

6. Climate Change Resilience and GHG Emissions

Appendix 6.1 - Greenhouse Gas Calculation Inputs

APPENDIX 6.1 GREENHOUSE GAS CALCULATION INPUTS

General project inputs

Table 1 General information

LCA timeline	60	years	BS EN 15978
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Table 2 Calculation area schedule for construction of the proposed development

Building	Unit	Area					
		2025	2026	2027	2028	2029	Total m²
Plot K residential	m²	5,531	11,063	11,063	11,063	5,531	44,250
Plot K Amenity	m²	265	530	530	530	265	2,118
Plot K Recreation	m²	305	609	609	609	305	2,436
Plot J Residential	m²		10,239	10,239	10,239	5,120	35,838
Plot J Amenity	m²		401	401	401	201	1,405
Plot J Commercial	m²		336	336	336	168	1,175

Embodied carbon (construction GHG emission) inputs

Table 3 Material embodied carbon benchmarks (lifecycle stage A1-A5)

Schedule typologies	Current project progress as provided by project Engineers (WSP)	Unit
Plot K	625	kgCO ₂ e/m².GIA
Plot J	800	kgCO ₂ e/m².GIA

Schedule typologies	Benchmark	Unit	Source
Residential and amenity areas	350	kgCO ₂ e/m².GIA	GLA 2022 Residential B-C (excluding B6 & B7) WLC benchmark
Commercial areas	200	kgCO ₂ e/m².GIA	GLA 2022 Retail B-C (excluding B6 & B7) WLC benchmark

Operational GHG emission calculation inputs

Table 4 Building emission rates as provided by the Energy Consultants

Building	kgCO ₂ e/m²/year
Domestic	60
Non-domestic (new-build commercial)	120

Table 5 BEIS (2023) and SAP (2016) emissions factors.

	kgCO ₂ /kWh	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050+
BEIS	Grid Domestic- BEIS projections (BEIS Measuring and reporting environmental impacts: guidance for businesses, 2021)	0.15150	0.131	0.098	0.073	0.063	0.054	0.049	0.042	0.033	0.026	0.021	0.020	0.020	0.018	0.018	0.017	0.016	0.015	0.015	0.009	0.008	0.008	0.008	0.005	0.005	0.003	0.003
BEIS	Grid Commercial / Public sector- BEIS projections (BEIS Measuring and reporting environmental impacts: guidance for businesses, 2021)	0.149	0.129	0.096	0.072	0.062	0.053	0.049	0.041	0.032	0.025	0.020	0.020	0.019	0.018	0.018	0.017	0.016	0.015	0.014	0.009	0.008	0.008	0.008	0.005	0.005	0.003	0.002
BEIS	Grid Industrial- BEIS projections (BEIS Measuring and reporting environmental impacts: guidance for businesses, 2019)	0.146	0.127	0.095	0.070	0.061	0.052	0.048	0.040	0.032	0.025	0.020	0.019	0.019	0.018	0.017	0.016	0.015	0.015	0.014	0.009	0.008	0.008	0.007	0.005	0.005	0.003	0.002
SAP	Grid SAP 2016 Consultation	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136	0.136
SAP	Gas SAP 2016 Consultation	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208

Table 6 Benchmarks and conversion factors used for GHG emissions associated with operational water consumption for the proposed development

Building/Use	Benchmark name	Benchmark	Source
Plot K residential	Domestic/residential Business as Usual Potable Water Use	125 L/day/person	RIBA 2030 (as provided by project MEP Engineers)
Plot K Amenity	General Assembly and Leisure, Clubs, Theatres - Public circulation areas	0.111 occupant density	BREEAM UK New Construction - Version 6.1.0)
	Places of assembly - Restaurants (per person)	7 L/day/person	BG 85_2024 Mechanical Criteria
Plot K Recreation	General Assembly and Leisure, Clubs, Theatres - Dry sports hall	0.047 occupant density	BREEAM UK New Construction - Version 6.1.0)
	Sports changing facilities - Sports halls (per person)	35 L/day/person	BG 85_2024 Mechanical Criteria
Plot J Residential	Domestic/residential Business as Usual Potable Water Use	125 L/day/person	RIBA 2030 (as provided by project MEP Engineers)
Plot J Amenity	General Assembly and Leisure, Clubs, Theatres - Public circulation areas	0.111 occupant density	BREEAM UK New Construction - Version 6.1.0)
	Places of assembly - Restaurants (per person)	7 L/day/person	BG 85_2024 Mechanical Criteria
Plot J Commercial	General Assembly and Leisure, Clubs, Theatres - Sales area – general	0.241 occupant density	BREEAM UK New Construction - Version 6.1.0)
	Places of assembly - Bars (per person)	4 L/day/person	BG 85_2024 Mechanical Criteria
All schedule typologies	Carbon factor for water supply	0.15311 kg CO ₂ per m ³ of water supplied	Department for Energy Security and Net Zero (DESNZ) Greenhouse Gas Reporting: Conversion Factors 2024
	Carbon factor for the treatment of foul water	0.18574 kg CO ₂ per m ³ of water supplied	

Table 7 Assumptions and conversion factors used for GHG emissions associated with operational transport for the proposed development

Assumed mode of transport	Assumed Distance travelled (km)	Source of assumed distance travelled	Annual trips	Number of trips over 60-year lifecycle	Carbon factor (total kgCO ₂ e per km)	Lifetime GHG emissions (tCO ₂ e)
HGVs	108	Department for Transport Domestic Road Freight Statistics, United Kingdom: 2018 (publishing.service.gov.uk)	16,790	1,007,400	All HGVs, average laden 0.872960	94,977.35
Cars	13	Nimblefins Average Car Journeys in the UK NimbleFins	132,130	7,927,800	Average cars, unknown fuel 0.166910	17,201.98

Appendix 6.2 - Climate Change Resilience Risk Assessment

Mayfield Phase 1b

Appendix 6.2 Climate Change Resilience Risk Assessment

0062001

19 December 2024

Revision P01

Revision	Description	Issued by	Date	Checked
P01	For Planning	CA	19.12.24	PL

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Glossary

Term	Definition
CCR	Climate Change Resilience
CCRA	Climate Change Risk Assessment
CO2	Carbon Dioxide
COP	Conference of the Parties
DLUHC	Department for Levelling Up, Housing, and Communities
EIA	Environmental Impact Assessment
ES	Environmental Statement
GHG	Greenhouse Gas
GMCA	Greater Manchester Combined Authority
IEMA	Institute of Environmental Management and Assessment
IPCC	International Panel on Climate Change
ISO	International Organization for Standardization
LA	Local Authority
MCC	Manchester City Council
MHCLG	Ministry for Housing, Community and Local Government
MVHR	Mechanical Ventilation with Heat Recovery
NPPF	National Planning Policy Framework
PIEVC	Public Infrastructure Engineering Vulnerability Committee
RCP	Representative Concentration Pathways
RSP	Reference Study Period
SRI	Solar Reflectance Index
UKCP18	UK Climate Projections 2018
UNDRR	United Nations Office for Disaster Risk Reduction
USGS	United States Geological Survey
WSP	Williams Sale Partnership (Engineering Consultancy)
WHO	World Health Organization

1 Introduction

Schedule 4, Clause 5(f) of the Town and Country Planning (EIA) Regulations 2017 states that information should be included in the ES on the likely significant effects of the development on the environment resulting from the vulnerability of the project to climate change.

In line with the IEMA EIA Guide to Climate Change Resilience and Adaptation (IEMA, 2020) (hereafter referred to as the 'IEMA Resilience & Adaptation Guidance'), there are two key strands to assessing climate change resilience and adaptation issues within EIA, as outlined below:

- The risks of changes in the climate impacting the project (i.e. the resilience or conversely the vulnerability of a project to future climate changes). The IEMA Resilience & Adaptation Guidance advises that this can be assessed using a traditional impact magnitude and effect significance methodology; however, it is better suited to a risk assessment type process. A climate change resilience risk assessment has therefore been undertaken and is reported in this part of the ES chapter; and
- The extent to which climate exacerbates or ameliorates the effects of the project on the environment (i.e., 'in-combination' effects). The IEMA (2020) guidance states that this is best analysed in the existing chapters of the ES and is suited to using traditional significance criteria from the respective chapters. Therefore, this has been included throughout each of the technical chapters and has been completed by each technical specialist.

2 Methodology and assessment criteria

2.1 Climate Change Resilience and Adaptation Workshop

The IEMA Resilience & Adaptation Guidance advises that climate resilience mitigation measures are best developed and agreed in a collaborative manner, with the climate change resilience coordinator working with the design team, the environmental topic leads, and the EIA coordinator to agree the measures.

A climate change resilience and adaptation workshop was held on 03 December 2024. The project team in attendance included members of the design team, the planning consultant and technical specialists covering a range of environmental topics from Buro Happold, Studio Egret West, Deloitte, and WSP. At the workshop,

Buro Happold presented:

- The key guidance relating to climate change resilience and adaptation in EIA;
- The approach being applied to climate change resilience and adaptation assessment in the EIA;
- The Met Office UK Climate Projections 2018 (UKCP18) climate change projections for the proposed development; and
- The relevant climate change hazards and the risks each pose to the proposed development.

Buro Happold then led a collaborative session with the team to discuss and agree mitigation measures to reduce the identified risks.

The workshop outcomes have been fed into this climate change resilience risk assessment.

2.2 Risk Assessment

This climate change resilience risk assessment has been undertaken in line with the IEMA Resilience & Adaptation Guidance. The methodology has also been informed by other guidance documents referenced in the IEMA Resilience & Adaptation Guidance, including the C40 Cities Climate Change Risk Assessment Guidance (2018), the Public Infrastructure Engineering Vulnerability Committee (PIEVC) Climate Risk Assessment Methodology (2015), and the National Highways Design Manual for Roads and Bridges LA 114 Climate, Sustainability & Environmental Appraisal. Risk has been assessed based on both the probability of an event occurring and the severity of the consequences of the event, should it occur.

A risk assessment has been undertaken that assesses the probability and consequence of climatic hazards/environmental hazards exacerbated by climate change occurring at the Site, considering the climate change projections set out below. The list of environmental hazards that have been considered has been adapted from the C40 Cities Climate Change Risk Assessment Guidance (2018). The assessment of risk has been informed by climate projection data from UKCP18, as well as other reports to be submitted alongside the planning application.

2.3 Probability

Table 2-1 summarises the criteria utilised to determine the likelihood rating for an effect, adapted from Appendix 1 of the IEMA Resilience & Adaptation Guidance. The project lifetime includes both the construction and operation stages.

In line with the principles set out in BS EN 15978, a Reference Study Period (RSP) of 60 years after opening (the fully operational opening year) has been used.

Table 2-1 Criteria used to determine likelihood (adopted from Appendix 1 of the IEMA Resilience and Adaptation guidance)

Score	Description (probability and frequency of occurrence)
1	The event occurs very rarely during the lifetime of the projects (60 years). For example once every 60 years (1 event).
2	The event occurs a limited number of times during the lifetime of the project (60 years). For example, once every 25 years (2-3 events).
3	The event occurs regularly during the lifetime of the project (60 years). For example, once every 2 – 5 years (12-30 events).
4	The event occurs frequently during the lifetime of the project (60 years). For example, once per year (60 events).
5	The event occurs very frequently during the lifetime of the project (60 years). For example, multiple times per year (more than 60 events).

2.4 Consequence

Table 2-2 summarises the criteria used to determine the consequence rating for effects relating to a climate risk. Consequence has been determined based on the extent to which the climate risk may impact on the amenity value and function of the Proposed Development. The amenity value is the positive element or elements that contribute to the overall character or enjoyment of the Proposed Development. The function is the extent to which the Proposed Development meets the purpose or purposes that it is designed to fulfil (i.e. a residential and commercial development).

Table 2-2 Criteria used to determine consequences (adapted from Appendix 1 of the IEMA Resilience and Adaptation Guidance).

Score	Description (probability and frequency of occurrence)
1	Very low but measurable effect on site users and the Proposed Development itself. Slight negative change in amenity value of the Proposed Development and slight negative change in function.
2	Low but measurable effect on site users and the Proposed Development itself. Low negative change in amenity value of the Proposed Development and slight negative change in function.
3	Moderate effect on site users and the Proposed Development itself. Moderate negative change in amenity value of the Proposed Development and slight negative change in function.
4	Moderate effect on site users and the Proposed Development itself. Major negative change in amenity value of the Proposed Development and low negative change in function.
5	Moderate effect on site users and the Proposed Development itself. Major negative change in amenity value of the Proposed Development and moderate negative change in function.

Score	Description (probability and frequency of occurrence)
6	Major effect on site users and the Proposed Development itself. Major negative change in amenity value of the Proposed Development and major negative change in function
7	Extreme effect on site users and the Proposed Development itself. Loss of asset.

2.5 Risk Rating

Table 2-3 sets out the matrix that has been used to determine the risk rating, based on both the probability of the event occurring and the severity of the consequences of the event, should it occur.

Table 2-3 Risk rating determined based on the likelihood and consequence scores

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

3 Limitations and assumptions

The main uncertainty regarding the climate change resilience assessment surrounds the climate change projections that the scheme is assessed against. Climate change projections (e.g., UKCP18) are presented using a set of scenarios that capture the relationships between human choices, emissions, concentrations and temperature change. The UKCP18 climate change projections have been selected, as they are UK specific, and relatively conservative. Some scenarios are consistent with continued dependence on fossil fuels, while others are associated with deliberate actions to reduce GHG emissions. Therefore, these climate change projections contain inherent uncertainty, reflecting the uncertainty associated with quantifying human activities (including technological change) and their influence on climate. In line with the IEMA Resilience & Adaptation Guidance (IEMA, 2020), RCP 8.5 has been used, which represents the most conservative, highest impact scenario.

4 Legislation and Policy

4.1 International Legislation and Policy

4.1.1 Paris Agreement 2015

Negotiations at the Conference of the Parties (COP) 21 led to the 2015 Paris Agreement, the aim of which is to maintain the increase in global average temperature at 'well below' 2oC and 'pursue efforts' to limit the temperature increase even further to 1.5oC.

A total of 160 parties, including the UK, made voluntary pledges to reduce emissions by 2030, however the cumulative effect of these would still lead to an estimated 3oC of warming or greater.

4.1.2 The Special Report on Global Warming of 1.5oC, International Panel on Climate Change (IPCC) 2018

The IPCC published a special report in response to the Paris Agreement, to present the impacts of the targeted 1.5oC temperature rise. The report highlighted that to achieve this, global emissions must decrease by 45% by 2030 (against a 1990 baseline), and that net zero global emissions (where emissions and removals from the atmosphere are balanced) must be achieved by 2050. This is noted to require rapid and far-reaching transitions of every sector on an unprecedented scale.

4.2 National Legislation and Policy

4.2.1 National Planning Policy Framework (NPPF) (MHCLG), 2024

Section 14 of the NPPF 2024 focuses on meeting the challenge of climate change, flooding and coastal change. As part of this, paragraph 164.a states that new developments should be planned in ways that:

'Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through incorporating green infrastructure and sustainable drainage systems.'

4.2.2 UK Climate Change Act 2008 (2050 Target Amendment) (Order 2019)

Section 56 requires the UK Government to undertake a Climate Change Risk Assessment (CCRA) on a five-yearly cycle, with the subsequent development of an adaption programme to deliver resilience against these risks. The Act stipulates that the Government must assess 'the risks for the United Kingdom from the current and predicted impacts of climate change'.

4.2.3 UK Climate Change Risk Assessment (HM Government, 2022)

The third and most recent UK-wide CCRA was published in 2022. The assessment outlines risks in the eight priority risk areas relating to the following topics:

- Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards (Priority Risk Area 1);
- Risks to soil health from increased flooding and drought (Priority Risk Area 2);

- Risks to natural carbon stores and sequestration from multiple hazards, leading to increased emissions (Priority Risk Area 3);
- Risks to crops, livestock and commercial trees from multiple climate hazards (Priority Risk Area 4);
- Risks to supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (Priority Risk Area 5);
- Risks to people and the economy from climate-related failure of the power system (Priority Risk Area 6);
- Risks to human health, wellbeing and productivity from increased exposure to heat in homes and other buildings (Priority Risk Area 7);
- Multiple risks to the UK from climate change overseas (Priority Risk Area 8); and
- Additional More Action Needed Risks.

4.2.4 The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting (Defra, 2018)

The second and most recent National Adaptation Programme sets out government's response to the second CCRA, showing the actions government is, and will be, taking to address the risks and opportunities posed by a changing climate. This breaks down the likely risks associated with climate change into the same six categories as those set out in the CCRA, which is outlined above.

4.3 Regional and Local Policy

4.3.1 Places for Everyone Joint Development Plan Documents for Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford and Wigan 2022 to 2039

Development will consider sustainability at the forefront of its design, making use of previously-developed (brownfield) land and vacant buildings to meet development needs.

When considering a whole life approach for any new building, embodied emissions from construction can account for up to half of the carbon impacts associated with its lifecycle. In addition, other emissions can be attributed to the end-of-life stages such as demolition, repair or refurbishment.

Objective 8: Improve the quality of our natural environment and access to green spaces.

Objective 8 includes an aim to: 'enhance special landscapes, green infrastructure, biodiversity and geodiversity; improve access to the natural environment and green spaces including parks; promote the role of green space in climate resilience and reducing flood risk.'

Policy JP-G2: Green Infrastructure

There is a clear strategic directive towards the enhancement and protection of green infrastructure and its contribution to the development of a Local Nature Recovery Strategy for Greater Manchester.

Any development that involves the removal of land from the Green Belt will need to offset the impact and delivery compensatory improvements.

Where possible, new green infrastructure should be integrated into development design and the developer should make appropriate provision for its long-term management and maintenance.

Policy JP-P1: Sustainable Places

The city region aims to be visually stimulating, socially inclusive and distinctive in design and cultural preservation.

It also aims to be resilient in its perception of environmental hazards, adaptable, durable and resource efficient, ensuring low-carbon footprint and an efficient use of land.

Design should also be functional and convenient, safe and supported by inclusive design that tackles socioeconomic inequalities. It should also be well-connected, comfortable and incorporate well-managed green infrastructure.

Policy JP-G3: River Valleys and Waterways

They will form a central part of the protection and improvement of green infrastructure as contributing to the Nature Recovery Network.

Some of the key considerations to river valleys and waterways are to: retain the open character; promote enjoyment of the features of valleys such as access to the countryside; protect the semi-natural habitats and their unique features such as ancient woodland; preserve areas of relative tranquillity and seclusion; reduce flood risk management through Natural Flood Management (NFM); improve water quality such as through land decontamination; enhance the re-naturalisation of riverbanks and flood plains; increase active access to green space through promotion of canals and watercourses for walking and cycling; and ensure the development relates positively to nearby rivers and other waterways.

4.3.2 Manchester's Local Development Framework. Core Strategy Development Plan 2012 to 2027 (MCC, 2012)

The Council will require all development to make sustainable use of resources, and adapt to climate change. This will be achieved by:

- *'Considering new developments in the transformation towards retrofitting of renewable energy sources and low or zero carbon infrastructure to existing building stock;*
- *Following the principles of an energy hierarchy by recognising the carbon embedded at every stage of activity and resources. Therefore, consider the total carbon footprint of new and refurbished buildings;*
- *Encouraging developers to use green infrastructure design facets such as green roofs, green walls, waterways and street trees to contribute to energy compliance with CO2 mitigation;*
- *Minimising flood risk by considering the appropriate siting, drainage and treatment of surface areas to ensure rainwater permeability;*
- *The potential to enhance green space zones to assist in the production of natural habitats which will provide species adaptation.'*

4.3.3 Manchester City Council Climate Change Action Plan 2020-2025

The Manchester City Council (MCC) Climate Change Action Plan sets out MCC's commitments to tackling climate change from 2020-2025 and builds on previous plans over the last decade.

The purpose of the plan is as follows:

- *"The document sets out MCC's commitments to tackling climate change over the next 5 years and builds on previous action plans over the last decade.*
- *It covers MCC's plans for adapting to the expected impacts of climate change and supporting and influencing others, including through the implementation of the Manchester Green and Blue Infrastructure strategy 2015-2025"*

Recommended targets and objectives of the plan are as follows:

- *"To adapt the city's buildings, infrastructure and natural environment to the changing climate and to increase the climate resilience of our residents and organizations.*
- *To improve the health and wellbeing of everyone in Manchester through actions that also contribute to our objective for CO2 reduction and adaptation and resilience, with particular focus on those most in need.*
- *To ensure that Manchester establishes an inclusive, zero carbon and climate resilient economy where every can benefit from playing an active role in decarbonizing and adapting the city to the changing climate"*
- *"We recognise that limiting CO2 emissions is not enough. Depending on how successful the world is at reducing emissions, global temperatures by 2100 are likely to rise by between 1.5°C and 4°C above pre-industrial levels. As such, we need to accept that some level of change is inevitable. Climate change is happening now and we need to assess the risks to our communities in order to reduce their vulnerability to these changes. Adopting appropriate mitigation measures will be essential if we are to create resilient communities of the future in Manchester."*

The plan states the following in relation to adaptation to climate change:

- *"Despite the increased international efforts to tackle climate change, we recognise that the world's climate is already changing and that adaptation is required to protect the city's people. We are committed to ensuring that climate change adaptation, including green and blue infrastructure, is included in new developments and across Council owned buildings and land.*
- *Further work needs to be done at a local level through ward plans and neighbourhoods to adapt to make communities more resilient to climate change. This will form part of the Council's work through Neighbourhoods Teams, Highways and also through the development of improved communication information and guidance."*

The plan states the following in relation to citywide emissions:

- *"The Council also recognises the importance of supporting and influencing our residents and organisations to take action to reduce their direct and indirect CO2 emissions and to adapt to the changing climate."*

It is stated that the following is included in the 2020-2025 Action Plan:

- *"This action plan details the activity that we will undertake over the next five years but also includes activities that will need to be developed and investigated further in order to ensure that we are on the right path to being zero carbon by 2038. The actions include activities to deliver a reduction in emissions from energy, transport and consumption (mitigation) but also adaptation and promoting investment in nature based solutions and green infrastructure."*

4.3.4 Manchester Climate Change Framework 2020-2025

The Manchester Climate Change Framework 2020-25 is the city's high-level strategy for tackling climate change. It sets out how Manchester will 'play its full part in limiting the impacts of climate change', a commitment in the Our Manchester Strategy 2016-25.

The framework sets the following objectives and targets:

- *'Staying within our carbon budgets – based on recommendations by the Tyndall Centre for Climate change Research in 2020*
- *Climate adaptation and resilience*
- *Health and wellbeing*
- *Inclusive, zero carbon and climate resilient economy'*

The frameworks sets the following areas for action to meet the objectives and targets:

- *'Buildings (existing and new)*
- *Green infrastructure and nature-based solutions'*

4.3.5 Manchester Green and Blue Infrastructure Strategy 2015-2025

The council aims to enhance and protect the recreational spaces of health and greenery such as gardens, golf courses and pond, placing emphasis on their incredible value and functionality.

The city has developed a long-term vision that integrates the extent and value of the city's green and blue infrastructure.

- Investment in river valleys and canals to restore biodiversity value and flood resilience;
- Embed green infrastructure as part of residential and city centre developments; and
- Smaller scale green infrastructure in Central Manchester such as tree planting and community greening have the potential for increasing an areas climate resilience.

The strategic plan acknowledges the challenges of COVID-19 and increase in extreme weather events, aiming to combat them through progressive resilience by protecting the climate functionality of existing spaces.

4.4 Climate Emergency Declaration

4.4.1 Manchester City Council Climate Emergency Declaration (2019)

Manchester City Council declared a Climate Emergency on 10th July 2019. The council meeting minutes read as follows:

'This Council notes:

- *The serious risks to Manchester's people, of climate change/global heating affecting economic, social and environmental well-being, supply chains – including food security, financial systems and local weather, among many others.*

- *That in 2008 the 'Principles of Tackling Climate Change in Manchester' were agreed as a call to action to engage people from all walks of life in climate change action and, build support for a new way of thinking about climate change.*
- *That Manchester leads the way, with an agreed Paris compliant carbon budget set in December 2018 and an acceleration of the target for becoming a zero-carbon city by 12 years, setting 2038 as the new target for the city, based on research from the world-renowned Tyndall Centre for Climate Change.*
- *The recent and welcome upsurge of action by the young people of Manchester, exemplifying the radical traditions of which Manchester is proud.'*

This Council agrees (or to the extent that the below concern executive functions, recommends to the Executive) to:

Declare a Climate Emergency.

- *'Continue working with partners across Manchester and GMCA to deliver the 2038 target, and determine if an earlier target can be possible, through a transparent and open review. Become carbon neutral by the earliest possible date.*
- *Encourage involvement in all wards by April 2020 through meetings as part of the Our Manchester strategy, to identify residents and partners who want to be actively involved in achieving the target, with provision for those who cannot attend. Ensure ward plans contain specific, measurable, achievable steps.*
- *Review all policies, processes and procedures to ensure the council can become carbon neutral. Present an action plan by March 2020 detailing how the city can stay within its carbon budget. Report back regularly to the NESC. Review the corporate plan.*
- *Work with the Tyndall Centre to review the actual emissions from aviation. Investigate the best way to include aviation in our overall carbon reduction programme in the long term.*
- *Make climate breakdown and the environment, an integral part of activity throughout the Council, including all decision making, ensuring key decisions take into account the impact on achieving the zero-carbon target and including an environmental impact assessment in all relevant committee reports.*
- *Ensure that everyone in the council receives carbon literacy training by the end of 2020. Make attendance easier by varying times and length of sessions.*
- *Encourage all staff on council business to use the lowest carbon, appropriate, travel. Investigate measures to ensure future procurement is carbon neutral. Increase the percentage of social value with an additional environmental element.*
- *Work with suppliers to green their supply chains, and support local production.*
- *Work with training providers to ensure Manchester residents can take on green jobs.*
- *Investigate and introduce measures to help reach domestic zero carbon levels including addressing fuel poverty and retrofitting existing homes.*
- *Investigate ways to ensure that future local plans place a mandatory requirement for all new development to be net zero carbon by the earliest possible date.*
- *Push GMCA to decarbonise public transport, heat and energy as early as possible.*

- *Through our role on GMPF, encourage divestment in fossil fuels as early as possible.*
- *Call on the government to:*
 - *provide powers and resources to make the zero-carbon target possible including funding for big capital projects;*
 - *accelerate the reduction of carbon emissions from aviation;*
 - *accelerate the decarbonisation of the electricity grid, funding low carbon energy generation; and*
 - *ensure that the UK prosperity fund focuses on enable the transition to a low carbon economy.'*

4.5 Guidance documents

4.5.1 IEMA EIA Guide to: Climate Change Resilience and Adaptation (IEMA, 2020)

This document is a revision to the IEMA guidance on Climate Resilience and Adaptation in EIA (2015) and reflects lessons learnt from emerging practice. It provides a framework for the effective consideration of climate change resilience and adaptation in the EIA process.

4.5.2 ISO 14090:2019 Adaptation to Climate Change – Principles, Requirements and Guidelines (BSI, 2019)

The main purpose of this standard is to provide organisations and projects with a consistent, structured and pragmatic approach to prevent or minimise the harm that climate change could cause and also to take advantage of opportunities.

4.5.3 C40 Cities Climate Change Risk Assessment Guidance (C40 Cities, 2017)

This document aims to provide a concise, easy-to-read guidance, to help cities to develop a climate risk assessment report. It provides the methodology and components of the assessment, as well as providing a comprehensive list of possible effects relating to climate change.

5 Current Baseline Conditions

Table 5-1 provides a summary of the current baseline climatic conditions taken from the closest Met Office weather station, Rochdale (Greater Manchester) Climate Station, to the north-east of the Proposed Development. The data provides average historic average climatic conditions for 1991-2020, which is assumed to be representative of the baseline year of the assessment (i.e. 2024). The monthly mean minimum/maximum temperatures are calculated from the average of the daily maximum and daily minimum temperatures for each month. The warmest month on average was July and the coolest month on average was February. The wettest month on average was December and the driest month on average was May. The sunniest month on average was May and the least sunny month on average was January.

Table 5-1 Summary of historic average climatic conditions for 1991-2020 taken from the Rochdale (Greater Manchester) Met office climate station

Month	Mean daily maximum temperature (degrees C)	Mean daily minimum temperature (degrees C)	Days of air frost (days)	Sunshine (hours)	Rainfall (mm)
January	6.93	1.50	10.16	32.16	119.19
February	7.45	1.41	9.32	49.83	97.11
March	9.57	2.51	6.06	98.86	89.91
April	12.47	4.55	2.33	152.72	68.36
May	15.60	7.19	0.28	175.45	65.67
June	18.24	10.13	0.00	152.85	82.87
July	20.01	11.94	0.00	170.77	96.90
August	19.55	11.77	0.00	153.52	100.22
September	17.11	9.55	0.00	116.33	97.80
October	13.39	6.85	1.07	78.66	116.78
November	9.70	3.86	5.05	41.64	123.53
December	7.18	1.50	10.10	42.69	138.88

6 Likely climate changes

The UK Climate Projections 2018 (UKCP18) (Met Office, 2018) provide the most up-to-date assessment of how the climate of the UK may change over the 21st century. UKCP18 uses Representative Concentration Pathways (RCPs). These are named according to the concentration of greenhouse gas modelled to occur in the atmosphere in 2100. There are four RCPs available in the UKCP18 climate projections: RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5. In line with the IEMA Resilience & Adaptation Guidance, RCP 8.5 has been used, which represents the most conservative, highest impact scenario. Table 6-1 summarises the projected summer and winter mean temperature and precipitation changes up to the 2090s for RCP 8.5.

Table 6-1 UKCP18 data for the North West of England under RCP 8.5

Season	Variable	Time period	Projected Change At		
			10 th percentile	50 th percentile	90 th percentile
Winter	Mean temperature (°C)	2020 – 2039	-1 to 0	0 to 1	1 to 2
		2040 – 2059	0 to 1	1 to 2	2 to 3
		2060 – 2079	0 to 1	2 to 3	3 to 4
		2080 – 2099	1 to 2	3 to 4	5 to 6
	Mean precipitation change (%)	2020 – 2039	-10 to 0	0 to 10	10 to 20
		2040 – 2059	-10 to 0	0 to 10	20 to 30
		2060 – 2079	-10 to 0	10 to 20	30 to 40
		2080 – 2099	0 to 10	20 to 30	40 to 50
	Mean daily maximum temperature change compared to 1981-2000	2020 – 2039	-1 to 0	0 to 1	1 to 2
		2040 – 2059	0 to 1	1 to 2	2 to 3
		2060 – 2079	0 to 1	2 to 3	3 to 4
		2080 – 2099	1 to 2	3 to 4	5 to 6
	Mean daily minimum temperature change compared to 1981-2000	2020 – 2039	-1 to 0	0 to 1	1 to 2
		2040 – 2059	0 to 1	1 to 2	2 to 3
		2060 – 2079	0 to 1	2 to 3	4 to 5
		2080 – 2099	1 to 2	3 to 4	5 to 6
Summer	Mean temperature (°C)	2020 – 2039	0 to 1	1 to 2	1 to 2
		2040 – 2059	0 to 1	2 to 3	3 to 4
		2060 – 2079	1 to 2	3 to 4	4 to 5
		2080 – 2099	2 to 3	4 to 5	8+
	Mean precipitation change (%)	2020 – 2039	-30 to -20	-10 to 0	10 to 20
		2040 – 2059	-40 to -30	-20 to -10	0 to 10
		2060 – 2079	-50 to -40	-30 to -20	0 to 10
		2080 – 2099	-60 to -50	-40 to -30	-10 to 0
	Mean daily maximum temperature change compared to 1981 – 2000	2020 – 2039	-1 to 0	1 to 2	2 to 3
		2040 – 2059	0 to 1	2 to 3	3 to 4
		2060 – 2079	1 to 2	3 to 4	5 to 6
		2080 – 2099	2 to 3	5 to 6	8+
	Mean daily minimum temperature change compared to 1981-2000	2020 – 2039	0 to 1	0 to 1	1 to 2
		2040 – 2059	0 to 1	1 to 2	3 to 4
		2060 – 2079	1 to 2	3 to 4	5 to 6
		2080 – 2099	2 to 3	4 to 5	6 to 7

According to UKCP18 data, on land the projected general trends of climate changes in the 21st century are similar to UKCP09, with a move towards warmer, wetter winters and hotter, drier summers. However, natural variations mean that some cold winters, some dry winters, some cool summers and some wet summers will still occur.

6.1 Temperature

UKCP18 projections show that there is expected to be more warming in the summer than in the winter.

6.2 Precipitation

Rainfall patterns across the UK are not uniform and vary on seasonal and regional scales and will continue to vary in the future. While UKCP18 projections show a clear shift to higher probability levels of dry summers, they also suggest that the likelihood of individual wet summers reduces only slightly. The risk of heavy rainfall events across all seasons, is likely to increase.

6.3 Sea level risk

According to UKCP18 projections, the global sea level has risen over the 20th century and will continue to rise over the coming centuries. The amount of sea level rise depends on the location around the UK and increases with higher emissions scenarios. Sea level rise over the coming centuries may affect tidal characteristics substantially (including tidal range).

6.4 Snow

According to UKCP18 projections, for the period 2061-2080, under a high emissions scenario (RCP8.5), the regional (12km) and local (2.2km) projections show a decrease in both falling and lying snow across the UK relative to the 1981-2000 baseline.

6.5 Wind

There are no compelling trends in storminess, as determined by maximum gust speeds, from the UK wind network over the last four decades. UKCP18 projections over the UK show an increase in near surface wind speeds over the UK for the second half of the 21st century for the winter season when more significant effects of wind are experienced. This is accompanied by an increase in frequency of winter storms over the UK. However, the increase in wind speeds is modest compared to interannual variability.

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

7 Identification and evaluation of risks with climate change

Table 7-1 provides a List of potential risks, as adapted from the C40 Cities Climate Change Risk Assessment Guidance (C40 Cities, 2017). A summary is provided of how the identified climate risks are likely to change in the future as a result of climate change. Probability and consequence ratings have been given to these risks, thereby generating a risk rating based on Table 2-3. The probability and consequence ratings outlined in Table 7-1 have been considered prior to the implantation of mitigation measures.

Table 7-1 Climate change risks

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
Rainstorm	Strong wind and heavy rain	Yes – rainstorms happen frequently in the UK and are likely to impact the Proposed Development	Damage and degradation of building materials through wetting and impact from rainfall. Discomfort for users of the Proposed Development.	The frequency of precipitation is likely to decrease, particularly in the summer. However, the risk of heavy rainfall events is likely to increase.	5 Rainstorms will occur very frequently during the lifetime of the Proposed Development.	1 Very low but measurable effect on site users and the Proposed Development. Damage and degradation of building materials through rainfall impacts.	5	No
Monsoon	<i>'A persistent seasonal wind, often responsible for seasonal precipitation regime.'</i> (National Weather Service, 2023)	No - Monsoons do not occur in the UK, and therefore do not present a climatic risk to the Proposed Development	N/A	N/A	N/A	N/A	N/A	N/A
Heavy snow	<i>'Large snowflakes that greatly reduce the visibility and falls at a rate exceeding 4cm</i>	Yes – Heavy snow can happen during winters in the UK and therefore have the potential to impact the	Damage to building materials (e.g. roofs). Discomfort and potential injury to users of the	The frequency of heavy snow events is likely to decrease.	2 Heavy snow is likely to occur a limited number of times during the lifetime of the	2 Low but measurable effect on site users and the Proposed Development. Damage to building	4	No

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	<i>per hour.</i> (Wild, 2023)	Proposed Development.	Proposed Development.		Proposed Development	materials and potential injury to users.		
Fog	<i>'Water droplets which are suspended in the air near the Earth's surface and causing reduced visibilities.'</i> (National Weather Service, 2023)	Yes – Fog occurs under certain climatic conditions in the UK, and therefore has the potential to impact the Proposed Development.	Increased risk of accidents as a result of impaired vision.	It is unknown how climate change will affect the frequency of fog.	5 Fog will occur very frequently during the lifetime of the Proposed Development	1 Very low but measurable effect on site users and the Proposed Development. Increased risk of accidents around the Proposed Development.	5	No
Hail	<i>'Precipitation of small balls or other pieces of ice (hailstones) falling separately or frozen together in irregular lumps. (Typically associated with thunderstorms and surface temperatures above freezing).'</i> (National	Yes – Hail occurs in the UK and therefore has the potential to impact the Proposed Development	Discomfort for users of the Proposed Development	The frequency of hailstorms is likely to increase.	5 Hail will occur very frequently during the lifetime of the Proposed Development	1 Very low but measurable effect on site users and the Proposed Development. Discomfort for users of the Proposed Development.	5	No

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	Weather Service, 2023)							
Severe wind	Mean wind speed exceeding 23 m/s (Met Office, 2024a).	Yes – Severe wind occurs in the UK and therefore has the potential to impact the Proposed Development	Damage to building materials. Discomfort and potential injury to users of the Proposed Development, and immediate surroundings	The frequency of severe wind and storms is likely to remain similar.	4 Severe wind is likely to occur frequently during the lifetime of the Proposed Development	2 Low but measurable effect on site users and the Proposed Development. Damage to building materials and potential injury to users.	8	Yes
Tornado	<i>'A violent rotating column of air, usually forming a pendant from a cumulonimbus cloud with the circulation reaching the ground. It nearly always starts as a funnel cloud and may be accompanied by a loud roaring noise. On a local scale, it is the most destructive</i>	No – Tornados are very rare in the UK. It is therefore very unlikely that they pose a climatic risk to the Proposed Development	N/A	N/A	N/A	N/A	N/A	N/A

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	<i>of all atmospheric phenomena'</i> (National Weather Service, 2023)							
Hurricane	<i>'A severe tropical cyclone with wind speeds in excess of 74 mph (64 knots).'</i> (National Weather Service, 2023)	No – Hurricanes cannot form at the latitudes of the UK, and therefore do not pose a climatic risk to the Proposed Development.	N/A	N/A	N/A	N/A	N/A	N/A
Extra tropical storm	<i>'Deep depressions that were originally hurricanes which have moved to higher latitudes.'</i> (Met Office, 2024b)	Yes – Extra tropical storms (such as ex-Hurricanes) can reach the UK, and therefore have the potential to impact on the Proposed Development.	Damage to building materials. Discomfort and potential injury to users of the Proposed Development and immediate surroundings.	The frequency of severe wind and storms is likely to remain similar.	3 Extra tropical storms are likely to happen regularly during the lifetime of the Proposed Development	3 Moderate effect on site users and the Proposed Development. Damage to building materials and potential injury to users.	9	Yes
Tropical storm	<i>'An organised cyclone in the tropics with wind speed between 35 and 64 knots.'</i>	No – Tropical storms do not occur in the UK and therefore do not pose a climatic	N/A	N/A	N/A	N/A	N/A	N/A

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	(National Weather Service, 2023)	risk to the Proposed Development						
Storm surge	<i>'A change in sea level that is caused by a storm.'</i> (Met Office, 2024c).	No – the Proposed Development is not located close to the coast, and is therefore not at risk of storm surge	N/A	N/A	N/A	N/A	N/A	N/A
Lightning	<i>'Electrical discharge caused by imbalances between storm clouds and the ground, or within clouds themselves.'</i> (National Geographic, 2024)	Yes – Lightning occurs during storms, and therefore has the potential to impact the Proposed Development	Potential damage to building materials. Injury to users of the Proposed Development unlikely but possible.	The frequency of lightning storms is likely to remain similar.	3 Lightning could to occur somewhat regularly in proximity to the site during the lifetime of the Proposed Development	2 Low but measurable effect on site users and the Proposed Development. Damage to building materials and potential injury to users.	6	No
Extreme winter conditions	<i>'A combination of heavy snow, blowing snow and/or dangerous wind chills'</i> (NOAA, 2024c)	Yes – Extreme winter conditions sometimes occur in the UK, and therefore have the potential to impact the	Damage to building materials (e.g. pipes bursting). Discomfort and potential injury to users of the	The frequency of extreme winter conditions is likely to decrease.	3 Extreme winter conditions are likely to occur regularly during the lifetime of the	3 Moderate effect on site users and the Proposed Development. This could include thermal discomfort, damage to building materials	9	Yes

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
		Proposed Development	Proposed Development.		Proposed Development.	and potential injury to users.		
Cold wave	'Average temperatures below 2°C for 5 days' or 'average temperatures below 0°C for 48hrs or more.' (Met Office, 2023)	Yes – Cold waves happen during winter months, and therefore have the potential to impact the Proposed Development	Damage to building materials (e.g. pipes bursting). Discomfort and potential injury to users of the Proposed Development.	The frequency of cold waves is likely to decrease.	3 Cold waves are likely to occur regularly during the lifetime of the Proposed Development.	3 Moderate effect on site users and the Proposed Development. This could include thermal discomfort, damage to building materials and potential injury to users.	9	Yes
Extreme cold days	Average temperatures below 0°C (Met Office, 2023)	Yes – Extreme cold days occur during winter months, and therefore have the potential to impact the Proposed Development	Damage to building materials (e.g. pipes bursting). Discomfort and potential injury to users of the Proposed Development.	The frequency of extreme cold days is likely to decrease.	3 Extreme cold days are likely to occur frequently during the lifetime of the Proposed Development.	3 Moderate effect on site users and the Proposed Development. This could include thermal discomfort, damage to building materials and potential injury to users.	9	Yes
Heat waves	Three days 'of hot weather relative to the expected conditions of the	Yes – Heat waves occur increasingly frequently in the UK, and therefore have the potential	Damage and degradation to building materials. Extended period of overheating in	The frequency of heat waves is likely to increase.	4 Heat waves are likely to occur frequently during	4 Moderate effect on site users and the Proposed	16	Yes

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	<i>area at that time of year, which may be accompanied by high humidity.'</i> (Met Office, 2024d)	to impact the Proposed Development	building affects comfort and health of occupants.		the lifetime of the Proposed Development.	Development. This could include health impacts, particularly for children and elderly visitors. Damage to buildings and overheating causing discomfort to occupants.		
Extreme hot days	A day where temperatures exceed 30°C (Met Office, 2023)	Yes – Extreme hot days occur increasingly frequently in the UK, and therefore have the potential to impact the Proposed Development	Damage and degradation to building materials. Intense overheating in building affects comfort and health of occupants.	The frequency of extreme hot days is likely to increase.	4 Extreme hot days are likely to occur frequently during the lifetime of the Proposed Development.	4 Moderate effect on site users and the Proposed Development. This could include health impacts, particularly for children and elderly visitors. Damage to buildings and overheating causing discomfort to occupants.	16	Yes
Drought	<i>'When rainfall in an area is below average for the region' or 'when water supplies such as streams and reservoirs</i>	Yes – Drought occurs in the UK and therefore has the potential to impact the	Potential damage to building foundations in areas with clay soils. Health of	The frequency of drought is likely to increase.	3 Drought is likely to occur frequently during the lifetime of the	4 Moderate effect on site users and the Proposed Development. Low effect on site users	12	Yes

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	<i>are low, which is caused by low rainfall, lack of snowmelt, or other reasons'</i> (Met Office, 2024e)	Proposed Development	flora and fauna on the site affected.		Proposed Development.	and the Proposed development. This is an inner city Development with little exposure to drought-impacted vegetation or topography.		
Wild fire	'Any uncontrolled vegetation fire which requires a decision, or action, regarding suppression' (Scottish Government, 2013)	Yes – Wild fires do occur in the UK, and therefore have the potential to impact the Proposed Development	Damage to buildings and contents. Potential injury to users of the Proposed Development.	The frequency of land fire is likely to remain similar.	1 Wild fires are likely to occur very rarely during the lifetime of the Proposed Development as it is in an urban setting. The Proposed Development is however located next to a park area, and therefore a wild fire cannot be ruled out.	6 Major effect on site users and the Proposed Development. Damage to buildings and contents. Potential injury to users.	6	No
Flash/surface flood	'A flood that occurs within a few hours (usually less than	Yes – flash/surface floods occur during periods of intense rainfall,	Damage to buildings and contents. Potential injury to users of	The frequency of flash/surface flooding is likely to increase.	2 Flash/surface floods are likely to	6 Potential for a major effect on site users	12	No

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	<i>six) of heavy or excessive rainfall, dam or levee failure.'</i> (National Weather Service, 2023)	there is the potential this could impact the Proposed Development. The Flood Risk Assessment states: <i>'Based on EA mapping, most of the site is considered to be at very low risk of flooding (<0.1% AEP). A small area of the site, adjacent to the River Medlock, is considered to be at low or medium risk of surface water flooding (0.1 - 1% AEP and 1 - 3.3% AEP respectively).'</i>	the Proposed Development.		occur very rarely during the lifetime of the Proposed Development	and the Proposed Development. Damage to buildings and contents. Potential injury to users.		

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
River/tidal flood	<i>'Where a rivers flow will exceed the bank sides and cause damage or obstruction to a nearby area.'</i> (Flood Guidance, 2024)	Yes – river flooding can occur during intense periods of rainfall, and therefore has the potential to impact the Proposed Development. The Site is largely within Flood Zone 1, however, the northwest side falls within Flood Zone 2 and 3	Damage to buildings and contents. Potential injury to users of the Proposed Development.	The frequency of river/tidal flooding is likely to increase.	2 River/tidal floods are likely to occur very rarely during the lifetime of the Proposed Development	6 Potential for a major effect on site users and the Proposed Development. Damage to buildings and contents. Potential injury to users.	12	No
Groundwater flood	The level of groundwater rises above the ground level as a result of increased rain, causing flooding on the surface (Flood Guidance, 2024)	Yes – groundwater flooding does occur in the UK, and therefore has the potential to impact the Proposed Development	Damage to buildings and contents. Potential injury to users of the Proposed Development.	The frequency of groundwater flooding is likely to remain at a similar level.	1 Groundwater floods are likely to occur very rarely during the lifetime of the Proposed Development	6 Potential for a major effect on site users and the Proposed Development. Damage to buildings and contents. Potential injury to users.	6	No
Permanent inundation	The increase of sea level over time to where an area is	No – Permanent inundation is unlikely to occur in central	N/A	N/A	N/A	N/A	N/A	N/A

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	continuously covered by water (DELWP, 2021)	Manchester in the lifetime of the Proposed Development						
Salt water intrusion	When salt water (from the ocean) gets into fresh water coastal aquifers (USGS, 2024)	No – The Proposed Development is not close to the sea, and therefore salt water intrusion is unlikely to impact the Proposed Development	N/A	N/A	N/A	N/A	N/A	N/A
Ocean acidification	<i>'A reduction in the pH of the ocean over an extended period of time, caused primarily by uptake of carbon dioxide (CO₂) from the atmosphere.'</i> (NOAA, 2024)	No – the Proposed Development is not located close to the ocean and is therefore unlikely to be impacted by ocean acidification	N/A	N/A	N/A	N/A	N/A	N/A
Landslide	<i>'The movement of a mass of rock, debris, or earth down a</i>	No – the Proposed Development is located in a relatively flat	N/A	N/A	N/A	N/A	N/A	N/A

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	<i>slope'</i> (USGS, 2024b)	location, and is therefore unlikely to be impacted by landslides						
Avalanche	<i>'A mass of snow, rock, ice, soil, and other material slides swiftly down a mountainside.'</i> (National Geographic, 2024b)	No – the Proposed Development is not located in a location that is steep enough or receives enough snow for avalanches to be a risk	N/A	N/A	N/A	N/A	N/A	N/A
Rock fall	<i>'Type of fast-moving landslide that happens when rock or earth falls, bounces, or rolls from a cliff or down a very steep slope.'</i> (Colorado Geological Survey, 2024)	No – the Proposed Development is located in a relatively flat location, and is therefore unlikely to be impacted by rock fall	N/A	N/A	N/A	N/A	N/A	N/A
Subsidence	<i>'Sinking of the ground because of underground material</i>	Yes – subsidence does occur in the UK, and therefore has the potential	Damage to building materials. Potential injury to users of the	The frequency of subsidence is likely to remain low.	1 Subsidence is likely to occur	6 Major effect on site users and the	6	No

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	<i>movement'</i> (NOAA, 2024b)	to impact the Proposed Development	Proposed Development.		very rarely during the lifetime of the Proposed Development	Proposed Development. Damage to building materials. Potential injury to users.		
Water-borne disease	<i>'Illnesses caused by microscopic organisms, like viruses and bacteria, that are ingested through contaminated water or by coming in contact with feces.'</i> (Lifewater, 2024)	Yes – water-borne diseases do occur in the UK, and therefore have the potential to impact the Proposed Development	Potential illness to users of the Proposed Development.	The frequency of water-borne disease is likely to increase but remain low.	2 Water-borne diseases are likely to occur a limited number of times during the lifetime of the Proposed Development	3 Moderate effect on site users and the Proposed Development. Potential illness to users.	6	No
Vector borne disease	<i>'Human illnesses caused by parasites, viruses and bacteria that are transmitted by vectors'</i> (living organisms) (WHO, 2024)	Yes – Vector borne diseases do occur in the UK, and therefore have the potential to impact the Proposed Development	Potential illness to users of the Proposed Development.	The frequency of vector-borne disease is likely to increase but remain low.	2 Vector borne diseases are likely to occur a limited number of times during the lifetime of the Proposed Development	3 Moderate effect on site users and the Proposed Development. Potential illness to users.	6	No
Airborne disease	<i>'Disease that is caused by a microorganism</i>	Yes – airborne diseases do occur in the UK, and	Potential illness to users of the	The frequency of air-borne disease is likely	2	3	6	No

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	<i>that is transmitted through the air.'</i> (Ather et al, 2013)	therefore have the potential to impact the Proposed Development	Proposed Development.	to increase but remain low.	Airborne diseases are likely to occur a limited number of times during the lifetime of the Proposed Development	Moderate effect on site users and the Proposed Development. Potential illness to users.		
Insect infestation	<i>'Recently detected insect pest population, including an incursion, or a sudden significant increase of an established insect, disease agents or weed population in an area leading to damage to plants in production fields, forests or natural habitats and causing substantial damage to productivity, biodiversity or natural</i>	Yes – Insect infestations do occur in the UK, and therefore have the potential to impact the Proposed Development	Potential illness to users of the Proposed Development.	The frequency of insect infestation is likely to increase but remain low.	2 Insect infestations are likely to occur a limited number of times during the lifetime of the Proposed Development	3 Moderate effect on site users and the Proposed Development. Potential illness to users.	6	No

Climate Hazard	Description	Is it relevant to the Proposed Development	Likely consequences of climate risk occurring	Change in probability as a result of climate change	Probability rating (1 – 5)	Consequence rating (1 – 7)	Risk rating	Mitigation needed?
	<i>resources'</i> (UNDRR, 2024)							

8 Climate change resilience measures proposed to be incorporated into the design of the Proposed Development.

Error! Reference source not found. summarises the mitigation measures that would increase resilience to the likely effects of climate change. The mitigation measures included in this table are expected to be included in the design or proposed to be secured by condition. These particularly focus on the hazards that have received high risk ratings in the risk assessment in Table 7-1.

Table 8-1 Climate change resilience measures

Risk	Mitigation measure
Severe Wind	- The Proposed Development will be built in line with current building regulations, and is therefore expected to be capable of withstanding severe wind and storm conditions. - Good practice measures will be implemented to improve user comfort in external areas. - A wind microclimate assessment has been undertaken. The assessment has considered pedestrian comfort and safety at the site. Based on the results, mitigation measures have been implemented to achieve acceptable conditions. These include: - Landscaping and boulders have been integrated at key locations for pedestrian movement and where wind acceleration is expected; and - In the southeast corner of Building K1, a 2 to 3m wide solid canopy in combination with a porous screen has been proposed to mitigate potentially unsafe wind speeds. The architectural integration of these measures will be conditioned to any planning consent and the details will be agree at a later date to minimise impact on placemaking. - Non-slip material will be used at ground level in external spaces to reduce risks of potential injury to site users during stormy conditions.
Extreme tropical storm	
Heat waves	- Mechanical Ventilation with Heat Recovery (MVHR) will be used in the proposed buildings, which will reduce the cooling demand. The MHVR units will have free cooling abilities. - Building materials that are optimized to heat gains in summer months will be used, reducing the cooling requirements. - An overheating analysis has been undertaken, guiding building design to reduce potential overheating and therefore reduce reliance on air conditioning systems. - The landscaping proposed at the site will provide some cooling effect.
Extreme hot days	

Risk	Mitigation measure
	- The proposed buildings are orientated north to south, and therefore provide opportunities for external shading. - Undercrofts and overhangs have been integrated into the design of the buildings, which providing external shading. - Over 70 trees will be planted, with a mix of single and multi stem. These will provide some shading in external areas. - Consideration will be made of shrink/swell of foundations with temperature change. - Dynamic optimisation modelling has been undertaken, to allow window placement and the façade to optimise daylight, overheating, and space heating demand of the façade elements. - The solar reflectance index (SRI) will be considered for external materials to reduce heat gain. A similar palette will be used to the adjacent Mayfield Park.
Drought	- Water meters and low flow fittings will be used throughout the development. - Leak detection units will be used throughout the development. - Manual watering will be used for external planting, greatly reducing water consumption from automatic irrigation. - Climate adapted plants will be planted, reducing the water required for maintenance.
Flash/surface flood	- The proposed finished floor levels within the Proposed Development are above the 1/100 +30% flood return rate. - As set out in the FRA: <i>To manage the surface water within the site, a drainage strategy is proposed which includes:</i> <i>Attenuation at source of runoff from plot roofs in green and blue-green roofs;</i> <i>Rain gardens, tree pits and permeable paving to store runoff in high frequency, low order storm events; and</i> <i>A large rain garden/attenuation basin at a downstream location to provide storage for low frequency, high order events'</i> <i>'With the proposed drainage strategy in place, the risk of flooding from surface water is considered to be low.'</i>
River/tidal flood	
Extreme winter conditions	- The Proposed Development will be built in line with current building regulations and will therefore have appropriate insulation and heating in place to withstand extreme winter and cold conditions. - Mechanical Ventilation with Heat Recovery (MVHR) will be used in the buildings, which will reduce the heating demand. - Building materials that are optimized to reduce heat loss in winter months will be sourced, reducing the heating requirements.
Cold wave	
Extreme cold days	

Risk	Mitigation measure
	• Non-slip material will be used in external areas, to reduce risks of potential injury to site users during snowy or icy conditions. • Some external seating will be timber, which will make it more comfortable in colder conditions. • Planting will be adapted to respond to individual microclimate conditions, so only plants that are able to withstand cooler temperatures will be planted where cooler temperatures will occur on site. • Revolving and lobbied doors will be used at building entrances. This will reduce the rush of cold air entering the building as people enter and exit. • Internal spaces will be heated appropriately for thermal comfort.
All risks	• Since the effects of climate change are dynamic and constantly changing, an adaptive management approach is recommended. The climate change resilience risk assessment should be periodically revisited by the design team during construction in order re-assess likely effects.

9 Residual Risk

Table 9-1 provides a summary of the residual effects of climate change on the Proposed Development. Mitigation measures outlined in Table 8-1 have been taken into account.

Table 9-1 Summary of residual risks based on probability and consequence taking into account mitigation measures

Risk	Risk rating pre-mitigation	Probability rating (1-5)	Consequence rating (1-7)	Risk rating
Rainstorm	5	5	1	5
Heavy snow	4	2	2	4
Fog	5	5	1	5
Hail	5	5	1	5
Severe wind	8	4	1	4
Extra tropical storm	9	3	2	6
Lightning	4	4	1	4
Extreme winter conditions	9	3	2	6
Cold wave	9	3	2	6
Extreme cold days	9	3	2	6
Heat waves	16	4	3	12
Extreme hot days	16	4	3	12
Drought	12	3	3	9
Wild fire	6	1	6	6
Flash/surface flood	12	2	4	8
River/tidal flood	12	2	4	8
Groundwater flood	6	1	6	6
Subsidence	6	1	6	6

Risk	Risk rating pre-mitigation	Probability rating (1-5)	Consequence rating (1-7)	Risk rating
Water-borne disease	6	2	3	6
Vector-borne disease	6	2	3	6
Airborne disease	6	2	3	6
Insect infestation	6	2	3	6

With the implementation of appropriate mitigation measures, the risk rating for all climate change hazards relating to the Proposed Development will be reduced.

10 Conclusion

Climate change risks to the Proposed Development have been identified using the C40 Cities Climate Change Risk Assessment Guidance. These risks have been assessed based on the probability of an event occurring and the consequence of that event occurring. Mitigation measures have been identified for risks where required, and an adaptive management approach has been recommended, whereby mitigation measures are added as needed throughout the lifecycle of the development. With the appropriate mitigation measures in place, the risk rating for all climate change risks relating to the Proposed Development have been reduced.

The proposed mitigation is considered sufficient to mitigate the various climate change risks in line with typical expectations for urban development in the UK. Nevertheless, due to the nature and scale of many climate hazards, which is beyond the control of mitigation options for the Proposed Development, some level of residual risk remains.

11 Reference List

This Climate Chante Resilience Risk Assessment has been prepared in reference to the following:

- British Standards Institute (2019). ISO 14090:2019 Adaptation to Climate Change – Principles, Requirements and Guidelines;
- C40 Cities (2017) Climate Change Risk Assessment Guidance;
- Department for Environment Food & Rural Affairs (2018). The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting;
- Department for Levelling Up, Housing, and Communities (DLUHC) (formerly Ministry for Housing, Community and Local Government (MHCLG)). (2021). National Planning Policy Framework;
- Greater Manchester Combined Authority. (2021). Places for Everyone Joint Development Plan Document. Greater Manchester Combined Authority.
- HM Government (2022) UK Climate Change Risk Assessment;
- Institute of Environmental Management and Assessment (IEMA) (2020) Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation;
- Manchester City Council. (2012). Manchester's Local Development Framework. Core Strategy Development Plan 2012 to 2027. Manchester City Council.
- Manchester City Council. (2020). Manchester City Council Climate Change Action Plan 2020-2025. Manchester City Council.
- Manchester City Council. (2022). 2022 Green and Blue Infrastructure Refresh. Retrieved from https://www.manchester.gov.uk/downloads/download/7456/2022_green_and_blue_infrastructure_refresh.
- Manchester Climate Change Agency. (2020). Manchester Climate Change Framework 2020-2025. Manchester Climate Change Agency.
- Met Office (2018) UK Climate Projections 2018 (UKCP18);
- Met Office (2023). User guide – Weather-health altering system. Available at: <https://assets.publishing.service.gov.uk/media/65450c2b59b9f5001385a240/User-guide-impact-based-weather-and-health-alerting-system.pdf>;
- Met Office (2024a). Beaufort wind force scale. Available at: <https://www.metoffice.gov.uk/weather/guides/coast-and-sea/beaufort-scale>
- Met Office (2024b). Hurricanes. Available at: <https://www.metoffice.gov.uk/research/weather/tropical-cyclones/hurricane>
- Met Office (2024c). Storm Surge. Available at: <https://www.metoffice.gov.uk/weather/learn-about/weather/types-of-weather/storms/storm-surge>

- Met Office (2024d). What is a heatwave? Available at: <https://www.metoffice.gov.uk/weather/learn-about/weather/types-of-weather/temperature/heatwave>
- Met Office (2024e). UK and Global extreme events – Drought. Available at: <https://www.metoffice.gov.uk/research/climate/understanding-climate/uk-and-global-extreme-events-drought#:~:text=Meteorological%20drought%20%E2%80%93%20when%20rainfall%20in,the%20local%20environment%20as%20well;>
- National Geographic (2024a). Lightning. Available at: <https://www.nationalgeographic.com/environment/article/lightning>
- National Geographic (2024b). Avalanche. Available at: <https://education.nationalgeographic.org/resource/avalanche/>
- National Weather Service (2023). Weather Glossary. Available at: https://www.weather.gov/otx/Full_Weather_Glossary;
- National Weather Service (2023). Weather Glossary. Available at: https://www.weather.gov/otx/Full_Weather_Glossary;
- NOAA (2024a). What is Ocean Acidification? Available at: <https://oceanservice.noaa.gov/facts/acidification.html;>
- NOAA (2024b). What is subsidence? Available at: <https://oceanservice.noaa.gov/facts/subsidence.html;> #
- NOAA (2024c). Severe Weather 101 – Winter Weather. Available at: [https://www.nssl.noaa.gov/education/svrwx101/winter/types/;](https://www.nssl.noaa.gov/education/svrwx101/winter/types/)
- Public Infrastructure Engineering Vulnerability Committee (PIEVC) (2015). Climate Risk Assessment Methodology;
- Scottish Government (2013) Fire and Rescue Service Wildfire Operational Guidance. Available at: <https://www.gov.scot/publications/fire-rescue-service-wildfire-operational-guidance/pages/4/>
- Town and Country Planning (EIA) Regulations 2017;
- UK Climate Change Act 2008 (2050 Target Amendment);
- UNDRR (2024). Insect Pest Infestations. Available at: <https://www.undrr.org/hips-cluster/insect-infestation#:~:text=An%20insect%20pest%20infestation%20is,and%20causing%20substantial%20damage%20to;>
- USGS (2024a). Freshwater/Saltwater Interface. Available at: <https://www.usgs.gov/mission-areas/water-resources/science/saltwater-intrusion;>
- USGS (2024b) What is a landslide and what causes one? Available at: <https://www.usgs.gov/faqs/what-landslide-and-what-causes-one;>
- WHO (2024). Vector-borne diseases. Available at: <https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases;>
- Wild (2024). Snow Glossary. Available at: http://www.drrichardwild.co.uk/index.php?page=Snow_Glossary

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