

11. Climate Change

Introduction

- 11.1 This Chapter has been prepared by Watt Energy and Consulting Engineers (WECE) and reports the likely significant effects of the Proposed Development in terms of climate change in the context of the Site and surrounding, and wider environment, recognising that climate change is a global issue.
- 11.2 Three aspects of climate change assessment will be presented within this chapter:
- Assessment of Impacts: A conventional impact assessment that will focus on the potential effects of the Proposed Development (i.e. greenhouse gas (GHG) emissions on the climate);
 - Mitigation of Climate Change: An overview of how the Proposed Development aids in the mitigation of climate change; and
 - Vulnerability and Risk Assessment: A qualitative discussion of the vulnerability of the Proposed Development to climate change effects
- 11.3 This Chapter (with its associated figures and appendices) is not intended to be read as a standalone assessment and reference should be made to the front end of this ES (Chapters 1 – 5), as well as the final chapters, 'Cumulative Effects' and 'Summary of Mitigation and Residual Effects' (Chapters 12).
- 11.4 This chapter is supported by the following appendices
- Appendix 11.1 – Sustainability Statement and Energy Strategy

Planning Policy Context

Legislation

Climate Change Act 2008ⁱ

- 11.5 The Climate Change Act 2008 establishes the framework for the UK to set and deliver GHG emission reduction targets; mainly through the establishment of the Committee on Climate Change which ensures targets are evidence based and independently assessed. The Act commits the UK government to reduce GHG emissions to a minimum of 80% below 1990 baseline levels by 2050. In addition to this, the Government is also required to regularly report on emission target progress,

assess the risks and opportunities to the UK associated with climate change, and develop preparation and adaptive plans for these.

- 11.6 The UK Climate Change Risk Assessmentⁱⁱ is required to be produced every five years under the Climate Change Act 2008, in order to look at the risks and opportunities arising for the UK from climate change. The 2017 series of reports, alongside other documents from the European Commissionⁱⁱⁱ and National House Building Council Foundation^{iv} are used in this chapter to assess potential vulnerabilities and adaptive potential of the proposed development and site regarding climate change impacts.

Town and Country Planning EIA Regulations 2017^v

- 11.7 On the 16th May 2017, the European Commission Environmental Impact Assessment Directive (2014/52/EU) was incorporated into English law under the Town and Country Planning (Environmental Impact Assessment) Regulations 2017. This legislation requires the consideration of climate change within an EIA. The key text in relation to climate change is provided below.

Schedule 3: Regulation 5(4)

1(f): "The characteristics of development must be considered with particular regard to the risk of major accidents and/or disasters relevant to the development concerned, including those caused by climate change, in accordance with scientific knowledge."

Schedule 4: Regulation 18(3) INFORMATION FOR INCLUSION IN ENVIRONMENTAL STATEMENTS

"A description of the likely significant effects of the development on the environment resulting from, inter alia:" ...

4: "A description of the factors specified in regulation 4(2) likely to be significantly affected by the development...climate (for example GHG emissions, impacts relevant to adaptation)"

5(f): "the impact of the project on climate (for example the nature and magnitude of GHG emissions) and the vulnerability of the proposed development to climate change"

Building Regulations

- 11.8 Parts of the subsequent discussion relate to energy use in buildings due to the direct relation with GHG emissions. Part L of The Building Regulations sets fabric energy efficiency standards, energy efficiency requirements and CO₂ emissions limits for dwellings and non-residential buildings. Approved document 'L1A and L2A 2021 edition provide details on the assessment criteria and methodologies

used to test whether buildings are compliant. Aside from any local planning policy requirements it must be demonstrated that a building is compliant with the building regulations to be approved by building control. These regulations are the government's key mechanism for reducing CO₂ emissions in buildings.

- 11.9 Calculations are undertaken using a prescribed methodology - the Standard Assessment Procedure (SAP). A Target Emissions Rate (TER) is calculated, which represents the minimum standard for a building of that size. A Dwelling Emissions Rate (DER) is then calculated which is an estimation of likely emissions for the development in question. The DER must not exceed the TER for a building to be compliant.
- 11.10 Whilst these assessments are typically undertaken post planning when specification and information regarding mechanical and electrical systems have been produced, the regulations are significant to this assessment because it legally binds new buildings to be constructed to a minimum standard, which can be utilised as a baseline.

National Planning Policy and Sustainable Design Definitions

National Planning Policy Framework^{vi}

- 11.11 The policies within the NPPF relevant to climate change can be found in chapter 14 'Meeting the challenge of climate change, flooding and coastal change'. Those most specific to this assessment are detailed below:
- 11.12 Paragraph 157: *"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in GHG emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."*
- 11.13 Paragraph 158: *"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."*
- 11.14 Paragraph 159: *"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 infrastructure; and b) can help to reduce GHG emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards."

- 11.15 Paragraph 160: *"To help increase the use and supply of renewable and low carbon energy and heat, plans should: a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts); b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers."*
- 11.16 Paragraph 162: *"In determining planning applications, local planning authorities should expect new development to: a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption."*
- 11.17 Paragraph 167: *"All plans should apply a sequential, risk-based approach to the location of development – taking into account the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by: a) applying the sequential test and then, if necessary, the exception test as set out below; b) safeguarding land from development that is required, or likely to be required, for current or future flood management; c) using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques); and d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations."*

Any Other Relevant National Planning or Development Strategies

- 11.18 Supplementary planning guidance on climate change was issued in 2014 with the aim to advise *"how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change."* This provides guidance to authorities for the implementation of climate change considerations into Local Plans but is helpful in outlining the topic areas for review and suggestions of general mitigation and adaptation methods.

Sustainable Design Definitions

11.19 As a result of ever changing and improving carbon emission targets, developments are required to take more sustainable approaches to the construction of their buildings which commonly differ from site to site. This results in buildings being explained under many definitions and using various terminology when they incorporate sustainable design to reduce these carbon emissions.

11.20 The most common of these terminologies can be summarised as:

- Net Zero Carbon;
- Carbon Neutral; and
- Low Carbon.

Table 11.1 below outlines the formal definitions of each of these terminologies.

Terminology	Carbon/Energy targets	Definition
Net Zero Carbon	Net Zero carbon emission	Buildings that generate 100% of their energy needs on-site without the need to import energy.
Carbon Neutral	Net Zero carbon emissions	Buildings achieving net zero carbon emissions by offsetting through the use of a renewable supplier (electricity only) or via a financial contribution.
Low Carbon	Carbon emission % reduction normally over the Building Regulation standards	Buildings achieving reduced carbon emissions through energy efficient design.

Local Planning Policy

Knowsley Local Plan Core Strategy

11.21 Policy SD1 – Sustainable Development states that:

“The NPPF requires that a presumption in favour of sustainable development be central to both plan-making and decision-taking. Policy SD1 reflects the commitment to this approach within Knowsley's Local Plan. All development must follow the principle of the Energy Hierarchy, being designed:

- 1) *When considering development proposals, a positive approach will be taken, which reflects the presumption in favour of sustainable development contained in the National Planning Policy Framework. Work will be undertaken pro-actively with applicants jointly to find solutions which mean that proposals can be approved wherever possible, and to secure development that improves the economic, social and environmental conditions in the area.*

- 2) *Planning applications that accord with the policies in this Local Plan (and any relevant policies in Neighbourhood Plans) will be approved without delay, unless material considerations indicate otherwise.*
- 3) *Where there are no policies relevant to the application or relevant policies are out of date at the time of making the decision then permission will be granted unless material considerations indicate otherwise – taking into account whether:*
 - a. *Any adverse impacts of granting permission would significantly and demonstrably outweigh the benefits, when assessed against the policies in the National Planning Policy Framework taken as a whole; or*
 - b. *Specific policies in that Framework indicate that development should be restricted*

11.22 Policy CS22: Sustainable and Low Carbon Development states that:

“It is important that Knowsley's development needs up to 2028 are delivered in a sustainable manner, so that the link between carbon emissions and growth is broken and the borough's vulnerable communities are protected from fuel poverty. Policy CS22 aims to achieve this by encouraging provision of appropriate renewable and low carbon energy infrastructure and increasing energy efficiency through sustainable construction techniques.

Sustainable Construction Principles

1. *New development will be required to meet high standards of sustainable design and construction and minimise carbon emissions. This should be achieved by:*
 - a. *Designing new buildings for flexible uses throughout their lifetime;*
 - b. *Avoiding the creation of adverse local climate conditions by using natural systems to avoid internal overheating and excessive heat generation;*
 - c. *Ensuring developments are comfortable and safe for users;*
 - d. *Making the most effective and sustainable use of water, aggregates and other resources;*
 - e. *Limiting energy use by incorporating high standards of insulation, heat retention, natural ventilation and passive solar techniques;*
 - f. *Landscaping (including measures such as green walls or roofs) to create shelter and reduce any heat island effect;*
 - g. *Using sustainable materials from local suppliers where possible;*

- h. Supplying energy efficiently and incorporating decentralised energy systems, using renewable and low carbon energy where feasible;*
- i. Managing flood risk, including through the use of Sustainable Drainage Systems (SuDS) and flood resilient design for infrastructure and property; and*
- j. Promoting sustainable waste practices in new and existing developments.*

Low Carbon Development, Community Energy Fund and Allowable Solutions

- 2. Government targets for carbon reduction in new development are expected to be implemented through updates to the Building Regulations. Where it is not technically feasible or economically viable to meet the requirements on site, contributions to the Council's Community Energy Fund may be accepted as one of a range of options under the Government's proposed 'Allowable Solutions' mechanism. The Fund will be used to support carbon reduction initiatives in Knowsley and potentially the wider Liverpool City Region.*

Sustainable Construction Targets

- 3. Local targets for sustainability in relation to specific development areas or sites may be outlined in the Local Plan: Site Allocations and Development Policies.*

Priority Zones and Decentralised Energy Networks

- 4. Knowsley Industrial Park and Knowsley Business Park are identified as a 'Priority Zone'. Within this area the Council and its partners will facilitate renewable and low carbon infrastructure by (subject to feasibility) requiring new development to:*
 - a. Make provision for connection to an existing or planned decentralised energy network; and*
 - b. Be designed to enable future connectivity in terms of proposed site layout, infrastructure and heating provision, including consideration of connections at a later date or phase.*
 - c. Subject to opportunity and need, additional 'Priority Zones' may be identified in the Local Plan: Site Allocations and Development Policies.*

11.23 Policy CS23: Renewable and Low carbon Infrastructure States that:

"1. The Council will support proposals that will produce and distribute decentralised, low carbon and renewable energy, provided that they do not cause significant harm (in terms of their number, scale, siting or cumulative impacts) to:

- a) Natural resources, biodiversity, geodiversity, water and air quality and, landscape character;*
- b) Aviation and transport safety;*

c) Historical and cultural assets;

d) Public amenity and living conditions; or

e) Openness and amenity of the Green Belt, except in very special circumstances.

2. Proposals must be accompanied by information that shows how the local environment will be protected, and how the site will be restored when energy production ends. Proposals resulting in an unacceptable impact must be mitigated by appropriate measures agreed by the Council."

Other Relevant Policy, Standards and Guidance

11.24 Due to the relatively recent incorporation of climate change within EIA regulations, there is currently little guidance on best practise techniques and methodologies to use in the assessment of effects.

11.25 This assessment has considered the following recent guidance:

- The Institute of Environmental Management and Assessment (IEMA), 'Environmental impact assessment guide to assessing GHG emissions and evaluating their significance' (2017)^{vii};
- IEMA and European Commission, 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment' (2013)^{viii} ;
- BSI - PAS 2080:2016 'Carbon Management in Infrastructure'^x
- European Investment Bank (EIB) (2014)^{xi}, and,
- Royal Institution of Chartered Surveyors (RICS) 'Whole life carbon assessment for the built environment' (2017)^{xii}

11.26 Although not specifically designed for EIA purposes, the European Investment Bank guidance sets out a credible and viable definition for the baseline scenario in terms of climate change, as this differs to the definition of a baseline scenario in other sections of the ES.

11.27 This methodological approach is recommended by the European Commission in its guidance document, 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment' (2013).

11.28 In summary, the baseline scenario does not consider a "do nothing scenario". It assumes that there is demand for housing and supply is required for housing targets to be met. Therefore, the assessment baseline scenario can be considered to be a 'typical' development which:

- Delivers the same outputs as the proposed development;

- Is built to standard building regulations using normal construction practices; and
- Is constructed in a nominal location

11.29 A 2019 technical note from European Bank for Reconstruction and Development (EBRD)^{xiii} states that this type of baseline is appropriate since *"it is recognised that 'something' must be done"* and it allows for a comparison of relative effect.

Approach

Assessment Methodology

- 11.30 The assessment considers the CO₂ emissions associated with electricity and gas use within the new homes forming the proposed development.
- 11.31 The development is adopting a 'fabric-first' approach whereby fabric efficiency and u-values have been designed to meet building regulations 2021 minima. This will mean the overall heating demand will be low.
- 11.32 Photovoltaic Panels (PV) are being considered by the design team to offset residual carbon emissions from the dwellings.
- 11.33 The proposed development aims to reduce the regulated residential emissions to comply with the current building regulations (June 2022). The current regulations are much more stringent than the previous ones so complying with these is sufficient from a policy perspective.

Defining Parameters

Residential

- 11.34 The build mix, has been provided by the architect and is based on the current proposal of 807 new build houses. These will be a mix of two, three and four bed dwellings, with a mix of affordable and private property types.

Scope of Assessment

- 11.35 Emissions from the operational phase will be assessed. Operational emissions include those from the electricity and gas use for both regulated and unregulated energy use during the operational phase of the development.

- 11.36 The emissions associated with transport movements of residents once the proposed development is completed are not included in the assessment as these are largely tied to actions outside the Applicants control.

Emission Calculations

- 11.37 The calculation being provided within this chapter, is the overall comparison between the Target Emission Rate (TER) and the Dwelling Emission Rate (DER) and this will show whether the Proposed Development has met the policy targets.

Sensitivity

- 11.38 When considering the effects of the proposed development on climate, unlike other technical areas assessment of individual receptors is not strictly applicable. Climate change is a global phenomenon and highly localised impacts as a direct result of emissions associated with this development area extremely unlikely. It is understood that certain regions, populations, and species are more sensitive to climate change than others, but it would not be reasonable to provide an assessment of the proposed developments potential impact on these receptors as any single development would have an infinitesimal impact on global climate change. However, it is still important to undertake the assessment to ensure the proposed development does not emit unacceptable levels of emissions not only in an effort to reduce future climate change impacts, but to contribute towards local and national emissions targets.

Characterisation of Impact

- 11.39 The impact that is assessed in relation to climate change is the release of GHG emissions. The categorisation of this in relation to the following criteria is explained below:
- Positive or negative – The impact overall can only be negative due to the guaranteed release of GHG emissions from development. However, the purpose of this assessment is to consider the efforts of the Applicant to minimise the negative impact. Therefore, in the context of this assessment, the impact has been considered ‘positive’ if the Applicant has gone beyond the minimum requirements of national and local policy to reduce or minimise emissions.
 - Extent – The release of GHG emissions may occur on a local extent, however the associated impact i.e. contribution to global warming and climate change, is a global issue.
 - Magnitude – Any single development has an infinitesimal impact on global climate change overall, but the assessment is still important to assess a development’s contribution to local and

national targets. Additionally, the assessment considers magnitude in the context of emission reduction compared to baseline scenarios.

- **Duration and Timing** – The duration of the impact extends from construction, through operational and decommissioning phases of the proposed development. Having said which, research has shown that the operational phase typically accounts for around 90-95% of emissions across the lifetime of a development.
- **Frequency** – Emissions are likely to occur albeit continuously across the lifetime of the site as a result of fossil fuel combustion, electricity use, transportation as well as natural processes.
- **Reversibility** – Once emitted into the atmosphere, GHG are circulated and partake in different processes and reactions, creating and breaking into different molecules, with varying lifespans and effects – this is essentially irreversible. It is however, possible to take actions which can sequester certain gases and remove them from the atmosphere, such as the use of green infrastructure and tree planting.
- **Likelihood** - Essentially, any form of activity or process will result in the release of GHGs to some degree. This includes activity associated with positive climate change action, such as the development of renewables. As a result, this assessment aims to consider how the inevitable impact is minimised and reduced in the design and planning of the proposed development.

Significance Criteria

- 11.40 For the purpose of this assessment, effects that are deemed to be significant are those described as minor, moderate or major in adverse scenarios, and in beneficial scenarios that exceed the local policy. This goes beyond the standard EIA practice and represents a strict and conservative approach, which aligns with the magnitude of climate change as an issue, and local policy targets to reduce carbon emissions beyond Building Regulations. The significance criteria are provided in Table 11.2.

Table 11.2: Significance Criteria

<i>Relative Emissions Compared to Baseline</i>	<i>Impact</i>	<i>Effect</i>	<i>Significance</i>
Over 25% higher	Negative	Major Adverse	Significant
Up to 25% higher	Negative	Moderate Adverse	Significant
Up to 15% higher	Negative	Minor Adverse	Significant

Up to 5% lower or no higher	Neutral	Neutral	Not Significant
Up to 15% lower	Positive	Minor Beneficial	Not Significant
Up to 25% lower	Positive	Moderate Beneficial	Significant
Over 25% lower	Positive	Major Beneficial	Significant

- 11.41 All emissions that have an adverse impact are significant because this outcome would indicate that the proposed development will fail to meet the minimum requirements set out in Building Regulations. Emissions from a proposed development that fall below the baseline can be classed as beneficial as this would indicate that building efficiency and energy use exceeds statutory regulation requirements. The beneficiary impact only becomes significant when the requirements of local policy are exceeded, demonstrating the Applicants commitment to sustainable development.
- 11.42 To avoid misinterpretation, it is important to understand the justification, but also the limitation, behind the use of this significance criteria. It leads to a robust method for comparing likely emissions arising from the proposed development, relative to the baseline of a similar 'typical' development. For planning purposes, where it is important to weigh the benefits of one development against another this is a useful and practical approach. The alternative approach, which arguably holds to a stricter interpretation of the absolute effects of the proposed development, is to take the baseline to be the 'no development' scenario. If this latter approach were to be adopted, then almost any form of development would result in increased levels of carbon emissions and would be considered to cause adverse (and most likely significantly adverse) impacts. As such, it would be much more difficult to identify whether a particular developer was making a genuine attempt to reduce emissions beyond the requirements of standard regulatory policy.

Assumptions/Limitations

- 11.43 The assessment considers the operational CO₂e emissions. It is not possible to fully understand, at this time, how energy use and emissions will vary within buildings over the operational life. This chapter assumes that all energy demand will be provided by gas and electricity.
- 11.44 Unregulated energy use could vary substantially when the proposed development is operational, but it is not possible to accurately predict this energy use.

Consultation

11.45 The scoping response states:

"The Council disagrees that Climate Change should be scoped out of the ES. Climate Change should form a chapter within the ES.

Given the scale of the development, the impact of the development should be considered in line with Schedule 4 5(f) of the 2017 Regulations. This should include (but not necessarily be limited to) greenhouse gas generation and consider climate effects both to and from the development and climate resilience measures including consideration of low carbon and renewable energy technologies in line with Local Plan policy CS22. This can either be a separate chapter or integrated into relevant chapters such as Air Quality. Consideration should also be given to the impact that the change of use may have on the land as a carbon sink. The planning application should be accompanied by an Energy Statement and a Sustainability Statement."

Baseline Conditions

11.46 The TER is 11.71 kg/CO₂/m²/year. This figure will be used as a comparison to understand whether the proposed development achieves policy.

Site Emissions

11.47 The Site is currently vacant and therefore there are currently no emissions from the Site.

Local Greenhouse gas emissions

11.48 The surroundings of the Site has many sources of greenhouse gases and as a result it would be difficult to quantify the exact amount of greenhouse gases being emitted.

Future Baseline

11.49 In the future the Site would have the same emissions if the Site was still vacant, if the Site was developed the emissions would vary depending on the use, therefore it's unrealistic to provide an estimate.

Embedded Mitigation

Construction

- 11.50 There are no embedded mitigation measures for construction.

Completed Development

- 11.51 The proposal includes improved fabric efficiency and includes the emissions saved from the solar PV.
- 11.52 PAS2080:2016 'Carbon Management in Infrastructure' is a framework for the carbon management process that focuses on the four key parts of the chain (Asset Owners/Managers, Designers, Constructors and Product/Material Suppliers). It is based around the concept that as delivery of a development progresses the people involved in managing carbon changes and the earliest stages offer the greatest opportunities to reduce carbon and cost. Following the design freeze and the beginning of the procurement the ability to influence carbon decreases from 80 to 50%, dropping further to 20% once construction begins. This highlights the importance of carbon management early in the design stages.
- 11.53 In order to meet local policy requirements, the Proposed Development will need to ensure that Part L Building Regulations (June 2022) is met. This can be met through both fabric improvements and including low carbon energy generation.
- 11.54 In order to reduce energy use, the Applicant will be required to design buildings that reduce space heating/cooling requirement and utilise energy efficient materials for construction, lighting and appliances.

Potential Impacts

Construction

- 11.55 The on-site emissions have been estimated using the average construction site emission value of 1400 kgCO₂e/£100k of the project value given within 'Whole life carbon assessment for the built environment'. This figure is based on data from 2015 and has not been adjusted to reflect inflation. The emissions arising from the on-site emissions from the construction and installation process are estimated to be 1610 tonnes of CO₂e. This expected to have a **neutral, non-significant impact** when compared to a similar development carrying out construction to generic standards. The materials used within the development should be recycled where possible to reduce potential further emissions related to the production of new materials.

Completed Development

- 11.56 The DER for the residential units has been calculated to be 11.51 kg/CO₂/m²/year which is a 1.8% reduction to the TER and so complies with Part L of the Building Regulations (June 2022). This results in a **neutral, non significant** impact. It should be noted that although the proposed development does not exceed the requirements of the Building Regulations (June 2022) these new Regulations are much more stringent than the previous Regulations.

Mitigation Measures

Demolition and Construction

- 11.57 Mitigation measures for construction include using materials that have low embodied emissions and reducing the distance travelling to the site.
- 11.58 The site waste management strategy will ensure first priority is given to the reusing of any demolished materials within the site, however if this is not possible secondary priority must be given to the redirecting from landfill; in line with the waste hierarchy.
- 11.59 Where new materials are to be used, careful consideration of their environmental impact will be taken. This will be achieved by ensuring that only materials that score well under The Green Guide to Specification are used. This useful online tool can be used as a reference that provides guidance on the relative environmental impacts for a wide range of different building specifications. The BRE's Environmental Profile Methodology determines the Life Cycle Assessment (LCA) of materials, which is what the Guide's specifications are based on.
- 11.60 In order to take full advantage of low impact materials, elements key to the scheme should be specified to achieve ratings of between A+ and C under The Green Guide's ratings. Insulation materials that are specified will also have a global warming potential (GWP) of 5 or less, with an ODP of 0. Additionally, 100% of all timber used as part of the scheme will be responsibly sourced from suppliers that are either Forest Stewardship Council (FSC) accredited, Programme for the Endorsement of Forestry Certification accredited, or a similar recognised accreditation body.

Completed Development

- 11.61 Energy efficiency and emissions reductions have been maximised for the development

- 11.62 In addition to significant emission reductions, the whole development can be classified as carbon neutral, as per the definition outlined in Table 11.1, if all of the energy used on site is from a 100% renewable energy electricity supply provider. However this is down to future homeowner choice.

Residual Impacts

- 11.63 The proposed development will result in the emissions of greenhouse gases, which is a long term and permanent effect.
- 11.64 The residual impacts are summarised in Table 11.3. It is worth reiterating that the result of a neutral impact is purely in relation to the applicant meeting emission targets within Part L of the Building Regulations and should not be interpreted as the Proposed Development having a positive contribution towards climate change.

Table 11.3 Residual Effects Summary

Description of Effect	Potential impact including significance	Mitigation	Residual effect including significance
Construction and Demolition			
Greenhouse gas emissions contributing to global warming and climate change	Neutral and not significant	Using environmentally friendly materials that are locally sourced where possible	Neutral and not significant
Completed Development			
Greenhouse gas emissions contributing to global warming and climate change	Neutral and not significant	Energy efficient build standard and Solar PV	Neutral and not significant

- 11.65 In order to eliminate all residual effects, the development would need to have completely net zero emissions. Notwithstanding embodied emissions in the materials and emissions from the plant used to construct the development, it would also be necessary to eliminate all operational emissions. Committing to green electricity tariffs and Class A appliances would help push operational emissions down. However, future homeowners would be able to select their own suppliers, so this cannot be

guaranteed. This effect is highlighted in PAS2080:2016 guidance which states there is minimal opportunity to impact carbon once a development is operational unless indirectly influenced in advance for e.g. installation of LED lighting, green energy sources etc.

Assessment of Cumulative Effects

- 11.66 The assessment of cumulative effects in conjunction with other developments in the area presents a challenge from a climate change standpoint. The increased development in the area will likely lead to an increase in greenhouse gas emissions being emitted from this area, although the impacts of this will be their contribution to global climate change. All developments in the area should aim to reduce their emissions through fabric efficient design and the installation of renewable and low carbon energy generation.

Resilience To Climate Change: Vulnerability and Risk Assessment

- 11.67 The update to EIA regulations not only require an assessment of the potential impacts of a proposed development on climate change but also its vulnerability to climate change itself. In the context of the proposed development, the spirit of the regulations is to ensure that the risk to climate change effects are identified and mitigated if required.

Global Climate Change Projections

- 11.68 Table 11.4 highlights the main projected global climate change issues.

Table 11.4: Projected global impacts of climate change.

Climate Change Issue	Projected Global Impacts
Solar Radiation	Long term projected changes in surface solar radiation, as a result of global warming, would suggest a decrease in available solar power due to a decrease in downwelling shortwave radiation, likely linked to the increase of water vapour ^{xiv} . This is considered to be anthropogenic strengthening of “natural” decadal variability in irradiance, known as global dimming and brightening, which is influenced by synoptic weather patterns, cloud variations and atmospheric aerosols ^{xv} .
Heat Waves	The Intergovernmental Panel on Climate Change (IPCC) ^{xvi} predict that temperature extremes will increase more rapidly than global mean surface temperature, with the number of hot days projected to increase in most land regions.
Extreme Rainfall and Flooding	IPCC and Met Office ^{xvii} both suggest a general uncertainty in the projection of changes in heavy precipitation for the UK due to position in the transition zone between north and south Europe’s contrasting projected changes. It is generally agreed the northern parts of the UK will experience overall increases of up to 10%, whilst southern areas may experience decreases of up to 5%. Overall, the UK is expected to see a general increase in precipitation trends up to 2100.
Rising Sea Levels	The most recent modelling indicates global sea level rise of 0.26-0.77m by 2100, under a 1.5°C warming scenario ^{xxiii} . Risk is amplified on small islands and in low lying coastal areas and deltas.
Storms and Winds	Atmospheric circulations have large variability across interannual through to decadal time scales, which makes forming projections with any reasonable confidence very difficult. There is more robust evidence in the Northern Hemisphere that since the 1970s there has been a general poleward shift of storm tracks and jet streams and near-surface terrestrial wind speeds have been declining by approximately 0.1-0.14 m s⁻¹ per decade across land^{xviii}. Despite anemometers being used for decades to measure near surface wind speed, the data has rarely been used to analyse trends and lacks important instrumentation meta data. In general, confidence is low in wind speed projections due to large uncertainties across global data sets.
Cold Spells and Snow	It has been observed the spring snow cover has been continuing to decrease in extent in the Northern Hemisphere and that cold temperature extremes are projected to decrease along with the number of frost days ^{xix} .

Climate Change Impacts

- 11.69 The Design of Future Climate Report published in 2010 identified three broad risk categories to buildings from future climate change in the UK, which are:
- Risk to comfort and energy performance: warmer winters will reduce heating requirements, however the increased use of cooling systems in the summer will present a challenge to energy consumption and carbon emissions;
 - Risk to construction: resistance to extreme conditions, detailing, and the behaviour of materials; and
 - Risk to water management: management of water during both flooding and drought events, and changes in soil composition.
- 11.70 Combined, these categories can be considered climate change threats that could result in increased energy demands, economic losses and loss of life.
- 11.71 Climate change may result in variations in approach to general building design and construction in order to offer a higher degree of protection against the identified perils. Many of these improvements will be brought about using existing off-the shelf components that are in common use in other places around the world but may not previously have been considered necessary in parts of the UK. Such design improvements will be beneficial for the overall quality of the UK housing stock, although it may result in some additional costs for developers.
- 11.72 As well as seeking improvements in the construction techniques for buildings there will also be a need to improve various aspects of their operational performance to provide more resilience for residents and occupants.
- 11.73 At more localised levels the effects themselves can manifest in different ways and therefore the most appropriate strategies should be selected on a site-specific basis. A coastal village may be at most risk from sea-level rises and storm surges, while at inland locations the threat of heat waves or high winds might be more significant. Adaptation involves developing a resilience and a preparedness to deal with the likely consequences of climate change.
- 11.74 Table 11.5 indicates the impact on the proposed development that could arise from climatic effects, reproduced from data in the National House Building Council and European Commission reports^{xx xxi} and the UK Climate Change Risk Assessment (2017) Evidence Reportⁱⁱ.

Climatic Factor	General impact	Component/sub structure impacted
Soil Drying	Increase will affect water tables and could affect foundations in clay soils.	Increased risk of basement heave or subsidence, water ingress, consequential damage to finishes and stored items. Ground shrinkage can lead to failure of electrical, gas and water pipes, foundations and sub-structures.
Temperature	Maximum and minimum changes will affect heating, cooling and air conditioning costs. Frequency of cycling through freezing point will affect durability. Daily maximum and minimum temperature will affect thermal air movement.	Air conditioning / heating / cooling systems due to increased cooling / decreased heating requirements. Overheating of mechanical and electrical equipment effecting lifespan, reliability and potential health and safety issues. Plastic materials will have a reduced lifespan. Structure / cladding / roofing membranes, sealants, pavements and roads have increased risk of cracking. Reduced capacity of overheated power lines. Building overheating (due to increased fabric efficiency and incorrect implementation). Solar PV modules work slightly less efficiently at high temperatures and some studies ^{xxii} have shown that high temperatures can age the panels more quickly. Decreased labour productivity.
Relative Humidity	Increase will affect condensation and associated damage or mould growth.	Timber framed construction. Internal walls, finishes and stored items.
Precipitation	Increase and decrease will affect water tables; cleaning costs will be increased in winter, with associated redecoration requirements; durability and risk of water ingress will be affected by combination of precipitation increase and gales.	Increased damage to roofing and higher risk of failure, increased chances of flooding. Structure / cladding/roofing membranes and sealants have increased risk of cracking due to different moisture movements. Damage to foundations and basements. Delays in construction and increased costs. Increased risk of subsistence.
Gales	Increase will affect need for weather tightness, risk of water ingress, effectiveness of air conditioning, energy use, risk of roof failures.	Increased damage to roofing and higher risk of failure.

Radiation	Increase may affect need for solar glare control.	Window specification and glare control requirement.
Cloud	Increase/decrease in seasonal lighting needs.	Changes in lighting systems and glare control requirement.

Table 11.5: Potential effects of climate change on the proposed development.

11.75 The UK Climate Change Risk Assessment identifies flooding and high temperatures as posing the greatest risks to the built environment. In the interest of completeness, and to account for potential irregular, adverse extreme weather, this section will also cover reducing risk to snow and ice, however projections suggest that overall these will become a decreasing risk with climate change.

Temperature

11.76 The UK Climate Change Risk Assessment 2017 states that buildings will need to be carefully designed to reduce heat loss during winter, reduce solar gain during summer and maximise the effectiveness of natural ventilation in buildings. The Carbon Trust^{xxiii} found that energy costs and associated CO₂ emissions are 30% higher in an air-conditioned building compared to natural ventilation, on top of increased capital and maintenance costs. Methods for reducing energy consumption of buildings for cooling and ventilation include:

- Using low energy lighting;
- Installing energy efficient appliances;
- Night cooling¹;
- Stack ventilation and wind scoops;
- Fan-coil units;
- Window shading or heat reflective glass;
- 'Dead band' control²; and,
- Smart meters.

¹ An established technique where cool night air is passed through the building to remove heat accumulated in the day. This could be natural or fan-assisted. When building fabric is cooled, it will absorb more heat the next day, reducing internal temperatures.

² When mechanical systems for cooling or heating are required, using dead band control can be effective in reducing energy consumption and costs. This creates a gap between temperature cut ins, preventing heat and cooling operating simultaneously.

- 11.77 Design measures can be incorporated into the wider development to reduce the urban heat island effect which can include planting deciduous trees and increasing the availability of green and blue spaces. The use of water features and vegetation to improve landscaping can provide a cooling effect as well as providing insects, invertebrates, small mammals and humans shading from the elements.
- 11.78 It is also essential to limit the heat release rate of materials used in linings, materials and finishes by strict compliance with national fire regulations. Consideration should be given to careful planning of open-plan living and work spaces, that reduce compartmentalisation, and have the potential to increase risk to fire. The increasing number of heatwaves could result in periods of dry environments, where the fire risk will increase significantly. The use of fire and smoke alarms in all properties is mandatory and the implementation of basic fire preparation and response plans can significantly reduce the risks to human life.

Precipitation

- 11.79 Following the IPCC Fifth Assessment on Climate Change Report series, key findings for the builder sector were summarised into a briefing called Climate Change: Implications for Buildings^{xxiv}. It found that increased precipitation and weather extremes pose a direct threat to building construction through delays, changes to building seasons and the increased likelihood of rebuilding and repair work.
- 11.80 A Flood Risk Assessment for the proposed development has been undertaken taking into consideration climate change projections of increased rainfall and flooding. The findings of this are summarised below:
- The site is within Flood Zone 1. Embedded mitigation of surface water flood events will be designed into the construction phase, making an allowance of an additional 40% for climate change. Where possible the site will look to utilise Sustainable Drainage Systems (SuDS) to reduce surface water run-off rates. Attenuation features will be provided for the 1 in 100 year flood event plus climate change.

Extreme Weather

- 11.81 Storm damage will typically involve the damage or removal of roof slates/tiles or potentially the whole roof structure. The National House Building Council (NHBC) Foundation recommends that the optimum roof angle is 30 ° to the horizontal to minimise the suction forces that will apply to the roof. At lower angles the suction forces will be greater and at higher angles the forces will tend to exert downward force on the roof. Eaves and roof structures that overhang external walls may be particularly susceptible to the effects of wind loading and sufficient consideration will be required to ensure that

problems are avoided. Wind loading can also apply significant lateral forces to buildings and modelling to ensure that adequate bracing is in place to deal with these forces will be necessary.

- 11.82 Storms can potentially lead to rain penetration through external masonry walls, particularly where walls are single-skin (e.g. garages) or where cavities have been poorly constructed (e.g. with debris in the cavity).
- 11.83 Another side effect of increased storms and high winds may be loss of centralised power through powerline failure or damage, as well as power loss potentially arising from flooding or other climate related events. Power failure could represent a risk of major accident in several ways from downed cables igniting a fire to resident's health and well-being coming under threat from not having access to essential services. In order to minimise the risk of major accidents and retain resilience to climate change the proposed development should consider the need for provision for the loss of power distribution for periods of time.
- 11.84 Although projections suggest an overall decrease in cold spells and snow, it is still important to consider risk mitigation in the event of adverse extreme weather. The vulnerability of residents and users of the proposed development will be dependent upon a variety of factors, including age and physical health, however appropriate design measures can reduce the risk to human health and accident, such as:
- Sufficient insulation;
 - Energy efficient buildings;
 - Secure and reliable energy supply;
 - Stress loading of roofs (snow bearing) – BS EN 1991-1-3:2003;
 - Cover and/or pitch walkways and driveways to aid drainage and avoid puddling that can form ice;
 - Ensure roof pitch is correct for water/snow shedding without avalanching;
 - Design drainage away from buildings and employ roof overhangs to keep snow and water away from foundations; and,
 - Use suitably textured materials on walkway surfaces, avoid steep gradients and provide railings and banisters to reduce risk of slipping and falling.

Limiting Impacts on Biodiversity

- 11.85 Impacts on biodiversity can include but are not limited to mortality, biome shifts, ecosystem change, water scarcity/flooding, pest exacerbation and ecosystem feedback capabilities, including carbon sequestration^{xxv}.
- 11.86 In the establishment of landscapes and ecological habitats the proposed development will need to consider the climate resilience of enhancements that are used.
- 11.87 The key to maintaining these landscapes in changing climates is focusing on maintaining functioning ecosystems³. Ecosystem resilience can be defined as *"the properties that enable an ecosystem to absorb expected and unforeseen change yet retain its character and remain functional"*. The important concepts are sustaining functional diversity, connectivity and upholding variety in ecological thresholds. This will ensure that built landscapes and existing habitats have the capability to continually offer shelter and forage in changing conditions.
- 11.88 Key aspects suggested for consideration when designing climate resilient landscaping are:
- Species selection: Drought tolerant species e.g. enzymic resilience to warmer temperatures;
 - Sensitivity to watering e.g. induced root hypoxia and rot from oversaturation;
 - Growth inhibition e.g. pollution tolerance;
 - Wind tolerance e.g. strong, deep root structures;
 - Year-round ecosystem services e.g. forage and shelter capability during different seasons to continually support ecology and human needs;
 - Avoiding fragmentation of green spaces, landscapes and ecological habitats where possible; and
 - Control use and ongoing spread of invasive and alien species that may impede native species ability to adapt or be in competition for resources during times of decreased availability e.g. as a response of extreme weather.

Limiting Impacts on Social Value, Waste Management and Travel Planning

- 11.89 Social value has many competing definitions, however, at the centre of most definitions is the value of maximising public benefit. As such, it is important to address the impact of the built environment on those who inhabit it ^{xii}. The potential risks of climate change from increased temperature and

precipitation increase has been addressed above; the mitigation actions outlined will help to ensure public benefit. In addition, the design of the development close to accessible public transport routes, and with the provision of facilities for cyclists can act to promote sustainable transport of inhabitants.

Conclusions

Assessment of Impacts

- 11.90 This assessment has measured the potential impacts on climate change for the proposed development at Cherryfield Drive. The development is targeting a low carbon development by minimising the heating demand through the adoption of a 'fabric-first' approach. A PV array is being considered at this stage to further offset residual emissions.
- 11.91 In addition to the significant emission reductions shown above, the development in its entirety, can tackle the predicted GHG emissions by offsetting the total amount produced through obtaining all operational energy from a 100% renewable energy electricity provider. This is course in down to homeowner choice in the future.

Mitigation of Climate Change

- 11.92 The proposed development, if built to modelled assumptions, will meet the requirements of Part L of the Building Regulations (2022). This is due to the significantly improved fabric efficiency and Solar PV.

Vulnerability and Risk Assessment

- 11.93 It will not be possible to eliminate every risk associated with climate change but through intelligent design, preparation and responsible construction, these risks will be minimised. Discussion and recommendations have detailed reducing these risks in key areas such as overheating, flooding and extreme weather, which has taken into consideration not only the health and safety of the users of the proposed development, but the resilience of the proposed development itself.

References

- ⁱ HM Government, 2008. Climate Change Act 2008. HMSO, London.
- ⁱⁱ HM Government (2017). UK Climate Change Risk Assessment 2017. HMSO, London.
- ⁱⁱⁱ European Commission, 2013. Staff Working Document (2013) 137 final 'Adapting infrastructure to climate change'. EC, Brussels.
- ^{iv} National House Building Council Foundation (2007). Climate change and innovation in house building: designing out risk (NF3). NHBC Foundation, Buckinghamshire.
- ^v Statutory Instrument 2017 No. 571 (2017). Town and Country Planning (Environmental Impact Assessment) Regulations 2017. HMSO, London.
- ^{vi} Ministry of Housing, Communities and Local Government (2018). National Planning Policy Framework 2018. HMSO, London.
- ^{vii} The Institute of Environmental Management & Assessment (IEMA) (2017). 'Environmental impact assessment guide to assessing greenhouse gas emissions and evaluating their significance'. IEMA, Lincoln.
- ^{viii} The Institute of Environmental Management & Assessment (IEMA) (2013). 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment'
- ^{ix} European Commission (2013). 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment'.
- ^x British Standards Institute (2016). Publicly Available Specification (PAS) 2080:2016 'Carbon Management in Infrastructure'.
- ^{xi} European Investment Bank (2014). 'EIB induced GHG footprint. The carbon footprint of projects financed by the bank. Methodologies for the assessment of Proposed Development GHG emissions and emissions variants'.
- ^{xii} Royal Institution of Chartered Surveyors (RICS) (2017). Whole life carbon assessment for the built environment.
- ^{xiii} Bartok et al. (2016). Projected changes in surface solar radiation in CMIP5 global climate models and in EURO-CORDEX regional climate models for Europe. Climate Dynamics
- ^{xiv} Parding et al. (2016). Influence of Synoptic Weather Patterns on Solar Irradiance Variability in Northern Europe. American Meteorological Society 29.

-
- ^{xv} IPCC (2018). Special Report on Global Warming of 1.5°C (SR15). Summary for Policy Makers.
- ^{xvi} Met Office (Undated). UK Climate: Observations, projections and Impacts. Met Office, Exeter
- ^{xvii} Vautard et al. (2010). Northern Hemisphere atmospheric stilling partly attributed to an increase in surface roughness. Nat. Geosci., 3 and McVicar et al. 2012. Global review and synthesis of trends in observed terrestrial near-surface wind speed: Implications for evaporation, J. Hydrol. (within IPCC, 2014. Fifth Assessment Report: Chapter 2.)
- ^{xviii} Intergovernmental Panel on Climate Change (IPCC) (2014). Fifth Assessment Report: The Physical Science Basis.
- ^{xviii} Department for Environmental and Rural Affairs (DEFRA), Department for Business, Energy and Industrial Strategy (DBEIS), Met Office and Environment Agency (2018). UK Climate Projections. Available at: <https://ukclimateprojections-ui.metoffice.gov.uk/ui/home>
- ^{xviii} National House Building Council Foundation (NHBC) (2007). Climate change and innovation in house building: designing out risk (NF3).
- ^{xviii} European Commission (2013). Adapting infrastructure to climate change.
- ^{xviii} Patt, A., Pfenninger, S. and Lilliestam, J., (2013). Vulnerability of solar energy infrastructure and output to climate change. Climate Change 121 pp93-102.
- ^{xviii} Carbon Trust (2012). Air conditioning: maximising comfort, minimising energy consumption.
- ^{xviii} Buildings Performance Institute Europe (BPIE), Global Buildings Performance Network (GBPN), World Business Council for Sustainable Development (WBCSD), Cambridge Institute for Sustainability Leadership (CISL) and Cambridge Judge Business School (CJBS) (undated). Climate Change: Implications for Buildings. Key findings from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) on Buildings.
- ^{xviii} Grimm, N.B., Chpain, F.S., Bierwagen, B., Gonzalez, P., Groffman, P.M., Luo, Y., Melton, F., Nadelhoffer K., Pairis, A., Raymond, P., Schimel and Williamson, C (2013). The impacts of climate change on ecosystem structure and function. Front Ecol Environ 11, 474-482
- ^{xviii} Friends of Ecosystem-based Approach (2018). Making Ecosystem-based Adaptation Effective. A technical paper prepared for the 46th session of the UNFCCC Subsidiary Body for Scientific and Technological Advice conference.
- ^{xii} UK Green Building Council. (2018). *Social value in new development: An introductory guide for local authorities and development teams*.

