15 Climate Change

15.1 Introduction

15.1.1 This chapter has been prepared by Hydrock Consultants to assess likely significant effects in relation to climate change as required by the Town and Country EIA Regulations 2017[1]. It describes the regulatory and planning context, assessment scope and methodology, how baseline conditions have been established and how predicted effects and their significance have been determined. This Chapter should be read in conjunction with the wider technical chapters within the Environmental Statement (ES) as well as the introductory chapters which describe the development and the applied EIA methodology.

15.1.2 As per best practice guidance from IEMA, climate change comprises two distinct areas:

- Climate Change Mitigation – an assessment of likely significant effects upon climate change resulting from the project and their mitigation, including an estimate of greenhouse gas (GHG) emissions;

- Climate Change Adaptation – an assessment of likely significant effects of climate change upon the project, including its vulnerability and the need for any adaptation measures to ensure project resilience to projected climate change scenarios.

15.1.3 A number of potential effects have been avoided in advance of this assessment through mitigation that is inherent into the design of the Project, as explained for relevant issues. The assessment reports the likely significant climate change effects and details of additional mitigation measures that are required to prevent, reduce or offset significant adverse effects, or further enhance beneficial effects. Assessment conclusions are presented in terms of residual effects and whether these are significant.

15.1.4 Additional details regarding the assessment of potential climate change effects (particularly with regards adaptation measures) is provided by the following technical Chapters within the ES as well as the Energy and Sustainability Statement prepared by Hydrock which accompanies the planning application and is provided as Appendix 15.1 to this ES Chapter:

- Chapter 7 – Ecology
- Chapter 8 – Transport
- Chapter 11 – Flood Risk and Drainage
- Chapter 12– Air Quality

15.1.5 The terms "carbon", "carbon dioxide (CO_2)" and "greenhouse gas (GHG)" are used interchangeably in this chapter depending on the terminology of referenced documents etc.

15.2 Methodology

15.2.1 The following sections set out the methodology and scope of the climate change mitigation and adaptation assessment work that has been undertaken to inform

[1] The Town and Country Planning (Environmental Impact Assessment) Regulations 2017; UK Government; 2017.

this Chapter and includes details of the relevant legal and regulatory requirements of legislation and policy that is relevant to the Development Proposal and this impact assessment. All key provisions of relevant legislation, policy and guidance are addressed throughout this Chapter and as summarised below.

Legislative and Policy Framework

15.2.2 In addition to the EIA Regulations 2017, the following legislation has informed this chapter:

15.2.3 The Paris Agreement[2] was made at COP 21 in Paris, on 12 December 2015. 195 parties to the United Nations Framework Convention on Climate Change (UNFCCC) reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

15.2.4 The Climate Change Act 2008[3] originally set a legally binding target for reducing UK CO_2 emissions by at least 80% by 2050 relative to 1990 levels. In 2019, the Act was amended to the effect that the minimum percentage by which the net UK carbon account for the year 2050 must be lower than the 1990 baseline was increased from 80% to 100% (net zero).

15.2.5 The Carbon Budgets are used to set interim targets to cap the total national emissions over a five-year budget period. They do not require emissions from specific locations, or even specific sectors, to reduce; so long as total emissions from the UK as a whole meet the budget limits. The first three budgets cover the periods 2008-12, 2013-17 and 2018-22. These budgets were set in May 2009[4]. The fourth carbon budget (2023-2027) was set based on recommendations from the Committee on Climate Change (CCC) in 2011[5] with the fifth carbon budget again based on CCC recommendations, set in 2016[6].

15.2.6 Building Regulations, Approved Document Part L (incorporating 2013 and 2016 amendments)[7] provide a mechanism in England by which staged reductions in regulated carbon emissions are required by new buildings. The government have recently undertaken public consultation on the 2020 Part L update which, based upon the significant decarbonisation of the national grid and the proposed Future Homes Standard being implemented from 2025 is likely to radically alter the way energy is delivered at new development sites.

15.2.7 The Carbon Plan – Delivering our Low Carbon Future[8] sets out how the UK proposes to achieve decarbonisation and the transition to a low carbon economy. It sets this objective within a framework of mitigating and adapting to climate change.

[2] Paris Agreement to the United Nations Framework Convention on Climate Change, Dec. 12, 2015, T.I.A.S. No. 16-1104

[3] The Climate Change Act 2008 (2050 Target Amendment) Order 2019, UK Government

[4] The Carbon Budgets Order 2009, UK Government

[5] The Carbon Budget Order 2011, UK Government

[6] The Carbon Budget Order 2016, UK Government

[7] Approved Document L1A: conservation of fuel and power in new dwellings, 2013 edition with 2016 amendments, UK Government, 2016

[8] The Carbon Plan – Delivering our Low Carbon Future; 2011; Department of Energy and Climate Change (DECC); UK Government.

15.2.8 Relevant national and local planning policy includes the revised National Planning Policy Framework (NPPF)[9], Planning Practice Guidance (PPG)[10], and Barnsley Local Plan[11] set out objectives to tackle the impacts of Climate Change. The Local Plan sets out policies for the new development which include:

- Policy MU1 - Land south of Barugh Green Road
- Policy T3 - New Development and Sustainable Travel
- Policy CC1 – Climate Change
- Policy CC2 - Sustainable Design and Construction
- Policy RE1 - Low Carbon and Renewable Energy
- Parking Supplementary Planning Document
- Sustainable Travel Plan Supplementary Planning Document

15.2.9 Local Policy requires an Energy and Sustainability Statement to be submitted with the planning application to set out the predicted energy demand of the proposed development and the degree to which the development meets current energy efficiency standards.

15.2.10 The following guidance has also informed the assessment of effects within this Chapter:

- The Net Zero – Technical Report[12] (2019) from the Committee on Climate Change provides updated guidance and progress towards meeting UK Carbon Budgets and Closing the Policy Gap.

- The Institute of Environmental Management and Assessment (IEMA) Climate Change Principles document, IEMA Principles: Climate Change Mitigation & EIA[13] sets out key considerations in the assessment of Climate Change impacts from development.

- The IEMA guidance document, Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation[14], first published in 2015 and updated in July 2020, provides guidance on the assessment of Climate Change Adaptation and Resilience; and

- The IEMA guidance document, Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance[15], published in 2017, provides guidance on the assessment of GHG emissions.

15.2.11 Topic specific guidance for mitigation and adaptation to climate change has been relayed the relevant topic expert and is outlined within the relevant chapter.

[9] Revised National Planning Policy Framework; February 2019, Department for Housing Communities and Local Government (DCLG); UK Government.
[10] Planning Practice Guidance (PPG); Department for Housing Communities and Local Government (DCLG); UK Government.
[11] Barnsley Local Plan, Adopted January 2019, Barnsley Metropolitan Borough Council
[12] Net Zero Technical Report, Committee on Climate Change, May 2019
[13] IEMA Principles: Climate Change Mitigation & EIA, IEMA, May 2010
[14] Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation, 1st Revision, IEMA, 2020
[15] Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance, IEMA, 2017

Summary of Consultation

15.2.12 The 'EIA Development Environmental Statement Scoping Opinion' document received from Barnsley Metropolitan Borough Council 23rd April 2021 confirms the following in respect of the Climate Change Chapter:

> *You will be aware that the council declared a climate emergency in September 2019 in order to bring the issue of climate change to the forefront of everyones minds. We have also set associated targets to become net zero as a borough by 2045. Whilst the adopted Local Plan and Masterplan Framework for Barnsley West (MU1) will ensure that the development comes forward in a sustainable manner, the Masterplan Framework itself notes the requirement that all developments will need to play their part in the climate response. A development of this scale needs to not only consider the impacts but also demonstrate how it will respond to those impacts. It is the council's view that Climate Change warrants its own chapter and cannot excluded in this instance.*

Sensitivity and Significance

15.2.13 The sensitivity of the Site is the degree to which is it susceptible to, or unable to cope with, adverse local effects of climate change which is in part identified via the baseline conditions as well as the potential receptors as relevant to the location, nature and scale of the development.

15.2.14 The assessment of risk includes assessing the likelihood (probability) and magnitude (severity) of the impacts identified, based upon the latest guidance from IEMA as summarised in Tables 15.1 and 15.2.

Table 15.1 - Likelihood of risk

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

15.2.15 The assessment of likelihood includes consideration of available climate projections data for the project. Although not all years will fit a clear trend of change (as the impacts of previous climate change lead to a more variable and unpredictable climate), climate projections show that there are likely to be changes to the average weather conditions in the future.

15.2.16 Table 15.2 has been edited to provide further detail on assessing significance of effects for climate change mitigation.

Table 15.2 - Magnitude of impact

Magnitude of Impact	Description
Very large	Considerable change from the baseline conditions and the receptor has no adaptability, tolerance or recoverability and/or is of very high sensitivity.
Large	Considerable change from the baseline conditions at a receptor which has limited adaptability, tolerance or recoverability OR Lesser change at a receptor which is of the high sensitivity. A large increase/decrease in GHG emissions (e.g. >10%) relative to local/regional baseline emissions and future UK carbon budgets.
>Moderate	Considerable change from the baseline conditions at a receptor which has a degree of adaptability, tolerance or recoverability OR Lesser change at a receptor that has limited adaptability, tolerance or recoverability A moderate increase/decrease in GHG emissions (e.g. 3-10%) relative to local/regional baseline emissions and future UK carbon budgets.
Minor	Small, but noticeable change from the baseline conditions on a receptor which has limited adaptability, tolerance or recoverability and/or is of the highest sensitivity OR Considerable change from the baseline conditions at a receptor which can adapt, is tolerant of the change or/and can recover from the change. A small increase/decrease in GHG emissions (e.g. 1-3%) relative to local/regional baseline emissions and future UK carbon budgets.
Negligible	Unlikely to cause a noticeable change at a receptor, despite its level of sensitivity OR Considerable change at a receptor which is not considered sensitive to any change. A negligible increase/decrease in GHG emissions (e.g. <1%) relative to local/regional baseline emissions and future UK carbon budgets.

15.2.17 The likelihood and magnitude of each impact is then considered against the following matrix (Table 15.3) which defines significance in the context of climate change, informed by professional judgement.

Table 15.3 - Significance matrix

		Measure of Likelihood				
		Very Low	Low	Medium	High	Very High
Measure of Magnitude	Negligible	Non-Significant	Non-Significant	Non-Significant	Non-Significant	Non-Significant
	Minor	Non-Significant	Non-Significant	Non-Significant	Significant	Significant
	Moderate	Non-Significant	Non-Significant	Significant	Significant	Significant
	Large	Non-Significant	Significant	Significant	Significant	Significant
	Very Large	Non-Significant	Significant	Significant	Significant	Significant

Background Studies to Inform Assessment

15.2.18 The following assessments have been undertaken as part of the EIA and are summarised within the Assessment of Impacts in section 15.5:

- GHG Assessment – A GHG assessment using the available design information for the Proposed Development to estimate the likely potential GHG emissions of construction and operation in the context of local emissions and UK carbon budgets to establish significance.
- Climate Change Risk Assessment – A climate change risk assessment of the Proposed Development against the current data and future climate predictions (Met Office climate projections, UKCP18 data) and using information from the UK Climate Change Risk Assessment to identify the likely long-term climate change effects and how the proposals will adapt to these.

Climate Change Mitigation Methodology

15.2.19 The method of assessment comprises the following components in accordance with IEMA guidance on GHG Assessment:

- Review of legislation, planning policy and guidance relating to climate change (see previous section);
- Establish GHG assessment scope and boundaries;
- Estimate GHG emissions from the existing site of the Project to establish baseline conditions;
- Estimate GHG emissions from the construction and operational phases of the Project ;
- Consider opportunities for GHG emissions reductions from the Project through appropriate mitigation measures in accordance with IEMA's GHG mitigation hierarchy; and
- Evaluate residual GHG emissions following mitigation within the context of baseline site conditions, local and regional GHG emissions and also future UK Carbon Budgets to establish their context, magnitude and significance.

Climate Change Adaptation Methodology

15.2.20 The method of assessment adopted to assess Climate Change Adaptation comprises the following principal components:

- A review of legislation, regulation and planning policy, focussing on climate change adaptation and resilience issues (as set out above);
- Identification of the existing baseline climatic conditions utilising data from the Met Office together with the identification of a relevant UKCP18 climate projections to establish future baseline conditions for the site;
- Preparation of a Climate Change Risk Assessment, which identifies risks to the Project from the projected changes in climate factors;
- A qualitative assessment of potential effects and impacts of the future climate change scenario during the construction and operational phases of the development; and
- Identification of any mitigation measures that are necessary and a review of the residual impacts.

15.3 Baseline Conditions

Establishing Current Baseline Conditions

15.3.1 The baseline for the construction and operational phases relates to GHG emissions and climate change risks occurring at the site in the 'do nothing' scenario. Average observed climate data for the period 1981 to 2010 has been utilised for the closest meteorological station to the development.

15.3.2 Given that the site is largely greenfield and farmland and no operational buildings, for the purposes of GHG assessment the emissions within the Project Site are assumed to be zero. This will allow for the completion of a worst-case assessment of net emissions and evaluation of the significance of these on future climate change.

Use of Climate Projections to Establish Future Baseline Conditions

15.3.3 The EIA Regulations 2017 also requires an outline the likely evolution of baseline conditions without implementation of the development (i.e. the 'do nothing' scenario) as far as changes from the baseline scenario can be assessed with reasonable effort on the basis of available information and scientific knowledge.

15.3.4 Projected climate data from the IPCC (UKCP18) has been used to establish how the current baseline position may alter as a result of climate change that has already been set in motion.

15.3.5 Given it is not possible to exactly predict future global GHG emissions, the UKCP18 climate projections make assumptions about the economic, social and physical changes to our environment that will influence climate change. Representative Concentration Pathways (RCPs) are a new method for capturing those assumptions with a set of scenarios. The RCPs replace the previous Low, Medium and High emissions scenarios.

Table 15.4 - Representative Concentration Pathways (RCPs)

RCP	Change in temperature (°C) by 2081-2100
RCP 2.6	1.6 (0.9 - 2.3)
RCP 4.5	2.4 (1.7 - 3.2)
RCP 6.0	2.8 (2.0 – 3.7)
RCP 8.5	4.3 (3.2 – 5.4)

15.3.6 RCPs specify concentrations of greenhouse gases that will result in total radiative forcing increasing by a target amount by the year 2100 relative to pre-industrial levels which then have a resultant change in temperature as outlined in Table 4.

15.3.7 Whilst RCP 4.5 would broadly align with the aims of the Paris Agreement to keep global temperature increases within 2°C, current best practice guidance from IEMA recommends the use of the high emissions scenario (RCP 8.5) to identify the 'worst case' range of potential future climate conditions at the site.

As such, the RCP 8.5 (high) emissions scenario has been selected for use within these assessments though this may over estimate climate risks should global efforts to reduce GHG emissions begin to take effect and result in a "medium" or even "low" emissions scenario in the years ahead.

15.4 Non-Significant Effects

15.4.1 The following non-significant effects are not considered further in this Chapter. A summary of these effects and appropriate qualitative evidence is provided below to support these assumptions. Where appropriate, this summary cross references other technical ES chapters.

Increase in summer temperatures during construction

15.4.2 Increasing summer temperatures (mean and daily) may lead to health and safety risks for construction workers. However, appropriate measures to reduce these risks, such as the provision of additional shaded refuges and drinking water supplies will reduce any risk to a low level will be implemented, managed and recorded via the Construction Environmental Management Plan (CEMP). These tertiary measures are therefore an integral part of the Proposed Scheme, and their implementation, will be delivered through the CEMP, the form and content of which will be part of the Schedule of Mitigation.

Decrease in summer rainfall and reduced water supplies during construction

15.4.3 Decreasing summer rainfall may reduce water supplies during construction, disrupting construction activities. However, measures to reduce these risks, such as monitoring of water supplies and implementation of water reduction targets will reduce the risk to a low level. These tertiary measures are an integral part of the Proposed Scheme, and their implementation, will be delivered through the CEMP, the form and content of which will be part of the Schedule of Mitigation.

Changing temperatures and rainfall levels and impact to existing ground conditions

15.4.4 Changing temperatures and rainfall may change the ground conditions at the Site, which in turn may impact proposed building foundations and structures, causing future risks to building users. However, the current Building Regulations require new development to consider the impact of ground conditions on foundation design and therefore there is a high level of certainty through the compliance with current Building Regulations that such risks will be designed out. These primary measures are an integral part of the Proposed Scheme, and their implementation, will controlled through condition, the form and content of which will be part of the Schedule of Mitigation.

Changing temperatures and rainfall levels and impact to existing biodiversity

15.4.5 Changing temperatures and rainfall may change the habitats within the Site, primarily those which have value – i.e. the SACs, SPAs, and Local Wildlife Sites as defined in Chapter 7: Ecology. Impacts on peak river flows of river basins are considered within Chapter 11: Flood Risk and Drainage using Environment Agency data which includes contingency for more vulnerable development types such as housing.

15.4.6 As part of the Proposed Scheme, compensatory habitats as outlined within the Mitigation proposed in Chapter 7: Ecology provide primary mitigation measures, integral to the design which will seek to enhance the biodiversity of the Site, mitigating the anticipated impacts of climate change in accordance with the England Biodiversity Strategy to include the selection of climate change tolerant species as part of the projects' biodiversity strategy. Implementation of the above is expected to be controlled via planning condition and the management plans include a requirement for monitoring which will ensure that any unforeseen impacts are also addressed.

Increased winter rainfall and risk to essential infrastructure and human health

15.4.7 The risk of all types of flooding and consideration of increased rainfall due to climate change is considered in Chapter 11: Flood Risk, and Drainage.

15.4.8 A full flood risk and drainage strategy supports the planning application and sets out the impacts of the Proposed Scheme and its resilience to potential for increased winter rainfall as a result of climate change. As a result, primary mitigation resulting from the design will reduce any risk to essential infrastructure and human health to a level that is not considered significant.

Disruption of transportation patterns and infrastructure due to severe weather conditions

15.4.9 Pedestrians and cyclists will be sensitive to extreme weather conditions which could affect transportation patterns. The increased likelihood of overheating could have a detrimental effect on the comfort of public transport users.

15.4.10 A Transport Assessment is provided as part of the planning application which sets out the impacts of the Proposed Scheme and how these will be mitigated, in line with the National Planning Policy Framework (NPPF). In addition, a Framework Travel Plan (FTP) has been prepared. This will set out a range of measures to encourage sustainable modes of travel and will include an implementation and monitoring strategy. These matters are addressed further in Chapter 8: Transport.

15.4.11 The Proposed Scheme will seek to create as many sustainable low-carbon travel choices as possible that minimise time, distance, and effort, providing an advantage over motor traffic and limiting any potential disruption of transportation patterns and infrastructure caused by severe weather conditions.

Increased carbon emissions from traffic during construction

15.4.12 An increase in traffic (including HGVs) during the construction phase of the Proposed Scheme was assumed at Scoping stage. The Transport Chapter (Chapter 8) confirms within Section 8.8.17 that increases to traffic flows will be minor adverse. Any required mitigation measures for traffic management during construction will be set out within the CEMP, prepared to define local routes to be used by lorries generated by construction activities so that carbon emissions

associated with the temporary increase in construction traffic to existing pedestrians, cyclists and drivers will not be significant, in line with the assessment of impact on traffic flows.

15.4.13 However, in the absence of more specific information at planning stage, RICs data has been utilised within the GHG assessment and includes estimates of the carbon emissions for average building construction sites, including those from construction traffic to provide a 'worst case' in terms of likely carbon emissions.

Changing summer temperatures and risk of overheating and demand for heating/ cooling

15.4.14 Increased summer temperatures could reduce the need for heating (and associated energy use and GHG emissions) whilst increase the need for cooling (and associated energy use and GHG emissions). All dwellings and non-residential buildings on site will be designed in accordance with Building Regulations which includes an assessment of overheating based on climatic conditions. Any impact will be dealt with via individual building level overheating assessment such as CIBSE Technical Memorandum 52 and 59 (The assessment of overheating in buildings other than dwellings and dwellings respectively).

15.4.15 An increase in summer temperature is unlikely to be significant and will not be considered as part of the EIA or reported in the ES.

15.5 Assessment of Impacts

Likely Significant Effects

15.5.1 Following responses to the scoping report and further work by technical disciplines, the following effects are identified as potentially significant and are assessed further within this Chapter:

- Green House Gas emissions

Current and Future Baseline

15.5.2 The closest meteorological station to the development site is at Finningley (Robin Hood Doncaster Airport) in Yorkshire. Average observed climate data has been utilised for the current conditions alongside projected climate (UKCP18) data to establish how the current baseline position may alter as a result of climate change that has already been set in motion.

15.5.3 Table 15.5 sets out the average observed climate data for Finningley for the period 1981 to 2010.

Table 15.5 - Baseline climatic conditions

Month	Max. temp. (°C)	Min. temp. (°C)	Days of air frost (days)	Sunshine (hours)	Rainfall (mm)	Days of rainfall ≥1 mm (days)	Monthly mean wind speed at 10m (knots)
January	7.3	1.0	10.9	59.1	44.4	9.9	9.2
February	7.8	1.0	11.1	77.4	32.2	7.7	8.8

March	10.5	2.6	6.2	108.7	37.3	9.2	9.2
April	13.0	4.1	3.1	148.0	47.2	8.8	7.9
May	16.4	6.7	0.4	189.5	43.4	8.8	7.5
June	19.5	9.9	0.1	174.6	63	8.8	7.3
July	21.9	11.9	0	190.6	49.5	8.6	7.1
August	21.7	11.5	0	178.2	52.4	9.0	7.2
September	18.7	9.6	0	135.2	52	7.5	7.6
October	14.3	6.8	1.3	101.5	53.8	9.6	7.8
November	10.1	3.6	5.2	64.4	50.5	10.1	8.0
December	7.4	1.3	10.6	50.5	48.8	11.0	7.9
Annual	14.1	5.9	48.8	1477.5	574.5	109.2	8.0

15.5.4 The EIA Regulations 2017 requires EIA to outline the likely evolution of baseline conditions without implementation of the development (i.e. the 'do nothing' scenario) as far as changes from the baseline scenario can be assessed with reasonable effort on the basis of available information and scientific knowledge.

Barnsley Metropolitan Borough Council Administrative Area

15.5.5 In addition to considering baseline conditions at the site level, this assessment presents GHG emissions from the development within the local context, this being Barnsley Metropolitan Borough Council's administrative area. Table 15.6 presents recent (2018) annual GHG emission (in kilotons of CO_2 equivalent, $ktCO_{2e}$) for the Barnsley Metropolitan Borough Council administrative area as obtained from the UK local authority and regional CO_2 emissions statistics published by Government[16]. The data provides total GHG emissions for the area as well as emissions by sector (including industrial & commercial, domestic and transport). For the purposes of the assessment data is presented for the industrial and commercial sector (electricity, gas and other fuels). This data can be used to contextualise emissions from the development and help determine the significance of effect.

Table 15.6 - Barnsley Metropolitan Borough Council 2018 GHG Emissions

Sector	GHG Emissions ($ktCO_2e$)
Domestic Sector 2018	421.9
Industrial & Commercial Sector 2018	404.2
Transport Sector 2018	308.4
All Sectors 2018	1134.5

Yorkshire and the Humber

15.5.6 Table 15.7 presents the same data as the previous table but for all of Yorkshire and the Humber region (i.e. all local authority areas within the region).

[16] UK Local Authority and Regional Carbon Dioxide Emissions National Statistics 2005 to 2016, 2018; Department for Business, Energy & Industrial Strategy (BEIS); UK Government.

Table 15.7 - Yorkshire and Humber 2018 GHG Emissions

Sector	GHG Emissions ($ktCO_2e$)
Domestic Sector 2018	8,275.1
Industrial & Commercial Sector 2018	9,381.2
Transport Sector 2018	7,261.4
All Sectors 2018	24,917.7

United Kingdom

15.5.7 The Climate Change Act 2008 sets a target to ensure the UK's net carbon account for the year 2050 is at least 80% lower than the 1990 baseline. Carbon budgets have been set up to the year 2032, and the Committee on Climate Change notes that, from this point forward (2018), an annual reduction in emissions of circa 3% is required to meet the 2050 target. On this basis, carbon budgets likely to be required post-2032 to meet the 2050 target have been estimated.

15.5.8 Table 15.8 sets out the UK Carbon Budgets up to 2050, including *(in italics)* those that have been estimated post the 6th Carbon Budget (2033-37) for the purposes of this assessment.

Table 15.8 - UK Carbon budgets

Carbon Budget & Period	GHG Emissions (million tonnes CO_2e)
1st Carbon Budget (2008 – 2012)	3,018
2nd Carbon Budget (2013 – 2017)	2,782
3rd Carbon Budget (2018 – 2022)	2,544
4th Carbon Budget (2023 – 2027)	1,950
5th Carbon Budget (2028 – 2032)	1,725
6th Carbon Budget (2033 – 2037)	965
7th Carbon Budget (2038 – 2042)	*645* TBC*
8th Carbon Budget (2043 – 2047)	*324* TBC*
9th Carbon Budget (2048 – 2050)	*0* TBC*

* = Estimated figure.

15.5.9 On this basis, the UK Carbon Budget across the development's construction phase (2023-2033) is estimated to be 3,916 million tCO_{2e}, and across the assumed operational phase (2026 to 2086) is estimated to be 4,146 million tCO_{2e}.

Future Baseline

15.5.10 Potential future baseline conditions have been established from the Met Office's latest UK climate projections (UKCP18). Table 15.9 presents projections for Yorkshire and the Humber for the 2020s and 2050s periods in the RCP 8.5 (i.e. "high") emissions and central (i.e. 50% probability) scenario. These future

periods respond to the assumed construction and operational phases of the development.

Table 15.9 - UKCP18 Projections (RCP 8.5, 50% probability)

Parameter	Projection (2020s)	Projection (2050s)
Temperature	Increase in winter mean temperature of 1.0°C	Increase in winter mean temperature of 2.0°C
	Increase in summer mean temperature of 1.1°C	Increase in summer mean temperature of 2.5°C
	Increase in annual mean temperature of 1.0°C	Increase in annual mean temperature of 2.1°C
Rainfall	Increase in winter mean precipitation of 4%	Increase in winter mean precipitation of 9%
	Decrease in summer mean precipitation of 6%	Decrease in summer mean precipitation of 21%

15.5.11 Informed by Tables 15.8 and 15.9 with respect to current and future climatic conditions, The Climate Change Risk Assessment for the Site presented in Table 15.10 below provides consideration to both extremes in short-term weather events that produce sudden shocks with effects on a number of receptors and extremes in longer term climatic variability.

Sensitive Receptors

15.5.12 The impacts of climate change on development are potentially wide ranging, the UK Climate Change Risk Assessment provides guidance on potentially sensitive receptors. Table 15.10 sets out a summary of climate change effects specific to the development site and the likely sensitive receptor(s) to identified risks and opportunities.

Table 15.10 - Climate change risk assessment

Climate Change Effect	Risk	Opportunity	Receptor(s)
Increase in winter mean temperature	Declining species and natural habitats from changing climate.	New species colonisation	Habitats and species
		Reduced energy use and GHG emissions	Energy infrastructure and climatic system
Increased summer mean and daily maximum temperature	Declining species and natural habitats from changing climate.	New species colonisation	Habitats and species

	Increased energy demand from additional cooling in buildings	-	Energy infrastructure and climatic system
	Overheating impacting health and wellbeing	-	Building occupants
	Ground movement due to ground movement and differential settlement	-	Buildings and infrastructure
	Water restrictions	-	Habitats and species Building infrastructure, building occupants and property
Decrease in summer rainfall	Fresh water supplies	-	Building operations
	Ground movement and differential settlement	-	Building infrastructure
Increase in winter rainfall	Increased river flow and risk of fluvial flooding	-	Building infrastructure, building occupants and property
	Ground movement and differential settlement	-	Building infrastructure

Climate Change Mitigation

Construction Phase

15.5.13 The construction of the development will result in GHG emissions from various activities, both on and off-site, including the consumption of fossil fuels by construction plant and vehicles, the generation of consumed mains electricity, the manufacture of construction materials, and the transport to / from site of workers, materials and wastes.

15.5.14 For both the construction and operational stage when considering secondary mitigation and residual effects, IEMA recommends use of the GHG Mitigation Hierarchy which provides a structure for mitigating GHG emissions and which has been adopted in relation to the Project as summarised in Table 15.11.

Table 15.11 - GHG mitigation hierarchy

Hierarchy	Description
Avoid	Investigate and deploy options to eliminate GHG emissions
Reduce	Ensure that construction and operational activities will deliver efficient use of energy and resources.
Substitute	Commit to deploying renewables and low carbon materials, methods and technologies in place of more carbon intensive sources.
Compensate	Develop a strategy to compensate for residual or unavoidable emissions.

15.5.15 Whole life carbon assessment for the built environment' guidance published by RICS in 2017[17] provides a benchmark factor for estimating average building construction site GHG emissions where more specific information is not available as typically the case at this planning stage prior to detailed design. This factor (1,400 $kgCO_{2e}$ per £100k project value) has been applied to the project value to estimate total construction site GHG emissions as presented in Table 15.12.

Table 15.12 - Estimated construction site GHG emissions

Parameter	Value
Estimate project value	£343.1 million
RICS construction emissions factor	1,400 $kgCO_2e$/£100k
Estimated construction site emissions	48,034 tCO_2e

15.5.16 RICS Methodology to calculate embodied carbon[18] provides benchmark estimates of embodied carbon associated with construction materials for various types of buildings. These benchmarks have been used to estimate embodied carbon associated with the development as presented in Table 15.13.

Table 15.13 - Estimated embodied carbon

Parameter	Value
Development floor area estimates	• 1,760 new homes • 114,131.5 sqm (Use Class B2/B8) • 6,377.8 sqm (Use Class E/B2/B8) • Est. 1,800 sqm New primary school • Est. 2,000 sqm Local shops and community facilities

[17] Whole life carbon assessment for the built environment; 1st Edition, Royal Institute of Chartered Surveyors (RICS), 2017

[18] Methodology to calculate embodied carbon; 1st Edition, Royal Institute of Chartered Surveyors (RICS), 2014

RICS embodied carbon factors	• 530 $kgCO_2e$/sqm – mid terrace/row house • 540 $kgCO_2e$/sqm – end terrace/row house • 540 $kgCO_2e$/sqm – semi-detached • 550 $kgCO_2e$/sqm - detached, single family home • 690 $kgCO_2e$/sqm – primary school • 860 $kgCO_2e$/sqm – business park • 435 $kgCO_2e$/sqm – small/medium light industrial • 520 $kgCO_2e$/sqm – large light industrial • 410 $kgCO_2e$/sqm – warehousing/ logistics • 690 $kgCO_2e$/sqm – local/neighbourhood centre • 750 $kgCO_2e$/sqm – high street retail/ district centre
Estimated embodied carbon	• 53,736 tCO_2e

15.5.17 Table 15.14 presents total GHG emissions estimates for the construction phase, comprising the site GHG emissions and embodied carbon emissions as set out above. Average annual construction phase GHG emissions are also presented based on the scheduled construction period to 2033.

Table 15.14 - Total and annual construction phase GHG emissions

Parameter	Value
Total Construction GHG Emissions	48,034 tCO_2e
Average Annual Construction GHG Emissions	4,803 tCO_2e

15.5.18 A 2013 report by the Department for Business, Innovation and Skills (BIS)[19] estimates that 64% of UK building materials are imported from the EU. It is also likely that construction materials were manufactured over a number of historical years. Whilst geographical and temporal boundaries of GHG emissions from construction materials do not therefore closely relate to the local / regional / national GHG emissions used to contextualise these development effects, embodied carbon from construction materials are nevertheless included in the assessment to ensure potential impacts are not underestimated.

15.5.19 Table 15.15 presents average annual construction phase GHG emissions in the context of 2018 industrial and commercial GHG emissions from Barnsley Metropolitan Borough Council's administrative area and Yorkshire and the Humber, as well as to the UK Carbon Budget estimated for the construction period (2023-33). Annual average construction phase GHG emissions are used for comparison with Barnsley Metropolitan Borough Council and Yorkshire and the Humber emissions (given these also represent annual emissions), whilst total construction phase GHG emissions are used within the context of the UK Carbon Budget.

[19] Monthly Statistics of Building Materials and Components; Commentary, Department for Business, Innovation & Skills (BIS), January 2013

Table 15.15 - Contextualised construction phase GHG emissions

Context	Construction Phase GHG Emissions (as a %)
Barnsley Metropolitan Borough Council 2018 Industrial & Commercial GHG Emissions	1.06% (annual GHG emissions)
Yorkshire and the Humber 2018 Industrial & Commercial GHG Emissions UK Carbon Budget 2023-33	0.028 % (annual GHG emissions) 0.0012% (total GHG emissions)

15.5.20 Predicted annual average construction phase GHG emissions from the development represent 1.06% of the Barnsley Metropolitan Borough Council's 2018 industrial, commercial and domestic sector GHG emissions, reducing to 0.028% of 2018 emissions from these sectors across the Yorkshire and the Humber, or <0.0012% of the UK Carbon Budget for the construction period (2023-33).

15.5.21 Whilst total annual construction phase emissions are forecast to be within the 1-3% threshold suggested in Table 2 for a minor adverse effect, direct annual construction site emissions (i.e. excluding embodied carbon in construction materials) represent only 1.06% of Barnsley Metropolitan Borough Council's 2018 industrial, commercial and domestic emissions.

15.5.22 Given that the above represents a 'worst case' based on RICs data and that any effects are temporary, the construction phase GHG emissions are considered upon assessment to be of minor magnitude with low probability which reduces their impact to non-significant.

Operational Phase

15.5.23 The operation of the development will also result in GHG emissions from the generation of consumed mains electricity to heat and power the dwellings. An estimate of the development's annual energy demands has been obtained from benchmark data available for dwellings and non-domestic buildings. This is deemed to be the worst case in terms of emission scenario.

15.5.24 Whilst GHG emissions will also be generated as a result of additional operational activities such mains water consumption, wastewater treatment, and the transport and treatment of waste, emissions from such sources are likely to be small compared to emissions from energy consumption and as a result are excluded from the assessment.

Operational GHG Emissions

15.5.25 Table 15.16 sets out predicted operational energy consumption for the development and associated GHG emissions during the assumed first year of operation (anticipated to be 2026).

15.5.26 GHG emissions over the assessed 60-year timescale are calculated using UK electricity consumption-based grid factors for the domestic sector published by

BEIS[20] which project continued decarbonisation of the UK grid from the ongoing uptake of renewables (especially offshore wind) and the closure of coal fired power stations. The carbon emissions have been estimated based on Hydrock's internal database of building carbon emission data. Industry benchmarks have previously been used for GHG emissions assessments; however, these have not been updates since 2011 and are significantly outdated.

Table 15.16 - Operational phase GHG emissions

Operational Emission Sources	Generation of consumed mains electricity ($ktCO_2e$)
2026 Development Operational GHG emissions	9.86 $ktCO_{2e}$ Use 0.99 emissions factor
Total Development Operational GHG emissions	138.2 $ktCO_{2e}$

15.5.27 The development has been assessed for its expected GHG emissions during their first year of operation (2026) accruing to 138.2 $ktCO_{2e}$ across the assessed 60 year period.

15.5.28 Table 15.17 shows how these emissions compare to the estimated UK Carbon Budget for this period, to 2018 industrial and commercial sector GHG emissions from Barnsley Metropolitan Borough Council's administrative area and the Yorkshire and the Humber region. Construction phase GHG emissions estimated for 2023 are used for comparison with Barnsley Metropolitan Borough Council and Yorkshire and the Humber emissions (given these also represent annual emissions), whilst total operational phase GHG emissions across the 2026-2086 period are used within the context of the UK Carbon Budget.

Table 15.17 – Contextualised operational phase GHG emissions

Context	Operational Phase GHG Emissions (as a %)
Barnsley Metropolitan Borough Council 2018 Industrial, Commercial and Domestic GHG Emissions	1.13% (first year GHG emissions)
Yorkshire and the Humber 2018 Industrial, Commercial and Domestic GHG Emissions	0.039 % (first year GHG emissions)
UK Carbon Budget 2026-2086	0.00348 % (total operational GHG emissions)

15.5.29 GHG emissions from the development in the first year of operation represent only 1.13% of Barnsley Metropolitan Borough Council's 2018 industrial, commercial and domestic sector GHG emissions, reducing to 0.039% of 2018 emissions from these sectors across the Yorkshire and the Humber region, or 0.00348% of the UK Carbon Budget for the 2023-2086 period.

15.5.30 As a result of the above assessment and the requirement for all UK buildings to be net zero by 2050 (and new homes to be 70-80% lower carbon by 2025),

[20] Data Tables 1-19 Supporting the Toolkit and the Guidance 2017, Department for Business, Energy & Industrial Strategy (BEIS), 2018

operational phase GHG emissions are considered to be of negligible magnitude and very high likelihood which reduces their impact to non-significant.

Climate Change Adaptation

15.5.31 As acknowledged within the IEMA Guidance, there is no agreed method of presenting climate information and approaches vary depending on the scale of the development and the application of professional judgement.

15.5.32 Measures to ensure adaptation to Climate Change and future resilience of the proposed development have been paramount to the design process for the Proposed Scheme.

15.5.33 Where possible, key evidence to determine the risks posed by climate change to the development have been reviewed to provide context for the qualitative assessment carried out. This approach is considered suitable given the nature of the development and is also a reference point for the climate change adaptation/resilience measures outlined in other technical chapters within the ES which will limit the cumulative impacts.

15.6 Residual Effects

15.6.1 There are no residual effects considered likely during the construction or operational stages as a result of climate change which cannot be appropriately mitigated by the mitigation measures which have been in built into the scheme proposals.

15.7 Cumulative Impacts

15.7.1 Consideration must also be given to the cumulative effects of the proposed development with that of other approved developments in the area where they may have an impact upon GHG emissions from their construction and operation.

15.7.2 An assessment of the cumulative effect of nearby committed developments is provided in Table 15.18.

Table 15.18 - Cumulative effects on climate change - committed developments

Planning Application Reference	Proposed Development Site Details	Cumulative Effects
2016/0259	Smithy Wood Lane - Residential development of 36 dwellings	None anticipated as result of the scale of development.
2016/0268	Green Road – Residential development of 50 dwellings	None anticipated as result of the scale of development.
2017/1002	Capitol Park – Development of approximately 7,000 sqm of industrial land use	None anticipated as a result of the low (regulated) energy intensity of industrial land use.
2019/0286	Capitol Park – Employment development of approximately 16,723 sqm	None anticipated as a result of the low (regulated) energy intensity of employment land use.

2020/0977	Land off Barugh Green Road – Residential development of 140 dwellings	None anticipated as result of the scale of development.

15.7.3 The GHG emissions presented in this Chapter are based on circumstances specific to the development; whilst external factors could have an impact on the quantity of estimated emissions, reasonable endeavours have been taken to ensure that likely scenarios are accounted for, for example in projections of future emission factors. Beyond this, there are no specific projects identified that are likely to have an inter-project effect on the quantity of GHG emissions.

15.7.4 Central estimates of the effects of climate change are presented as part of the adaptation section of this Chapter, and no further assessment of cumulative effects is considered necessary.

15.7.5 No inter-project cumulative effects are anticipated on the basis that climate change adaptation effects and impacts are specific to the development and will not result in impacts to neighbouring development.

15.8 Conclusion

15.8.1 The Climate Change chapter assesses both the impact of the development on climate change as a result of GHG emissions and associated mitigation measures, as well as potential impacts of climate change on the development and the associated adaptation measures to ensure long term resilience.

15.8.2 In accordance with IEMA guidance and in the context of the UK Climate Change Risk Assessment, the key receptors identified include: habitats and species, construction employees and equipment, energy infrastructure; building occupants; building infrastructure; and building operations.

15.8.3 The assessment has identified a wide range of primary mitigation inherent to the design of the development, and tertiary mitigation which sets out legislative and/or policy requirements which are to be incorporated into the detailed design stage, construction, or operational practices. Mitigation measures that are included to reduce GHG emissions from the operational stage of the development are detailed in the Sustainability Appraisal Statement (Appendix 15.1) As a result, the majority of potential effects have been determined to be insignificant.

15.8.4 Taking into account primary and tertiary mitigation, three potentially significant effects have been identified and assessed in this chapter: the GHG emissions related to construction and operation, and the potential for overheating impacting on building occupants during operation. To mitigate the impact of the identified effects, the following design and operational measures are proposed:

- Building in line with UK Government carbon reduction targets for residential and non-residential development to reduce the impact of the development on the climatic system; and

- Thermal dynamic modelling of occupied building spaces in line with relevant CIBSE guidance (TM59 and TM52 for residential and non-residential buildings respectively) and design for thermal comfort taking into account predicted annual temperature rise as a result of climate change to minimise the risk of summertime overheating for building occupants.

15.8.5 As a result of these measures, no significant effects are identified.