Calculations submitted as part of this Application for details) resulting in a 232.6% increase in habitat units post-intervention. This includes habitat retention, creation, enhancement and likely succession of habitats. Through ensuring that the planting is suited to adapt to the climatic changes outlined, through increasing the biodiversity of the Site, it is considered that the Development will be increasingly resilient to the effects of climate change. Although the effects of climate change is uncertain, the enhancement in biodiversity will result in a residual minor beneficial effect.

Noise and Vibration

8.117 As a result of higher temperatures, any building services equipment that provide cooling for the Development are likely to be required to operate at a higher intensity and for longer periods in the future, resulting in increased noise emissions. Noise sensitive receptors which are naturally ventilated (i.e. residential dwellings) are also likely to have their windows open for longer periods of time as a result of the increased temperatures, resulting in increased noise exposure. However, no significant effects are predicted as a consequence.

Air Quality

8.118 There is considerable uncertainty as to how background pollutant concentrations and vehicle emissions factors will change in future years. The analysis within Chapter 6 has shown that the magnitude of change in $N0_x$ and PM impacts resulting from vehicle emission generated by the Development will be 'negligible' at all receptor locations considered for the year 2024.

Precipitation & Flood Risk Assessment

8.119 The risk from increased precipitation is the potential for flooding, particularly if it is associated with extreme events. For the Development this increases the risk for potential destruction/disruption of infrastructure, e.g., flooding to building or disruption to travel. The effects of flooding are discussed later in this chapter. UKCP18 show that over the winter season precipitation is projected to increase.

8.120 The Site is in an area which is considered to be at 'low' risk of fluvial and groundwater flooding. The Development is not considered likely to alter overland flood routes or cause water displacement, therefore, no significant effects are anticipated.

8.121 The Drainage Strategy submitted alongside the planning application, in conjunction with the Flood Risk Assessment, provides inherent mitigation measures aimed to minimise risk of flooding.

8.122 Surface water from the Site will be collected via rainwater pipes, channels and road gullies to a below ground attenuation system which will connect to the existing piped system in Hawker Place. This surface water drainage attenuation has been modelled to withstand a range of events, including a 1 in 100 year flood event + 40% climate change event.

8.123 Furthermore, Sustainable Urban Drainage Systems (SuDS) have been considered during the design process. As discussed with regards to the provision of habitat creation on Site and the

resultant improvements in the resilience of the site with regards to biodiversity, brown roofs and rain gardens / bio-retention areas are to be provided. Furthermore, permeable paving and below ground attenuation systems form part of the Development. Permeable paving not only serves to attenuate waters, but also provide water quality measures through filtering the water. Excess water that does not infiltrate into the permeable paving will runoff into raingardens. The raingardens have been added to the SuDS treatment train for water quality and to reduce the volume of runoff, as the water will be filtered through the biodiverse planting and soil layers, with excess water from larger storm events that is not used by the planting to be collected in the stone layer below.

8.124 A site management team will ensure the maintenance of these strategy for the whole life maintenance of the network.

8.125 The Flood Risk Assessment identifies the need for the Development to be flood resistant and resilient, including safe access and escape routes for extreme flood events, 'design floods'. This includes:

- 1 in 100 (1%) fluvial flood accounting for climate change; and
- 1 in 200 (0.5%) tidal/coastal flood accounting for climate change.

8.126 Climate change is projected to increase the likelihood of flooding from most flood sources and therefore an assessment of the effects has been considered over the estimated development lifetime. Given the embedded mitigation[5] and Flood Risk Assessment conducted and submitted as part of the planning application, the magnitude of effect on the operation of the Development is assessed as low and the overall significance of effect is not significant.

Sustainability

8.127 Chapman BDSP has produced an energy and sustainability statement, to be found at Appendix 8.5, which outlines the nature of the proposals in terms of sustainability and explores the following:

- How the proposals are inherently sustainable in principle, due to their location, scale and mixed range of proposed uses;
- How the development is committed to sustainability objectives and targets;
- How the parameters and principles that underpin the applications might be implemented

[5] Outlined in Chapter 3 – Site and Development Description paragraphs 3.10 and 3.12. Also refer to supporting Design and Access Statement.

to embrace the latest thinking;
- How the development will address climate change in its design;
- How the best use of recycling and waste management will be encouraged; and
- How the development will encompass and prioritise life cycle and carbon assessment for construction and in use.

8.128 In addition to the above, a Design Stage pre – assessment has been carried out for the detailed elements of the Development, which indicates an anticipated BREEAM percentage score of 63% can be achieved based on the current design, and consequently the design has the potential to meet the 'Very good' target rating (>55%).

8.129 The energy strategy for reducing carbon dioxide emissions and energy consumptions within the Development will be to embrace a 'lean, clean and green approach'. The aspects of this approach are listed below:

- Lean – reduce the need for energy consumption by using advanced building modelling software and passive construction techniques;
- Clean – use energy as efficiently as possible through incorporation of high – efficiency systems and effective controls; and
- Green – supply energy from low or zero carbon technologies to help realise emission targets.

8.130 The energy strategy for this Development focuses on providing spaces that are comfortable throughout the year, but with minimal energy consumption and carbon emissions. The design approach for the Development follows the GLA energy hierarchy,i.e. being 'lean, clean, and green', and London Borough of Waltham Forest policies to achieve the following targets:

- 10% and 15% reduction in regulated carbon emissions through energy efficiency measures (Be Lean) for the domestic and non-domestic areas of the proposed development;
- An on-site reduction of 35% beyond Part L 2013 for the Development.

8.131 These targets are in line with the GLA's sustainable Design and Construction SPG as well as Waltham Forest Policy.

8.132 A 5G ambient loop district heating using Air Source Heat Pumps is the preferred system for the Development. The ambient loop system provides a source of energy to generate heating, hot water & cooling as required, serving all residential blocks and commercial/retail units.

8.133 Photovoltaic Panels (PV) are proposed for 440m^2 of roof space. Totalling 269 PVs, an efficiency of 18% is expected to maximise the Development's renewable energy generation capability.

8.134 These actions help to reduce fossil fuel usage and greenhouse gas emissions equivalent to 374 tonnes of CO_2 per annum. It represents a 64% saving in regulated carbon emissions when compared to the Building Regulations Part L2013 baseline. This is over and above the current London Plan targets and a significant step toward enabling the development to achieve zero regulated carbon emissions in the future.

8.135 During the operational phase of the Development, the Development will aim to meet a reduction in the amount of waste generated in line with regional LBWF policy. In order to minimise and manage waste generated on site, an integrated waste management strategy will be developed that will be follow the waste hierarchy; avoid, reuse, recycle and disposal of waste.

8.136 The Development seeks to use sustainable construction methods, including the use of steel construction materials, off – site manufacturing and materials, re use of materials from demolished structures and excavated during site preparation works and minimising water consumption through a range of measures.

8.137 The following passive design features are proposed and form inherent mitigation measures embedded within the design of the Development:

- High levels of envelope insulation to prevent heat loss;
- Airtight construction to prevent heat loss;
- Thermal bridges between building elements to prevent heat loss;
- Optimised glazing-to-solid ratios to minimise heat loss and overheating risk and cooling whilst maximising daylight;
- Highly efficient double glazing throughout with low-emissivity coatings to minimise heat loss and also prevent excessive solar gains.

8.138 This is in conjunction with the following energy-efficient plant propositions:

- High-efficiency mechanical ventilation systems with heat recovery for commercial and domestic areas;
- Low energy lighting throughout with occupant detection, where possible; and
- Smart meters, system controls and diagnostic systems to operate the building effectively.

8.139 The energy strategy of the scheme has considered multiple measures in line with the energy hierarchy to mitigate the effects of climate change through the specification of passive design, energy-efficient systems and low and zero carbon (LZC) technologies. The measures mitigate energy use in the first instance whilst also providing a significant proportion of the estimated resultant energy use via renewable energy sources.

8.140 The implementation of the options above, where appropriate, will reduce the overall carbon footprint of the Development and lead to a potential reduction in GHG emissions associated with the Development over its lifetime.

Mitigation Measures

8.141 During the construction phase, the potential for effects is associated with emissions from vehicles and plant, particulate matter and dust associated with construction activities. A Construction Environmental Management Plan (CEMP) will be prepared and agreed with LBWF as part of any planning consent. The CEMP will include all best practice measures. As the emissions from construction phase traffic would be temporary, significant impacts are unlikely. During demolition of the existing infrastructure (See Chapter 3), the re-use, recycling and reduction of construction waste will be promoted to reduce the Development's overall carbon footprint by reducing the need to extract raw materials.

GHG emissions related to Transport

8.142 During the construction phase, a Waste Management Strategy will include an Outline Construction Waste Management Plan to be secured by planning condition, to ensure the segregation of construction materials for ease of re-use and recycling, thus minimising waste to landfill. Where possible and in line with best practice guidance, material will be processed at sites as close to the Site.

8.143 A Travel Plan (TP) is submitted alongside the planning application which identifies an appropriate package of measures aimed at promoting sustainable travel, with an emphasis of promoting alternatives to the private car. This in turn, is to the effect of mitigating effects on climate change from vehicular emissions.

8.144 A Travel Plan coordinator (TPC) will be appointed to take responsibility of the development and management of the plan. The TPC will ensure that the adoption of the TP is effective and efficient and will be included in all green leases for tenants. The provision of an approved TP will be incorporated into the Section 106 Agreement for the application.

8.145 The Development is considered 'car-free' and therefore it is not necessary to formulate specific measures for single occupancy vehicle trips as the residents will naturally travel to and from the site via sustainable modes of transport. Instead, the targets focus on promoting cycling to and from the Site. Hard engineering measures included within the design of the development include:

- Permeable pedestrian environment, of high quality with attractive public open spaces; well maintained and legible routes; lighting; signage and the use of quality materials. This is so that a safe and secure pedestrian environment is provided within the Site. The Site already benefits from good pedestrian connectivity to local amenities and transport links.
- Car parking spaces are provided at a ratio of approximately 0.043 spaces per dwellings, for blue badge holders;
- Safe and secure cycle parking will be within the Development, in line with TfL standards. In total, 1,054 long stay cycle parking and 15 short stay visitor cycle parking spaces will be provided;
- All homes within the Development will be able to access broadband, subject to signing up to an internet service provider, which will ensure that residents have the ability to work from home, carry out web-based shopping and access online travel and service information;
- Introduction of a car club along Hawker Place, which enables residents to use a car occasionally;
- Parcel lockers will be provided so that the number of repeat or failed deliveries is minimised.

8.146 Soft measures included in the TP aiming at promoting a communication strategy for residents includes: Website Information and a residential travel pack.

Residual Effects

8.147 In accordance with the methodology prescribed in Chapter 2 of this ES, the anticipated residual effects have been classified according to whether they are considered to be negligible, minor, moderate or major; and beneficial or adverse. The mitigation measures outlined above have the potential to further reduce the carbon emissions arising from the Development through influencing behavioural change, where possible.

8.148 In most cases, residual effects during construction will be of a temporary nature, but given that the duration of construction could be up to four years, some effects could be regarded as being short term.

8.149 No significant residual effects have been identified in relation to climate change adaptation or emissions reduction.

Cumulative Effects

8.150 The cumulative impact of carbon emissions arising from global human activity is High. This is true to the nature of climate change as a global, cumulative problem. As committed developments have been assessed throughout this ES and particularly through the cumulative vehicular transport scenarios, the potential inter-scheme cumulative effects during the operational phase of the Development have already been considered.

8.151 It is assumed that all committed developments will be required to meet relevant standards for emissions reduction and to comply with related planning policy. On this basis, it is considered appropriate to assume that any applications that are consented include 'reasonable' measures to avoid, reduce and /or offset the generation of greenhouse gas emissions and therefore that no significant cumulative effects are anticipated.

Summary

8.152 To reflect the new requirements of the 2017 EIA Regulations, an assessment has been undertaken of the potential effects of the Development on climate change. This includes the effects of the Development on climate change (climate change mitigation) and the vulnerability of the Development to climate change ('climate change adaptation/resilience').

8.153 The assessment has been undertaken in accordance with published guidance on considering climate change in Environmental Impact Assessment and consequently reviews how climate change has been considered at all stages of project progression and assessment.

8.154 Construction and operation of the Development is likely to result in emissions of CO_2 from direct sources and indirect sources. It is not anticipated that the scale of projected climate change identified will fundamentally alter baseline conditions or the effects included in this ES. Overall, with the design and mitigation measures proposed, the Development is considered to be resilient to projected climate change.

8.155 A Whole Life Cycle (WLC) assessment of embodied carbon has also been undertaken. The current WLC assessment, albeit based on a number on assumptions, shows that the project meets the GLA WLC benchmark for residential developments (900-1000 kg CO_2e/m^2 GIA) and currently even falls within the Aspirational WLC benchmark for Stages A1-A5 (construction materials, transportation to Site and construction/installation processes.)

8.156 Indicative results based upon operational vehicular projections for the operational year (2024) estimate that the Development will result in 381kg of carbon dioxide emissions, per annum, without mitigation when compared to the baseline scenario. Key design principles, such as adherence to the Building Regulations, are embedded within the Development to minimise climate risks.

8.157 Table 8.7 contains a summary of the likely significant effects of the Development.

Table 8.7: 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											
Construction vehicle movements	Permanent	Negligible	N/A	X							Negligible
Completed Development (Vulnerability of the Development to Climate Change)											
Projected increase in mean summer and winter temperatures.	Permanent	Negligible	N/A - No significant climate change resilience effects have been identified	X							Negligible
Projected increase in annual precipitation.	Permanent	Negligible	N/A - The area will be protected by flood defences that were designed with climate change effects in mind.	X							Negligible
Projected decrease in mean summer precipitation.	Permanent	Negligible	N/A - No significant climate change resilience effects have been identified	X							Negligible
Extreme weather events (such as heavy and/or Prolonged precipitation and storm events).	Permanent	Negligible	N/A - No significant climate change resilience effects have been identified	X							Negligible
Completed Development (Effects of the Development on Climate Change)											
Vehicular Emissions	Permanent	Minor Adverse (Locally). Expected minor to negligible (Nationally).	Travel Plan to promote sustainable travel.	X							With the implementation of mitigation measures, minor adverse to negligible effects are expected locally and negligible effects nationally.
Building Emissions	Permanent	Moderate to Minor Adverse (Locally). Expected minor to negligible (Nationally).	N/A	X							Negligible

Indirect Emissions (Energy)	Permanent	Moderate to Minor Adverse (Locally). Expected minor to negligible (Nationally).	N/A	X							Negligible
Cumulative Effects											
Construction											
No significant effects											
Operation											
No significant effects											

*** Geographical Level of Importance**

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

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