

First Street Plot 10

Stage 2 Climate Change Risk Review

Ask Real Estates

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Executive Summary

First Street Plot 10 is aiming for a high level of sustainability performance, in operation and in urban performance. Cundall are appointed as Sustainability Champion to review overall progress on sustainability objectives, and to prepare a Climate Risk Assessment for the project.

Climate Resilience is a focus for Plot 10, where the Project Team has collaborated to reduce the risks associated with the physical hazards of climate change. By working through the Climate Change Risk Assessment process, the team has managed to reduce the level of the risk in the Project, as outlined below:

Risk Category	# of Risks from First Risk Assessment	# of Risks from Second Risk Review	% Change
Low Risk	9	15	67%
Moderate Risk	13	7	-46%
High Risk	2	2	0%
Total Risk	24	24	-

Table 0-1: Summary of Results from Second Risk Review

As seen in Table 0-1, a total of 15 Low Risks and 7 Moderate Risks have been identified as part of the second risk review stage. These climate hazards present residual risks to the Project and should still be considered as residual risks for the Plot 10 development. The 2 High Risks have remained unchanged since further design team comments. These should be prioritised heavily following further design progress. More details on these residual risks are provided in Section 3.1 Risk Management of the report.

Actions Undertaken during Stage 3

- A Climate Change Risk Assessment was undertaken.
- A CCRA workshop undertaken to present risks and discuss mitigation.
- Two stage risk assessment performed via risk tracker (see Appendix A) implemented to track activity and progress and informed by design team.

Risk Management

A copy of the project risk tracker has been circulated to the design team for input and feedback. This tracker is designed to be updated through the design process and should reflect the applicable levels of risk given the design stage, incorporated mitigation measures as well as the planned operation and maintenance of the asset. Following this, further recommendations are provided corresponding to the identified climate risks to the development and the wider site.

From the second risk evaluation, the mitigation responses assessed have reduced the 13 moderate risks to **7 Moderate Risks. The 2 high risks remain and can be mitigated through investment in landscaping and waterproof detailing.** All other risks remain categorised as low risks which, although do not

present significant risks to the project appropriate mitigation measures, should be considered and incorporated into the project.

Residual Low risks to the Project include increased maximum summer temperatures and intense rainfall events, which are outlined in the tracker provided (see Appendix A). The risks to the project have been split between the different project components (public realm and building) and plot 10a and 10b.

Contents

1.0	Introduction	1
1.1	Project Description	1
1.2	Climate Hazard and Identification	1
2.0	Climate Change Risk Review	1
2.1	Climate Change Scenarios	1
2.2	Climate Change Risk Rating	1
2.3	Climate Change Risk Assessment	1
3.0	Risks and Opportunities	4
3.1	Risk Management	4
3.2	Summary and Next Steps	5
4.0	Appendices	2
Appendix A -	CCRA Risk Tracker	2

1.0

Introduction

1.0 Introduction



The aim of the development is to be resilient to the impacts and risks of future climate change. Key climate drivers have been considered within the Climate Change Risk Assessment (CCRA) listing how each might impact the development over its life.

Adaptation measures to mitigate these have been evaluated within the CCRA Risk Tracker.

The focus of this report will be on the climate resilience and adaptation aspect of the Plot 10 development. It provides an overview of the Climate Change Risk Assessment developed for the design of the Plot 10 development, where the design currently stands and recommendations for the following design stage.

1.1 Project Description

The project comprises a 12-storey building which will form part of the large Plot 10 development. The Plot 10a building will comprise of office spaces and relevant mixed-use facilities including changing rooms, cycle storage and a gym. The Plot 10b building is a purpose-built student accommodation scheme with a ground floor food market hall. The buildings will be separated with a mixture of hard and soft landscaping which will include flower-rich perennial planting, trees and green roofs and walls.



Figure 1-1: Plot 10a Proposed landscaping strategy

1.2 Climate Hazard and Identification

1.2.1 Objective

To be climate resilient, adapting to our changing world.

1.2.2 Project Approach

The study area for the CCRA is focused on both 10a and 10b Plots. For the purposes of this assessment, the project has been divided into two receptors by which associated risks have been identified. This list of receptors is not intended to be comprehensive and inclusive of all the different physical and geographical receptors at the site, it is instead intended to structure the risk assessment and mitigation measures. The receptors identified are:

- Buildings
- Public realm

Each of the project receptors are comprised of a number of corresponding components. These components will be included in the risk assessment and mitigation measures will be specified to manage any climate related risks to the building components. A summary of the specific components to project are listed below:

- Structure / Façade
- Services
- Civil / Infrastructure
- Landscape / Ecology

Depending on the specific life cycle of the Project the stakeholders which should be considered and consulted as part of the physical risk assessment will vary. For the early stages of the project, impacted stakeholders could include construction workers and the local community. As the project moves into the operational phase, impacted stakeholders will transition over to employees working on the site, visitors to the site and the surrounding communities and ecosystems.

2.0

Climate Change Risk Review

2.0 Climate Change Risk Review

Most UK design standards are still based on historic weather data, meaning that buildings and infrastructure are not fit for the current observed warming, let alone the significant further warming expected over the coming decades.

2.1 Climate Change Scenarios

Recognising that global mean temperatures have already reached 1.1°C above the pre-industrial average, we are almost certain to reach the Paris Agreement aspiration limit of 1.5°C in the next decade. The climate scenarios range from a world where emissions are rapidly reduced to meet global targets (RCP 2.6) to one where there is little or no effort to reduce greenhouse gas emissions (RCP 8.5), as shown in table 3-1. This project has considered the impacts of climate change scenarios (RCP 2.6, RCP 4.5 & RCP 8.5) for three time periods (2020s, 2050s & 2080s) as shown in Table 2-1.

Scenario	Description	Mean Global Temperature Increase by 2100 (and Likely Range)
RCP2.6	Very strong mitigation of emissions to limit global temperature increase to below 2°C.	1.6°C (0.9 - 2.3°C)
RCP4.5	Strong mitigation of emissions but unlikely to limit global temperatures to <2°C.	2.4°C (1.7 - 3.2°C)
RCP6.0	Some mitigation of emissions but likely to see global temperature increases of closer to 3°C.	2.8°C (2.0 - 3.7°C)
RCP8.5	Little to no mitigation of emissions, with a continued reliance on fossil fuels, resulting in temperature increases of over 4°C.	4.3°C (3.2 - 5.4°C)

Table 2-1: Representative Concentration Pathways

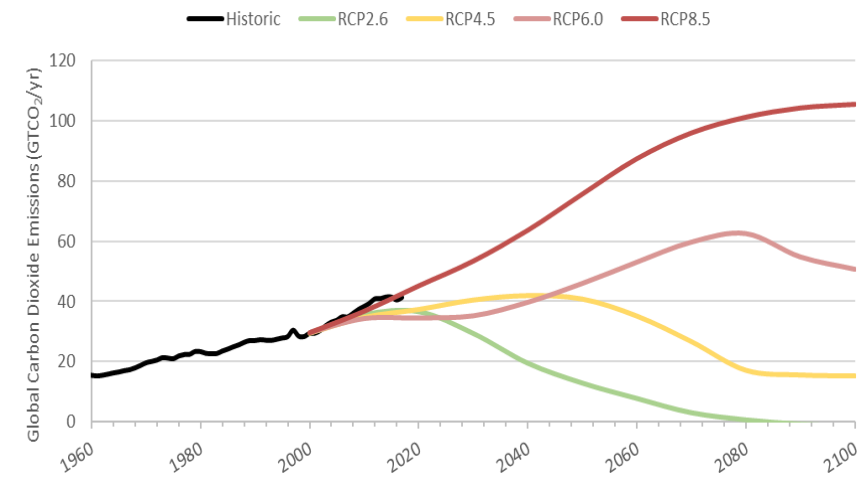


Figure 2-1: Global Mean Temperature Increases under Future Emission Scenarios with respect to Pre-industrial Average

To respond to these pressing issues, a detailed climate change risk assessment has been carried out. Key data was obtained for the region encompassing the development site and the assessment has identified the climate hazards for climate change scenarios using the Met Office’s UK Climate Projections (UKCP18) User Interface.

This tool allows the user to obtain climate model data at a regional (25 km) and local (2.2 km) scale for a range of climate variables including: Severe cold weather, Extreme hot weather, Power Failure, Cold events, River flooding, Flash flooding, Surface flooding, Change in sea level, Wind speeds and gusts, Changing of ground conditions.

2.2 Climate Change Risk Rating

Consideration of climate risks have been calculated based on a one-to-three scale of the likelihood and consequence (as shown in Table 2-2). This provides an overall risk rating between a 1 (Negligible) to 16 (Extremely High) which can help to prioritise high risk items and guide mitigation planning and actions (Table 2-3).

Criteria Level	Likelihood	Consequence
Low	Based on the climate data and future climate change projections, the Project has low exposure to climate hazard.	Minor damage to building and public realm which can be repaired through routine operations and maintenance works.
		Minor interruptions (1-2 hours) to operations and disruption to local infrastructure routes.
Moderate	Based on the climate data and future climate change projections, the Project has moderate exposure to climate hazard.	Moderate damage to building and public realm which result in repair works which exceed the routine budgets for O&M works.
		Moderate interruptions (1 day) to operations and disruption to local infrastructure routes.
High	Based on the climate data and future climate change projections, the Project has high exposure to climate hazard.	High level of damage to building and public realm which require immediate repairs, and replacement works.
		Multiday interruptions (2-3 days) to operations and disruption to local infrastructure routes.
Very High	Based on the climate data and future climate change projections, the Project has very high exposure to climate hazard.	Very high level of damage to building and public realm which require immediate repairs, and replacement works.
		Very long interruptions (5-7 days) to operations and disruption to local infrastructure routes.

Table 2-2: Level of Criteria for Corresponding Likelihood and Consequence

			Likelihood						
			Low (1)	Moderate (2)	High (3)	Very High (4)			
Consequence	Low (1)	1	2	3	4				
	Moderate (2)	2	4	6	8				
	High (3)	3	6	9	12				
	Very High (4)	4	8	12	16				
Key	Negligible	Very Low	Low	Moderate (4)	Moderate (6)	Moderate (8)	High	Very High	Extremely High

Table 2-3: Risk Matrix

2.3 Climate Change Risk Assessment

Using the UKCP18 data, the physical risks applicable to the site include **increasing temperatures, increasing or decreasing rainfall, and flooding.**

2.3.1 Temperatures

Increases in temperature are a consistent feature of each of the climate scenarios. The most significant risks are likely to be a result of increases in summer peak temperatures. Currently, according to historical weather data, the average summer temperatures for June to August range from 18-20°C during the day and 13°C during the night, while the average winter temperatures remain at 7°C during the day and 4°C during the night. There is also snowfall of 5-6cm for 9 days in December and 11 days in January.

Over time, the following is anticipated for summer and winter temperatures:

2.3.1.1 Maximum Summer Temperatures

By 2020s, the maximum summer temperatures are similar across all scenarios at just over 1.0-1.1°C increase. By 2050s, maximum temperatures will rise to between -0.7°C and 4.3°C under RCP 4.5 and between -0.2°C and 5.2°C under RCP 8.5 above historical levels. By 2080s, scenarios show significant increases, from an average increase of 3.1°C for RCP 4.5 to 4.9°C for RCP 8.5. The elongated ranges show a high degree of uncertainty about long-term temperature peaks so increases at the high end of 6.4°C (RCP 4.5) and 8.8°C (RCP 8.5) should be considered a clear risk.

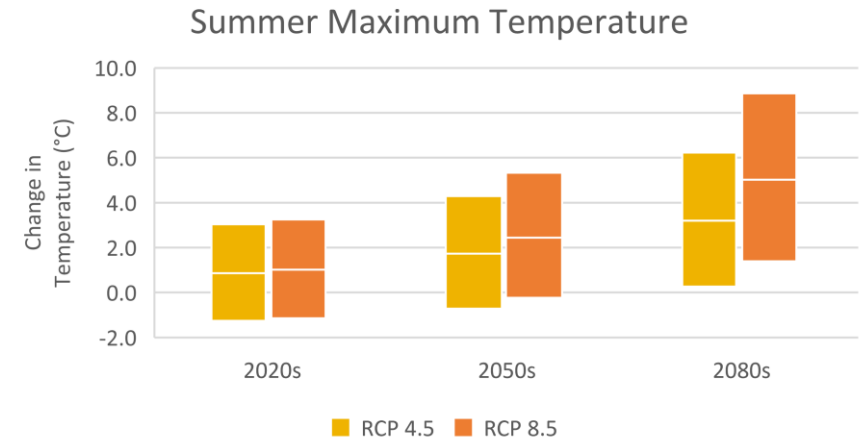


Figure 2-2: Change in Mean Summer Maximum Temperatures across both RCP Scenarios

2.3.1.2 Minimum Winter Temperatures

Winter temperatures start out with a gentle increase of 0.7°C increase across the RCP scenarios by 2020s, but by 2050s, this has increased by an average of 1.3°C for RCP 4.5 to 1.8°C for RCP 8.5. By 2080s, this has increased to a further 2.0°C for RCP 4.5 and 3.1°C for RCP 8.5.

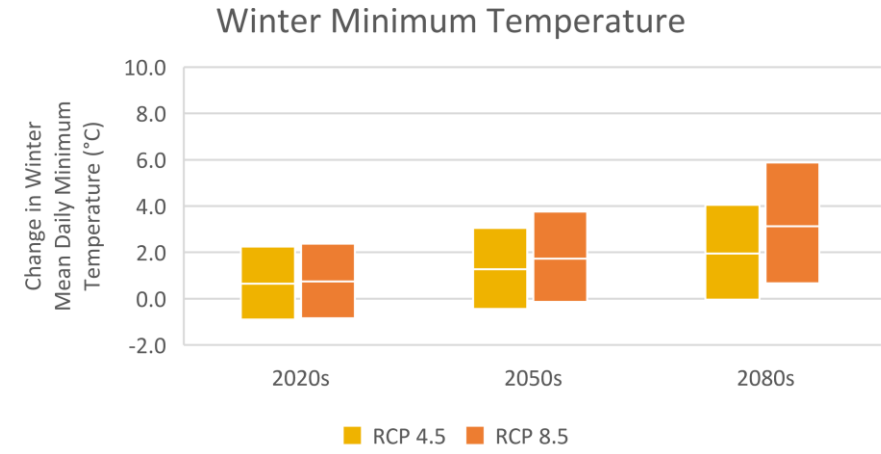


Figure 2-3: Change in Mean Winter Minimum Temperatures across both RCP Scenarios

2.3.2 Rainfall

Changes in annual precipitation patterns are a consistent feature across each of the climate scenarios. Each scenario projects increases in winter precipitation which is predicted to fall in shorter more intense downpours. According to historical weather data, the current average rainfall in winter months is 106mm with a peak of 117.17mm in November, and the average rainfall in summer months is 101.5mm with peak of 112.7mm in August. The climate scenarios indicate that summer will see reductions in the overall volume of rainfall which is again predicted to fall in shorter more intense downfalls.

2.3.2.1 Summer Precipitation

Summer precipitation in this decade indicates a reduction of 9% across all scenarios by 2020s. By 2050s, this range has increased projections of 18% to 22% reductions in rainfall for RCP 4.5 and RCP 8.5 respectively. By 2080s, precipitation rates continue to decrease with RCP 4.5 showing a central 24% reduction and RCP 8.5 a 35% reduction.

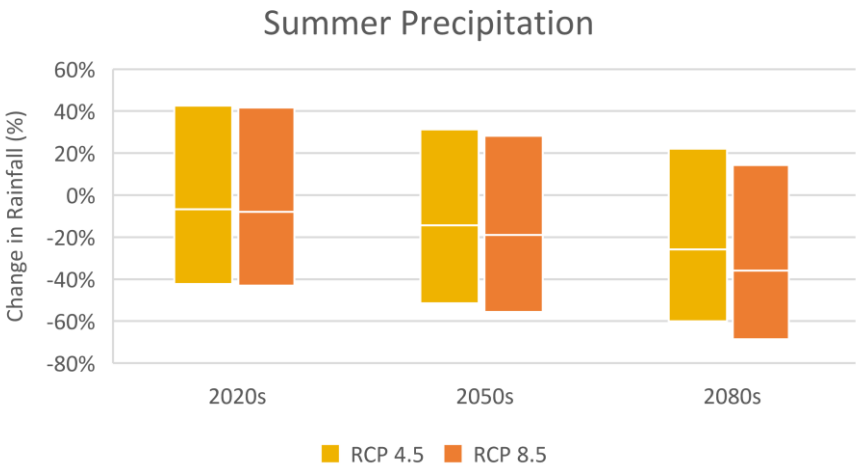


Figure 2-4: Change in Mean Summer Precipitation across both RCP Scenarios

2.3.2.2 Winter Precipitation

Winter rainfall in this decade is likely to increase across all scenarios at 1-2% central and 31-32% at high end of ranges by 2020s. By 2050s, increases of 6-8% are seen across the two scenarios with the high end of the ranges reaching 37-39%. By 2080s, the high ends of the ranges continue to become more extreme, rising to 44% for RCP 4.5 and 51% for RCP 8.5.

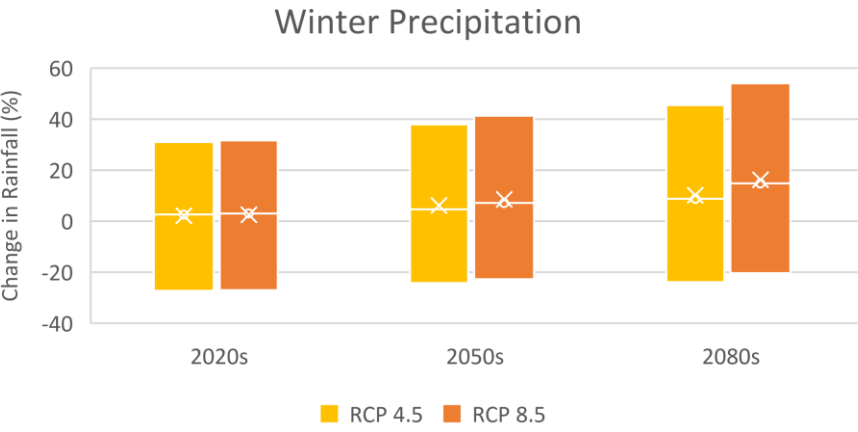


Figure 2-5: Change in Mean Winter Precipitation across both RCP Scenarios

2.3.3 Flooding

Flood mapping for the Project indicates that the site is susceptible to varying degrees of flood risk, as detailed below, and described in further detail in the Project Flood Risk Assessment:

- The majority of the site is within Flood Zone C1 (i.e., within the extreme flood extent (1 in 1000 (0.1%) annual probability flood event) and is served by significant infrastructure. Some of the site is located within Flood Zone 2.
- The risk of fluvial flooding varies across the site. Baseline modelling shows that small parts of the Proposed Development site would be inundated in the 1% (1 in 100) current day (2013) fluvial flood event (with flood depths of up to 1.34m) whereas the majority of the Proposed Development site is shown to be inundated in the 1% (1 in 100) 2088 fluvial flood event (with flood depths of up to 1.44m).
- The Project site is at low risk of flooding from the sea, equivalent to an annual chance of flooding between 1 in 1000 (0.1%) and 1 in 200 (0.5%).
- When the potential impacts of sea level rise due to climate change are considered up to the year 2088, the baseline modelling predicts that the defences would be overtopped. However model outputs show that the Project site would remain flood free in this event.

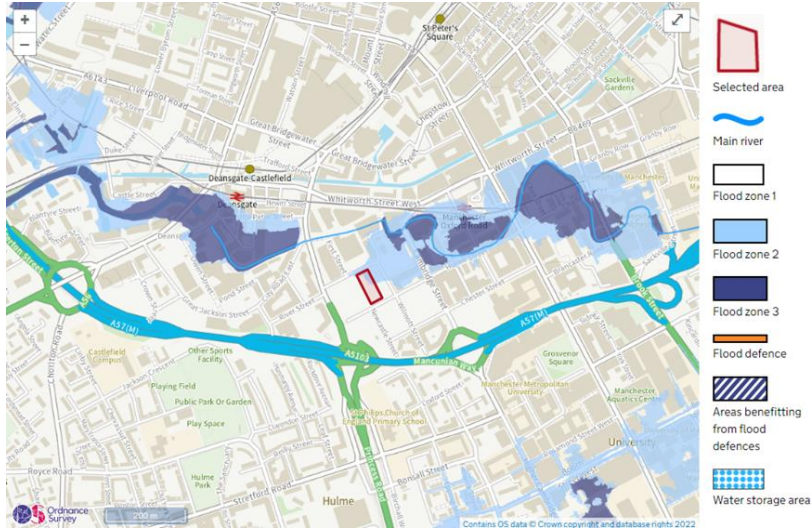


Figure 2-6: Flood Risk Map for the Plot 10 development

3.0

Risks and Opportunities

3.0 Risks and Opportunities

With the climate hazards identified alongside location specific data, all levels of risk have been identified and reported. There have been a high proportion of high-risk items, and mitigation actions have been outlined which have been adopted by the design team.

3.1 Risk Management

A copy of the project risk tracker has been circulated to the design team for input and feedback. This tracker is designed to be updated through the design process and should reflect the applicable levels of risk given the design stage, incorporated mitigation measures as well as the planned operation and maintenance of the asset. Following this, further recommendations are provided corresponding to the identified climate risks to the development and the wider site. The most critical risks to the project relate to the increase in maximum summer temperatures and are outlined below. The risks to the project have been split between the different project components (public realm and building).

From the second risk evaluation, **7 Moderate Risks** have been identified for mitigation from a previously assessed list of 13 Moderate Risks. The **2 High Risks** that remain unchanged are again identified for mitigation, with residual risks and recommended mitigation measures included in the assessment. A further list of 6 Low Risks have also been recognised which, although do not present significant risks to the project appropriate mitigation measures, should be considered and incorporated into the project.

3.1.1 Moderate Risk #1

Risk Impact	Increasing Temperatures in Building (Building Services)
Risk Description	- Extended periods of hot weather can lead to regional disruptions to electrical distribution and results in power outages for buildings onsite - HVAC systems running at maximum capacity for longer resulting in additional wear and tear and increasing the likelihood of mechanical failure and maintenance works. - Overheating of elevator controllers / main distribution transformer - Future utility costs increasing - Comfort cooling system may not have sufficient capacity to maintain comfort conditions and cause heat stress for occupants - Additional cooling capacity to meet increasing temperatures contribute to increased demand on buildings electrical infrastructure
Key Mitigation Actions (by Design Team)	Plot 10a Structural Façade to allow mixed mode ventilation with opening vents, operable windows and normal office ventilation system. Plot 10b

Second Risk Rating	Moderate (4)
Residual Risk	Consider HVAC systems that can be specified to a level that enables on-demand increases when temperatures increase in the future.

3.1.2 Moderate Risk #2

Risk Impact	Intense Rainfall in Public Realm (Structures)
Risk Description	Overwhelming of building guttering and drainage system could result in water falling into access routes and public realm spaces.
Key Mitigation Actions (by Design Team)	Plot 10a Blue roof proposed for terrace areas - can be future-proofed to consider increased level of rainfall and be designed to hold a greater volume of water before discharging.
Second Risk Rating	Moderate (4)
Residual Risk	Guttering on site should be regularly checked and maintained to avoid blockages and water backups

3.1.3 Moderate Risk #3

Risk Impact	Intense Rainfall in Building (Structures)
Risk Description	Drainage and guttering overwhelmed by intense rainfall events resulting in water ingress into building envelope
Key Mitigation Actions (by Design Team)	Plot 10a - Blue roof proposed for terrace areas - can be future-proofed to consider increased level of rainfall and be designed to hold a greater volume of water before discharging. - Concrete slab construction will prevent water ingress from above.
Second Risk Rating	Moderate (4)
Residual Risk	Guttering on site should be regularly checked and maintained to avoid blockages and water backups. Flood detection system to be installed in business critical areas of the buildings.

3.1.4 Moderate Risk #4

Risk Impact	Intense Rainfall in Building (Building Services)
Risk Description	- Roof top equipment damaged by heavy rainfall events or ponding of water on rooftop. - Heavy rainfall and regional flooding could result in ingress into ground floor and basement areas resulting in damage to mechanical / electrical equipment, floors, finishes and furniture.

Key Mitigation Actions (by Design Team)	Plot 10a Basement plant equipment does not include electrical provision. Cold water stores / tanks and booster sets. Substations and switch rooms located at ground floor.
	Plot 10b Infrastructure Public realm levels to be designed to direct overland flows away from the building.
	Landscape Allow space for guttering replacement.
Second Risk Rating	Moderate (6)
Residual Risk	Guttering on site should be regularly checked and maintained to avoid blockages and water backups. Flood detection system to be installed in business critical areas of the buildings.

3.1.5 Moderate Risk #5

Risk Impact	Flooding in Building (Infrastructure)
Risk Description	Foundations and substructure not designed to accommodate changing weather and groundwater conditions.
Key Mitigation Actions (by Design Team)	Plot 10b Infrastructure Pile and foundation design to consider saturated ground conditions in the event of flooding and/or changes to ground water levels.
Second Risk Rating	Moderate (4)
Residual Risk	Substructure design to model water table using future weather files and upsize foundation and pile design accordingly.

3.1.6 Moderate Risk #6

Risk Impact	Snow Impacts on Public Realm (Building Services)
Risk Description	Regional power outages/shut downs resulting in temporary disruption to street lighting.
Key Mitigation Actions (by Design Team)	N/A
Second Risk Rating	Moderate (4)
Residual Risk	Consider installing solar powered emergency lighting at access points into and out of the site.

3.1.7 Moderate Risk #7

Risk Impact	Snow Impacts on Buildings (Building Services)
Risk Description	- Extended periods of snowfall/storm events can lead to regional disruptions to electrical distribution and results in power outages for buildings onsite. - Additional heating capacity to meet increased frequency of cold days contribute to increased demand on building's electrical infrastructure. Heating systems running at maximum capacity for longer resulting in additional wear and tear and increasing the likelihood of mechanical failure and maintenance works. - Future utility costs increasing. - Comfort heating system may not have sufficient capacity to maintain comfort conditions and cause heat/ventilation stress for occupants. - Regional power outages/shutdowns resulting in loss of electrical heating in building.
Key Mitigation Actions (by Design Team)	N/A
Second Risk Rating	Moderate (6)
Residual Risk	Consideration that electrical infrastructure has sufficient capacity to accommodate the higher peak heating loads. Ensure both thermal and energy analysis of the building considers the impact of climate change on the analysis. BCO recommends designs consider medium emissions scenario (RCP4.5) as a minimum. Install sufficient backup generation to accommodate critical lab operations.

3.1.8 High Risk #1

Risk Impact	Increasing Temperatures in Public Realm (Landscape)
Risk Description	Drainage and guttering overwhelmed by intense rainfall events resulting in water ingress into building envelope.
Key Mitigation Actions (by Design Team)	Plot 10a Landscape - Proposing draught and heat resistant species that will cope with future climate change. - Incorporating bio-swales along River Street east and collect surface runoff. Including water retaining materials in soil mix such as clay pebbles and water retaining granules.
Second Risk Rating	High (9)
Residual Risk	Ecological assessment to inform landscaping strategy and the prioritisation of native vs drought tolerant planting. On-site attenuation to capture water during flash flooding and high rainfall events. Consider installation of a secondary irrigation

	system for landscaped areas to be used during high temperature events and any resulting drought periods.
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3.1.9 High Risk #2

Risk Impact	Increasing Temperatures in Building (Landscape)
Risk Description	Roof top and green wall vegetation may brown and die, leading to increased irrigation costs and/or replacement.
Key Mitigation Actions (by Design Team)	Plot 10b No landscaping is proposed on the roof of Plot 10b. Landscape is limited to the ground floor.
Second Risk Rating	High (9)
Residual Risk	Ecological assessment to inform landscaping strategy and the prioritisation of native vs drought tolerant planting. On-site attenuation to capture water during flash flooding and high rainfall events. Consider installation of a secondary irrigation system for landscaped areas to be used during high temperature events and any resulting drought periods.

In consideration of the second risk evaluation for the Climate Change Risk Assessment, there are still several residual risks for the Project that need to be further investigated and improved upon as part of any future risk assessment process.

3.2 Summary and Next Steps

An assessment has been carried out on how these risks have been reduced and the impact of reducing the moderate risks means that the low risks have increased, but this means the consequences of climate change have been considered in this project's lifetime. However, the 2 High Risks have remained unchanged since further design team comments. These should be prioritised heavily following further design progress.

There are opportunities to further mitigate risks through consideration of how the site area of Plot 10 can prepare for future climate emergencies. This could potentially mean a flooding event, future power outage or a civic event which is outlined in the Greater Manchester's Community Risk Register. This area is a public urban space and a civic asset which will need further consideration by the infrastructure management team. Support from the landscape and ecology team can also create substantial impacts for the mitigation and resilience of the site from climate emergencies.

4.0

Appendices

4.0 Appendices

Appendix A - CCRA Risk Tracker

#	Climate Change Impact	Project Component	Design Discipline				Plot A / B	Risk Description	First Risk Rating					Current Mitigation Options		Status		Second Risk Rating						
			Architecture/ Structures	Building Services	Civils & Infrastructure	Landscape & Ecology			Consequence	This includes the mitigation options that the design team are currently implementing.	Design Team to confirm the current mitigation options.	Consequence												
													1	2	3	4	1	2	3	4				
Increasing Average / Maximum Temperatures																								
1	Increasing average / maximum temperatures	Public realm	[X]				Plot A - Commercial	Overheating of public spaces making them uncomfortable for users	Likelihood	1	1	2	3	4	Incorporation of green infrastructure at the site providing localised shading for public realm users	JMA comments: The precast concrete cladding extends 6m above the Floor 12 FFL. This will offer shading to the terrace in the way of tall column structures which are restrained back to the core by secondary steel at high level - this will again provide shading from above.	Likelihood	1	1	2	3	4		
Plot B - Residential							Overheating and humidity of outdoor furniture (i.e. benches) and fixtures (handrails, bike racks) making them unable to be used for their intended purposes	2		2	4	6	8	2				2	4	6	8			
							Urban heat island impacts causing increase in temperatures and day-time temperatures	3		3	6	9	12	3				3	6	9	12			
								4		4	8	12	16	4				4	8	12	16			
2						[X]			Plot A - Commercial	Regional power outages resulting in temporary disruption to street lighting.	Likelihood	1	1	2	3	4	Consider installing solar powered emergency lighting at access points into and out of the site	Planit comments: Incorporating variety of planting in public spaces including trees, perennials and shrubs. Check cool roofs/green roofs with architects.	Likelihood	1	1	2	3	4
Plot B - Residential				2	2	4	6	8	2	2		4	6	8										
				3	3	6	9	12	3	3		6	9	12										
				4	4	8	12	16	4	4		8	12	16										
3							[X]		Plot A - Commercial	Access roads and surfaces such as asphalt can become susceptible to permanent deformation	Likelihood	1	1	2	3	4	Designing hardscaping based on industry standards and taking account of future weatherfiles and predicted increases in surface temperatures	TGA comments: External canopies / pergolas have been proposed by the Landscape Architects to provide the external seating with shelter from the sun.	Likelihood	1	1	2	3	4
Plot B - Residential				2	2	4	6	8	2	2		4	6	8										
				3	3	6	9	12	3	3		6	9	12										
				4	4	8	12	16	4	4		8	12	16										
4						[X]	Plot A - Commercial	Water shortages could lead to landscape vegetation loss and die back	Likelihood	1	1	2	3	4	Ecological assessment to inform landscaping strategy and the prioritisation of native vs drought tolerant planting	JMA comments: A specialist wind mitigation report is being progressed for the entire site. Wind mitigation measures to be implimented where required	Likelihood	1	1	2	3	4		
		Extended drought to the soils may impede their availability to absorb any flash flood or rainfall events leading to flooding following summer storms	2	2	4	6	8	2		2	4	6	8											
	Plot B - Residential	Non native planting susceptible to predators and pests	3	3	6	9	12	3		3	6	9	12											
		New pests and diseases in wake of higher temperatures and migration	4	4	8	12	16	4		4	8	12	16											
								Increase in native drought-tolerant species																
								Increased dry winds may impact/cause damage to species coming in																
5		Building	[X]				Plot A - Commercial	Thermal expansion of building materials	Likelihood	1	1	2	3	4	Material specification should consider future increased in mean and maximum temperatures	JMA comments: External shading via louvres above each window on south elevation. Natural shading provided by scalloped pre-cast cladding. Glazing reduced to 40% whilst	Likelihood	1	1	2	3	4		

#	Climate Change Impact	Project Component	Design Discipline				Plot A / B	Risk Description	First Risk Rating					Current Mitigation Options		Status		Second Risk Rating				
			Architecture/ Structures	Building Services	Civils & Infrastructure	Landscape & Ecology			1	Consequence			This includes the mitigation options that the design team are currently implementing.	Design Team to confirm the current mitigation options.	1	Consequence						
										2	3	4				2	3	4				
Increasing Average / Maximum Temperatures																						
6							Plot B - Residential	Decreased service life of building components and accelerated deterioration of the façade through UV exposure	Likelihood	2	2	4	6	8	The building should incorporate both internal and external shading structures which will protect materials and occupants from UV exposure Overheating assessments to be done differently according to building type: Plot 10a will align with commercial building regulations and Plot 10b will align with residential building regulations. Ventilation strategies to be done differently: consideration of passive cooling/ventilation, openable windows	60% solid to the façade has been introduced to reduce solar gain and therefore reduce the energy demands by reducing the need to provide cooling. The increase in solid façade will have additional insulation which will improve the thermal performance of the façade which will further reduce heat losses. The solid façade will be made from a natural material; pre cast concrete has been chosen for its inherent reduction in embodied carbon. Use of this material will provide significant savings in the energy used to construct the building. It will also improve the airtightness of the façade resulting in less energy escaping from the building. TGA comments: The principle material proposed on Plot 10b is brickwork. This is a UV stable product. The specific brickwork selected will take the UV Stability into further consideration. Overheating and Ventilation assessments are being carried out by Ridge to ensure that the size of windows , degree that they open and the free air they provide addresses the overheating and ventilation requirement of all rooms. The window has been positioned a minimum of 200mm back from the external finish to provide a degree of shading from the summer sun.	Likelihood	2	2	4	6	8
								Increased UV exposure may result in deterioration of flexible elements (e.g. sealants)		3	3	6	9	12				3	3	6	9	12
										4	4	8	12	16				4	4	8	12	16
			[X]				Plot A - Commercial	Extended periods of hot weather can lead to regional disruptions to electrical distribution and results in power outages for buildings onsite	Likelihood	1	1	2	3	4	Consideration that electrical infrastructure has sufficient capacity to accommodate the higher peak cooling loads. Promote passive cooling techniques in the building design to reduce heat gains and load on systems. DfP modelling to optimise efficiency of operation: natural ventilation, passive cooling techniques, openable windows and thermal fabric. Ensure both thermal and energy analysis of the building considers the impact of climate change on the analysis. BCO recommends designs consider medium emissions scenario (RCP4.5) as a minimum. Over typical 15-20 year service life of cooling system (Max temperature of 1-1.5°C above historic levels) Install sufficient backup generation to accommodate critical lab operations	JMA comments: The facade has been designed to allow for mixed mode ventilation with opening vents as part of the glazing system. These will provide natural ventilation to the workplace. The vents will be manually opened. On temperate days, the windows will open to allow fresh air into the floor plate. This fresh air will be pulled across the floor plate by mechanical extractors and will provide fresh air to all parts of the workplace. Using natural ventilation reduces the energy requirement by removing the need to provide fresh air to office floor plates. When the air outside is too cold or hot, the panels will close and a normal office ventilation system will operate to provide fresh air. The access to natural ventilation will also help to improve employee wellbeing. Natural ventilation helps to avoid recirculated air, reducing CO2 which in turn improves employee's performance and health.	Likelihood	1	1	2	3	4
								HVAC systems running at maximum capacity for longer resulting in additional wear and tear and increasing the likelihood of mechanical failure and maintenance works.		2	2	4	6	8				2	2	4	6	8
								Overheating of elevator controllers / main distribution transformer		3	3	6	9	12				3	3	6	9	12
Plot B - Residential	Future utility costs increasing	Likelihood	4	4	8	12	16	people to WFH if there are power outages TGA comments: M&E to provide comment on if the HVAC systems etc can be spec to a level that enables an increase on demand should temperture increase in the future.		Likelihood	4	4	8	12	16							
	Comfort cooling system may not have sufficient capacity to maintain comfort conditions and cause heat stress for occupants																					
	Additional cooling capacity to meet increasing temperatures contribute to increased demand on buildings electrical infrastructure																					
7							Plot A - Commercial	N/A	Likelihood	1	1	2	3	4	N/A		Likelihood	1	1	2	3	4
										2	2	4	6	8				2	2	4	6	8
							Plot B - Residential			3	3	6	9	12				3	3	6	9	12
										4	4	8	12	16				4	4	8	12	16
8							Plot A - Commercial	Roof top and green wall vegetation may brown and die, leading to increased irrigation costs and/or replacement.	Likelihood	1	1	2	3	4	Ecological assessment to inform landscaping strategy and the prioritisation of native vs drought tolerant planting	221109 Penny Anderson: appropriate planting design is being covered by Planit with input from PA	Likelihood	1	1	2	3	4
								2		2	4	6	8	On-site attenuation to capture water during flash flooding and high rainfall events	Planit comments: Check with architects on wheather we have roof top gardens and green walls	2		2	4	6	8	

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			Architecture/ Structures	Building Services	Civils & Infrastructure	Landscape & Ecology				Consequence				This includes the mitigation options that the design team are currently implementing.	Design Team to confirm the current mitigation options.		Consequence					
										1	2	3	4				1	2	3	4		

Increasing Average / Maximum Temperatures																											
							Plot B - Residential				3	3	6	9	12	TGA comments: No landscaping is proposed on the roof of Plot 10b. Landscape is limited to the ground floor. Planit to provide comment on attenuation capacity.							3	3	6	9	12
											4	4	8	12	16								4	4	8	12	16

Intense Rainfall Events																								
9	Intense rainfall events	Public realm	[X]				Plot A - Commercial	Overwhelming of building guttering and drainage system could result in water falling into access routes and public realm spaces.	Likelihood	1	1	2	3	4	Onsite drainage and guttering to be designed using future weather files or with adequate space to easily upsize system should it be required in the future	JMA comments: Blue roof proposed for terrace areas - floors 11 & 12. The blue roof can be future proofed to take into account increase level of rainfall and be designed to hold a greater volume of water before discharging.	Likelihood	1	1	2	3	4		
							Plot B - Residential			2	2	4	6	8				2	2	4	6	8		
										3	3	6	9	12				3	3	6	9	12		
										4	4	8	12	16				4	4	8	12	16		
10				[X]				Plot A - Commercial	N/A	Likelihood	1	1	2	3	4	N/A		Likelihood	1	1	2	3	4	
							Plot B - Residential				2	2	4	6	8				2	2	4	6	8	
											3	3	6	9	12				3	3	6	9	12	
											4	4	8	12	16				4	4	8	12	16	
11							[X]	Plot A - Commercial	Changes in peak rainfall events could increase the volume of surface water runoff leading to water overflowing into access roads	Likelihood	1	1	2	3	4	High water table at the site makes large scale infiltration unfeasible. Total attenuation volume allowance at the site currently 3,010m3. On-site rain gardens will be attenuation features with slow water release into a piped drainage system.	Planit comments: Raingardens and bioswales. All tree planting in soft landscape. Check with MEP on attenuation	Likelihood	1	1	2	3	4	
							Plot B - Residential				2	2	4	6	8				2	2	4	6	8	
										3	3	6	9	12	Surface water runoff from the Project should be managed in line with national and local policy requirements through the implementation of the surface water drainage strategy which would utilise SUDS features and ensure no detrimental effects on site or to neighbouring land.			ROC comments: The proposed SW discharge rate from the site (10b) has been limited to 4.85l/s which is a 50% betterment on the calculated Q1 (1 in 1 year storm) run-off rate for the existing brownfield site in line with local planning policy. SW attenuation is provided in the form of a below ground tank for all rainfall events up to the Q100 (1 in 100 year storm) + 40% allowance for climate change.		3	3	6	9	12
										4	4	8	12	16						4	4	8	12	16
12							[X]	Plot A - Commercial	Changes in peak rainfall events could increase the volume of surface water runoff leading to water overflowing into areas of landscaping and waterlogging of soils resulting in damage to planting onsite.	Likelihood	1	1	2	3	4	Drainage strategy design to incorporate both infiltration and attenuation. On-site rain gardens will be attenuation features with slow water release into a piped drainage system and reducing the risk of waterlogging of soils.	221109 Penny Anderson: suggestion to use solar/renewables to power any additional irrigation needs and to make any irrigation 'water neutral'	Likelihood	1	1	2	3	4	
							Plot B - Residential				2	2	4	6	8				2	2	4	6	8	
										3	3	6	9	12	ROC comments: SW drainage discharges to public sewer. Infiltration not feasible due to ground conditions. Scope for SUDS features within the public realm is limited due to levels and extensive hard landscaping, rain gardens to be incorporated where feasible.			Planit comments: Raingardens and bioswales. Check with MEP on attenuation		3	3	6	9	12
										4	4	8	12	16						4	4	8	12	16
13				[X]			Plot A - Commercial	Drainage and guttering overwhelmed by intense rainfall events resulting in water ingress into building envelope	Likelihood	1	1	2	3	4	Onsite drainage and guttering to be designed using future weather files or with adequate space to easily upsize system should it be required in the future	JMA comments: Blue roof proposed for terrace areas - floors 11 & 12. The blue roof can be future proofed to take into account increase level of rainfall and be designed to hold a greater volume of water before discharging. Concrete slab construction will prevent water ingress from above.	Likelihood	1	1	2	3	4		
						Plot B - Residential				2	2	4	6	8				2	2	4	6	8		
									3	3	6	9	12						3	3	6	9	12	
									4	4	8	12	16						4	4	8	12	16	
14			Building			[X]	Plot A - Commercial	Roof top equipment damaged by heavy rainfall events or ponding of water on rooftop	Likelihood	1	1	2	3	4	Onsite drainage and guttering to be designed using future weather files or with adequate space to easily upsize system should it be required in the future	JMA comments: Basement plant equipment does not include electrical provision. Cold water stores / tanks and booster sets. Substations and switch rooms located at ground floor. MEP to advise further.	Likelihood	1	1	2	3	4		
				Plot B - Residential	Heavy rainfall and regional flooding could result in ingress into ground floor and basement areas resulting in damage to mechanical / electrical equipment, floors, finishes and furniture			2	2	4	6	8		2			2	4	6	8				
									3	3	6	9	12	Specification of ground floor and basement equipment which is resilient to water ingress or can be easily repaired and replaced if damaged by flooding.			ROC comments: Public realm levels to be designed to direct overland flows away from the building	Ridge comments: allow space for guttering replacement.		3	3	6	9	12
									4	4	8	12	16							4	4	8	12	16
15						[X]	Plot A - Commercial	Overwhelming of building guttering and drainage system could result in water falling into access routes and public realm	Likelihood	1	1	2	3	4	Onsite drainage and guttering to be designed using future weather files or with adequate space to easily upsize system should it be required in the future	JMA comments: Flat blue roof construction will discharge all water inboard through the building via RWPs to below ground drainage points. No rainwater will be allowed to flow over the building façade.	Likelihood	1	1	2	3	4		
									2	2	4	6	8				2	2	4	6	8			
																Planit comments: Check with architects whether we have roof garden								

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										1	2	3	4				1	2	3	4			

Increasing Average / Maximum Temperatures																								
							Plot B - Residential	spaces overwhelming local drainage systems.		Likelihood	3	3	6	9	12				Likelihood	3	3	6	9	12
											4	4	8	12	16					4	4	8	12	16
16						[X]	Plot A - Commercial	Waterlogging of landscaped areas on the rooftop.		Likelihood	1	1	2	3	4	Onsite landscaping should be designed to be climate appropriate and have sufficient drainage to accommodate high rainfall events	JMA comments: Blue roof and adequate controlled drainage.		Likelihood	1	1	2	3	4
						2	2				4	6	8	2	2					4	6	8		
						3	3				6	9	12	3	3					6	9	12		
						4	4				8	12	16	4	4					8	12	16		

Flooding																							
17	Flooding	Public realm	[X]				Plot A - Commercial	N/A	Likelihood	1	1	2	3	4	N/A		Likelihood	1	1	2	3	4	
										Plot B - Residential	2	2	4	6				8	2	2	4	6	8
18				[X]				Plot A - Commercial	N/A	Likelihood	3	3	6	9	12	N/A		Likelihood	3	3	6	9	12
								Plot B - Residential			4	4	8	12	16				4	4	8	12	16
19						[X]		Plot A - Commercial	Flooding and onsite water ponding resulting in manholes and service trenches being unable to be accessed.	Likelihood	1	1	2	3	4	Depths of service trenches and power supply routes to consider current and future ground water levels and accessibility during flooding events.		Likelihood	1	1	2	3	4
								Plot B - Residential			2	2	4	6	8				2	2	4	6	8
20							[X]	Plot A - Commercial	Waterlogging and surface ponding of landscaped areas.	Likelihood	3	3	6	9	12	Consider that surrounding buildings use rainwater storage or community rainwater storage to reduce surface water runoff. The public realm can use SUDS and soft landscaping where possible, and ideally involve local stakeholders to generate ownership of this community area.	Planit comments: Raingardens and bioswales	Likelihood	3	3	6	9	12
								Plot B - Residential			4	4	8	12	16				4	4	8	12	16
21							Plot A - Commercial	Accessibility into the building may be restricted and routes to the science park disrupted during flooding	Likelihood	1	1	2	3	4	Current design includes onsite water attenuation, landscaping and SUDS.	221109 Penny Anderson: water storage/irrigation needs for landscaping needs will be reviewed by the wider team as planting specs are developed	Likelihood	1	1	2	3	4	
						Plot B - Residential	2			2	4	6	8	2				2	4	6	8		
22						[X]	Plot A - Commercial	Heavy rainfall and regional flooding could result in ingress into ground floor and basement areas resulting in damage to mechanical / electrical equipment, floors, finishes and furniture	Likelihood	3	3	6	9	12	Provide alternative transport routes to the site and emergency exit routes	JMA comments: A secondary entrance is proposed which will provide access off Hulme Street to the rear of the building. This is the higher end of the site and therefore least likely to be affected by flooding.	Likelihood	3	3	6	9	12	
							Plot B - Residential			4	4	8	12	16				4	4	8	12	16	
23							Plot A - Commercial	Foundations and substructure not designed to accommodate changing weather and groundwater conditions	Likelihood	1	1	2	3	4	Onsite drainage and guttering to be designed using future weather files or with adequate space to easily upsize system should it be required in the future	JMA comments: Blue roof proposed for terrace areas - floors 11 & 12. The blue roof can be future proofed to take into account increase level of rainfall and be designed to hold a greater volume of water before discharging. An opening in the slab above the basement with lifting device will allow any damaged plant to be replaced if need be. This is written into the access & maintenance strategy for the building.	Likelihood	1	1	2	3	4	
						Plot B - Residential	2			2	4	6	8	2				2	4	6	8		
24						[X]	Plot A - Commercial	N/A	Likelihood	3	3	6	9	12	Specification of ground floor and basement equipment which is resilient to water ingress or can be easily repaired and replaced if damaged by flooding.	ROC comments: GF slab level set above EA predicted flood levels such that the building (10b) is within flood zone 1	Likelihood	3	3	6	9	12	
							Plot B - Residential			4	4	8	12	16				4	4	8	12	16	

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									1	2	3	4																1

Increasing Average / Maximum Temperatures

Snowing																								
1	Snowing	Public realm	[X]				Plot A - Commercial	Snowing in public spaces making them uncomfortable for users	Likelihood	1	1	2	3	4	Shelter for fixtures Mats to be placed inside entrance door	JMA comments: Storage areas to keep equipment locked away safe in extreme weather can be provided. The cycle store is internal and therefore not affected.		Likelihood	1	1	2	3	4	
							Plot B - Residential	Snow on outdoor furniture (i.e. benches) and fixtures (handrails, bike racks) making them unable to be used for their intended purposes		2	2	4	6	8					2	2	4	6	8	
2			[X]			Plot A - Commercial	Regional power outages/shut downs resulting in temporary disruption to street lighting.	Likelihood	1	1	4	6	8	Consider installing solar powered emergency lighting at access points into and out of the site		JMA comments: This can be provided. MEP to advise.		Likelihood	1	1	4	6	8	
						Plot B - Residential	Restricted accessibility of transport.		3	3	6	9	12						3	3	6	9	12	
3			[X]			Plot A - Commercial	Surface run off around public realm.	Likelihood	1	1	2	3	4	Designing hardscaping based on industry standards and taking account of future weather files and predicted increases in surface temperatures				Likelihood	1	1	2	3	4	
						Plot B - Residential	N/A		2	2	4	6	8						2	2	4	6	8	
4		[X]			Plot A - Commercial	N/A	Likelihood	1	1	2	3	4	N/A			Likelihood	1	1	2	3	4			
					Plot B - Residential	N/A		2	2	4	6	8					2	2	4	6	8			
5		[X]			Plot A - Commercial	MEP equipment at roof level - accessibility of equipment	Likelihood	1	1	2	3	4	Shelter to be provided to equipment at roof level			Likelihood	1	1	2	3	4			
					Plot B - Residential	Extended periods of snowfall/storm events can lead to regional disruptions to electrical distribution and results in power outages for buildings onsite		2	2	4	6	8					2	2	4	6	8			
6		[X]				Plot A - Commercial	Extended periods of snowfall/storm events can lead to regional disruptions to electrical distribution and results in power outages for buildings onsite	Likelihood	1	1	2	3	4	Consideration that electrical infrastructure has sufficient capacity to accommodate the higher peak heating loads.			Likelihood	1	1	2	3	4		
									2	2	4	6	8					2	2	4	6	8		
	3								3	6	9	12	3					3	6	9	12	Ensure both thermal and energy analysis of the building considers the impact of climate change on the analysis. BCO recommends designs consider medium emissions scenario (RCP4.5) as a minimum.	Install sufficient backup generation to accommodate critical lab operations	
	4								4	8	12	16	4					4	8	12	16			
	4								4	8	12	16	4					4	8	12	16			
	4								4	8	12	16	4					4	8	12	16			

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									1	2	3	4			1	2	3	4						

Increasing Average / Maximum Temperatures																														
								stress for occupants																						
7					[X]		Plot A - Commercial	N/A	Likelihood	1	2	3	4	N/A																
							2			4	6	8																		
							3			6	9	12																		
							4			8	12	16																		
8					[X]		Plot A - Commercial	N/A	Likelihood	1	2	3	4	N/A																
							2			4	6	8																		
							3			6	9	12																		
							4			8	12	16																		

