

Annexure J:

Climate Adaption and Resilience Plan



Sydney Olympic Park

CLIMATE ADAPTATION PLAN

AUGUST, 2025

Sydney Olympic Park

CLIMATE ADAPTATION PLAN

AUGUST, 2025

Acknowledgment

We acknowledge the Traditional Owners of country throughout Australia and recognises their continuing connection to land, waters, skies, and community.

We are inspired by and learn from knowledge and stories of Country.

Atelier Ten pays our respect to Traditional Owners and their cultures, and to Elders past and present.

PROJECT INFORMATION

JOB TITLE: SYDNEY OLYMPIC PARK MASTERPLAN
JOB NUMBER: 1803
DOCUMENT TITLE: CLIMATE ADAPTATION PLAN
VERSION: 04

PREPARED

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DATE: 05-06-2023

APPROVED

APPROVED BY: S. MONTI
SIGNED: SM
DATE: 29-02-2024

REVISIONS

NO	DATE	CHECKED	APPROVED
00	30-03-2023	SM	SM
01	05-06-2023	SM	SM
02	21-12-2023	SM	SM
03	29-02-2024	SM	SM
04	02-04-2025	SM	SM
05	22-08-2025	SM	SM

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Glossary

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AR4	The IPCC Fourth Assessment Report (2007)
AR5	The IPCC Fifth Assessment Report (2013)
AR6	The IPCC Sixth Assessment Report (2021)
ARI	Average Recurrence Interval
AS	Australian Standard
BoM	Bureau of Meteorology
CAP	Climate Adaptation Plan
CRA	Climate Risk Assessment
CSIRO	Commonwealth Scientific and Industrial Research
EIS	Environmental Impact Statement
ENSO	El Niño–Southern Oscillation
FFDI	Forest Fire Danger Index
FRM	Floodplain Risk Management
GBCA	Green Building Council of Australia
HAT	Highest Astronomical Tide
GCM	Global Climatic Models
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
IP	Infrastructure and Place Division
ISCA	Infrastructure Sustainability Council Australia
NARcliM	NSW / ACT Regional Climate Modelling project
OEH	NSW Office of Environment and Heritage
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
RCPs	Representative Concentration Pathways
RCMs	Regional Climate Models
REF	Review of Environmental Factors
SDG	Sustainable Development Guidelines
SLR	Sea Level Rise
SS	Storm Surge
TERM	Transport for NSW Enterprise Risk Management

TfNSW	Transport for NSW
TSR	Transport for NSW Standard Requirements
WCRP	World Climate Research Program's
WRF	Weather Research and Forecasting model

Executive Summary

This Climate Adaptation Plan (CAP) has been prepared to support the Sydney Olympic Park 2050 Master Plan and could form part of any third-party sustainability rating tool submission (e.g. Green Star, ISCA, etc.).

Climate Trends

Climate change is having worldwide impacts on society, the economy, and the environment. In Australia, the CSIRO Climate Change in Australia 2020 publication, states that: “Observed climate information indicates that Australian average surface air temperature has increased by 0.9 °C since 1910, and many heat-related records have been broken in recent years. Sea level has risen about 20cm over the past century.”

Climate Projections

Across Australia the upward trend in temperature and sea level, together with an increased intensity of rainfall and cyclonic activity, pose increasing humanitarian, financial, environmental, governance and business risks.

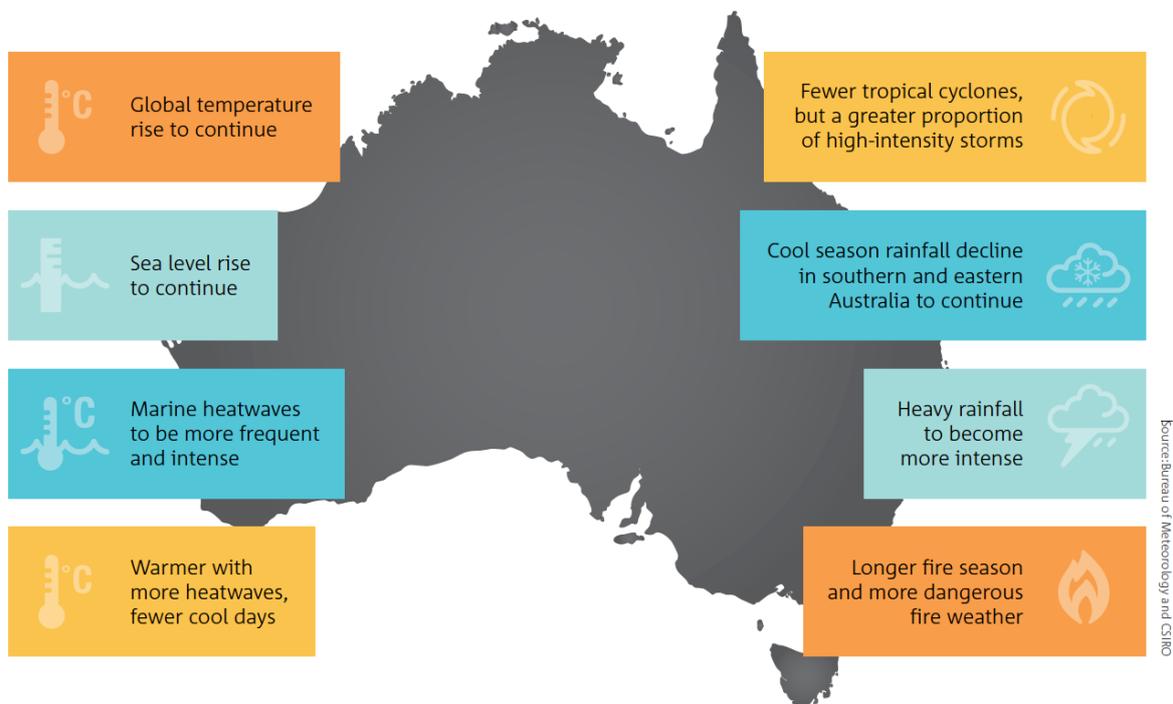


FIGURE 0.1: BOM AND CSIRO GENERAL SYNOPSIS (BOM & CSIRO 2020)

The climate projections for this Climate Adaptation Plan were selected using a conservative climate modelling pathway (representative concentration pathway (RCP) 8.5), so that practical and realistic design and operational action can be taken. This pathway represents not only the worst-case emissions scenario, but also the most likely case, and aligns with best practice industry expectations.

The risk assessment covers two timescales (2040 and 2090), as well as the risk variables outlined in Table 0.1. The objective of this research is to better understand the environmental, social, economic and governance risks to Sydney Olympic Park as the climate continues to change. This will in turn set the foundation for Sydney Olympic Park Authority’s risk management decision making.

TABLE 0.1: RISK VARIABLES CONSIDERED

Element	Variable
Sea surface temperature	Increase in sea level
	Increase in storm surge/tide level
	Increase in water temperature
Air temperature	Increase in adjacent air temperature and humidity
	Increase in mean maximum temperature
	Increased annual mean temperature
	Increased number of hot days over 35°C
Precipitation	Increased event of extreme cold temperatures
	Greater frequency of higher intensity rainfall events
Drought	Increase in annual total rainfall
Wind	Decrease in annual total rainfall
Extreme storms	Increased wind speeds
	Increase in frequency and severity of storms
	Increasing frequency of electrical storms and lightning strikes
Humidity	Changes to east coast cyclone patterns
Bushfire	Changes to relative humidity
Solar radiation	Increase in risk of bushfires
Waterway health	Increase in level of UV
Soil health	Declining waterway health
	Soil health
	Soil moisture
	Ground stability
	Runoff
pH	Groundwater level
	Soil pH
Evapotranspiration	Freshwater pH
Fog	Increased evapotranspiration
Seismicity	Increased frequency of fog events
	Earthquake
Civil disturbance	Tsunami
	Attack
	Civil unrest
	Pandemic
	Financial crisis
Critical infrastructure failure	Community cohesion
	Transport and logistics network
	Electrical network
	Water network
	Waste network
Shift in business models	Digital network
	Demographic shifts
	Economic models
Social stresses	Governance shifts
	Geopolitical environment
	Local economic environment

Summary of reassessed climate risks

The climate risks identified for the infrastructure within the scope of this CAP following the application of adaptation measures, are summarised below.

TABLE 0.2: SUMMARY OF INITIAL AND REASSESSED RISKS FOR SHORT-TERM (2040) TIME SCALE

Risk Rating	Very High	High	Medium	Low	Very Low
Number of Risks	18	79	75	6	0
Number of Reassessed Risks	0	22	145	11	0

All 178 potential climate change risks identified received incumbent and/or potential adaptation measures which help to mitigate and reduce the likelihood of that event occurring.

All 18 'very high' risks will be mitigated, all but 22 high risks will be mitigated to medium or low-level risks.

Adaptation measures – 'Big Moves'

Sydney Olympic Park Authority is seeking to implement high value initiatives with the greatest resilience benefits. Five strategic initiatives which aim to deliver holistic co-benefits and resilience outcomes across physical and temporal scales, and to different stakeholder groups, have been selected in response to this Climate Adaptation Plan. These initiatives are:

- **Thriving Country and Ecosystems**

Develop and implement a regeneration-based program, led by Traditional Custodians and Sydney Olympic Park Authority, that aims to centre nature as the heart of Sydney Olympic Park.

- **Sharing Economy Hub**

Establish a community-centric sharing economy hub, managed by Sydney Olympic Park Authority, that aims to strengthen community connections whilst increasing economic, social and environmental resilience.

- **Circular Repair Hub**

Establish a circular repair hub that attracts innovative businesses to the precinct, as well as services the needs of the wider Sydney area, increasing economic resilience through creating alternative economies, as well as reducing environment impact and increasing social connection.

- **Smart City**

Develop Sydney Olympic Park as a 'smart city' that utilises technology to improve resiliency outcomes, to increase resilience through monitoring and managing key sustainability outcomes.

- **NSW Centre of Resilience Excellence**

Establish an Australian Centre of Resilience Excellence at Sydney Olympic Park to increase the resilience of Sydney and beyond through an innovative approach to interactive learning and education.

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1. Introduction

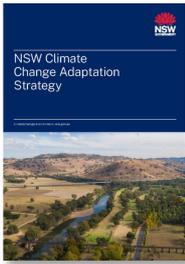
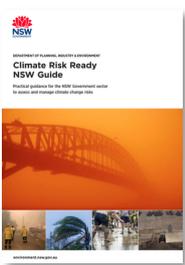
Meteorological records show that since the 1950s the duration, frequency and intensity of heatwaves have increased across many parts of Australia, including NSW. Australia’s warmest year on record was 2019, and the seven years from 2013 to 2019 all rank in the nine warmest years (BoM & CSIRO 2020). In parallel with rising temperatures, over the past 30 years the number of fire days has also continued to rise across NSW. Throughout the state, the fire season is starting earlier and lasting longer with fire weather often extending into spring and autumn (Climate Council 2014a).

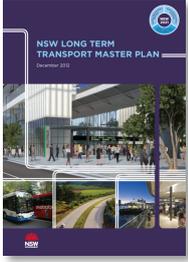
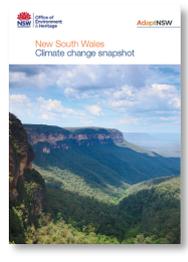
In addition to temperature related risks, impacts from flooding and sea level rise have the capacity for widespread damage and disruption. During the 20th century, Sydney experienced flooding events three times more frequently because of sea-level rise (Climate Council 2014b). By 2100 it is likely that today’s 1-in-100 year flood will occur every day or so (Climate Council 2014b).

Recognising that the impacts from climate change pose a significant risk to its business, infrastructure assets, and the communities it serves, Sydney Olympic Park Authority and the NSW Government is committed to building climate resilience across its current and future projects. Addressing climate risk is highlighted within a number of NSW Government’s guiding strategic documents including:

TABLE 1.1: NSW GOVERNMENT CLIMATE RISK-RELATED STRATEGIC DOCUMENTS

Document	Description
	<p>Climate Change (Net Zero Future) Act 2023 (New South Wales Government 2023)</p> <p>Establishes statutory greenhouse gas emissions reduction targets (50% by 2030, 70% by 2035, net zero by 2050) and a legislative objective for NSW to become more resilient to a changing climate. Reinforces the need for projects to support both emissions reduction and adaptation objectives through proactive, evidence-based action aligned with the Act’s guiding principles.</p>
	<p>Net Zero Plan Stage 1: 2020–2030 (DPIE 2020a)</p> <p>This plan is the foundation for NSW’s action on climate change and goal to reach net zero emissions by 2050. It outlines the governments approach to protect our future by growing the economy, creating jobs, and reducing emissions over the next decade. The plan supports a range of initiatives targeting energy, electric vehicles, hydrogen, primary industries, technology, built environment, carbon financing and organic waste.</p>
	<p>Net Zero Plan Stage 1: 2020–2030 Implementation Update (DPIE 2020b)</p> <p>Following the foundation laid in March 2020, the update outlines NSW’s government work and partnerships with communities, businesses, and industry to progress towards a net zero future.</p>

Document	Description
	<p>NSW Climate Change Adaptation Strategy (DPE 2022)</p> <p>Sets out an ambitious approach to climate change adaptation. The strategy provides a framework that will strengthen and expand action to adapt to climate change now and over the long-term, setting out key decision-making principles and objectives and a suite of actions.</p>
	<p>Planning for a more resilient NSW: A strategic guide to planning for natural hazards (DPE 2021)</p> <p>The guide is intended to prompt consideration of relevant natural hazards in an integrated and multi-disciplinary way. It discusses high level existing policies, identify natural hazards relevant to NSW to be considered in strategic planning and sets out guiding principles to inform land-use planning decisions and manage natural hazard risk.</p>
	<p>Resilience outcomes for the planning system (DPIE 2021b)</p> <p>This project presents a series of outcomes to promote resilience in the land use planning system and ensures that resilience and support for rebuilding/recovery are embedded at all levels, including in the legislation, strategic planning, precinct planning, and statutory planning provisions.</p>
	<p>Climate Risk Ready NSW Guide (DPIE 2021a)</p> <p>The guide helps NSW Government staff to lead, influence and enable their organisations to better understand their exposure to climate change risks and opportunities. It outlines steps to consider the potential climate risks to an enterprise, program or project and encourages integration of these risks into enterprise risk management frameworks and procedures.</p>
	<p>Managing climate risks to assets and services (Audit Office of New South Wales 2021)</p> <p>This report assessed how effectively the Department of Planning, Industry and Environment (DPIE) and NSW Treasury have supported state agencies to manage climate risks to their assets and services. Climate risks that can impact on state agencies' assets and services include flooding, bushfires, and extreme temperatures. Impacts can include damage to transport, communications, and energy infrastructure, increases in hospital admissions, and making social housing or school buildings unsuitable.</p>

Document	Description
	<p>Future Transport 2056 (TfNSW 2020)</p> <p>The 40-year vision, directions, and principles for customer mobility in NSW, guiding transport investment over the longer term. It identifies that: ‘moving to an environmentally, economically and socially sustainable transport system is essential to tackle climate change...’</p>
	<p>NSW Long term Transport Masterplan (TfNSW 2012)</p> <p>The plan identifies responding to climate change as a state-wide action of priority, with Action 8.8.3 focused on boosting our resilience to climate change and natural disasters by assessing climate resilience.</p>
	<p>NSW Climate Change snapshot (OEH & Adapt NSW)</p> <p>This snapshot presents a summary of climate change projections for NSW. It outlines some key characteristics of the state, including its current climate, before detailing the projected changes to the state’s climate in the near and far future.</p>
	<p>DPE Climate Change Risk Assessment</p> <p>Workshop detailing climate change impacts and scenarios for NSW and leadership actions.</p>

1.1 Purpose of this plan

This Climate Adaptation Plan (CAP) has been prepared to support the development of the Sydney Olympic Park 2050 Master Plan.

The purpose of the CAP is to:

- Define the climate change projections over the design life of the infrastructure.
- Define the risk assessment process.
- Outline the project management approach to demonstrate compliance with recognised standards and guiding instruments.
- Manage risk through:
 - Identification of climate change and natural hazard related risk and assign risk rating.
 - Where necessary mitigate risk through adaptation measures and re-assess risk.

- Enhance resilience through design and operational action.
- Define roles and responsibilities.

1.2 Document structure

The report is structured as follows:

1. **Introduction** | Outlines the study context and requirements addressed by this report.
2. **Methodology** | Outlines the climate risk assessment process and stakeholder engagement undertaken.
3. **Context** | Outlines the context of the project, and the scope and boundaries of the assessment.
4. **Climate change** | Provides the current and future climate context that forms the assessment.
5. **Risk assessment** | Provides a summary of the risk assessment undertaken.
6. **Adaptation plan** | Provides the adaptation actions that have been integrated and considered in early planning.
7. **Monitoring and review** | Outlines next steps for consideration in subsequent planning and design phases.
8. **Assurance** | Summarises the key requirements for compliance with Green Star Communities.
9. **Implementation** | Proposes several priority outcomes and strategic initiatives to deliver holistic resilience.

2.0 Methodology

2.1 Risk management process

This Climate Adaptation Plan (CAP) is the result of a collaborative and iterative risk management process engaging all relevant stakeholders involved in the Sydney Olympic Park 2050 Master Plan planning and design process, as presented below in Figure 2.1.



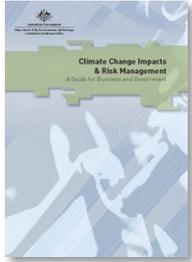
FIGURE 2.1: CAP PROCESS

The purpose of the risk assessment is to help mitigate the potential for climate change induced risks through informed decision making, which in turn enables the planning, design and operation of a climate resilient precinct and infrastructure.

2.2 Guiding instruments

The climate change risk assessment provided in this report has been undertaken in line with the following relevant standards and guidelines.

TABLE 2.1: STANDARDS AND SUSTAINABILITY BENCHMARKING FRAMEWORKS

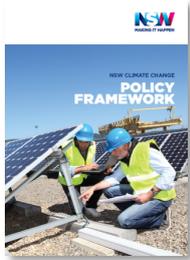
Document	Description
	<p>AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk based approach (Standards Australia 2013)</p> <p>Provides principles and generic guidelines on the management of the risks that settlements and infrastructure face from the impacts of climate change. In particular it describes a systematic approach to planning the adaptation of settlements and infrastructure based on the risk management process given in AS/NZS ISO 31000:2009.</p>
	<p>Climate Change Impacts & Risk Management: A Guide for Business and Government (AGO 2006)</p> <p>The Guide provides a framework for managing the increased risk to organisations due to climate change impacts. The prime focus of the Guide is on the initial assessment and prioritisation of these risks.</p>

Document	Description
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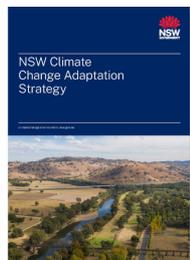
ISO 31000-2018 – Risk Management – Principles and Guidance (ISO 2018)

Adopted in Australia and New Zealand as AS/NZS ISO 31000:2009, provides a set of internationally endorsed principles and guidance on how organisations can integrate decisions about risks and responses into their existing management and decision-making processes.



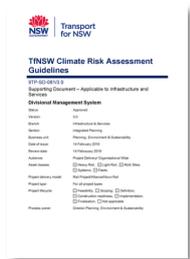
NSW Climate Change Policy Framework (OEH 2016)

Aims to maximise the economic, social, and environmental wellbeing of NSW in the context of a changing climate and current and emerging international and national policy settings and actions to address climate change.



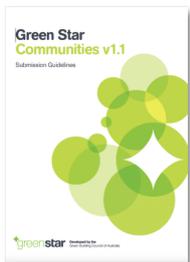
NSW Climate Adaptation Strategy (NSW Government 2022)

Provides details regarding the NSW Government’s strategy to roll-out strengthened climate change action across the state. It aims to provide a suite of decision-making principles for adaptation, metrics to use to assess climate risk, development of future climate adaptation plans and ways to embed climate action into government frameworks.



Transport for New South Wales Climate Risk Assessment Guidelines (TfNSW 2021)

Sets out guidance and requirements for transport infrastructure projects in NSW around how to conduct a climate risk assessment including identifying risks, assessing consequences, conducting a risk assessment, identifying risk mitigation strategies and developing management and monitoring programs (TfNSW 2021).



Green Star Communities v1.1 (GBCA 2016)

Assesses the planning, design and construction of large-scale development projects at a precinct, neighbourhood and/or community scale. It provides a rigorous and holistic rating across five impact categories – including Adaptation and Resilience (Credit 04).

Document	Description
	<p>Infrastructure Sustainability Rating Tool Technical Manual v1.2 (ISCA 2016)</p> <p>The IS rating scheme evaluates sustainability initiatives and potential environmental, social, and economic impacts of infrastructure projects and assets – including Climate Change Adaptation.</p>
	<p>GRESB Real Estate Scoring Methodology (GRESB 2016)</p> <p>The GRESB Real Estate Assessment provides the basis for the systematic reporting, objective scoring, and peer benchmarking of ESG management and performance for property companies and funds around the world.</p>

2.3 Data sources

Recent advances in climate science, and the release of the Intergovernmental Panel on Climate Change (IPCC) Fourth and Fifth Assessment Reports (AR4 and AR5) have given rise to a wealth of climate data being made publicly available.

The following (Figure 2.2) provides a hierarchy of data sources to be referenced as part of the climate risk assessment.

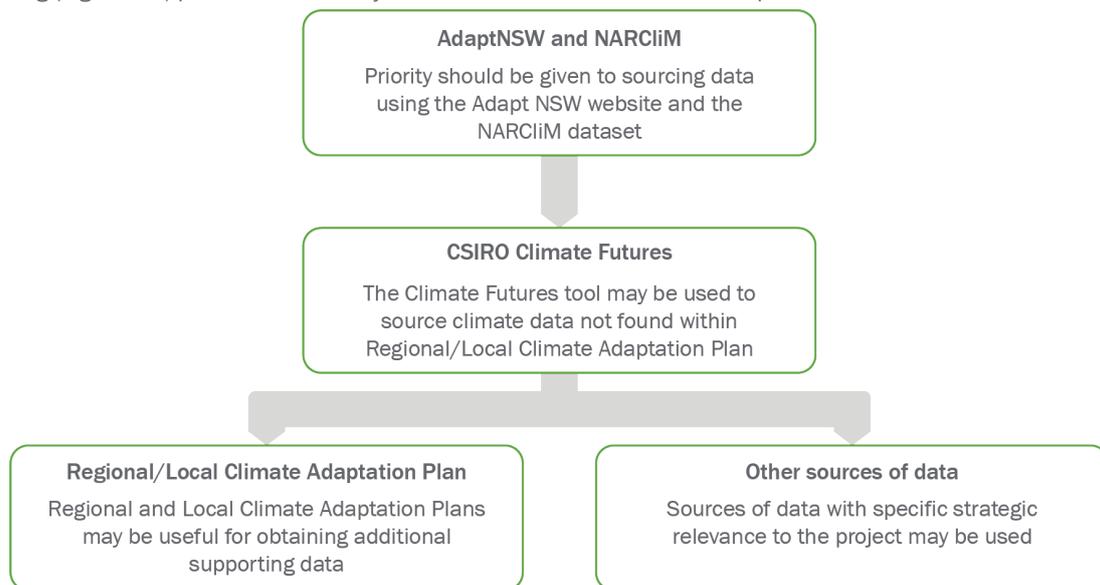


FIGURE 2.2: HIERARCHY OF CLIMATE DATA SOURCES

Adapt NSW and NARcliM: The NSW Office of Environment and Heritage (OEH 2014) has developed a range of publicly available resources to assist communities, businesses and government entities in understanding and minimising the impacts of climate change (NSW Government 2014). NARcliM data (NSW/ACT Regional Climate Modelling project) (ARC Centre of Excellence for Climate System Science 2012) produces a comprehensive ensemble of regional climate data for south-east Australia with the aim of providing projections that cover the range of likely future changes in climate (University of New South Wales 2012).

CSIRO - Climate Futures (Clarke, Whetton & Hennessy 2011; Whetton et al. 2012): Provides a selection of both AR4 and AR5 projections that enables users to explore, and obtain data for, projected monthly, 3-monthly, 6-monthly, and annual changes in up to 14 climate variables (extreme temperature, precipitation, sea level rise etc).

Regional/Local Climate Adaptation Plan: Climate projections may also be used from overarching regional or local authority Climate Adaptation Plans.

Other sources of climate projections may be used if they are deemed to provide specific strategic relevance.

2.4 Stakeholder engagement

A preliminary risk assessment was prepared based on the findings of a desktop review. A risk register was developed, identifying climate risks and initial likelihood and consequence ratings were allocated for each risk statement in line with criteria outlined by the Australian Greenhouse Office (AGO 2006).

The preliminary risk assessment was followed by series of stakeholder engagement activities. Workshops were conducted with project team members and stakeholders to inform the assessment, validate climate risks, and identify appropriate adaptation responses. A summary of these activities is outlined in Table 2.2.

TABLE 2.2: STAKEHOLDER ENGAGEMENT ACTIVITIES

Workshop	Date	Description
Scoping Workshop	09/03/2023	Participants established the context for risk assessment and reviewed the preliminary risk assessment.
Adaptation Workshop	23/03/2023	Participants reviewed the context and proposed adaptation measures with a focus on those ranked highest.

The stakeholder organisations engaged as a part of the CAP process are listed in Table 2.3. All provided inputs to the risk allocation exercise and development of adaptation actions.

TABLE 2.3: CAP RISK WORKSHOP ORGANISATION

Sydney Olympic Park Authority	SJB
Civille	Atelier Ten

3.0 Context

3.1 Project

Located on the southern edge of the Parramatta River and on the eastern border of the City of Parramatta, Sydney Olympic Park is a well-established events venue that services the wider Sydney region. With a total area of 640 ha, the current development includes 210 ha of town centre comprising of a mixture of sporting and recreation venues, high density residential developments, and low scale commercial buildings. The remaining 430 ha of the precinct is made up of terrestrial and estuarine ecosystems, parklands including 105ha of remediated landfills, sports venues, and historical sites.

The Sydney Olympic Park 2050 Master Plan aims to reshape the precinct's identity from a sports and events venue to a thriving, high-density suburb. Taking a Country First approach to place-making, Sydney Olympic Park will be a place that reconnects people with nature and prioritises both ecological and human needs equally. Taking a comprehensive approach to planning, the precinct will be a distinctive centre where communities can thrive. Through the investment in public transport infrastructure, including light rail and Sydney Metro upgrades, Sydney Olympic Park will be connected to the heart of Sydney.

Currently, Sydney Olympic Park is home to around 3,700 residents. By 2050, approximately 28,650 people are predicted to be living at Sydney Olympic Park. The 2050 Master Plan will provide more housing, including affordable homes, as well as community facilities, retail, entertainment, commercial buildings, and an improved public realm.



FIGURE 3.1: SYDNEY OLYMPIC PARK MASTER PLAN BOUNDARIES

3.2 Scope

The climate risk assessment considers all matters associated with the Sydney Olympic Park 2050 Master Plan design, maintaining operations and meeting future requirements for any potential tenants, their workforce and visitors while onsite or commuting. It also includes consideration of the surrounding community within the City of Parramatta, City of Canada Bay, Cumberland Council and Strathfield Council, as well as the Greater Sydney region. The assessment assumes a design life of the precinct of <120 years.

3.3 Success criteria

The climate adaptation success criteria describe Sydney Olympic Park Authority's long-term climate mitigation, adaptation, and resiliency objectives. They have been designed to assist Sydney Olympic Park Authority in qualitatively assessing the success of this Climate Adaptation Plan. The success criteria are also supported by a set of priorities and strategic initiatives that respond to climate and resiliency risks, specific to Sydney Olympic Park.

The success criteria for Sydney Olympic Park includes:

TABLE 3.1: SUCCESS CRITERIA FOR SYDNEY OLYMPIC PARK

Success Criteria	SOPA	Asset Owner	Tenants and residents	Community
Environmental				
<ul style="list-style-type: none"> The ecological values of Sydney Olympic Park are monitored and strengthened to protect against long term climate threats. 	✓		✓	✓
<ul style="list-style-type: none"> Ecological systems at Sydney Olympic Park can bounce back following repeated shocks and stresses. 	✓		✓	✓
<ul style="list-style-type: none"> The local community leads nature stewardship through environmental education programs, citizen science initiatives and local conservation groups. 	✓		✓	✓
<ul style="list-style-type: none"> SOPA's remediated landfills and associated infrastructure are protected against climate change threats for ongoing long-term containment of legacy wastes and protection of the environment. 	✓		✓	✓
Social				
<ul style="list-style-type: none"> The local community at Sydney Olympic Park is strong, connected, diverse and resilient. 	✓		✓	✓
<ul style="list-style-type: none"> Community groups can lead the process of recovery after shocks and stresses. 	✓	✓	✓	✓
<ul style="list-style-type: none"> Sydney Olympic Park Authority plays a key role in facilitating community building for new residents and tenants. 	✓	✓	✓	✓
<ul style="list-style-type: none"> Human health is prioritised and maintaining the safety/mitigating leachate from remediated and contaminated lands is a key focus of all resiliency initiatives to facilitate appropriate beneficial reuse of these lands. 	✓		✓	✓
<ul style="list-style-type: none"> The safety of occupants, visitors, and the public is maintained during disruption. 	✓	✓	✓	✓

Success Criteria	SOPA	Asset Owner	Tenants and residents	Community
<ul style="list-style-type: none"> Sydney Olympic Park Authority plays a key role in facilitating major public transport infrastructure projects and enhancing active transport links to deliver resilient connected communities. 	✓	✓	✓	✓
Financial				
<ul style="list-style-type: none"> Financial losses from shocks and stresses are mitigated through planning, design, and operations that have considered climate and resiliency, and have implemented de-risking initiatives. 	✓	✓		
<ul style="list-style-type: none"> Opportunities for innovation in the resiliency space are embraced by Sydney Olympic Park Authority as well as future developers. 	✓	✓	✓	✓
Operations				
<ul style="list-style-type: none"> Sydney Olympic Park experiences continuity of operations through disruption, and bounces back immediately following, requiring little to no remedial works. 	✓	✓	✓	✓
<ul style="list-style-type: none"> Sydney Olympic Park continues to function as world leading sports and events venue in the face of local, regional, national, and international scale shocks and stresses. 	✓	✓		✓
<ul style="list-style-type: none"> All stakeholders involved in the Sydney Olympic Park 2050 Master Plan are aware of their responsibilities to mitigate and adapt to shocks and stresses and make the most of opportunities to innovate in the face of resiliency challenges. 	✓	✓		
Governance				
<ul style="list-style-type: none"> Through its Mass Care Facility, Sydney Olympic Park provides key services to support the wider Sydney region's resiliency in the face of shocks and stresses. 	✓			✓
<ul style="list-style-type: none"> Sydney Olympic Park plays a leading role in regional resilience education and capacity building through its existing and upcoming educational programs. 	✓	✓	✓	✓

3.4 Geographic boundaries

The process considers all new and existing buildings, public domain, and enabling infrastructure within the primary boundaries of Sydney Olympic Park, as defined by the Sydney Olympic Park 2050 Master Plan. It also takes into account neighbouring communities, downstream infrastructure, all transport networks (rail, metro, light rail, bus, pedestrian and active mobility routes) that converge at the site, and regional considerations related to climate change.

TABLE 3.2: GEOGRAPHIC BOUNDARIES

Consideration	Boundaries
Primary	All buildings, landscapes, ecosystems, infrastructure, and public domain within project boundaries.
Secondary	Neighbouring community, buildings, parks, and infrastructure.
Tertiary	Public transport networks (pedestrian, bike, bus, train, tram/light rail, and metro) that pass through and by the site, and regional considerations related to climate change.

3.5 Stakeholders

Beyond those who participated in the risk management workshops, this CAP considers additional stakeholders who will be affected by Sydney Olympic Park's ability to respond to climate and resilience related shocks, stresses, and disruptions and may form part of any future review.

TABLE 3.3: ADDITIONAL STAKEHOLDERS CONSIDERED

Stakeholder	Summary of objectives and concerns
Sydney Olympic Park Authority	Acting as developer; continuity of operations (transport, commercial, institutional, residential); community cohesion; safety and accessibility of workers, residents, and visitors; integrity of infrastructure.
Transport for NSW (Sydney Buses, Light Rail, Metro)	Continuity of operations; safety and accessibility of workers, residents, and visitors; integrity of infrastructure.
NSW Environmental Protection Authority	Healthy environmental function; protection of environmental values.
Council (City of Parramatta Council)	Continuity of business operations, safety and accessibility of workers, residents, and visitors; integrity of infrastructure.
Building owner(s)	Earnings, long term viability of the asset; integrity of infrastructure.
Current, future, and neighbouring residents	Safety and accessibility; integrity of infrastructure; community connectedness and resilience; community cohesion.
Tenants	Continuity of business operations; safety and accessibility of staff, residents, and visitors.
Workforce	Security of employment, safety, and accessibility.
Visitors	Safety and accessibility.
Transit riders	Safety and accessibility; continuity of service.
Infrastructure owners	Continuity of operations; infrastructure protection.
Government agencies (NSW Police, Fire, Ambulance, Resilience NSW)	Public safety.
Traditional Custodians	Access to Country; ecosystem services; education values.
Ecosystems	Health; function; resilience; biodiversity.
Insurers	Financial loss; premiums.
Sports providers	Activation of precinct; training and development; successful delivery of sporting events.
Venue operators	Activation of precinct; successful delivery of events.

3.6 Identified assets or asset classes

The following assets or asset classes, as identified in AS 5334 are covered by this CAP:

TABLE 3.4: ASSET OR ASSET CLASS – AS 5334-2013 (STANDARDS AUSTRALIA 2013)

Sector	Component (indicative)	Notes	Covered
Places	Cities		<input type="checkbox"/>
	Towns		<input type="checkbox"/>
	Villages		<input type="checkbox"/>
	Hamlets		<input type="checkbox"/>
Buildings	Residential	All housing types including mixed use centres, multiple dwellings, and public and community housing such as boarding houses	<input checked="" type="checkbox"/>
	Commercial	Includes all facilities that facilitate professional services, banking, administration centres, call centres, resorts, etc.	<input checked="" type="checkbox"/>
	Industrial	Includes processing, manufacturing, and warehousing	<input checked="" type="checkbox"/>
	Recreational	Includes major event facilities	<input checked="" type="checkbox"/>
	Retail	Includes shopping malls, bulky goods centres, and mixed-use centres	<input checked="" type="checkbox"/>
	Public	Includes schools, hospitals, universities, and courts	<input checked="" type="checkbox"/>
	Historic	Heritage listed and state significant	<input checked="" type="checkbox"/>
	Tourism	Public and private facilities	<input checked="" type="checkbox"/>
Energy	Electricity generation		<input checked="" type="checkbox"/>
	Electricity transmission and distribution		<input checked="" type="checkbox"/>
	Oil and gas storage, transmission, and distribution		<input checked="" type="checkbox"/>
	Liquid fuels storage and distribution		<input checked="" type="checkbox"/>
Water	Water storage	Includes dams and header tanks	<input checked="" type="checkbox"/>
	Water supply and distribution	Includes pipes and pumps	<input checked="" type="checkbox"/>

Sector	Component (indicative)	Notes	Covered
	Sewerage	Includes pipes, pumps, and sewerage treatment plants	✓
	Irrigation	Includes pipes and pumps	✓
	Drainage	Includes pipes and pumps, open drains such as swales, concrete formed structures, bio-filtration systems, and other water sensitive urban design elements	✓
Green infrastructure	Public open space and private domain landscapes	Includes regional, district and local parks, streetscapes, trees and gardens, private open space	✓
	Natural landscape systems	Includes conserved systems such as river corridors, urban National Parks and State Forests, vegetation and habitat reserves, foreshores, and cliffs	✓
	Wetland treatment systems	Natural and engineered systems that maintain healthy ecosystem function of wetlands.	✓
	Cultural landscapes	Includes urban public lands such as botanic gardens, archaeological (indigenous and settlement) sites and monuments	✓
	Urban agriculture	Includes community gardens, urban farms for food production and/or commercial plant production	✓
Transport	Roads	Includes all gazetted roads, sealed, or unsealed, formed and unformed	✓
	Tunnels	All transport tunnels	✓
	Bridges	All transport bridges	✓
	Rail	Includes railway stations, fixed structures and rolling stock	✓
	Airports		✗
	Ports	Includes jetties, wharves, sea walls, navigational aids	✓
	Pedestrian and cycle	Includes footpaths and cycle ways	✓
Communication	Fixed line	Includes all overhead lines	✓
	Underground		✓
	Transmission facilities	Includes data, radio, TV, and phone systems	✓
	Remote telemetry systems	SCADA	✓
ICT	Critical systems and data		✓
	Mining, oil, and gas extraction		✗

Sector	Component (indicative)	Notes	Covered
Resource development	Forestry		<input checked="" type="checkbox"/>
	Fisheries	Includes aquaculture	<input checked="" type="checkbox"/>

3.7 Design life

Design life is defined as the period within which an element of the works must continue to meet the performance and technical requirements for the project and remain within specified limits of reliability, availability, and maintainability without major renewal beyond normal cyclic maintenance activities. It also benchmarks the requirements for durability.

The preliminary design life of asset elements is defined below:

TABLE 3.5: DESIGN WORKING LIFE

Asset	Design life
Structural elements	
Building structures and other common structures	60 years
Civil and hydraulic elements	
Drainage (inaccessible elements)	100 years
Drainage (accessible elements)	50 years
Building pavement	50 years
Road pavement	15 years
Mechanical and electrical elements	
Critical infrastructure systems – security & communications	25 years
Critical system equipment (cameras, access control, etc.)	15 years
HVAC - heat pumps	15 to 25 years
HVAC – split systems	7 to 10 years
HCAV – fans	15 to 20 years
Architectural elements	
Materials and finishes	20 years
Facades	30 years

4.0 Climate change

4.1 Emissions scenarios

The Intergovernmental Panel on Climate Change (IPCC (Intergovernmental Panel on Climate Change) 2014) publishes four greenhouse gas concentration trajectories known as Representative Concentration Pathways (RCPs) which are used for climate modelling and research, as detailed below:

TABLE 4.1: RCPs AND GLOBAL WARMING

Scenario		Global warming mean and likely range (°C)
RCP 2.6	Emissions peak 2010-2020, then decline substantially	1.0°C (0.3 to 1.7)
RCP 4.5	Emissions in RCP 4.5 peak around 2040, then decline	1.8°C (1.1 to 2.6)
RCP 6.0	Emissions peak around 2080, then decline	2.2°C (1.4 to 3.1)
RCP 8.5	Emissions continue to rise throughout the 21 st century	3.7°C (2.6 to 4.8)

Recognising the degree of uncertainty that exists regarding future climate, the fifth IPCC assessment report (AR5) introduced a series of Representative Concentration Pathways (RCPs) to help provide parameters around varying greenhouse gas (GHG) emission trajectories. The RCPs represent four plausible climate futures that may eventuate over the coming years. The most conservative scenario is represented by RCP 8.5 which assumes a high emissions pathway with global GHG emissions continuing to rise throughout the 21st century. Currently, RCP 8.5 represents not only the worst-case emissions scenario, but also the most likely case. As such, until further climate data revises this prediction, we recommended that RCP 8.5 is used when sourcing relevant climate projections.

4.2 Time scales

Given the scale of the proposed development and enabling infrastructure, the expected design life of the development (>120 years), the timeframe for the proposed construction works and the available climate data, two-time scales have been used for the assessment. These time scales and the rationale for their selection are summarised in Table 4.2 below.

TABLE 4.2: DEVELOPMENT TIME SCALES DESCRIPTIONS

Time scale	Year	Rationale
Medium-term	2040	Some new development settling into operations, some still under design and/or construction. Existing development continuing operations with some retrofits required. Current design intent/use unchanged, relatively similar climate settings.
Long-term	2090	All new development built and operating. Existing development being replaced as reaching end of life. Possibly changed/adapted future use types, significantly advanced climate change scenario.

4.3 Risk variables

The following risk variables have been used for the risk assessment, however the geographical and topographical site context together with the findings of the risk workshop(s) will ultimately determine the salient risks to the project. Key variables for this project cover environmental, social, and economic risks.

TABLE 4.3: RISK VARIABLES CONSIDERED

Element	Variable
Sea surface temperature	Increase in sea level
	Increase in storm surge/tide level
	Increase in water temperature
	Increase in adjacent air temperature and humidity
Air temperature	Increase in mean maximum temperature
	Increased annual mean temperature
	Increased number of hot days over 35 °C
	Increased event of extreme cold temperatures
Precipitation	Greater frequency of higher intensity rainfall events
Drought	Increase in annual total rainfall
Wind	Decrease in annual total rainfall
Extreme storms	Increased wind speeds
	Increase in frequency and severity of storms
	Increasing frequency of electrical storms and lightning strikes
	Changes to east coast cyclone patterns
Humidity	Changes to relative humidity
Bushfire	Increase in risk of bushfires
Solar radiation	Increase in level of UV
Waterway health	Declining waterway health
Soil health	Soil health
	Soil moisture
	Ground stability
	Runoff
	Groundwater level
pH	Soil pH
	Freshwater pH
Evapotranspiration	Increased evapotranspiration
Fog	Increased frequency of fog events
Seismicity	Earthquake
	Tsunami
Civil disturbance	Attack
	Civil unrest
	Pandemic
	Financial crisis
	Community cohesion
Critical infrastructure failure	Transport and logistics network
	Electrical network
	Water network
	Waste network
	Digital network
Shift in business models	Demographic shifts
	Economic models
	Governance shifts
Social stresses	Geopolitical environment
	Local economic environment

4.4 Observed climate

Local climate for the region is predominantly temperate, which typically results in warm wet summers/autumn and mild, dry winter/spring. Being located in the western suburbs of the Greater Sydney region, temperatures can be higher than in more coastal areas (e.g. eastern suburbs). Rainfall patterns are typically seasonal, with higher rainfall experienced during autumn

months and lower rainfall in spring (Table 4.4). Storms result in periods of heavy rainfall and strong winds and may lead to flood events.

TABLE 4.4: CLIMATE EXPOSURE (BOM 2023A AND BOM 2023B)

Climate variable	Averages (2011-2023) and (1995-2011 rainfall)
Average maximum daily temperature	Ranging from 28.9°C (January), to 18.4°C (June)
Average minimum daily temperature	Ranging from 19.3°C (January), to 6.5°C (July)
Extreme temperatures above 35°C	9.8 days per year over 35°C, typically in late spring and summer months
Average monthly rainfall	Ranging from 109.8mm (February) to 52.7mm (September)

4.4.1 Mean temperature

The local area typically experiences average maximum daily temperatures ranging from 28.9°C in January to 18.4°C in June, and average minimum daily temperatures ranging from 19.3°C in January to 6.5°C in July. Given its coastal location, the average temperatures for the local area are typically more severe than those experienced closer to the Sydney coast.

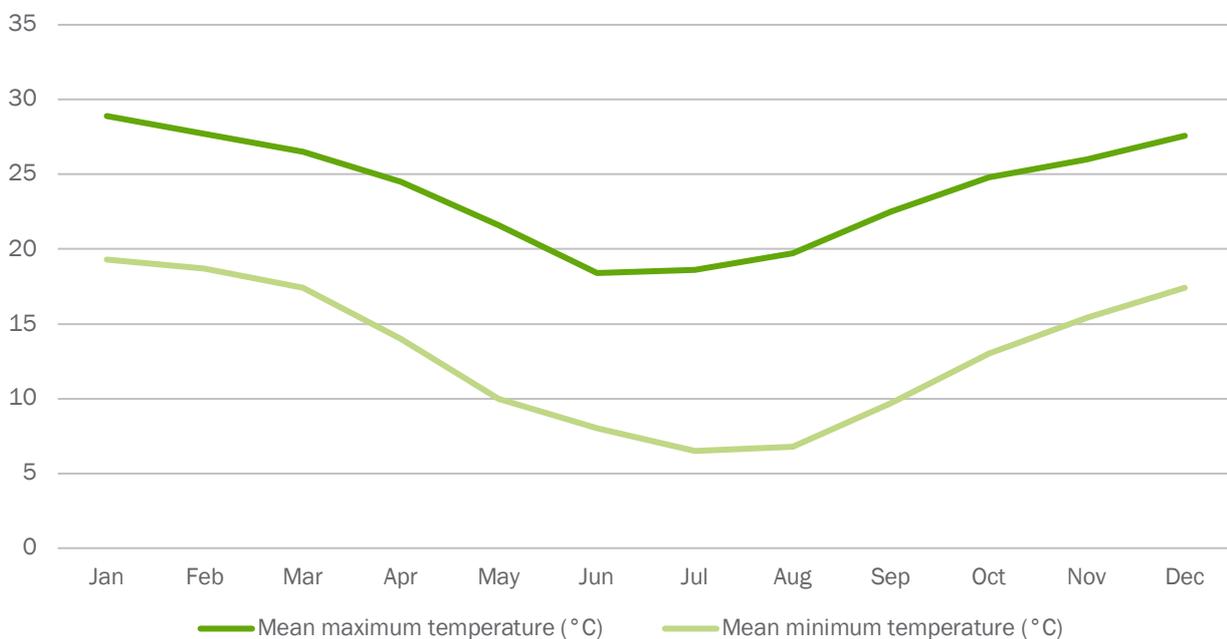


FIGURE 4.1: MEAN MAXIMUM AND MINIMUM TEMPERATURES RECORDED AT SYDNEY OLYMPIC PARK (ARCHERY CENTRE AND VIS METER) (1859 -2020) (BOM 2023A AND 2023B)

4.4.2 Urban heat island

Urban heat islands occur in urban areas and lead to consistently higher temperatures than surrounding areas, driven by a greater retention of heat. This is caused by the sun's heat being absorbed by hard surfaces with high thermal mass such as buildings, dark roofs, car parks, paved surfaces, and roads. Human activities, such as motorised transport and using air conditioning also increase these impacts due to their generation of waste heat.

Figure 4.2 shows thermal imagery for the City of Parramatta local government area (LGA) and shows mean daytime temperatures for the entire summer, measured between 10th December 2018 and 28th February 2019 (Pfausch and Rouillard 2019). Higher temperatures are seen in parts of the city that are heavily urbanised and/or characterised by large areas of paved and roofed surfaces.

Sydney Olympic Park is shown to have exposure to urban heat island effects above the mid-range, experiencing air temperatures somewhere between 27-30 °C, likely driven by limited permeable land cover in the town centre and asphalt/concrete paved roads. Changes in land use towards higher density in the town centre could result in an increase in the heat island effect if mitigation measures aren't taken. Design features currently being considered for the Sydney Olympic Park 2050 Master Plan that may help to reduce the heat island effect include expanding ecosystems into the town centre, increasing vegetation cover and setting baseline targets for canopy coverage, shading structures throughout the public domain, and water features.

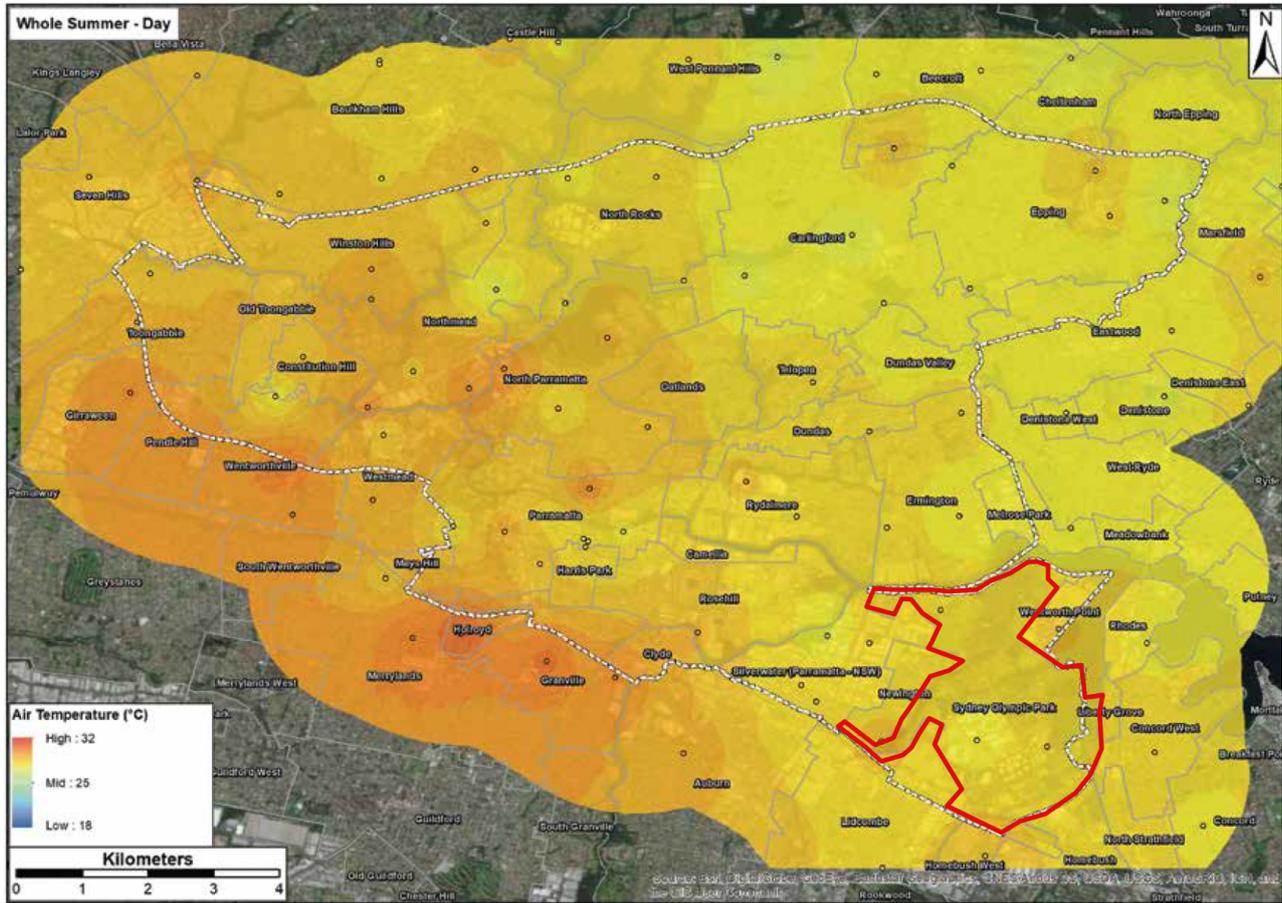


FIGURE 4.2: URBAN HEAT MAPPING IN SUMMER (EXISTING CONDITION - SYDNEY OLYMPIC PARK OUTLINED IN RED) (MAP SOURCE: PFAUTSCH AND ROUILLARD 2019).

4.4.3 Extreme heat

The local area historically experiences an average of 9.8 days above 35 °C per year. Similarly to mean temperature averages, this is likely driven by the site's location. Temperature records for Sydney Olympic Park AWS (Archery Centre) show highest maximum temperatures can typically exceed 40 °C between October and March.

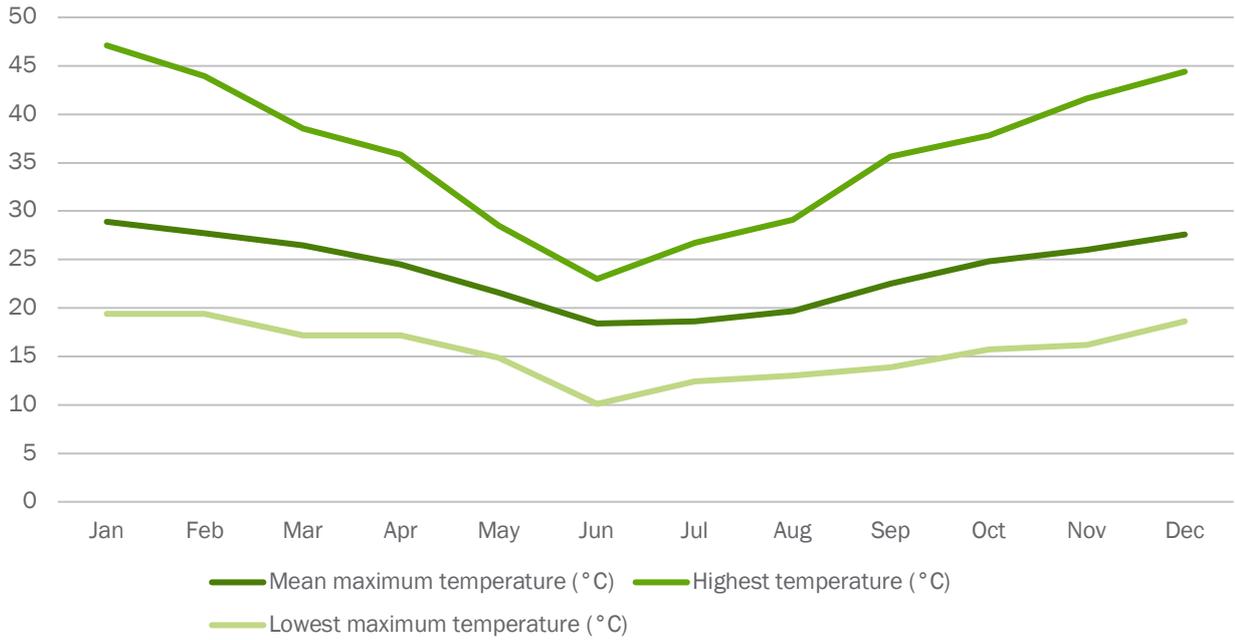


FIGURE 4.3: AVERAGE MAXIMUM AVERAGE TEMPERATURES AND HISTORICAL MAXIMUM TEMPERATURES RECORDED AT SYDNEY OLYMPIC PARK AWS (ARCHERY CENTRE) (2011-2023) (BOM 2023A)

4.4.4 Mean rainfall

Annual rainfall for the local area has averaged 911.8mm over the period 1995-2011. Typically, January to June are the wettest months of the year, while August to September receive the lowest average rainfall.

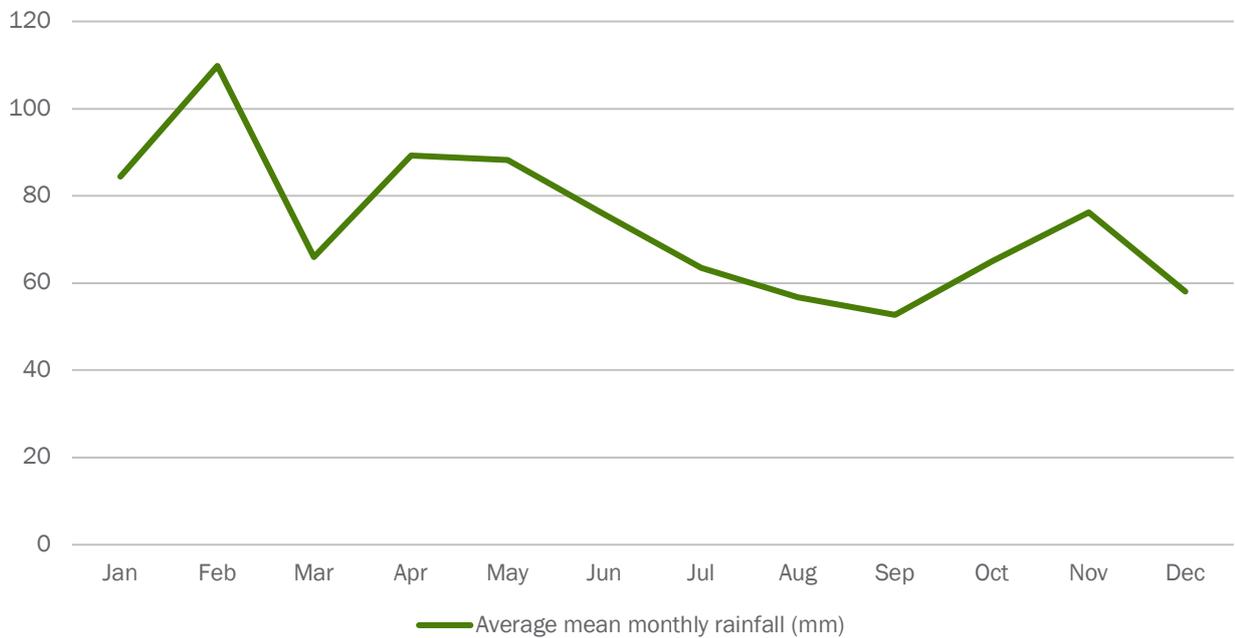


FIGURE 4.4: AVERAGE MEAN RAINFALL RECORDED AT SYDNEY OLYMPIC PARK AWS (ARCHERY CENTRE) (1995-2011) (BOM 2023B)

4.4.5 Extreme rainfall and flooding

Sydney Olympic Park falls within the Lower Parramatta River catchment which is located in Parramatta's eastern suburbs. Extreme rainfall events are predicted to increase in intensity, with high confidence (CSIRO 2023).

Sea level rise projection studies have been conducted for Sydney Olympic Park, as reflected in the development's previous CAP. A baseline of the Highest Astronomical Tide (HAT) was taken from Powell Creek at Bicentennial Park between 2001 and 2010 (Many Hydraulics Lab) and compared with a:

- Projected sea level rise of 40 cm above HAT by 2050
- Project sea level rise of 90 cm above HAT by 2100.

The results are shown below.

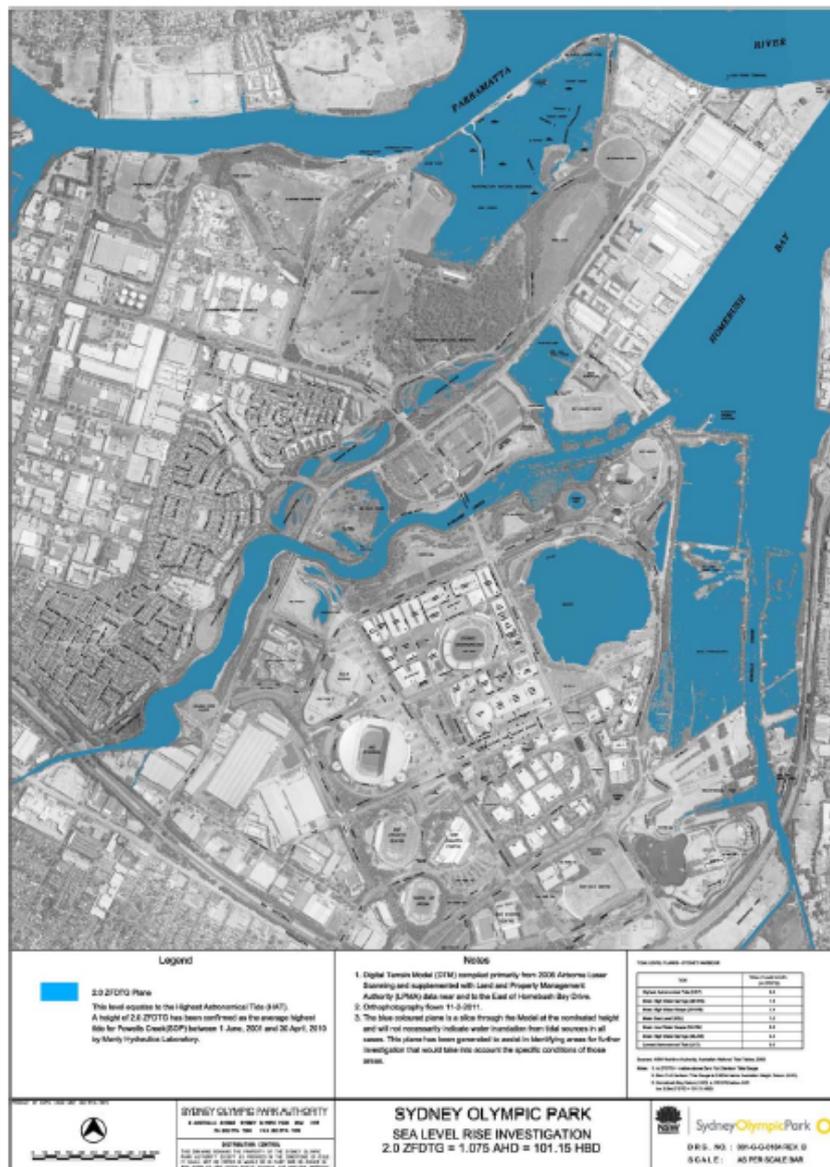


FIGURE 4.5: BASELINE HIGHEST ASTRONOMICAL TIDE (SOURCE – SYDNEY OLYMPIC PARK CAP 2019)

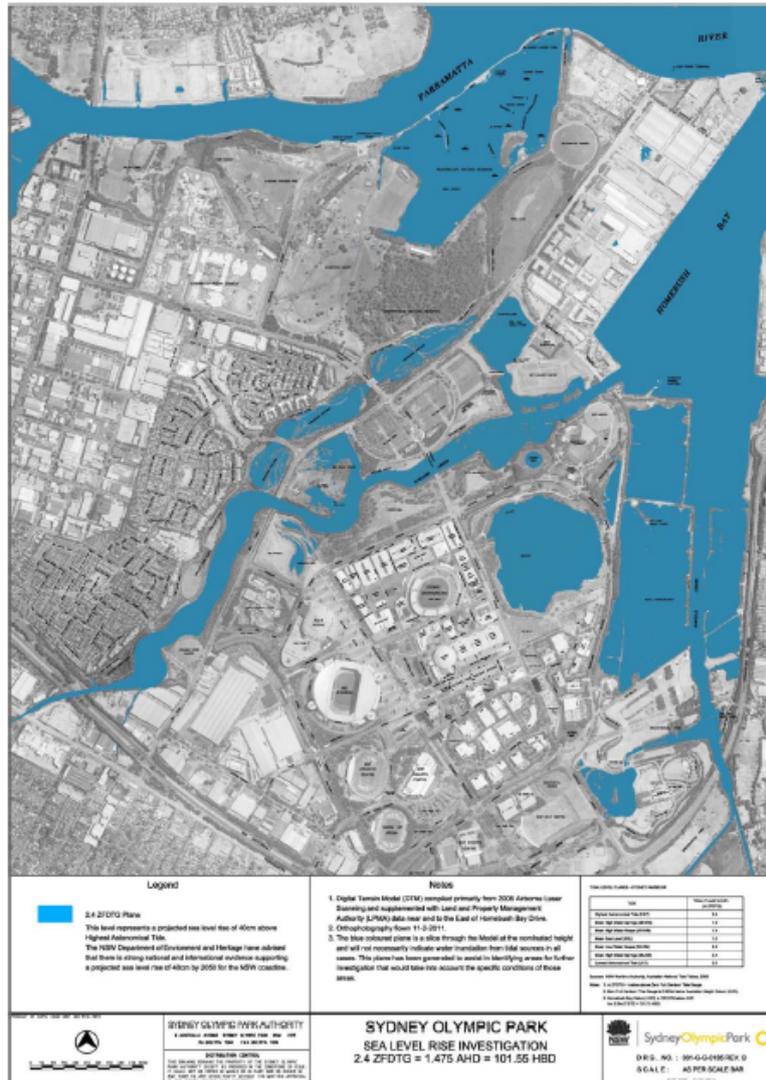


FIGURE 4.6: SEA LEVEL RISE 40 CM ABOVE HAT (SOURCE – SYDNEY OLYMPIC PARK CAP 2019)

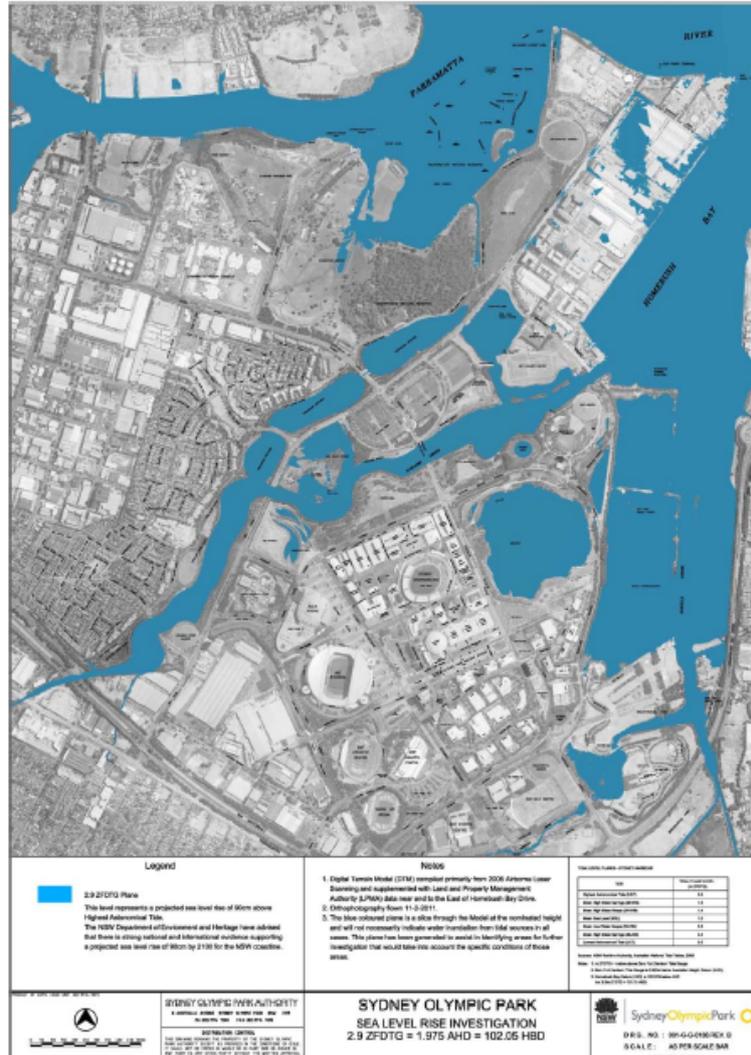


FIGURE 4.7: SEA LEVEL RISE 90 CM ABOVE HAT (SOURCE – SYDNEY OLYMPIC PARK CAP 2019)

Mott MacDonald has undertaken a flood risk analysis for Sydney Olympic Park and provided mapped flood planning levels, along with corresponding land use recommendations and future planning control guidance, to support a resilient development response across the precinct. Full details can be found in *Annexure P: Flooding Assessment Report*, with an excerpt of the relevant section included below.

Future planning controls for floor level based around the opportunity to provide an increased amenity within the precinct are under development. A preliminary Flood Planning Level (FPL) assumes a 1% AEP flood level + 0.5m freeboard. This could be varied depending on the land use based on NSW Floodplain Risk Management Manual (2023) guidance, but this initial FPL would apply to habitable floors of new structures. The reason for variation by land use is to ensure that the activation of the streetscape is consistent throughout the precinct, noting some areas are lower lying or subject to greater overland flows through the adjacent road reserve. It is recommended this principle is applied through a relevant planning control that requires proponents to provide the flood planning considerations of proposed floor levels.

Recommended Planning Control

All developments must demonstrate the following considerations have been made in design of finished floor levels and re-grading of the finished surface to interface with existing public domain levels:

- Consistency of the re-grading of design finished surfaces with desired local overland flow behaviour,*

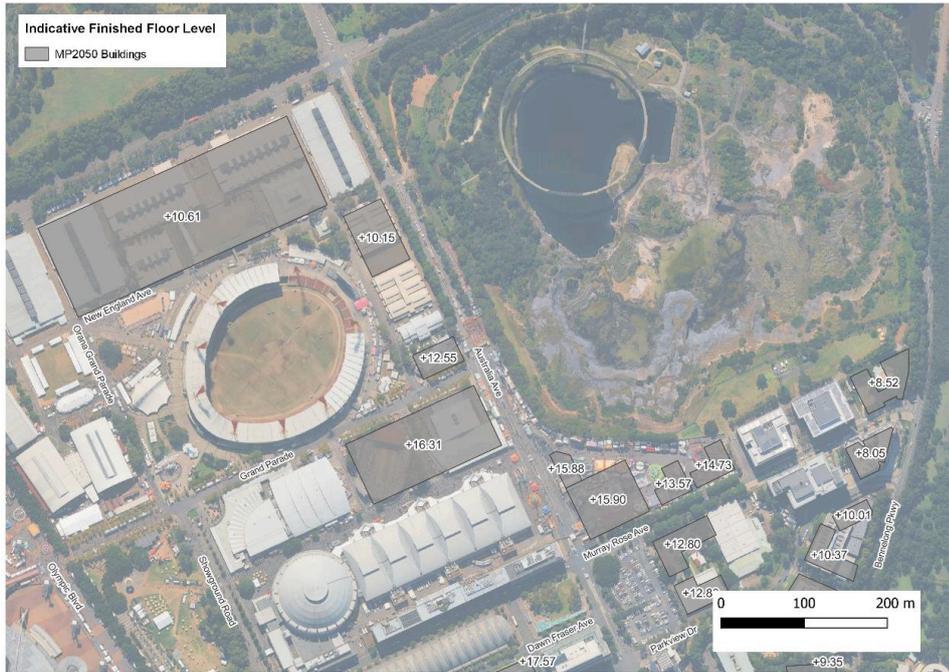


FIGURE 4.10: FLOOR LEVELS AND PROPOSED PRECINCT STRUCTURES – AUSTRALIA AVENUE (SOURCE: MOTT MACDONALD)

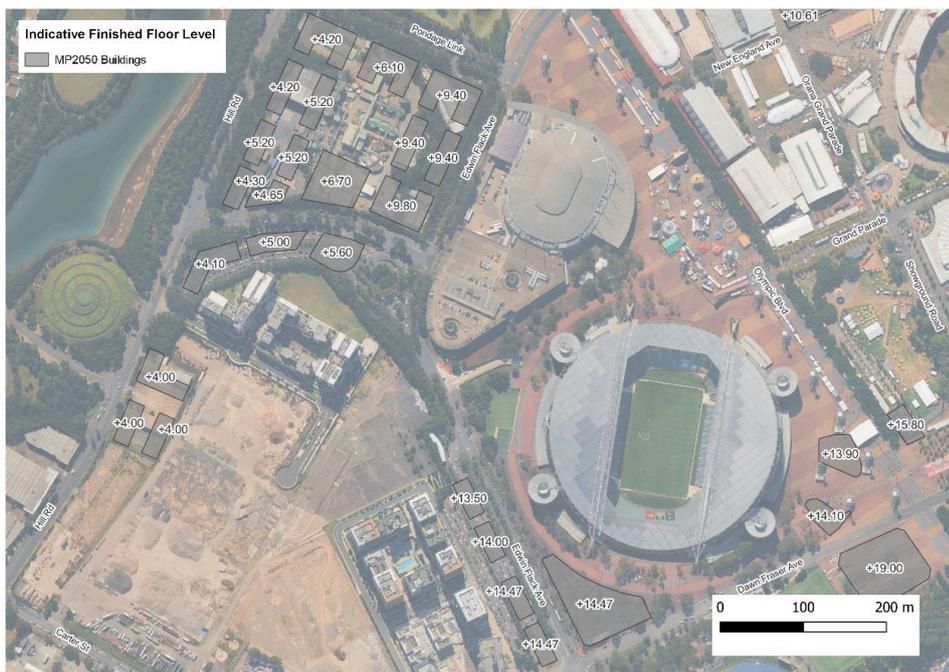


FIGURE 4.11: FLOOR LEVELS AND PROPOSED PRECINCT STRUCTURES – HILL ROAD (SOURCE: MOTT MACDONALD)

4.4.6 Storm events

The Sydney region is susceptible to storm events, predominantly in the form of east coast lows (ECLs) that develop because of ex-tropical cyclones that decay as they move south or interactions between troughs of low pressures/cold fronts with warmer sea surface temperatures. Within the Greater Sydney area, several recent storm events (BoM 2021c) have been observed:

- In June 2016, the East Coast Storms and Flood events resulted in flash flooding and property damage across Sydney.
- In March 2017 a severe thunderstorm resulted in 33,000 homes without power across western Sydney, as well as road closures.
- In December 2018 a severe thunderstorm impacted Sydney's northwest, leading to 3,788 calls for assistance to the NSW State Emergency Service, and left 55,000 homes without power throughout nearby Castle Hill, North Parramatta, Winston Hills, and Carlingford.
- In February 2019 45,000 homes in Sydney's northwest lost power due to a storm event, with up to 5,000 homes without power for multiple days.
- In February 2020 Sydney experienced two east coast lows (8th and 18th February) with rain up to 400mm falling over three days and winds exceeding 100km/h.

In addition to gale force winds and heavy widespread flooding, ECLs also generate rough seas and storm tides. Storm tides can lead to coastal flooding, particularly when they combine with astronomical high tides or king tides. This was evidenced in 2016 when an east coast low-driven storm tide combined with a king tide affected areas of Greater Sydney such as Collaroy which experienced severe inundation and erosion.

4.4.7 Bushfires

Sydney Olympic Park is at risk of bushfires due to a combination of climatic conditions and the extent of green space and natural areas throughout the development. In 2015, a fire in the car park outside the Aquatic Centre resulted in the loss of 47 cars and the evacuation of around 3,500 people from the building (Wells 2015). Resilience measures have since been implemented to reduce bushfire risks, such as planting fire resistant species, updates to strategies and landscape management plans, and an irrigation system upgrade (Martin 2021). Sydney Olympic Park is located on remediated lands that were once landfill sites. Gas is generated by landfill sites, which could pose both an explosion and human health risk during bushfire events.

Bushfires also have the potential to have indirect impacts at Sydney Olympic Park, particularly on human health and wellbeing. Poor air quality and infrastructure failure during out-of-control bushfires both pose significant risks for all communities in the Greater Sydney region.

In NSW, the typical fire season is from spring to mid-summer. Bushfire risk particularly increases after dry winters and springs (BOM 2023). Conditions that drive fire risk are associated with low-pressure systems in southern Australia that push north strong, hot, dry westerly winds (BOM 2023).

In September 2022, Australia rolled out a nationally consistent Fire Danger Rating System (AFDRS). Whilst the system doesn't predict the chance of a fire occurring, it uses weather forecasting and vegetation data to assess the level of danger, should a bushfire occur (Government of Western Australia – DFES 2023). The Australian-wide Fire Danger Ratings are outlined below:

TABLE 4.5: AUSTRALIAN FIRE DANGER RATINGS (GOVERNMENT OF WESTERN AUSTRALIA – DFES 2023, NSW RURAL FIRE SERVICE 2023)

Fire Danger Rating	Fire Behaviour Index	Interpretation (NSW RFS)
No rating	Below 12	No rating issued
Moderate	12-23	Plan and prepare
High	24-49	Be ready to act
Extreme	50-99	Take action now to protect your life and property
Catastrophic	100+	For your survival, leave bushfire risk areas

The Forest Fire Danger Index (FFDI) has also been used in NSW to quantify fire weather. The FFDI combines observations of temperature, humidity, and wind speed with an estimate of the fuel state. AdaptNSW (OEH 2015a) notes that long-term FFDI estimates are available for two weather stations in the region, Sydney Airport and Richmond. The average annual FFDI for the period 1990–2009 is 5.5 at Sydney Airport and 7.1 at Richmond. Fire weather is classified as 'severe' when the FFDI is above 50, and most of the property loss from major fires in Australia has occurred when the FFDI reached this level. Severe fire weather conditions are estimated to occur on average one day per year at Sydney Airport and 1.8 days per year at Richmond.

4.5 Climate projection snapshot

A summary of the key climate related effects relevant to Sydney Olympic Park can be found below in Table 4.6. This data has been taken from AdaptNSW and Transport for NSW (TfNSW) *Climate Risk Assessment Tool 1: Climate Data* (2021), a tool that provides a summary of the CCRA model results. The CCRA model is built in Matlab using parametrization and optimisation algorithms applied to gridded NARClIM1.5 data, combined with other sources.

NARClIM data contains projections from four Global Circulation Models and three downscaling techniques, providing a total of 6 projection scenarios. This CCRA model combines all 6 ensembles (gridded raw data) and selects the most extreme values for each climate variable and a unique geographical location, creating a new data set that is more suitable for climate change risk assessment. This data is not representative of the exact climate future, and it is built for risk estimation only.

The TfNSW tool provides information about projected climate related changes across several timeframes:

- Near future (2021-2050)
- Mid future (2051-2080)
- Far future (2071-2100).

In addition, the tool provides data for sea level rise based on Climate Analytics data (using (Bamber et al. 2019)), as well as Urban Heat Island Effect, Heat Vulnerability Index and Disaster Resilience Index based on SEED and BNHCRC data.

In depth details of relevant climate data, projections, and commentary from AdaptNSW (OEH 2014) and NARClIM (ARC Centre of Excellence for Climate System Science 2012) can be found in 11.1 Climate Data.

Table 4.6: Climate projection snapshot (TfNSW 2021 and AdaptNSW 2023)

	2020-2039 (Near Future)	2060-2079 (Far Future)
Maximum temperatures	+0.5 - 0.8 °C	+1.5 - 2.4 °C
Minimum temperatures	+0.4 - 0.8 °C	+1.4 - 2.5 °C
Days above 35 °C	+4 days	+11 days
Days above 40 °C	+1 day	+4 days
Cold nights	-5 nights	-12 nights
Average annual rainfall	-13.0% to +18.3%	-8.7% to +24.2%
Extreme rainfall	-3 to +12%	-7 to +10%
Evaporation	+1 to +8%	+2 to +24%
No. of droughts per decade	2 - 5	1 - 9
Extreme winds	-5 to +8%	-16 to +24%
No. of fire days	9 - 11	10 - 15

5.0 Risk assessment

5.1 Risk assessment process

Based on the project context and climate projections an initial risk assessment was drafted by Atelier Ten incorporating potential impacts, and estimated levels of consequence and likelihood for both 2040 and 2090. These were drawn from prior experience in climate adaptation and resilience planning on projects of a similar nature, and/or location with comparable context.

The initial risk assessment assumes a business-as-usual approach to development not incorporating any formal risk assessment or adaptation measures.

The measures of consequences were adapted from AS 5334-2013 and the initial CAP undertaken for Sydney Olympic Park in 2019, and can be seen in Table 5.1: Risk Criteria – Qualitative Measures of Consequences (AS5334 2013). The level of consequence in the risk assessment is influenced by both the level of occupancy of the subject development (assumed partially occupied at 2040, and fully occupied by 2090), and the surrounding suburbs (assumed increasingly developed and occupied at both time periods).

TABLE 5.1: RISK CRITERIA – QUALITATIVE MEASURES OF CONSEQUENCES (AS5334 2013)

Consequence	Adaptive Capacity	Infrastructure	Social	Governance	Financial	Environmental	Economy
Insignificant	No change	No infrastructure damage, no change to service	No adverse human health effects	No changes to management required	Little financial loss or increase in operating expenses	No adverse effects on natural environment	No effects on the broader economy
Minor	Minor decrease to the adaptive capacity of the asset. Capacity easily restored.	Localised infrastructure service disruption. No permanent damage. Some minor restoration work required. Early renewal of infrastructure by 10-20%. Need for new/modified ancillary equipment.	Short-term disruption to employees, customers or neighbours. Slight adverse human health effects or general amenity issues.	General concern raised by regulators, requiring response action	Additional operational costs Financial loss small, <10%	Minimal effects on the natural environment	Minor effect on the broader economy due to disruption of service provided by the asset
Moderate	Some change in adaptive capacity. Renewal or repair may need new design to improve adaptive capacity.	Limited infrastructure damage and loss of service. Damage recoverable by maintenance and minor repair. Early renewal of infrastructure by 20-50%.	Frequent disruptions to employees, customers or neighbours. Adverse human health effects	Investigation by regulators for corrective actions required	Moderate financial loss 10-50%	Some damage to the environment, including local ecosystems. Some remedial action may be required	High impact on the local economy, with some effect on the wider economy
Major	Major loss in adaptive capacity. Renewal or repair would need new design to improve adaptive capacity.	Extensive infrastructure damage requiring major repair. Major loss of infrastructure service. Early renewal of infrastructure by 50-90%.	Permanent physical injuries and fatalities may occur. Severe disruptions to employees, customers, or neighbours.	Notices issued by regulators for corrective actions. Changes required in management. Senior management responsibility questionable.	Major financial loss 50-90%	Significant effect on the environment and local ecosystems. Remedial action likely to be required.	Serious effect on the local economy spreading to the wider economy
Extreme	Capacity destroyed, redesign required when repairing or renewing asset.	Significant permanent damage and/or complete loss of the infrastructure and the infrastructure service. Loss of infrastructure support and translocation of service to other sites. Early renewal of infrastructure by 90%.	Severe adverse human health effects, leading to multiple events of total disability or fatalities. Total disruption to employees, customers, or neighbours. Emergency response at a major level.	Major policy shifts. Change to legislative requirements	Extreme financial loss > 90%	Very significant loss to the environment. May include localised loss of species, habitats, or ecosystems. Extensive remedial action essential to prevent further degradation. Restoration likely to be required.	Major effect on the local, regional, and state economies.

The measures of likelihood were also taken from AS 5334-2013 and the initial CAP, and can be seen in Table 5.2: Risk Criteria – Qualitative Measures of Likelihood (AS 5334 2013). The level of likelihood in the risk assessment is influenced by the RCP 8.5 emissions scenario and increases over the two time periods (2040 and 2090).

TABLE 5.2: RISK CRITERIA – QUALITATIVE MEASURES OF LIKELIHOOD (AS 5334 2013)

Likelihood	Description	Recurrent Or Event Risks	Long Term Risks
Almost Certain	Is expected to occur in nearly all circumstances – E.g. At least once per month	Has happened several times in the past year and in each of the previous 5 years or Could occur several times per year	Has a greater than 90% chance of occurring in the identified time period if the risk is not mitigated
Likely	Will probably occur in most circumstances – E.g., Less than once every month but more than once per annum	Has happened at least once in the past year and in each of the previous 5 years or May arise about once per year	Has a 60–90% chance of occurring in the identified time period if the risk is not mitigated
Possible	May occur at some time – E.g., Less than once every month but more than once in 5 years	Has happened during the past 5 years but not in every year or May arise once in 25 years	Has a 40–60% chance of occurring in the identified time period if the risk is not mitigated
Unlikely	Could occur but not often – E.g., Less than once in 5 years but more than once in 20 years	May have occurred once in the last 5 years or May arise once in 25 to 50 years	Has a 10–30% chance of occurring in the future if the risk is not mitigated
Rare	May occur in exceptional circumstances – E.g., Less than once in 20 years	Has not occurred in the past 5 years or Unlikely during the next 50 years	May occur in exceptional circumstances, i.e., less than 10% chance of occurring in the identified time period if the risk is not mitigated

Consequences and likelihoods are combined to develop a risk rating matrix based on AS 5334-2013, which can be seen in Table 5.2: Risk Criteria – Qualitative Measures of Likelihood (AS 5334 2013). This matrix acts as criteria for the organisation to use when evaluating risks as part of the risk assessment process. It combines a number rating system to allow for Sydney Olympic Park to assess risks on a scale of highest through to lowest.

TABLE 5.3: RISK RATING MATRIX (AS 5334 2013)

Consequence	Likelihood				
	Rare	Unlikely	Possible	Likely	Almost Certain
Extreme	Medium - 8	High - 17	Very High - 21	Very High - 23	Very High - 25
Major	Medium - 7	Medium - 12	High - 18	Very High - 22	Very High - 24
Moderate	Low - 4	Medium - 11	Medium - 14	High - 19	High - 20
Minor	Low - 2	Low - 6	Medium - 13	Medium - 15	Medium - 16
Insignificant	Very Low - 1	Low - 3	Low - 5	Medium - 9	Medium - 10

The level of **acceptable** risk will depend on a series of factors including the project context, potential impacts, and an organisation's appetite for risk. In some cases, it may be deemed necessary to mitigate all high and extreme risks to medium

or low. In other cases, it may be impossible to mitigate an extreme risk entirely, yet the scope of adaptation measures may be deemed acceptable.

Given the inherent uncertainty in climate change projections and the potential for serious or irreversible damage to settlements and infrastructure, it is entirely appropriate that organisations adopt a prudent and conservative risk attitude for risks from climate change. Organisations should also adopt a proactive attitude to maximising opportunities and benefits associated with a changing climate.

The below table outlines the risk assessment conducted for the Sydney Olympic Park 2050 Master Plan. It was discussed at two climate and resiliency workshops conducted by Atelier Ten, and was reviewed in detail by the project team following the scoping workshop on the 9th of March 2023, and at a high-level following the strategy workshop held on the 23rd March 2023. Participants reviewed the levels of consequence and likelihood and suggested additional potential impacts.

5.2 Results

The climate risk assessment contains 178 risks specific to Sydney Olympic Park across the 19 risk variables considered. Table 5.4 summarises the results of the assessment, and the graphs below show the 2040 and 2090 results per risk variable.

TABLE 5.4: SUMMARY OF RISK ASSESSMENT RESULTS

Risk Level	2040 Timescale	2090 Timescale
Very high	18	88
High	79	64
Medium	75	25
Low	6	1
Very low	0	0

The variables with the highest risks in 2040 include air temperature, precipitation, bushfire, social stresses, air temperature, extreme storms, critical infrastructure failure, civil disturbance, and shift in business models. By 2090, wind, seismicity, and soil are added to this list.

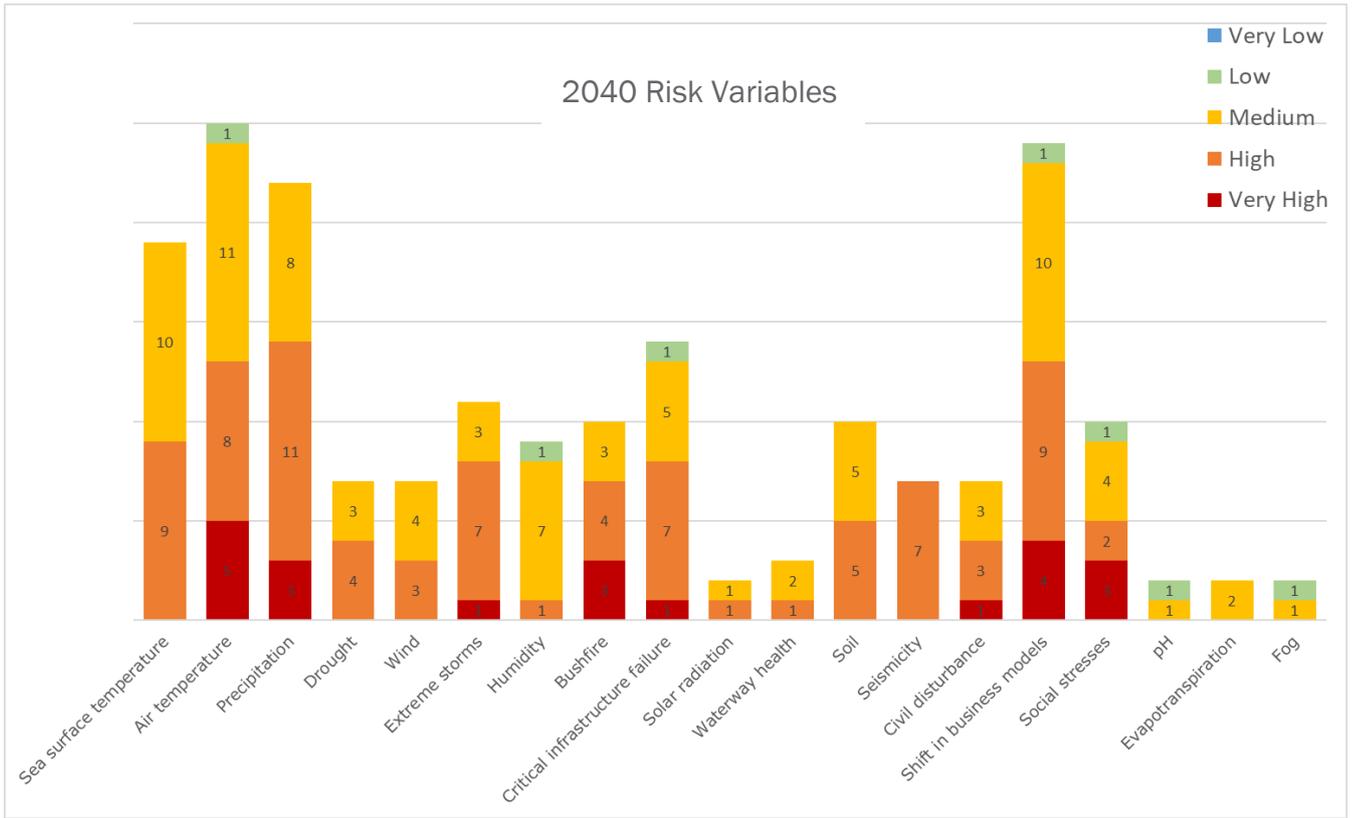


FIGURE 5.1: 2040 CLIMATE RISKS FOR SYDNEY OLYMPIC PARK

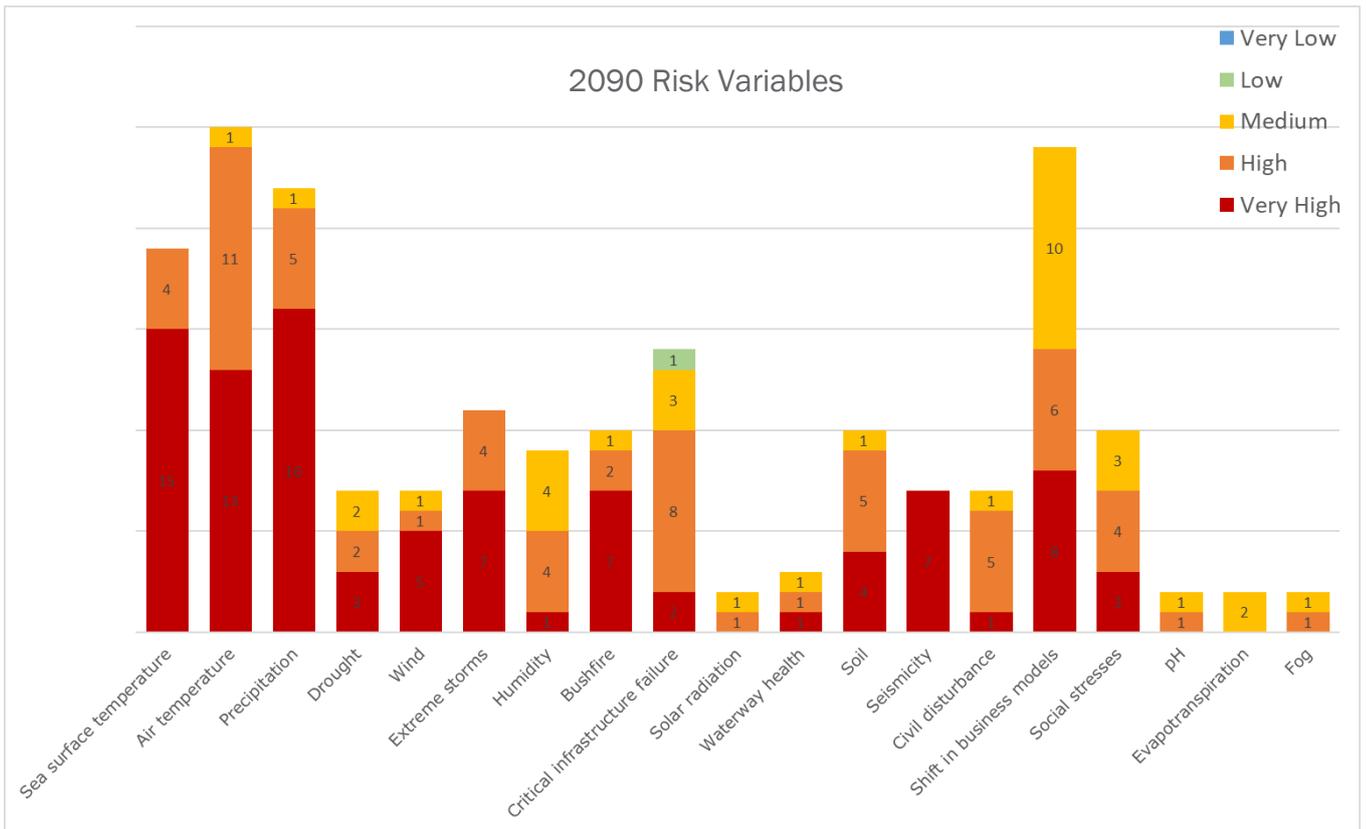


FIGURE 5.2: 2090 CLIMATE RISKS FOR SYDNEY OLYMPIC PARK

The following pages summarise all risks in detail.

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
1	Sea surface temperature	Increase in sea level Storm surge/storm tide	Direct	Inundation - flood damage Direct: Potential for inundation of infrastructure during storms resulting in flood damage and safety risk from backed up overland flow.	Place-based	Financial Infrastructure Economy	Major	Possible	High - 18	Extreme	Almost Certain	Very High - 25
2	Sea surface temperature	Increase in sea level Storm surge/storm tide	Direct	Inundation - estuarine habitat Direct: Sea level and high tides increase in height, impacting sensitive mangrove and estuarine ecosystem balance and resulting in a loss of land area.	Place-based	Environmental Social Financial	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
3	Sea surface temperature	Increase in sea level	Direct	Inundation - ecosystem movement Direct: Inundation will force species/communities to move inland/upslope where in most cases there is no capacity due to development.	Place-based	Environmental	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
4	Sea surface temperature	Increase in sea level	Direct	Inundation - loss of ecosystem services Direct: Sea level rise and inundation leads to a loss of species and communities along with their contribution to protecting and stabilising the shoreline from erosion and filtering pollutants/sediment from the water that flows through them.	Place-based	Environmental Social Financial	Major	Possible	High - 18	Major	Likely	Very High - 22
5	Sea surface temperature	Increase in sea level	Direct	Inundation - disease Direct: Backed up overland flow from inundation events, as well as inundation of new areas, increases mosquito habitat and risk of mosquito borne illness.	Place-based	Social	Moderate	Likely	High - 19	Major	Almost Certain	Very High - 24
6	Sea surface temperature	Increase in sea level	Direct	Inundation - remediated lands Direct: Sea level rise could lead to saltwater intrusion into leachate infrastructure of remediated lands especially pump pits PP21 (Wilson Park - the most vulnerable across SOPA site), PP24 (Wilson Park), PP20 (Blaxland Common), then PP19 the PP18 (Woo-la-ra) - resulting in damages to pumps and compliance breaches.	Place-based	Financial Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22
7	Sea surface temperature	Increase in sea level	Direct	Inundation - stormwater systems Direct: Higher sea levels could lead to deeper and more frequent flooding of water and sewage infrastructure and surcharging of trunk stormwater systems.	Place-based	Financial Infrastructure	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
8	Sea surface temperature	Increase in sea level	Direct	Inundation - liveability and access Direct: Projected sea level rise could cause impacts on liveability and access to residential areas of SOP.	Integrated	Social Infrastructure Financial	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
9	Sea surface temperature	Increase in sea level	Direct	Inundation - erosion Direct: Sea level rise leads to inundation of areas alongside waterways, resulting in increased erosion.	Integrated	Environmental Financial	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
10	Sea surface temperature	Increase in sea level	Direct	Inundation - topsoil and vegetation Direct: Sea level rise and king tides lead to topsoil and vegetation loss through currents and movement.	Place-based	Environmental	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
11	Sea surface temperature	Increase in sea level	Direct	Inundation - leachate collection infrastructure Direct: Inundation of electrical, control, and monitoring equipment of leachate collection and transfer infrastructure, leading to failure of critical infrastructure which can result in a pollution incident.	Integrated	Environmental Infrastructure Social	Major	Possible	High - 18	Major	Likely	Very High - 22
12	Sea surface temperature	Increase in sea level	Direct	Inundation - leachate generation Direct: Increase in leachate generation and extraction due to higher volumes and higher salt concentrations may cause reduction of treatment performance of biological leachate treatment systems, resulting in non-compliance with EPL10243.	Integrated	Governance Environmental Infrastructure Social	Major	Possible	High - 18	Major	Likely	Very High - 22
13	Sea surface temperature	Increase in sea level	Direct	Inundation - debris Direct: Sea level rise and king tides lead to waste and debris washing through/onto the site from waterways. Larger debris can lead to damage to property and infrastructure.	Integrated	Environmental Infrastructure Social	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
14	Sea surface temperature	Increase in sea level	Direct	Saltwater intrusion Direct: Saltwater intrusion disproportionately impacts some areas of the project (e.g. Leachate collection systems, Bennelong Parkway).	Integrated	Infrastructure Financial Environmental	Major	Possible	High - 18	Major	Likely	Very High - 22
15	Sea surface temperature	Increase in sea level	Direct	Intrusion - landscaping Direct: Saltwater intrusion, contaminating water sources including stormwater harvested for irrigation, as well as groundwater resources, impacting ability to irrigate gardens.	Place-based	Environmental Social	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
16	Sea surface temperature	Increase in sea level	Direct	Intrusion - building degradation Direct: Saltwater intrusion, contaminating water sources leading to the degradation of building materials (e.g., foundations).	Place-based	Financial Infrastructure Social	Major	Possible	High - 18	Extreme	Likely	Very High - 23
17	Sea surface temperature	Increase in water temperature	Direct	Warming water – habitat Direct: increase in water temperature degrades habitat quality for estuarine life currently resident in the Parramatta River, resulting in species losses and migration.	Place-based	Social Environmental	Moderate	Likely	High - 19	Major	Likely	Very High - 22
18	Sea surface temperature	Increase in water temperature	Direct	Warming water Direct: Increase in water temperature may cause algal blooms and resultant consequences on human health (toxicity), aesthetics, and ecological health. It may also impair habitat and food sources for migratory shorebirds.	Integrated	Social Environmental Financial	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
19	Sea surface temperature	Increase in adjacent air temperature and humidity	Direct	Warming water Direct: warmer water increases nearby air temperature and humidity	Place-based	Social Financial	Minor	Likely	Medium - 15	Moderate	Likely	High - 19
20	Air Temperature	Increase in mean maximum temperature	Direct	Electrical assets - power supply on site Direct: Extended high temperatures may have an adverse impact on the operation of some electrical equipment, such as components in kiosks or sub-stations or external control cabinets or switchboards or LEDs used in street lighting leading to system failure or service interruptions.	Integrated	Financial Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22
21	Air Temperature	Increase in mean maximum temperature	Direct	Electrical assets - leachate collection systems Direct: Failure of critical leachate collection and transfer infrastructure or communication infrastructure due to heat pressures which may result in pollution incidents.	Integrated	Financial Infrastructure Environmental	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24
22	Air Temperature	Increase in mean maximum temperature	Direct	Financial loss Direct: Increased intensity of temperatures creates larger demand for indoor events and undercover events.	Process-oriented	Financial Infrastructure	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
23	Air Temperature	Increase in mean maximum temperature	Direct	Financial loss Direct: Increased heat and extreme weather events may result in a lower number of patrons visiting SOP.	Integrated	Financial Infrastructure Social	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
24	Air Temperature	Increase in mean maximum temperature	Indirect	Financial loss Direct: Impacts of frequency and intensity of extreme temperature events results in increases in insurance premiums and public liability insurance premiums.	Process-oriented	Financial	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24
25	Air Temperature	Increase in mean maximum temperature	Direct	Infrastructure under-provision Direct: Increase in average temperatures, and specifically increases in number of days over 35 deg C results in day-to-day increased demand for relevant infrastructure to comfortably move people around SOP.	Integrated	Financial Infrastructure Social	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
26	Air Temperature	Increase in mean maximum temperature	Direct	Infrastructure degradation Direct: Increased frequency and intensity of heatwaves leads to degradation in infrastructure, including buildings, transport facilities, and landscaping.	Place-based	Financial Infrastructure	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
27	Air Temperature	Increase in mean maximum temperature	Direct	Worker and visitor health and wellbeing Direct: Increased frequency and intensity of extreme heat events will impact the health of on outdoor workers and visitors to SOP.	Integrated	Social Financial	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
28	Air Temperature	Increase in mean maximum temperature	Direct	Ecological function Direct: Combined with lower rainfall degrades ecological functioning in wetland areas, saltmarsh and other areas of high biodiversity value.	Integrated	Environmental Social	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
29	Air Temperature	Increase in mean maximum temperature	Direct	Ecological function Direct: Changes in long term climate (including sudden cold shock events) could force species migration, decline and/or loss.	Integrated	Environmental Social	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
30	Air Temperature	Increased annual mean temperature	Direct	Landscapes Direct: Combined with lower rainfall will result in the loss of many plant species from heat stress, and less vigorous growth of many of the survivors. Issues with management of pest plants and animals. Loss of landscape amenity.	Place-based	Financial Infrastructure Environmental	Moderate	Almost Certain	High - 20	Moderate	Almost Certain	High - 20
31	Air Temperature	Increased annual mean temperature	Indirect	Energy costs Indirect: Increase in average temperatures may lead to an increase in energy demand and associated utility costs.	Integrated	Financial Social	Major	Likely	Very High - 22	Major	Likely	Very High - 22
32	Air Temperature	Increased annual mean temperature	Direct	Threat to wildlife - reptiles Direct: Warmer temperature during egg incubation may impact on the breeding success of reptiles such as the long-necked turtles.	Integrated	Environmental	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
33	Air Temperature	Increased annual mean temperature	Direct	Threat to wildlife - invertebrates Direct: Warmer temperature will decrease survivorship of beneficial invertebrates and their functions of pollination and pest control.	Integrated	Environmental Social	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
34	Air Temperature	Increased annual mean temperature	Direct	Heat impacts on leachate Direct: Temperature changes in the air and soil makes contaminated lands more toxic, could increase/change leachate mitigation measures required.	Integrated	Governance Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
35	Air Temperature	Increase in mean maximum temperature	Direct	Network blackouts - leachate collection systems Direct: Failure of critical leachate collection and transfer infrastructure or communication infrastructure which may result in pollution incidents.	Integrated	Financial Infrastructure Environmental Social	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24
36	Air Temperature	Increased number of hot days over 35°C	Direct	Heat Islands Direct: Increases in number of days above 35°C may contribute towards urban heat island effects, leading to reduced comfort and negative health outcomes for building occupants and pedestrians.	Integrated	Financial Social	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24
37	Air Temperature	Increased number of hot days over 35°C	Direct	Thermal comfort Direct: HVAC system may experience overload, affecting thermal comfort for building occupants, and increasing HVAC maintenance and operating costs.	Integrated	Financial Infrastructure Social	Minor	Likely	Medium - 15	Moderate	Almost Certain	High - 20

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
38	Air Temperature	Increased number of hot days over 35°C	Direct	Network blackouts Direct: Frequent interruptions to mains power supply can lead to service interruption, power losses to infrastructure and buildings.	Place-based	Financial Infrastructure Social	Major	Possible	High - 18	Major	Likely	Very High - 22
39	Air Temperature	Increased number of hot days over 35°C	Direct	Ecological function Direct: Extreme temperature (high and low) can impact plant communities, including mangroves, by impairing flowering and fruiting success.	Integrated	Environmental	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
40	Air Temperature	Increased number of hot days over 35°C	Direct	Homeless and vulnerable people displacement Direct: Extreme heat affects people sleeping rough or otherwise seeking shelter in public realm.	Integrated	Social	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
41	Air Temperature	Increased number of hot days over 35°C	Direct	Threat to wildlife Direct: Increased hot days over 35°C leading to heat stress and death in sensitive animal species - particularly birds and bats.	Integrated	Environmental	Major	Possible	High - 18	Moderate	Likely	High - 19
42	Air Temperature	Increased number of hot days over 35°C	Direct	Localised significant impacts Direct: Extreme heat events lead to significant localised impacts across the site (e.g., Brick pit frog-breeding ponds).	Integrated	Environmental Infrastructure Social	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
43	Air Temperature	Increased event of extreme cold temperatures	Direct	Cool Islands - ecological impacts Direct: Extreme cold events or changes in frost patterns may result in loss of individual mangroves, changes in growth patterns or die-off events.	Place-based	Environmental	Major	Unlikely	Medium - 12	Major	Possible	High - 18
44	Air Temperature	Increased event of extreme cold temperatures	Direct	Cool Islands - infrastructure and social impacts Direct: Overshading from buildings and/or other structures may result in an increase in need for artificial/carbon-based heating inside buildings.	Place-based	Infrastructure Social Financial	Minor	Unlikely	Low - 06	Moderate	Possible	Medium - 14
45	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Flood immunity Direct: Greater frequency of higher intensity rainfall events may lead to changes in flood immunity levels.	Place-based	Financial Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22
46	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Building structures - floor levels and roof drainage Direct: Greater frequency of higher intensity rainfall events may lead to localised flooding, damage due to scour and less safe operating conditions.	Place-based	Financial Infrastructure	Major	Likely	Very High - 22	Major	Likely	Very High - 22

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
47	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Infrastructure - electrical Direct: Extreme rainfall events leading to flash flooding and inundation of electrical infrastructure, leading to power loss to the site.	Place-based	Financial Infrastructure Social	Major	Possible	High - 18	Major	Likely	Very High - 22
48	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Infrastructure - public realm Direct: Increase in the frequency and intensity of rainfall and storm events leads to infrastructure becoming isolated by flooding (e.g., rail and roads closed, walking/cycling paths blocked, public realm cut-off).	Integrated	Infrastructure Social	Major	Possible	High - 18	Major	Likely	Very High - 22
49	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Infrastructure - water and sewerage Direct: Increase in the frequency and intensity of rainfall events leads to deeper and more frequent flooding of water and sewage treatment systems.	Place-based	Infrastructure	Major	Unlikely	Medium - 12	Major	Possible	High - 18
50	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Infrastructure - leachate collection systems Inundation of electrical/control/monitoring equipment of leachate collection and transfer infrastructure: may cause failure of critical infrastructure which can result in a pollution incident.	Integrated	Financial Infrastructure Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
51	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Egress Direct: Greater frequency of higher intensity rainfall events may increase events that limit access and egress, resulting in tenants and residents being stranded at the development.	Place-based	Financial Social	Major	Likely	Very High - 22	Major	Likely	Very High - 22
52	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Civil drainage Direct: Greater frequency of higher intensity rainfall events may lead to inundation of drainage infrastructure because of insufficient system capacity, with resulting damage on site or adjacent, service disruption and safety risk. This includes extreme rainfall events and king tides.	Process-oriented	Financial Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22
53	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Stormwater systems Direct: Extreme rainfall levels could result in overwhelming stormwater systems, leading to potential damage. This includes litter boom/baskets and GPTs.	Integrated	Financial Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
54	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Remediated lands - leachate Direct: Greater frequency of higher intensity rainfall events may lead to on-site flash or localised flooding, resulting in loss of leachate from remediated land to the receiving environment.	Integrated	Financial Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22
55	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Landscapes - plants Direct: Greater frequency of higher intensity rainfall events may affect health of plants and lead to tree and tall plant instability due to saturated soils.	Place-based	Financial Infrastructure	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
56	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Landscapes - landscape infrastructure Direct: Greater frequency of higher intensity rainfall events may damage and degrade landscape infrastructure (e.g., Electrical systems).	Place-based	Financial Infrastructure	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
57	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Estuarine habitat – stormwater runoff Direct: Greater frequency of higher intensity rainfall events may affect water quality and salinity levels through increased stormwater runoff, compromising habitat quality for species resident in the Paramatta River.	Place-based	Social Environmental	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
58	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Freshwater habitat - pest species Direct: Increased frequency of flooding of wetlands leads to an increase in the of spread pests and introduced species, as well as habitat for mosquitos. In particular, the endangered green and golden bell frog and other fauna is impacted by the invasive pest fish gambusia, which is spread by flooding. Carp is also spread by flooding. Invasive weeds such as alligator weed are also a threat in flood waters.	Integrated	Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
59	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Freshwater and estuarine habitats - change in ecosystem composition Direct: Increased frequency of flooding events alters the species compositions of wetlands and estuarine ecosystems, increasing vegetation management load.	Integrated	Environmental Financial	Major	Possible	High - 18	Extreme	Likely	Very High - 23
60	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Financial Loss Direct: Impact of extreme rainfall/storm events resulting in less patronage, no shows or cancellation of scheduled events.	Integrated	Financial Infrastructure Social	Moderate	Likely	High - 19	Moderate	Likely	High - 19

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
61	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Financial Loss Direct: Impacts of frequency and intensity of extreme rainfall/storm events results in increases in insurance premiums and public liability insurance premiums.	Process-oriented	Financial	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24
62	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Erosion Direct: Increased frequency and severity of storm events can lead to flash flooding and erosion, as well as accumulation of sediment and debris at other locations.	Integrated	Environmental Infrastructure	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
63	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Erosion Direct: Increased frequency and severity of storm events can lead to strong currents through the Parramatta River and erosion.	Place-based	Environmental Infrastructure	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
64	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Heritage assets Direct: Greater frequency of higher intensity rainfall events will accelerate building fabric aging, increase likelihood of water damage from roof and wall leaks.	Place-based	Financial Infrastructure	Minor	Possible	Medium - 13	Moderate	Likely	High - 19
65	Precipitation	Greater frequency of higher intensity rainfall events	Direct	Localised flash flooding Direct: Greater frequency of higher intensity rainfall events leads to threat to life and damage to property at Lake Belvedere and Hill Road, as well as other specifically vulnerable sites.	Integrated	Financial Infrastructure Social	Major	Possible	High - 18	Major	Likely	Very High - 22
66	Precipitation	Increase in annual total rainfall	Direct	Infrastructure Direct: Annual average rainfall increases, resulting in undersized stormwater and rainwater capture infrastructure.	Place-based	Infrastructure	Moderate	Unlikely	Medium - 11	Major	Unlikely	Medium - 12
67	Drought	Decrease in annual total rainfall	Indirect	Landscapes Indirect: Decrease in annual total rainfall leading to a reduction in regional water storages and reduce water supplies making it difficult to water landscaping.	Place-based	Financial Environmental Social	Minor	Likely	Medium - 15	Minor	Almost Certain	Medium - 16

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
68	Drought	Decrease in annual total rainfall	Direct	Remediated soils - drying and movement Direct: Decrease in annual total rainfall leading to loss of vegetative cover, resulting in erosion of topsoils and potential cracking of clay capping, leading to movement and non-containment of contaminated soils. Could also lead to increased landfill gas coming to the surface, resulting in air pollution and creating poorer ground conditions that impact on reuse of areas.	Place-based	Financial Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
69	Drought	Decrease in annual total rainfall	Direct	Creek habitats Direct: Rainwater fed creeks dry up leading to disruptions of the local creek ecosystems.	Place-based	Environmental	Moderate	Possible	Medium - 14	Moderate	Possible	Medium - 14
70	Drought	Decrease in annual total rainfall	Indirect	Potable water availability - built form Indirect: Decrease in annual total rainfall may result in water restrictions prohibiting water use in heat rejection, irrigation, human consumption.	Process-oriented	Infrastructure	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
71	Drought	Decrease in annual total rainfall	Indirect	Potable water availability - leachate systems Direct: Decrease in annual total rainfall may result in less stormwater availability for irrigation and dilution water for biological leachate treatment systems, leading to non-compliance with treatment criteria resulting in shutdown of treatment system and risking overflow and pollution events.	Process-oriented	Environmental Infrastructure Social	Major	Possible	High - 18	Major	Likely	Very High - 22
72	Drought	Decrease in annual total rainfall	Indirect	Potable water pricing Indirect: Decrease in annual total rainfall may result in water restrictions and pricing impacts on tenants, running costs of water-cooled systems for building owners.	Process-oriented	Financial Social	Minor	Likely	Medium - 15	Moderate	Likely	High - 19
73	Drought	Decrease in annual total rainfall	Direct	Wetland wildlife - loss of breeding and lifecycle supporting habitat Direct: Drought conditions reduce stormwater storage, leading to a loss of natural and irrigation water available for freshwater ecosystems (ponds, wetlands). This leads to a loss of habitat for amphibian, bird, and reptile species that rely on wetlands for key parts of their lifecycle, including the endangered green and golden bell frog and Latham's snipe.	Integrated	Environmental	Major	Possible	High - 18	Extreme	Likely	Very High - 23
74	Wind	Increased wind speeds	Direct	Debris Direct: Increasing wind speeds during extreme weather events may dislodge loose furniture or equipment (including vegetation) damaging exposed plant equipment and facades, people, private property, and/or making the public domain unsafe.	Integrated	Financial Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22
75	Wind	Increased wind speeds	Direct	Wind driven rain Direct: Increasing wind speeds coupled with greater frequency of higher intensity rainfall events may lead to wind driven rain flooding upper levels and penetrating facades.	Place-based	Financial Infrastructure	Moderate	Possible	Medium - 14	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
76	Wind	Increased wind speeds	Direct	Pedestrian and cyclist comfort and safety - wind tunnels Direct: Increasing wind speeds exacerbated by tall buildings and the Plaza may lead to wind tunnel conditions making the public realm uncomfortable, inaccessible, and potentially unsafe.	Place-based	Financial Social	Major	Unlikely	Medium - 12	Major	Possible	High - 18
77	Wind	Increased wind speeds	Direct	Electrical assets Direct: Wind damage to electrical circuitry (overhead wiring) may result in disruption to services and increase maintenance costs.	Process-oriented	Financial Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22
78	Wind	Increased wind speeds	Direct	Public realm assets - leachate systems Direct: Wind damage to antennas required for transmitting radio signals between landfill sites which can cause communication failures resulting in malfunctions and potentially pollution incidents.	Place-based	Financial Infrastructure Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
79	Wind	Increased wind speeds	Direct	Public realm assets Direct: Wind damage to shade structures, kiosks, and other items in the parks and public domain.	Place-based	Financial Infrastructure	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
80	Wind	Increased wind speeds	Direct	Landscape Direct: Wind damage to shade trees, including downed branches and whole trees.	Place-based	Financial Infrastructure	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
81	Extreme storms	Increase in frequency and severity of storms	Direct	Hailstorms Direct: Increase in extreme hailstorm events may damage to cladding, exposed plant and services, landscapes, entryways and horizontal/sloped glazing.	Integrated	Financial Infrastructure	Moderate	Almost Certain	High - 20	Major	Almost Certain	Very High - 24
82	Extreme storms	Increase in frequency and severity of storms	Direct	Dust storms Direct: Dust storms caused by a combination of drought, hot weather, and westerly wind. Increased risk of systems damage and occupant respiratory illness.	Integrated	Financial Social	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
83	Extreme storms	Increase in frequency and severity of storms	Direct	Windstorms/small tornadoes Direct: Increase in micro-burst windstorms small tornados, compromising life-safety of anyone in public realm and in buildings insufficiently resistant to extreme winds.	Integrated	Financial Infrastructure Social	Major	Possible	High - 18	Major	Likely	Very High - 22

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
84	Extreme storms	Increase in frequency and severity of storms	Direct	Windstorms/small tornadoes - leachate systems Direct: Damage to antennas required for transmitting radio signals between landfill sites which can cause communication failures resulting in malfunctions and potentially pollution incidents.	Integrated	Financial Infrastructure Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
85	Extreme storms	Increase in frequency and severity of storms	Indirect	Displacement Indirect: Increase in frequency and severity of storms may result in damage to properties, causing displacement and disruption of tenant / business activity during clean up and repair.	Process-oriented	Financial	Minor	Likely	Medium - 15	Moderate	Almost Certain	High - 20
86	Extreme storms	Increasing frequency of electrical storms and lightning strikes	Direct	Loss of communications - infrastructure and pollution Direct: Storms and wind cause decline in quality of radio communication between landfill sites. This can cause malfunctions of critical infrastructure which can result in a pollution incident.	Process-oriented	Infrastructure Financial Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
87	Extreme storms	Increasing frequency of electrical storms and lightning strikes	Direct	Lightning strike Direct: Increasing frequency of electrical storms and lightning strikes can damage building elements, public infrastructure, natural habitat (trees and mangroves) and electrical systems either directly or indirectly through fire.	Process-oriented	Financial Infrastructure Environmental	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
88	Extreme storms	Increasing frequency of electrical storms and lightning strikes	Direct	Lightning strike - leachate systems Direct: Increasing frequency of electrical storms and lightning strikes can damage leachate collection and transfer infrastructure which can cause system failure and pollution incidents.	Integrated	Financial Infrastructure Environmental Social	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24
89	Extreme storms	Increase in frequency and severity of storms	Direct	Homeless and vulnerable people displacement Direct: Severe storms affect people sleeping rough or otherwise seeking shelter in public realm.	Integrated	Social	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
90	Extreme storms	Changes to east coast cyclone patterns	Direct	Infrastructure damage Direct: Changing cyclone weather patterns bring tropical cyclones further down the east coast of Australia. Infrastructure not built to cyclone standards, with damage occurring during these events.	Integrated	Financial Infrastructure	Extreme	Unlikely	High - 17	Extreme	Possible	Very High - 21

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
91	Extreme storms	Changes to East Coast cyclone patterns	Direct	Risk to life Direct: Changing cyclone weather patterns bring tropical cyclones further down the east coast of Australia. Infrastructure not built to cyclone standards, resulting in risk to human life.	Integrated	Social	Extreme	Unlikely	High - 17	Extreme	Possible	Very High - 21
92	Humidity	Changes to relative humidity	Direct	Maintenance Direct: Build-up of mould and condensation leading to increased operations and maintenance requirements and costs, as well as poor health outcomes for residents.	Integrated	Financial Infrastructure Social	Minor	Likely	Medium - 15	Moderate	Almost Certain	High - 20
93	Humidity	Changes to relative humidity	Direct	Plant pollination and vigour Direct: Increases in humidity and unseasonal relative humidity can impair plant pollination time periods and extent, and vigour.	Integrated	Environmental Financial	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
94	Humidity	Changes to relative humidity	Direct	Heritage assets Direct: Accelerated building aging, build-up of mould and condensation leading to increased operations and maintenance requirements and costs.	Integrated	Financial Infrastructure	Minor	Likely	Medium - 15	Minor	Almost Certain	Medium - 16
95	Humidity	Changes to relative humidity	Direct	Deterioration Direct: Accelerated carbonation of concrete structures.	Process-oriented	Financial Infrastructure	Moderate	Possible	Medium - 14	Moderate	Possible	Medium - 14
96	Humidity	Changes to relative humidity	Direct	Thermal comfort Direct: Changes in relative humidity resulting in decreasing thermal comfort resulting in health impacts or decreased productivity.	Place-based	Financial Infrastructure Social	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
97	Humidity	Changes to relative humidity	Indirect	Pest species distribution Indirect: Changes in humidity may increase encroachment pest species, as well as increases in species breeding, causing damage to natural ecosystems.	Integrated	Financial Environmental Social	Minor	Unlikely	Low - 06	Moderate	Possible	Medium - 14
98	Humidity	Changes to relative humidity	Indirect	Disease transmission - waterborne diseases Indirect: Changes in humidity may increase the spread of waterborne diseases.	Process-oriented	Financial Environmental Social	Major	Unlikely	Medium - 12	Major	Possible	High - 18

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
99	Humidity	Changes to relative humidity	Indirect	Disease transmission - fungal diseases Indirect: Changes in humidity may increase the spread of fungal diseases that impact flora and fauna. Could disproportionately impact endangered species, particularly amphibians.	Process-oriented	Environmental	Major	Unlikely	Medium - 12	Extreme	Possible	Very High - 21
100	Humidity	Changes to relative humidity	Indirect	Energy costs Indirect: Increase in relative humidity may lead to an increase in energy demand and associated utility costs.	Place-based	Financial Infrastructure	Moderate	Possible	Medium - 14	Moderate	Possible	Medium - 14
101	Bushfire	Increase in risk of bushfires	Direct	Air quality Direct: Increase in number of severe fire weather risk days leading to exposure to smoke and particulate pollution for workers and visitors, that may cause respiratory distress, as well as reduced visibility.	Integrated	Social	Moderate	Almost Certain	High - 20	Moderate	Almost Certain	High - 20
102	Bushfire	Increase in risk of bushfires	Direct	Infrastructure damage Increased frequency and severity of bushfire events leads to increased incidence of blackouts due to electricity supply infrastructure damage. Public domain lighting and operational equipment is compromised.	Integrated	Financial Infrastructure Social	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
103	Bushfire	Increase in risk of bushfires	Direct	Ash and debris Direct: Airborne ash and debris from bushfires around Sydney could foul waterways, degrade landscape, impose maintenance burden on built environment.	Integrated	Financial Infrastructure Environmental	Minor	Likely	Medium - 15	Minor	Almost Certain	Medium - 16
104	Bushfire	Increase in risk of bushfires	Direct	Damage to electrical and control equipment - leachate systems Direct: Fire directly causes damage to electrical and control equipment of leachate collection and transfer infrastructure resulting in failures and malfunctions and potentially in pollution incidents.	Integrated	Financial Infrastructure Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
105	Bushfire	Increase in risk of bushfires	Direct	Trees as fire risk Direct: Tree species vulnerable to heat and drought, creating local fire hazard, damage to property and risk to life.	Integrated	Environmental Infrastructure	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24
106	Bushfire	Increase in risk of bushfires	Direct	Loss of ecosystem functioning, biodiversity loss and habitat availability Loss of ecosystem functioning, biodiversity, and habitat due to bushfire. This includes both natural areas and extending into the parklands and town centre.	Integrated	Environmental	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
107	Bushfire	Increase in risk of bushfires	Direct	Remediated lands - fire pollution Risk of more bushfire events increasing likelihood of fire breaking out over remediated or landfill areas, resulting in localised air pollution and/or risk to human health, including risk of explosion of landfill gas	Integrated	Environmental Social Financial	Major	Possible	High - 18	Major	Likely	Very High - 22
108	Bushfire	Increase in risk of bushfires	Direct	Soil health Direct: Soil microbe assemblages may be negatively impacted by fire, for example earthworm populations - which are natural bio-turbulators of soil.	Integrated	Environmental	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
109	Bushfire	Increase in risk of bushfires	Direct	Localised bushfire vulnerability Direct: Greater frequency of bushfires leads to threat to life and damage to property at Newington Forest and Woo-La-Ra, as well as other specifically vulnerable sites.	Integrated	Environmental Social Infrastructure Financial	Major	Possible	High - 18	Major	Likely	Very High - 22
110	Bushfire	Increase in risk of bushfires	Direct	Small vegetation as fire risk Direct: Understorey and ground cover planting and on rooftops vulnerable to heat and drought, creating local fire, damage to property and risk to life.	Integrated	Environmental Infrastructure	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24
111	Solar radiation	Increase in level of UV	Direct	Life cycle Direct: Increased levels of UV could contribute to the increased rate of photo-oxidation and result in a shorter expected life of materials, especially polymer-based products.	Process-oriented	Financial Infrastructure	Insignificant	Almost Certain	Medium - 10	Insignificant	Almost Certain	Medium - 10
112	Solar radiation	Increase in level of UV	Direct	Human health Direct: Increased levels of UV could contribute to increased skin damage and increased skin cancer risks for people in parks and public realm.	Integrated	Social	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
113	Waterway Health	Declining Waterway Health	Direct	Infrastructure Direct: The increasing extreme weather conditions over time, rainfall intensity, drought, rising temperature and UV radiation is likely to lead to declining waterway health and could result in the need to retrofit additional hydraulic or landscape infrastructure.	Process-oriented	Financial Infrastructure Environmental	Major	Possible	High - 18	Major	Likely	Very High - 22
114	Waterway Health	Declining Waterway Health	Direct	Infrastructure Direct: Declining waterway health could result in overwhelm of stormwater management infrastructure, including litter boom/baskets and GPTs.	Process-oriented	Financial Infrastructure Environmental	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
115	Waterway Health	Declining Waterway Health	Indirect	Discharge Licence Indirect: The increasing extreme weather conditions over time, rainfall intensity, drought, rising temperature and UV radiation is likely to lead to declining waterway health and could result in increasing and more stringent discharge obligations with greater operational cost implications.	Process-oriented	Financial Environmental	Moderate	Possible	Medium - 14	Moderate	Possible	Medium - 14
116	Soil	Soil health	Direct	Contaminated soils Direct: Contaminated/remediated soils could expose people to unhealthy chemicals, other dangers. Indirect: Contaminated/remediated soils could compromise built environment material integrity over time.	Integrated	Financial Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
117	Soil	Soil moisture Ground stability	Direct	Infrastructure and buildings Direct: Reduced soil moisture over time leading to movement and destabilisation of soils, putting buildings and infrastructure at risk of damage.	Place-based	Infrastructure	Major	Unlikely	Medium - 12	Major	Possible	High - 18

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
118	Soil	Soil moisture Ground stability	Direct	Infrastructure and buildings Direct: Increase in soil moisture over time leading to saturation of soils, putting buildings and infrastructure at risk of damage.	Place-based	Infrastructure	Major	Unlikely	Medium - 12	Major	Possible	High - 18
119	Soil	Ground stability	Direct	Infrastructure and buildings Direct: Decrease soil moisture leading to erosion of soils, putting buildings and infrastructure at risk of damage.	Place-based	Infrastructure	Major	Unlikely	Medium - 12	Major	Possible	High - 18
120	Soil	Ground stability	Direct	Infrastructure and buildings Direct: Remediated soils move/become unstable, resulting in damage to buildings and infrastructure.	Place-based	Infrastructure	Major	Possible	High - 18	Major	Possible	High - 18
121	Soil	Runoff	Direct	Environmental health Direct: Increase in soil moisture over time leading to saturation of soils, leading to excess runoff into waterways.	Place-based	Infrastructure Environment	Moderate	Unlikely	Medium - 11	Moderate	Possible	Medium - 14
122	Soil	Ground stability	Direct	Infrastructure and buildings Direct: Unplanned settling of remediated soils, leading to building and infrastructure damage.	Place-based	Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22
123	Soil	Groundwater level	Direct	Infrastructure and buildings Direct: Rising groundwater levels leading to building and infrastructure damage.	Place-based	Infrastructure	Major	Possible	High - 18	Major	Likely	Very High - 22
124	Soil	Groundwater level	Direct	Soil pollution Direct: Rising groundwater levels leading to loss of leachate from remediated landfills containment cell into surrounding soils.	Integrated	Environmental Social	Major	Possible	High - 18	Major	Likely	Very High - 22
125	Soil	Groundwater level	Direct	Infrastructure and buildings Direct: Reduced groundwater levels leading to soil movement and building and/or infrastructure damage.	Place-based	Infrastructure	Major	Unlikely	Medium - 12	Major	Possible	High - 18
126	pH	Soil pH	Direct	Flora species Soil pH changes result in some plant species' growth habits being impacted negatively, leading to losses in landscaping and natural ecosystems.	Integrated	Environment	Minor	Unlikely	Low - 06	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
127	pH	Freshwater pH	Direct	Ecosystems Direct: Water pH changes result in some aquatic species' habitat being impacted negatively, as well as algal blooms, leading to losses in biodiversity.	Integrated	Environment Social	Moderate	Unlikely	Medium - 11	Major	Possible	High - 18
128	Evapotranspiration	Increased evapotranspiration	Indirect	Water shortages Indirect/direct: Increased evapotranspiration may result in reduced groundwater recharge and surface water outflows into dams, resulting in water shortages.	Integrated	Social Financial	Moderate	Unlikely	Medium - 11	Moderate	Possible	Medium - 14
129	Evapotranspiration	Increased evapotranspiration	Direct	Impairment of bioretention Direct: Extreme evapotranspiration impairs the bioretention systems that serve the purpose of WSUD balance.	Integrated	Environmental	Moderate	Unlikely	Medium - 11	Moderate	Possible	Medium - 14
130	Fog	Increased frequency fog events	Indirect	Interruptions to transport operations Indirect: An increase in major fog events leads to interruptions in public transport operations, leading to lack of access to the site by commuters, visitors and event patrons.	Process-oriented	Social Financial	Minor	Unlikely	Low - 06	Minor	Possible	Medium - 13
131	Fog	Increased frequency fog events	Direct	Impaired plant pollination and fertilisation Direct: An increase in major fog events leads to impairment of plant pollination and natural fertilisation, especially in case of mangroves that are impacted by frost associated with fog.	Integrated	Environmental	Moderate	Unlikely	Medium - 11	Major	Possible	High - 18
132	Seismicity	Earthquake	Direct	Shaking Direct: Shaking and ground rupture resulting in damage to or collapse of buildings and other rigid structure.	Integrated	Financial Infrastructure Social Economy	Extreme	Unlikely	High - 17	Extreme	Possible	Very High - 21
133	Seismicity	Earthquake	Direct	Remediated soils - movement Direct: Shaking and ground rupture resulting in movement of remediated/polluted soils resulting in loss of containment of contaminated soils.	Integrated	Financial Infrastructure Social Economy	Extreme	Unlikely	High - 17	Extreme	Possible	Very High - 21
134	Seismicity	Earthquake	Direct	Liquefaction Direct: Shaking of water-saturated granular material (such as reclaimed land) temporarily loses its strength and transforms from a solid to a liquid causing buildings and rigid structures to tilt or sink into the liquified deposits.	Integrated	Financial Infrastructure Social Economy	Extreme	Unlikely	High - 17	Extreme	Possible	Very High - 21
135	Seismicity	Earthquake	Direct	Collapse of waste containment systems Direct: Shaking of land leads to the collapse of waste containment systems and infrastructure.	Integrated	Financial Infrastructure Social Environmental	Extreme	Unlikely	High - 17	Extreme	Possible	Very High - 21
136	Seismicity	Tsunami	Direct	Tidal wave Direct: Tidal wave damages floating structures, buildings, rigid structures, and landscapes either directly through the force of the wave, or indirectly through debris or erosion.	Integrated	Financial Infrastructure Social Economy	Extreme	Unlikely	High - 17	Extreme	Possible	Very High - 21
137	Seismicity	Tsunami	Direct	Remediated and contaminated soils - inundation Direct: Tidal wave inundated remediated and contaminated soils leading to soil and water pollution.	Integrated	Financial Social Environment	Extreme	Unlikely	High - 17	Extreme	Possible	Very High - 21

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
138	Seismicity	Tsunami	Direct	Strong currents Direct: Currents significantly stronger than normal lead to increased erosion of sea walls, and cause impact damage to ferries, cruise ships, and another watercraft.	Integrated	Financial Infrastructure Social Economy	Major	Possible	High - 18	Major	Likely	Very High - 22
139	Civil Disturbance	Shocks identified by Resilient Sydney	Direct	Terror attack - physical damage Direct: Physical damage to buildings and infrastructure from targeted blasts or explosions.	Integrated	Financial Infrastructure Social Economy	Extreme	Unlikely	High - 17	Extreme	Unlikely	High - 17
140	Civil Disturbance	Shocks identified by Resilient Sydney	Direct	Terror attack - pathological damage Direct: Potential public health effects from chemical or other biological attack requiring isolation, quarantine, decontamination.	Integrated	Financial Infrastructure Social Economy	Extreme	Unlikely	High - 17	Extreme	Unlikely	High - 17
141	Civil Disturbance	Shocks identified by Resilient Sydney	Direct	Civil unrest Direct: Localised effects of lawlessness around the asset leading to the need to temporarily shelter in place for building occupants and business interruption to tenants.	Integrated	Financial Infrastructure Social Economy	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
142	Civil Disturbance	Shocks identified by Resilient Sydney	Direct	Cyber attack Direct: Data connections to the asset or tenant become compromised and may lead to Building Control Management System being compromised and interrupting business operations.	Process-oriented	Financial Infrastructure Economy	Major	Unlikely	Medium - 12	Major	Unlikely	Medium - 12
143	Civil Disturbance	Stressors identified by Resilient Sydney	Direct	Disease pandemic Direct: Interruptions to use of commercial offices during public health movement controls affecting business continuity leading to inefficient building operations at part loads and low occupancy.	Integrated	Financial Social Economy	Major	Likely	Very High - 22	Major	Almost Certain	Very High - 24
144	Civil Disturbance	Stressors identified by Resilient Sydney	Indirect	Diminishing community cohesion Indirect: People more at risk when they don't know each other.	Integrated	Social	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
145	Civil Disturbance	Stressors identified by Resilient Sydney	Indirect	Financial crisis Indirect: Local or global economic disturbance can lead to negative effects on asset value and utility and becoming stranded.	Integrated	Financial Social Economy	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
146	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Direct	Digital network outages Direct: As business and social models shift, the reliance on internet infrastructure for work and social communication will increase. Failure of this network could result in stranded residents.	Integrated	Infrastructure Social	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
147	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Direct	Waste Direct: Critical infrastructure to deal with residential waste when the municipal garbage trucks fail to collect them on schedule.	Integrated	Infrastructure Financial Social	Minor	Likely	Medium - 15	Moderate	Likely	High - 19
148	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Direct	Electrical network outages Direct: As utility transitions to a smart grid and away from baseload coal and gas generation more grid instability is likely in the short to medium term as involuntary load shedding occurs over peak days.	Integrated	Financial Infrastructure Economy	Major	Possible	High - 18	Major	Likely	Very High - 22
149	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Direct	Water quality Direct: Drinking water quality can be affected by periods of low rain or bushfire smoke and runoff into dams leading to 'boil water' alerts to prevent water borne infections.	Integrated	Financial Social	Moderate	Likely	High - 19	Moderate	Likely	High - 19
150	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Direct	Transport network failures Direct: Road and/or public transport services are interrupted leading to commuters being stranded.	Place-based	Financial Infrastructure Economy	Minor	Almost Certain	Medium - 16	Minor	Almost Certain	Medium - 16
151	Critical Infrastructure Failure	Additional acute shocks	Direct	Logistics failure Direct: Closure of loading docks and access roads limiting supply of goods and services to public and private tenants and users.	Integrated	Financial Economy Social	Major	Possible	High - 18	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
152	Critical Infrastructure Failure	Additional acute shocks	Direct	Development volume - major services Direct: A high volume of development in a short period of time leads to pressures on major service infrastructure and provision.	Integrated	Infrastructure Social	Moderate	Likely	High - 19	Moderate	Likely	High - 19
153	Critical Infrastructure Failure	Additional acute shocks	Direct	Development volume - transport infrastructure Direct: A high volume of development in a short period of time leads to pressures on transport infrastructure, leading to advanced depreciation.	Integrated	Infrastructure Social	Major	Possible	High - 18	Major	Possible	High - 18
154	Critical Infrastructure Failure	Additional acute shocks	Direct	Development volume - drainage system and waterways Direct: A high volume of development in a short period of time leads to pressures on drainage systems and waterways.	Integrated	Infrastructure Social	Major	Possible	High - 18	Major	Possible	High - 18
155	Critical Infrastructure Failure	Additional acute shocks	Direct	Loss of telecommunications Direct: Loss of telecommunications from any shock and/or stress leads to business losses, impacts on security, and social stress.	Integrated	Financial Social Economy	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19
156	Critical Infrastructure Failure	Additional acute shocks	Direct	Delivery delays Direct: Delays in infrastructure delivery resulting from any shock and/or stress leading to impact on quality of life, and overuse of existing assets. This in turn leads to expedited deterioration of existing assets.	Process-oriented	Financial Infrastructure Social	Major	Possible	High - 18	Major	Possible	High - 18
157	Critical Infrastructure Failure	Additional acute shocks	Direct	Stormwater system failure Direct: localised flooding resulting from failing stormwater infrastructure.	Place-based	Financial Infrastructure Economy	Moderate	Unlikely	Medium - 11	Moderate	Possible	Medium - 14
158	Critical Infrastructure Failure	Additional acute shocks	Direct	Inability to secure infrastructure funding Direct: Being unable to secure funding to build infrastructure that is responsive to climate and resiliency risk mitigation measures results in a lack of implementation. During development and construction, project leads being unable to secure funding. This leads to all risks in this risk assessment being amplified.	Process-oriented	Financial Infrastructure Social Environmental	Extreme	Possible	Very High - 21	Extreme	Possible	Very High - 21
159	Critical Infrastructure Failure	Additional acute shocks	Direct	Sewer system failure Direct: Public health compromised by failure of sewer system to remove waste, or failure of water supply system to provide water to remove waste.	Place-based	Financial Infrastructure Economy	Moderate	Rare	Low - 04	Moderate	Rare	Low - 04
160	Shift in Business Models	Shocks identified by Resilient Sydney	Indirect	Shift in mobility systems Indirect: Electrification of personal transport results in large shift demand profiles on electricity grid.	Integrated	Financial Infrastructure	Major	Possible	High - 18	Major	Almost Certain	Very High - 24

Risk ID	Element	Variable	Exposure	Potential Impact	Response required	Key Criteria (AS 5334)	2040			2090		
							Consequence	Likelihood	Initial Risk	Consequence	Likelihood	Initial Risk
161	Shift in Business Models	Stressors related to social changes	Indirect	Changing demographics Indirect: Changes in expected or projected demographics for the precinct, city or region result in shift in demand for public space and amenity type.	Integrated	Financial Economy Social	Minor	Likely	Medium - 15	Minor	Likely	Medium - 15
162	Shift in Business Models	Stressors related to social changes	Indirect	Changing demographics Indirect: Changes in expected or projected demographics for the precinct, city or region result in shift in job market and programmatic needs.	Integrated	Financial Infrastructure Social	Moderate	Likely	High - 19	Moderate	Likely	High - 19
163	Shift in Business Models	Stressors related to social changes	Indirect	Shift in workplace needs Indirect: Long term changes in business models and operations leads to major changes in workplace requirements and buildings requiring substantial retrofits to be fit for purpose.	Place-based	Financial Infrastructure Social	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
164	Shift in Business Models	Stressors related to social changes	Indirect	Ageing population Indirect: Ageing population leads to increasing demand for healthcare and allied wellbeing services along with potential reductions in workforce.	Place-based	Financial Economy Social	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
165	Shift in Business Models	Stressors related to governance changes	Indirect	Carbon pricing Indirect: The introduction of carbon pricing for business operations leads to elevated operational costs for businesses who may seek alternative accommodation with reduced carbon footprints.	Process-oriented	Financial Economy Social	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
166	Shift in Business Models	Stressors related to social changes	Indirect	Increased demand for low carbon living Consumer preferences shift towards low carbon living.	Process-oriented	Financial Economy Social	Moderate	Likely	High - 19	Moderate	Almost Certain	High - 20
167	Shift in Business Models	Stressors related to social changes	Indirect	Changing residential models Indirect: Shifts in demand for housing types leads to increased vacancies and stranded assets.	Process-oriented	Financial Economy Social	Moderate	Possible	Medium - 14	Major	Likely	Very High - 22
168	Shift in Business Models	Stressors related to economic changes	Indirect	Lack of infrastructure provision capacity Indirect: Developers don't have the capacity or ability to meet the requirements set out by SOPA to mitigate and manage the impacts of climate and resiliency risks. This results in provision of lower quality infrastructure with limited adaptive capacity,	Process-oriented	Financial Infrastructure Social Environmental	Extreme	Possible	Very High - 21	Extreme	Possible	Very High - 21

FIGURE 5.3: SYDNEY OLYMPIC PARK CLIMATE RISK ASSESSMENT

169	Shift in Business Models	Stressor identified by DPE	Indirect	Lack of resourcing post climate change-driven events Physical impacts from climate change-driven events add to the resourcing recovery requirements (financial and human) pressures for DPE to deliver on core objectives.	Process-oriented	Financial Infrastructure Social Environmental	Major	Possible	High - 18	Extreme	Possible	Very High - 21
170	Shift in Business Models	Stressor identified by DPE	Indirect	DPE Planning Frameworks do not keep pace with the required sustainability, adaptation and mitigation actions for both Government and State-owned corporations Indirect: The increasing intensity and frequency of climate change driven events overtakes the currency and effectiveness of DPE Planning Frameworks	Process-oriented	Governance Environmental	Moderate	Possible	Medium -14	Moderate	Possible	Medium -14
171	Shift in Business Models	Stressor identified by DPE	Direct	DPE does not anticipate or adapt to the expected demand for relocated, social housing in climate-resilient locations Changes to the frequency and intensity of natural disasters causes loss of habitable land resulting in increased demand for climate-resilient locations	Integrated	Financial Infrastructure Social Environmental Governance	Moderate	Unlikely	Medium - 11	Major	Unlikely	Medium - 12
172	Shift in Business Models	Stressor identified by DPE	Indirect	Net Zero - Non-compliance Environmental regulation required for net-zero increases tension between landholders and regulatory staff leading to greater non-compliance	Process-oriented	Governance Environmental Social Infrastructure	Moderate	Likely	High - 19	Moderate	Possible	Medium - 14
173	Shift in Business Models	Stressor identified by DPE	Indirect	Net Zero - Legislative Changes Legislative changes to support net-zero targets result in private sector revenue loss or costs and compensation is sort via the courts.	Process-oriented	Governance Social	Minor	Unlikely	Low-06	Minor	Possible	Medium-13
174	Shift in Business Models	Stressor identified by DPE	Indirect	Insufficient staff capability Insufficient staff capability and expertise to meet DPE climate change challenges and evidence collection due to Inaccurate workforce forecasting and planning	Process-oriented	Governance	Moderate	Likely	High - 19	Moderate	Likely	High - 19
175	Shift in Business Models	Stressor identified by DPE	Indirect	Absence of First Nations culture Inadequate engagement with first nations peoples for adaptation planning to ensure cultural aspects are considered in climate mitigation	Process-oriented	Governance Social	Minor	Possible	Medium-13	Minor	Possible	Medium-13
176	Shift in Business Models	Stressor identified by DPE	Indirect	Delays of NSW program outcomes Delays in DPE's NSW government state significant program outcomes due to the increasing frequency and severity of climate-driven events. <i>(potential change) Increasing frequency and severity of climate-driven events disrupts DPE's NSW Government State Significant Program outcomes</i>	Process-oriented	Governance	Major	Likely	Very High-22	Major	Likely	Very High-22
177	Shift in Business Models	Stressor identified by DPE	Direct	Failure of mitigation and adaptation measures Mitigation and adaptation measures are inadequate, uncoordinated, and lack the agility to respond to the impacts of extreme climate events resulting in the failure to deliver on DPE state outcomes & premier priorities	Integrated	Governance Environmental	Extreme	Likely	Very High-23	Extreme	Possible	Very High-21

178	Shift in Business Models	Stressor identified by DPE	Direct	DPE Program volunteers Decrease in DPE program volunteer numbers to support heritage, conservation and research programs due to the increasing number and severity of climate change events	Process-oriented	Governance Environmental Social	Minor	Possible	Medium-13	Minor	Possible	Medium-13
179	Shift in Business Models	Stressor identified by DPE	Indirect	Legal Liability Increasing class actions and other legal liability issues due to failure to consider climate risk in current/future planning decisions	Process-oriented	Governance Social	Minor	Possible	Medium-13	Minor	Likely	Medium-15
180	Shift in Business Models	Stressor identified by DPE	Direct	Water Security Insufficient water security for NSW due to unavailability of water or allocation and planning decisions, inadequate infrastructure, and the potential of being impacted by climate variability.	Integrated	Governance Environmental Infrastructure	Extreme	Possible	Very High -21	Extreme	Likely	Very High -23
181	Shift in Business Models	Stressor identified by DPE	Indirect	Insurance TMF premium increases impact costs and viability of ongoing insurance for DPE assets.	Process-oriented	Governance Social Financial	Minor	Possible	Medium-13	Minor	Possible	Medium-13
182	Shift in Business Models	Stressor identified by DPE	Indirect	Asset write-downs Unplanned asset write-downs of existing assets or asset life cycles diminished, and increased maintenance requirements driven by climate change impacts	Process-oriented	Governance Infrastructure Financial	Moderate	Possible	Medium-14	Moderate	Possible	Medium-14
183	Shift in Business Models	Stressor identified by DPE	Direct	Extreme Heat for DPE staff Increasing extreme heat days and heatwaves leading to more heat stress/solar exposure for outdoor DPE staff and public	Place-based	Environmental Social	Moderate	Possible	Medium-15	Major	Likely	Very High -22
184	Social Stressors	Stressors related to development	Direct	Development volume - traffic Direct: A high volume of development in a short period of time leads to significant impacts on traffic and accessibility leading to pressures on existing infrastructure and resident frustrations.	Integrated	Infrastructure Social	Minor	Almost Certain	Medium - 16	Minor	Almost Certain	Medium - 16
185	Social Stressors	Stressors related to social changes	Indirect	Development volume - health and environment Direct: A high volume of development in a short period of time leads to extended periods of time where environmental impacts are experienced including excessive noise and dust, leading to negative impacts on human and ecosystem health.	Process-oriented	Social Environmental	Moderate	Almost Certain	High - 20	Moderate	Almost Certain	High - 20

186	Social Stressors	Stressors related to social changes	Indirect	Changing political environment Indirect: Political extremism, or unstable governments, could compromise project delivery or operations.	Process-oriented	Financial Economy Social	Minor	Unlikely	Low - 06	Minor	Possible	Medium - 13
187	Social Stressors	Stressors related to social changes	Indirect	Increasing inequality Indirect: Increasing economic inequality leads to reciprocal problems of increased vacancy rates and crime.	Integrated	Financial Economy Social	Moderate	Likely	High - 19	Moderate	Likely	High - 19
188	Social Stressors	Stressors related to social changes	Indirect	Housing affordability Indirect: Decreasing housing affordability leads to increased vacancy rates for residential buildings and population shift to other cities.	Integrated	Financial Economy Social	Major	Likely	Very High - 22	Major	Likely	Very High - 22
189	Social Stressors	Stressors related to social changes	Indirect	War Indirect: Conflict directly or indirectly involving the region or population which has a consequential effect on potential precinct use.	Integrated	Financial Economy Social	Major	Likely	Very High - 22	Major	Likely	Very High - 22
190	Social Stressors	Stressors related to social changes	Direct	Mass care facility SOPA fails to prepare for role in MOU for Sydney Mass Care Facility at SOP, resulting in reputational damage to SOPA.	Integrated	Adaptive Capacity Financial	Moderate	Possible	Medium - 14	Major	Possible	High - 18
191	Social Stressors	Stressors related to social changes	Indirect	Homelessness Indirect: Increasing homelessness results in reduced demand for residential programs, and increasing pressure on public domain services.	Place-based	Financial Infrastructure Social	Minor	Likely	Medium - 15	Minor	Likely	Medium - 15
192	Social Stressors	Stressors related to social changes	Indirect	Economic collapse Indirect: Global or National financial and economic downturn leads to increased vacancy rates from reduced capital inflows. Organisation collapse of bespoke third-party service providers.	Integrated	Financial Economy Social	Major	Likely	Very High - 22	Major	Likely	Very High - 22
193	Social Stressors	Stressors related to social changes	Indirect	Financial collapse Indirect: Organisational collapse of bespoke third-party service provider leaves precinct without critical service(s), and additional pressure on public services to fill the gap.	Integrated	Financial Infrastructure Economy	Moderate	Possible	Medium - 14	Moderate	Likely	High - 19

6.0 Adaptation plan

6.1 Approach

The following Adaptation Plan is the result of focused workshops and ongoing work throughout the master plan phase. During the workshops participants developed a list of adaptation measures incumbent in the current design and operations, as well as potential future initiatives. Potential future adaptation measures took two forms:

1. Potential additional design approaches for exploration throughout the detailed design phase of the Sydney Olympic Park 2050 Master Plan; and
2. Operational responses for consideration either now, or at later stages, that warrant remaining on the table for subsequent revisions.

Adaptation measures were proposed for all potential impacts regardless of risk level and range from minor additions to the existing design, to major amendments. At this time a reassessment of the 2040 consequences and likelihood took place with a view to reducing the overall risk rating. The expectation being that a reduction in the 2040 risk level would also result in a reduction in the 2090 risk level.

All 178 potential risks identified for the year 2040 in the risk assessment component of the Climate Adaptation Plan have been addressed by incumbent and potential design and operational adaptation measures to reduce the likelihood of that event occurring. All 18 'very high' risks have been mitigated, but 22 'high risks' remain. Most (145) risks are now considered medium, and 11 are low.

It is important to note that, if potential design and operational initiatives are not implemented as per the risk assessment table, then the 2040 risks will be higher than estimated in the table below.

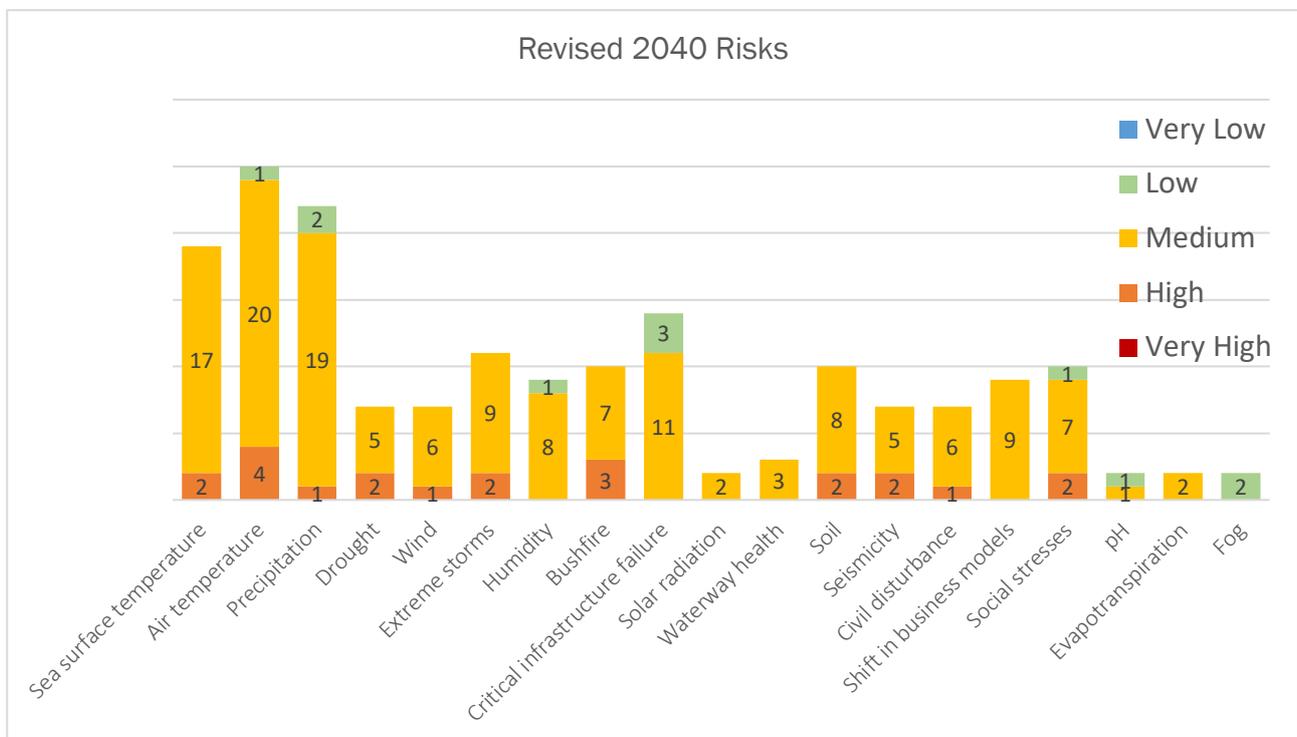


FIGURE 6.1: REVISED 2040 CLIMATE RISKS FOR SYDNEY OLYMPIC PARK

6.2 Adaptation measures and reassessed risk

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
1	Sea surface temperature	Increase in sea level Storm surge/storm tide	Inundation - flood damage Direct: Potential for inundation of infrastructure during storms resulting in flood damage and safety risk from backed up overland flow.	- WSUD principles in master plan to assist natural water flows.	- The development should be designed around RCP 8.5 future sea levels. - Drainage systems designed to take into account future sea level rise. - Street levels and building thresholds design to RCP 8.5 sea level rise projections. - Green space design considers natural overland flows and incorporate nature based solutions into landscape design. - Use smart technology to monitor water levels.	Sydney Olympic Park Authority Flood Modeller Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
2	Sea surface temperature	Increase in sea level Storm surge/storm tide	Inundation - estuarine habitat Direct: Sea level and high tides increase in height, impacting sensitive mangrove and estuarine ecosystem balance and resulting in a loss of land area.	- SOPA have an environmental program and management team that exists to protect and monitor ecosystems.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future sea level rise impacts. - Provision of habitat within urban footprint. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
3	Sea surface temperature	Increase in sea level	Inundation - ecosystem movement Direct: Inundation will force species/communities to move inland/upslope where in most cases there is no capacity due to development.	- SOPA have a an environmental program and management team that exists to protect and monitor ecosystems.	- Setting aside areas in the development for vegetation migration. - Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of a ecosystem management plan that considers future sea level rise impacts. - Provision of habitat within urban footprint. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Landscape Achitect Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
4	Sea surface temperature	Increase in sea level	Inundation - loss of ecosystem services Direct: Sea level rise and inundation leads to a loss of species and communities along with their contribution to protecting and stabilising the shoreline from erosion and filtering pollutants/sediment from the water that flows through them.	- SOPA have a an environmental program and management team that exists to protect and monitor ecosystems.	- Ensure plant species selection is salt tolerant, and is able to assist with stabilisation of river banks. - Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of a ecosystem management plan that considers future sea level rise impacts.	Sydney Olympic Park Authority Landscape Achitect Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
5	Sea surface temperature	Increase in sea level	Inundation - disease Direct: Backed up overland flow from inundation events, as well as inundation of new areas, increases mosquito habitat and risk of mosquito borne illness.	- Mosquito Management Program and spraying. - Improvements to tidal flushing system to discourage mosquito breeding. - WSUD principles embedded into master plan design (which may also increase mosquito risk in certain areas).	- Flood modelling to take into account RCP 8.5 future sea level and inundation risk. - Design of development to allow for water to flow off the site and not pool. - Community awareness programs for mosquito-related illnesses.	Sydney Olympic Park Authority Flood Modeller Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
6	Sea surface temperature	Increase in sea level	Inundation - remediated lands Direct: Sea level rise could lead to saltwater intrusion into leachate infrastructure of remediated lands especially pump pits PP21 (Wilson Park - the most vulnerable across SOPA site), PP24 (Wilson Park), PP20 (Blaxland Common), then PP19 the PP18 (Woola-ra) - resulting in damages to pumps and compliance breaches.		- Flood modelling should be conducted to take into account RCP 8.5 future sea level and should inform specialist management plans for remediated/contaminated lands. - Regular monitoring of contaminated/remediated lands for leachate. - Use of monitoring equipment to monitor sea level, ground water salinity and ground water levels. - Equipment (pumps etc) should be designed to withstand future sea level rise under an RCP 8.5 scenario.	Sydney Olympic Park Authority Environmental Engineer Flood Modeller Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12
7	Sea surface temperature	Increase in sea level	Inundation - stormwater systems Direct: Higher sea levels could lead to deeper and more frequent flooding of water and sewage infrastructure and surcharging of trunk stormwater systems.	- WSUD principles in master plan to assist natural water flows.	- Sewage infrastructure should be designed to withstand sea level rise and flooding under an RCP 8.5 scenario. - Develop a site-wide Integrated Water Management Plan.	Stormwater Consultant Flood Modeller Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Moderate	Unlikely	Medium - 11
8	Sea surface temperature	Increase in sea level	Inundation - liveability and access Direct: Projected sea level rise could cause impacts on liveability and access to residential areas of SOP.	- WSUD principles in master plan to assist natural water flows.	- Public realm and community infrastructure design should be based on flood modelling under an RCP 8.5 scenario.	Stormwater Consultant Flood Modeller Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Moderate	Possible	Medium - 14
9	Sea surface temperature	Increase in sea level	Inundation - erosion Direct: Sea level rise leads to inundation of areas alongside waterways, resulting in increased erosion.		- Ensure plant species is able to assist with stabilisation of river banks. - Tree planting programs along waterways. - The design of the master plan should take into account future sea level rises and erosion patterns. - Conduct a Waterway Erosion Study.	Sydney Olympic Park Authority Stormwater Consultant Flood Modeller Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
10	Sea surface temperature	Increase in sea level	Inundation - topsoil and vegetation Direct: Sea level rise and king tides lead to topsoil and vegetation loss through currents and movement.	- WSUD principles in master plan to assist natural water flows.	- Ensure plant species is able to assist with stabilisation of river banks. - Tree planting programs along waterways. - The design of the master plan should take into account future sea level rises and erosion patterns. - Develop a Landscape Management Plan that takes into account landscape needs for topsoil.	Sydney Olympic Park Authority Stormwater Consultant Flood Modeller Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
11	Sea surface temperature	Increase in sea level	Inundation - leachate collection infrastructure Direct: Inundation of electrical, control, and monitoring equipment of leachate collection and transfer infrastructure, leading to failure of critical infrastructure which can result in a pollution incident.		- Flood modelling should be conducted to take into account RCP 8.5 future sea level and should inform specialist management plans for remediated/contaminated lands. - Ensure that electrical, control and monitoring equipment is located above expected flood levels under an RCP 8.5 scenario. - Regular monitoring of contaminated/remediated lands for leachate. - Use of monitoring equipment to monitor sea level, ground water salinity and ground water levels. - Equipment (pumps etc) should be designed to withstand future sea level rise under an RCP 8.5 scenario.	Environmental Engineer Electrical Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
12	Sea surface temperature	Increase in sea level	Inundation - leachate generation Direct: Increase in leachate generation and extraction due to higher volumes and higher salt concentrations may cause reduction of treatment performance of biological leachate treatment systems, resulting in non-compliance with EPL10243.		<ul style="list-style-type: none"> - Flood modelling should be conducted to take into account RCP 8.5 future sea level and should inform specialist management plans for remediated/contaminated lands. - Ensure that electrical, control and monitoring equipment is located above expected flood levels under an RCP 8.5 scenario. - Regular monitoring of contaminated/remediated lands for leachate. - Use of monitoring equipment to monitor sea level, ground water salinity and ground water levels. - Equipment (pumps etc) should be designed to withstand future sea level rise under an RCP 8.5 scenario. 	Environmental Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Possible	High - 18
13	Sea surface temperature	Increase in sea level	Inundation - debris Direct: Sea level rise and king tides lead to waste and debris washing through/onto the site from waterways. Larger debris can lead to damage to property and infrastructure.	- WSUD principles in master plan to assist natural water flows.	<ul style="list-style-type: none"> - Flood modelling should be based on an RCP 8.5 scenario, and the design of the project should include features to reduce flooding risks.- Increase protective nature-based solutions infrastructure along vulnerable areas. 	Stormwater Consultant Flood Modeller Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Moderate	Possible	Medium - 14
14	Sea surface temperature	Increase in sea level	Saltwater intrusion Direct: Saltwater intrusion disproportionately impacts some areas of the project (eg. Leachate collection systems, Bennelong Parkway).		<ul style="list-style-type: none"> - Conduct site-wide vulnerability mapping in line with sea level rises expected under a RCP 8.5 scenario to identify high risk areas. - Develop specific design responses and risk management plans for high risk areas. 	Sydney Olympic Park Authority Flood Modeller	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
15	Sea surface temperature	Increase in sea level	Intrusion - landscaping Direct: Saltwater intrusion, contaminating water sources including stormwater harvested for irrigation, as well as groundwater resources, impacting ability to irrigate gardens.	- WSUD principles help to maintain moisture in gardens.	- Conduct modelling under an RCP 8.5 scenario to determine risk to particular freshwater sources within the development. - Ensure that backup irrigation sources are available where current sources are expected to fail. - Select salt tolerant plant species. - Collect rainwater for irrigation purposes.	Flood Modeller Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Moderate	Possible	Medium - 14
16	Sea surface temperature	Increase in sea level	Intrusion - building degradation Direct: Saltwater intrusion, contaminating water sources, leading to the degradation of building materials (e.g. foundations).		- Conduct modelling under an RCP 8.5 scenario to determine risk to particular freshwater sources within the development. - Include requirements for structures to be protected from salt water intrusion in building design guidelines. - Monitoring equipment to detect saltwater intrusion.	Sydney Olympic Park Authority Flood Modeller Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Major	Unlikely	Medium - 12
17	Sea surface temperature	Increase in water temperature	Warming water - habitat Direct: increase in water temperature degrades habitat quality for estuarine life currently resident in the Parramatta River, resulting in species losses and migration.	- An environmental program exists to protect and monitor ecosystems at Sydney Olympic Park.	- Ecosystem assessment to establish presence of at-risk species.- Creation of habitat structures to allow animals to shift habitats into cooler areas.- Inclusion of logs and other in-water shade structures for animals to seek shelter.- Ecosystem assessment to establish presence of at-risk species.- Active management of at risk species.	Sydney Olympic Park Authority Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Likely	High - 19

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
18	Sea surface temperature	Increase in water temperature	Warming water Direct: Increase in water temperature may cause algal blooms and resultant consequences on human health (toxicity), aesthetics, and ecological health. It may also impair habitat and food sources for migratory shorebirds.	- Water quality monitoring is conducted at Sydney Olympic Park.	- Develop an environmental management plan for algal bloom events that takes into account future climate projections (RCP 8.5).	Ecologist Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
19	Sea surface temperature	Increase in adjacent air temperature and humidity	Warming water Direct: warmer water increases nearby air temperature and humidity	- Increased tree canopy cover in the public realm will help reduce temperatures/increase comfort.	- Design building HVAC systems to control humidity levels. - Set green space and tree canopy cover targets for the public realm. - Provide shade structures in public domain. - Provide fans in outdoor public realm respite areas.	Electrical Engineer Architect Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Minor	Likely	Medium - 15
20	Air Temperature	Increase in mean maximum temperature	Electrical assets - power supply on site Direct: Extended high temperatures may have an adverse impact on the operation of some electrical equipment, such as components in kiosks or sub-substations or external control cabinets or switchboards or LED's used in street lighting leading to system failure or service interruptions.		- Energy demand modelling should include future temperature projections (RCP 8.5) to allow adequate planning for power infrastructure upgrades associated with the master plan. - Consider microgrids. - Ensure back-up power is available. - Require solar passive design principles in developer design guidelines. - Design HVAC loads for increasing capacity. - Substation footprints should take into account increased loads. - Monitor and manage energy demands with smart technology.	Sydney Olympic Park Authority Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
21	Air Temperature	Increase in mean maximum temperature	Electrical assets - leachate collection systems Direct: Failure of critical leachate collection and transfer infrastructure or communication infrastructure due to heat pressures which may result in pollution incidents.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Energy demand modelling should include future temperature projections (RCP 8.5) to allow adequate planning for power infrastructure upgrades associated with the master plan. - Ensure back-up power is available. - Design infrastructure to withstand projected temp. increases.	Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Major	Possible	High - 18
22	Air Temperature	Increase in mean maximum temperature	Financial loss Direct: Increased intensity of temperatures creates larger demand for indoor events and undercover events.	- Master Plan aims to diversify Sydney Olympic Park's operations to include more commercial, retail and residential income streams.	- Ensure community facilities (shade structures, respite centres) have sufficient space for population influxes during major events. - Design new sports venues with increased shade. - Require event organisers to have heat management plans in place.	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
23	Air Temperature	Increase in mean maximum temperature	Financial loss Direct: Increased heat and extreme weather events may result in a lower number of patrons visiting SOP.	- Master Plan aims to diversify Sydney Olympic Park's operations to include more commercial, retail and residential income streams.	- Diversify income streams through different attractions and offerings. - Ensure community facilities (shade structures, respite centres) have sufficient space for population influxes during major events. - Design new sports venues with increased shade. - Require event organisers to have heat management plans in place.	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
24	Air Temperature	Increase in mean maximum temperature	Financial loss Direct: Impacts of frequency and intensity of extreme temperature events results in increases in insurance premiums and public liability insurance premiums.		- Ensure that the master plan is designed to withstand the impacts of major climate related events. - Conduct modelling (heat and flood) to ensure that no assets are at risk. - Require in developer design guidelines that modelling is conducted for all assets and they are designed to respond to specific threats.	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	Moderate	Likely	High - 19
25	Air Temperature	Increase in mean maximum temperature	Infrastructure under-provision Direct: Increase in average temperatures, and specifically increases in number of days over 35 deg C results in day-to-day increased demand for relevant infrastructure to comfortably move people around SOP.	- Master Plan aims to diversify Sydney Olympic Park's operations to include more commercial, retail and residential income streams.	- Increase tree canopy cover in public realm and set minimum canopy cover targets. - Use light coloured surfaces in public realm. - Provide covered walkways. - Provide shade structures and respite areas for the public to escape the heat. - Ensure community facilities are freely available to the public (eg. libraries, shopping centres, other community facilities). - Monitor heat throughout the development and advertise temperatures on digital boards. - Provide drink fountains and water play spaces.	Sydney Olympic Park Authority Architect Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
26	Air Temperature	Increase in mean maximum temperature	Infrastructure degradation Direct: Increased frequency and intensity of heatwaves leads to degradation in infrastructure, including buildings, transport facilities, and hardscaping.		- Require in developer design guidelines that new buildings and infrastructure is designed to withstand temperatures under an RCP 8.5 climate scenario.- Monitor temperatures throughout the development and advertise temperatures on digital boards.- Consider green walls, green roofs and other temperature-reducing features.	Sydney Olympic Park Authority Architect Landscape Architect Civil Engineer Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Moderate	Unlikely	Medium - 11
27	Air Temperature	Increase in mean maximum temperature	Worker and visitor health and wellbeing Direct: Increased frequency and intensity of extreme heat events will impact the health of on outdoor workers and visitors to SOP.		- Ensure all construction contractors are aware of their obligations with regards to heatwave conditions and worker safety. - Require heat management plans from all contractors. - Increase shade cover for outdoor workers during operations. - Increase tree canopy cover in public realm and set minimum canopy cover targets. - Use light coloured surfaces in public realm. - Provide covered walkways. - Provide shade structures and respite areas for the public to escape the heat. - Ensure community facilities are freely available to the public (eg. libraries, shopping centres, other community facilities). - Monitor heat throughout the development and advertise temperatures on digital boards. - Provide drink fountains and water play spaces.	Sydney Olympic Park Authority Builders			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
28	Air Temperature	Increase in mean maximum temperature	Ecological function Direct: Combined with lower rainfall degrades ecological functioning in wetland areas, saltmarsh and other areas of high biodiversity value.	- An environmental program exists to protect and monitor, and educate about the natural areas at Sydney Olympic Park.	Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future heat impacts. - Provision of habitat within urban footprint. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
29	Air Temperature	Increase in mean maximum temperature	Ecological function Direct: Changes in long term climate (including sudden cold shock events) could force species migration, decline and/or loss.	- An environmental program exists to protect and monitor, and educate about the natural areas at Sydney Olympic Park.	Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future heat impacts. - Provision of habitat within urban footprint. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
30	Air Temperature	Increased annual mean temperature	Landscapes Direct: Combined with lower rainfall will result in the loss of many plant species from heat stress, and less vigorous growth of many of the survivors. Issues with management of pest plants and animals. Loss of landscape amenity.	- Landscape management plans exist for the development.	- Landscape architect and ecologist assess which species should be incorporated into the design to take account of future climate projections (RCP 8.5) (utilise programs like Which Plant Where). - Balance of high- and low-evapotranspirative plant species takes into account RCP 8.5 climate predictions. - Stormwater collection and storage on deck used to irrigate landscapes. - Recycled water supply for reliable irrigation. - Monitor and educate about measures taken.	Sydney Olympic Park Authority Ecologist Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
31	Air Temperature	Increased annual mean temperature	Energy costs Indirect: Increase in average temperatures may lead to an increase in energy demand and associated utility costs.		- Embedded network(s), virtual power plant(s), microgrid, precinct-scale systems. - Require passive design principles to be adopted in developer design guidelines. - Precinct and building energy storage.	Sydney Olympic Park Authority Electrical Engineer Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Moderate	Possible	Medium - 14
32	Air Temperature	Increased annual mean temperature	Threat to wildlife - reptiles Direct: Warmer temperature during egg incubation may impact on the breeding success of reptiles such as the long-necked turtles.	- An environmental program exists to protect and monitor, and educate about the natural areas at Sydney Olympic Park.	- Identify areas of the Park important to species as shelter refuges during heat events. - Investigate and implement habitat management actions to facilitate survival such as provide watering prior to predicted heat events to increase humidity, provide water sources away from direct sunlight and exposure to high temperatures. - Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future heat impacts.	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
33	Air Temperature	Increased annual mean temperature	Threat to wildlife - invertebrates Direct: Warmer temperature will decrease survivorship of beneficial invertebrates and their functions of pollination and pest control.	- An environmental program exists to protect and monitor, and educate about the natural areas at Sydney Olympic Park.	- Identify areas of the Park important to species as shelter refuges during heat events. - Investigate and implement habitat management actions to facilitate survival such as provide watering prior to predicted heat events to increase humidity, provide water sources away from direct sunlight and exposure to high temperatures. - Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future heat impacts.	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
34	Air Temperature	Increased annual mean temperature	Heat impacts on leachate Direct: Temperature changes in the air and soil makes contaminated lands more toxic, could increase/change leachate mitigation measures required.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Contaminated lands/environmental management team aware of risks and continuously review management plans in line with RCP 8.5 climate projection.	Sydney Olympic Park Authority Environmental Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Possible	High - 18
35	Air Temperature	Increase in mean maximum temperature	Network blackouts - leachate collection systems Direct: Failure of critical leachate collection and transfer infrastructure or communication infrastructure which may result in pollution incidents.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Infrastructure demand modelling should include future temperature projections (RCP 8.5) to allow adequate planning for power infrastructure upgrades associated with the master plan. - Ensure back-up power is available. - Design infrastructure to withstand projected temp. increases.	Sydney Olympic Park Authority Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Possible	High - 18
36	Air Temperature	Increased number of hot days over 35 °C	Heat Islands Direct: Increases in number of days above 35 °C may contribute towards urban heat island effects, leading to reduced comfort and negative health outcomes for building occupants and pedestrians.	- Increased green cover in new master plan.- WSUD strategy, which increases green space in the town centre. - Pop-up shade structures during events.	- Setting a target for tree canopy coverage based on best available science. - Mass care facility could be used as respite centre.- Community centre with free access could be used to escape heat.- Mandating/encouraging green roofs/walls/facades in development design guidelines.- Mandating/encouraging light coloured roofing, concrete, asphalt, high-reflectivity in design guidelines.- Permanent public respite shading structures.- Active public cooling infrastructure/instruments (mistifiers, fans) late/24hours.- Emergency heat plans.- Monitoring and digitally communicating temperatures throughout the public realm.	Sydney Olympic Park Authority Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
37	Air Temperature	Increased number of hot days over 35 °C	Thermal comfort Direct: HVAC system may experience overload, affecting thermal comfort for building occupants, and increasing HVAC maintenance and operating costs.		- Mass care facility and/or community facilities could act as publicly available respite centre. - Include requirements for passive design features (natural ventilation, aspect, shading) in developer design guidelines. - Include efficiency specifications for HVAC systems in design guidelines. - Specify minimum NABERS Energy performance requirements that go above and beyond best practice.	Sydney Olympic Park Authority Electrical Engineer Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
38	Air Temperature	Increased number of hot days over 35 °C	Network blackouts Direct: Frequent interruptions to mains power supply can lead to service interruption, power losses to infrastructure and buildings.		- Provision of microgrids. - Space considerations for future battery storage or backup either at building or precinct-scale. - Passive design specified in design guidelines. - On-site energy storage as a minimum, explore on site generation on roofs, facades and integrated into public realm structures. - Divert emergency power to vertical transportation. - Buildings designed to operate during network blackout.	Sydney Olympic Park Authority Electrical Engineer Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
39	Air Temperature	Increased number of hot days over 35 °C	Ecological function Direct: Extreme temperature (high and low) can impact plant communities, including mangroves, by impairing flowering and fruiting success.	- An environmental program exists to protect and monitor, and educate about the natural areas at Sydney Olympic Park.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future heat impacts. - Provision of habitat within urban footprint. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
40	Air Temperature	Increased number of hot days over 35 °C	Homeless and vulnerable people displacement Direct: Extreme heat affects people sleeping rough or otherwise seeking shelter in public realm.	- Increased landscaping in public realm improves access to shade.	- Shaded respite areas for use by the public on hot days. - Mass care facility could act as a respite centre for vulnerable people during heatwaves. - Mandate in design guidelines that compassionate infrastructure is provided that supports increased use by homeless people. - Inclusive public domain that intentionally does not integrate hostile architecture. - Integrate diverse physical social infrastructure facilities (e.g. health, education, arts and culture).	Sydney Olympic Park Authority Architect Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
41	Air Temperature	Increased number of hot days over 35 °C	Threat to wildlife Direct: Increased hot days over 35 °C leading to heat stress and death in sensitive animal species - particularly birds and bats.	- An environmental program exists to protect and monitor, and educate about the natural areas at Sydney Olympic Park.	- Identify areas of the Park important to species as shelter refuges during heat events. - Investigate and implement habitat management actions to facilitate survival such as provide watering prior to predicted heat events to increase humidity, provide water sources away from direct sunlight and exposure to high temperatures. - Ecosystem assessment to establish	Sydney Olympic Park Authority Ecologist Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		Reassessed Risk
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	
					presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future heat impacts.								
42	Air Temperature	Increased number of hot days over 35° C	Localised significant impacts Direct: Extreme heat events lead to significant localised impacts across the site (eg. Brickpit frog-breeding ponds).		- Conduct site-wide heat mapping under RCP 8.5 climate scenarios to identify areas of vulnerability.	Sydney Olympic Park Authority Environmental Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Moderate	Possible	Medium - 14
43	Air Temperature	Increased event of extreme cold temperatures	Cool Islands - ecological impacts Direct: Extreme cold events or changes in frost patterns may result in loss of individual mangroves, changes in growth patterns or die-off events.	- An environmental program exists to protect and monitor, and educate about the natural areas at Sydney Olympic Park.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future heat impacts. - Provision of habitat within urban footprint. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12
44	Air Temperature	Increased event of extreme cold temperatures	Cool Islands - infrastructure and social impacts Direct: Overshading from buildings and/or other structures may result in an increase in need for artificial/carbon based heating inside buildings.		- Plan out building heights to ensure that no areas are over-heated or excessively shaded. - Have clearly defined maximum building heights for each development.	Sydney Olympic Park Authority Planner	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Minor	Rare	Low - 02

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
45	Precipitation	Greater frequency of higher intensity rainfall events	Flood immunity Direct: Greater frequency of higher intensity rainfall events may lead to changes in flood immunity levels.	- Integrated precinct scale stormwater treatment systems [as identified in Figure 3.5.1 of Master Plan 2050].- WSUD elements, such as raingardens and passive irrigation, in the design of new streets and upgrades of existing streets [as identified in Figure 3.5.1 of Master Plan 2050].- Stormwater infrastructure designed using RCP 8.5 flood levels (e.g. raised basement thresholds).- Stormwater report aligns with RCP 8.5 modelling.- Flood management and emergency plans in place.- Evacuation is the primary flood emergency response strategy.- The precinct maintains safe access to trunk roads (A6 Silverwater Rd, A3 Homebush Bay Dr) under 1% AEP conditions via local roads.- Evacuation planning is incorporated into the flood modelling and supported by the precinct's internal road hierarchy and grading strategy.- For events like the PMF when evacuation routes may be cut off, key facilities (e.g. Stadium Australia, Sydney Showground Stadium) are designated as emergency shelters—these buildings are equipped to provide refuge, sanitation, and basic services for large populations during extreme flood events.- Shelter-in-place is considered viable across most of the precinct due to relatively low flood hazard ratings and short-duration inundation in urban areas (typically <6 hours).		Sydney Olympic Park Authority Planner Civil Engineer Stormwater Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
46	Precipitation	Greater frequency of higher intensity rainfall events	Building structures - floor levels and roof drainage Direct: Greater frequency of higher intensity rainfall events may lead to localised flooding, damage due to scour and less safe operating conditions.	<ul style="list-style-type: none"> - The master plan retains mature vegetation to preserve site hydrology and resilience to climate stresses. Supplementary endemic planting builds on this character. - New plantings are selected based on their suitability to local soil, water, and climate conditions, particularly near sensitive zones like grasslands and nature reserves. - The public domain incorporates materials that manage surface water runoff, contributing to flood resilience through infiltration and reduced overland flow. - Shelters and amenities are embedded in the public domain to support safe and functional use during extreme events. - All developments must demonstrate: <ul style="list-style-type: none"> - Consistency of finished surface levels with overland flow paths. - Freeboard above 1% AEP flood levels for basement and building entries. - Assessment of flood impacts up to the 1% AEP event. - Emergency egress arrangements for all flood events up to the PMF. - These controls ensure all new buildings are elevated and graded to remain functional and safe during major flood events. 		Sydney Olympic Park Authority Planner Civil Engineer Stormwater Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
47	Precipitation	Greater frequency of higher intensity rainfall events	Infrastructure - electrical Direct: Extreme rainfall events leading to flash flooding and inundation of electrical infrastructure, leading to power loss to the site.		<ul style="list-style-type: none"> - Ensure all electrical infrastructure is placed above flash flooding levels (RCP 8.5) - require in developer design guidelines. - Ensure back-up power systems are designed throughout the development. - Develop flood management and emergency plans. 	Sydney Olympic Park Authority Electrical Engineer Stormwater Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
48	Precipitation	Greater frequency of higher intensity rainfall events	Infrastructure - public realm Direct: Increase in the frequency and intensity of rainfall and storm events leads to infrastructure becoming isolated by flooding (eg. rail and roads closed, walking/cycling paths blocked, public realm cut-off).	<ul style="list-style-type: none"> - Integrated precinct scale stormwater treatment systems [as identified in Figure 3.5.1 of Master Plan 2050]. - WSUD elements, such as raingardens and passive irrigation, in the design of new streets and upgrades of existing streets [as identified in Figure 3.5.1 of Master Plan 2050]. - The master plan retains mature vegetation to preserve site hydrology and resilience to climate stresses. Supplementary endemic planting builds on this character. - New plantings are selected based on their suitability to local soil, water, and climate conditions, particularly near sensitive zones like grasslands and nature reserves. - The public domain incorporates materials that manage surface water runoff, contributing to flood resilience through infiltration and reduced overland flow. - Shelters and amenities are embedded in the public domain to support safe and functional use during extreme events. - Evacuation is the primary flood emergency response strategy. - The precinct maintains safe access to trunk roads (A6 Silverwater Rd, A3 Homebush Bay Dr) under 1% AEP conditions via local roads. - Evacuation planning is incorporated into the flood modelling and supported by the precinct's internal road hierarchy and grading strategy. - For events like the PMF when evacuation routes may be cut off, key facilities (e.g. Stadium Australia, Sydney Showground Stadium) are designated as emergency shelters—these buildings are equipped to provide refuge, sanitation, and basic services for large populations during extreme flood events. - Shelter-in-place is considered viable across most of the precinct due to relatively low flood hazard ratings and short-duration inundation in urban areas (typically <6 hours). 	- Plan out appropriate and safe uses for high-risk areas.	Sydney Olympic Park Authority Planner Civil Engineer Stormwater Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
49	Precipitation	Greater frequency of higher intensity rainfall events	Infrastructure - water and sewerage Direct: Increase in the frequency and intensity of rainfall events leads to deeper and more frequent flooding of water and sewerage treatment systems.	<ul style="list-style-type: none"> - WSUD can reduce pressure on municipal systems. - Stormwater infrastructure designed using RCP 8.5 flood levels. - Stormwater report aligns with RCP 8.5 modelling. - Flood management and emergency plans in place. 		Sydney Olympic Park Authority Civil Engineer Stormwater Consultant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
50	Precipitation	Greater frequency of higher intensity rainfall events	Infrastructure - leachate collection systems Inundation of electrical/control/monitoring equipment of leachate collection and transfer infrastructure: may cause failure of critical	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	<ul style="list-style-type: none"> - Infrastructure design should take into account future flood projections (RCP 8.5). - Ensure back-up power is available. 	Sydney Olympic Park Authority Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
51	Precipitation	Greater frequency of higher intensity rainfall events	<p>infrastructure which can result in a pollution incident.</p> <p>EgressDirect: Greater frequency of higher intensity rainfall events may increase events that limit access and egress, resulting in tenants and residents being stranded at the development.</p>	- Evacuation is the primary flood emergency response strategy.- The precinct maintains safe access to trunk roads (A6 Silverwater Rd, A3 Homebush Bay Dr) under 1% AEP conditions via local roads.- Evacuation planning is incorporated into the flood modelling and supported by the precinct's internal road hierarchy and grading strategy.- For events like the PMF when evacuation routes may be cut off, key facilities (e.g. Stadium Australia, Sydney Showground Stadium) are designated as emergency shelters—these buildings are equipped to provide refuge, sanitation, and basic services for large populations during extreme flood events.- Shelter-in-place is considered viable across most of the precinct due to relatively low flood hazard ratings and short-duration inundation in urban areas (typically <6 hours).		Sydney Olympic Park Authority Civil Engineer Stormwater Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
52	Precipitation	Greater frequency of higher intensity rainfall events	<p>Civil drainage Direct: Greater frequency of higher intensity rainfall events may lead to inundation of drainage infrastructure as a result of insufficient system capacity, with resulting damage on site or adjacent, service disruption and safety risk. This includes extreme rainfall events and king tides.</p>	<ul style="list-style-type: none"> - Integrated precinct scale stormwater treatment systems [as identified in Figure 3.5.1 of Master Plan 2050]. - WSUD elements, such as raingardens and passive irrigation, in the design of new streets and upgrades of existing streets [as identified in Figure 3.5.1 of Master Plan 2050]. - All new developments must provide an integrated water cycle management plan with development applications for new buildings, substantial alterations and additions to existing buildings and public spaces, in accordance with the WSUD guidelines. - All new developments must provide appropriate sediment and erosion control measures and ensure that downstream waterbodies and waterways are not impacted during construction. - All new developments must implement stormwater treatment suitable for each catchment in accordance with Table 3.3.4 of Master Plan 2050. - Stormwater infrastructure designed using RCP 8.5 flood levels. - Stormwater report aligns with RCP 8.5 modelling. - Flood management and emergency plans in place. 		Sydney Olympic Park Authority Civil Engineer Stormwater Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
53	Precipitation	Greater frequency of higher intensity rainfall events	Stormwater systems Direct: Extreme rainfall levels could result in overwhelming stormwater systems, leading to potential damage. This includes litter boom/baskets and GPTs.	- Integrated precinct scale stormwater treatment systems [as identified in Figure 3.5.1 of Master Plan 2050]. - WSUD elements, such as raingardens and passive irrigation, in the design of new streets and upgrades of existing streets [as identified in Figure 3.5.1 of Master Plan 2050]. - All new developments must provide an integrated water cycle management plan with development applications for new buildings, substantial alterations and additions to existing buildings and public spaces, in accordance with the WSUD guidelines. - All new developments must provide appropriate sediment and erosion control measures and ensure that downstream waterbodies and waterways are not impacted during construction. - All new developments must implement stormwater treatment suitable for each catchment in accordance with Table 3.3.4 of Master Plan 2050. - Stormwater infrastructure designed using RCP 8.5 flood levels. - Stormwater report aligns with RCP 8.5 modelling. - Flood management and emergency plans in place.		Environmental Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
54	Precipitation	Greater frequency of higher intensity rainfall events	Remediated lands - leachate Direct: Greater frequency of higher intensity rainfall events may lead to on-site flash or localised flooding, resulting in loss of leachate from remediated land to the receiving environment.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Management plans should take into account future flood projections (RCP 8.5).	Environmental Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Possible	High - 18
55	Precipitation	Greater frequency of higher intensity rainfall events	Landscapes - plants Direct: Greater frequency of higher intensity rainfall events may affect health of plants and lead to tree and tall plant instability due to saturated soils.	- The master plan retains mature vegetation to preserve site hydrology and resilience to climate stresses. Supplementary endemic planting builds on this character. - New plantings are selected based on their suitability to local soil, water, and climate conditions, particularly near sensitive zones like grasslands and nature reserves.	- Species selection and placement should consider the risk of saturated soils. - Monitoring and management plans should be put in place for all trees across the public realm.	Sydney Olympic Park Authority Arborist Landscape Architect Environmental Engineer Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
56	Precipitation	Greater frequency of higher intensity rainfall events	Landscapes - landscape infrastructure Direct: Greater frequency of higher intensity rainfall events may damage and degrade landscape infrastructure (eg. Electrical systems).		- Landscape infrastructure and electrical designs should be required to be designed to respond to rainfall and flooding risks (eg. Inundation).	Landscape Architect Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Moderate	Unlikely	Medium - 11

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
57	Precipitation	Greater frequency of higher intensity rainfall events	Estuarine habitat -- stormwater runoff leachate Direct: Greater frequency of higher intensity rainfall events may affect water quality and salinity levels through increased stormwater runoff leachate, compromising habitat quality for species resident in the Paramatta River.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).		Environmental Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
58	Precipitation	Greater frequency of higher intensity rainfall events	Freshwater habitat - pest species Direct: Increased frequency of flooding of wetlands leads to an increase in the of spread pests and introduced species, as well as habitat for mosquitos. In particular, the endangered green and golden bell frog and other fauna is impacted by the invasive pest fish gambusia, which is spread by flooding. Carp is also spread by flooding. Invasive weeds such as alligator weed are also a threat in flood waters.	- Current control of some invasive species is through the control of water levels and increased flooding will reduce management capacity to implement control. - All new developments must provide an integrated water cycle management plan with development applications for new buildings, substantial alterations and additions to existing buildings and public spaces, in accordance with the WSUD guidelines.- All new developments must provide appropriate sediment and erosion control measures and ensure that downstream waterbodies and waterways are not impacted during construction.- All new developments must implement stormwater treatment suitable for each catchment in accordance with Table 3.3.4 of Master Plan 2050.	- Ecosystem assessment to establish presence of at-risk species.- Active management of at risk species.- Creation of an ecosystem management plan that considers future flooding impacts.- Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
59	Precipitation	Greater frequency of higher intensity rainfall events	Freshwater and estuarine habitats - change in ecosystem composition Direct: Increased frequency of flooding events alters the species compositions of wetlands and estuarine ecosystems, increasing vegetation management load.	- Current control of some invasive species is through the control of water levels and increased flooding will reduce management capacity to implement control. - All new developments must provide an integrated water cycle management plan with development applications for new buildings, substantial alterations and additions to existing buildings and public spaces, in accordance with the WSUD guidelines. - All new developments must provide appropriate sediment and erosion control measures and ensure that downstream waterbodies and waterways are not impacted during construction. - All new developments must implement stormwater treatment suitable for each catchment in accordance with Table 3.3.4 of Master Plan 2050.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future flooding impacts. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
60	Precipitation	Greater frequency of higher intensity rainfall events	Financial Loss Direct: Impact of extreme rainfall/storm events resulting in less patronage, no shows or cancellation of scheduled events.	- Master Plan aims to diversify Sydney Olympic Park's operations to include more commercial, retail and residential income streams. - Flood management and emergency plans in place.	- Design new venues with increased shelter. - Ensure transport infrastructure is design to withstand/continue to operate during extreme rainfall events (in line with RCP 8.5 scenario).	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
61	Precipitation	Greater frequency of higher intensity rainfall events	Financial Loss Direct: Impacts of frequency and intensity of extreme rainfall/storm events results in increases in insurance premiums and public liability insurance premiums.	- Stormwater report aligns with RCP 8.5 modelling. - Flood management and emergency plans in place. - All new buildings are required to achieve a Green Star Buildings rating, which mandates climate resilience planning, including climate risk identification and adaptation responses.	- Ensure that the master plan is designed to withstand the impacts of major climate related events. - Conduct modelling (heat and flood) to ensure that no assets are at risk.	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
62	Precipitation	Greater frequency of higher intensity rainfall events	Erosion Direct: Increased frequency and severity of storm events can lead to flash flooding and erosion, as well as accumulation of sediment and debris at other locations.	- All new developments must provide an integrated water cycle management plan with development applications for new buildings, substantial alterations and additions to existing buildings and public spaces, in accordance with the WSUD guidelines. - All new developments must provide appropriate sediment and erosion control measures and ensure that downstream waterbodies and waterways are not impacted during construction. - All new developments must implement stormwater treatment suitable for each catchment in accordance with Table 3.3.4 of Master Plan 2050. - Stormwater report aligns with RCP 8.5 modelling. - Flood management and emergency plans in place.	- Creeks and waterways should maintain natural vegetation. - Consider tree planting programs that involve the community (citizen science).	Sydney Olympic Park Authority Landscape Architect Environmental Engineer Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
63	Precipitation	Greater frequency of higher intensity rainfall events	Erosion Direct: Increased frequency and severity of storm events can lead to strong currents through the Parramatta River and erosion.	- All new developments must provide an integrated water cycle management plan with development applications for new buildings, substantial alterations and additions to existing buildings and public spaces, in accordance with the WSUD guidelines. - All new developments must provide appropriate sediment and erosion control measures and ensure that downstream waterbodies and waterways are not impacted during construction. - All new developments must implement stormwater treatment suitable for each catchment in accordance with Table 3.3.4 of Master Plan 2050. - Stormwater report aligns with RCP 8.5 modelling. - Flood management and emergency plans in place.	- Creeks and waterways should maintain natural vegetation. - Consider tree planting programs that involve the community (citizen science).	Sydney Olympic Park Authority Landscape Architect Environmental Engineer Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
64	Precipitation	Greater frequency of higher intensity rainfall events	Heritage assets Direct: Greater frequency of higher intensity rainfall events will accelerate building fabric aging, increase likelihood of water damage from roof and wall leaks.	- Stormwater report aligns with RCP 8.5 modelling. - Flood management and emergency plans in place.	- Ensure upgrades/retrofits are design in line with RCP 8.5 projections.	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Minor	Unlikely	Low - 06
65	Precipitation	Greater frequency of higher intensity rainfall events	Localised flash flooding Direct: Greater frequency of higher intensity rainfall events leads to threat to life and damage to property at Lake Belvedere and Hill Road, as well as other specifically vulnerable sites.	- Integrated precinct scale stormwater treatment systems [as identified in Figure 3.5.1 of Master Plan 2050]. - WSUD elements, such as raingardens and passive irrigation, in the design of new streets and upgrades of existing streets [as identified in Figure 3.5.1 of Master Plan 2050]. - Evacuation is the primary flood emergency response strategy. - The precinct maintains safe access to trunk roads (A6 Silverwater Rd, A3 Homebush Bay Dr) under 1% AEP conditions via local roads. - Evacuation planning is incorporated into the flood modelling and supported by the precinct's internal road hierarchy and grading strategy. - For events like the PMF when evacuation routes may be cut off, key facilities (e.g. Stadium Australia, Sydney Showground Stadium) are designated as emergency shelters—these buildings are equipped to provide refuge, sanitation, and basic services for large populations during extreme flood events. - Shelter-in-place is considered viable across most of the precinct due to relatively low flood hazard ratings and short-duration inundation in urban areas (typically <6 hours).	- Ensure design of each precinct responds to flood risks. - Develop site-specific management plans for key risk areas.	Sydney Olympic Park Authority Civil Engineer Stormwater Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
66	Precipitation	Increase in annual total rainfall	Infrastructure Direct: Annual average rainfall increases, resulting in undersized stormwater and rainwater capture infrastructure.	- WSUD can reduce pressure on municipal systems.- Stormwater infrastructure designed using RCP 8.5 flood levels.- Stormwater report aligns with RCP 8.5 modelling.	- Ensure requirements for rainwater tanks to be sized according to RCP 8.5 rainfall predictions are included in developer design guidelines.	Sydney Olympic Park Authority Civil Engineer ESD Consultant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Minor	Unlikely	Low - 06
67	Drought	Decrease in annual total rainfall	Landscapes Indirect: Decrease in annual total rainfall leading to a reduction in regional water storages and reduce water supplies making it difficult to water landscaping.	- Bioswales planned for the site. - WSUD helps to manage water supplies.	- Recycled water supply ensures reliable irrigation. - Onsite rainwater storage. - Water efficient plant species selection for public realm.	Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Minor	Possible	Medium - 13

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
68	Drought	Decrease in annual total rainfall	Remediated soils - drying and movement Direct: Decrease in annual total rainfall leading to loss of vegetative cover, resulting in erosion of topsoils and potential cracking of clay capping, leading to movement and non-containment of contaminated soils. Could also lead to increased landfill gas coming to the surface, resulting in air pollution and creating poorer ground conditions that impact on reuse of areas.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Management plans should take into account future drought projections (RCP 8.5).	Environmental Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Possible	High - 18
69	Drought	Decrease in annual total rainfall	Creek habitats Direct: Rainwater fed creeks dry up leading to disruptions of the local creek ecosystems.	- SOPA have a an environmental program and management team that exists to protect and monitor ecosystems.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future drought impacts. - Provision of habitat within urban footprint, including drought refugia in planning processes to avoid reactive management at time of need. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint. - Monitor creek water levels and the impact on flora and fauna.	Sydney Olympic Park Authority Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
70	Drought	Decrease in annual total rainfall	Potable water availability - built form Indirect: Decrease in annual total rainfall may result in water restrictions prohibiting water use in heat rejection, irrigation, human consumption.		- Require in developer design guidelines: onsite water capture and recycling, and rainwater tanks for building use (toilet flushing, non-potable uses), water efficient fixtures and fittings.	Sydney Olympic Park Authority Architect Hydraulic Engineer Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Minor	Likely	Medium - 15
71	Drought	Decrease in annual total rainfall	Potable water availability - leachate systems Direct: Decrease in annual total rainfall may result in less stormwater availability for irrigation and dilution water for biological leachate treatment systems, leading to pollution events.non-compliance with treatment criteria resulting in shutdown of treatment system and risking overflow and pollution events.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Management plans should take into account future drought projections (RCP 8.5).	Environmental Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Possible	High - 18

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
72	Drought	Decrease in annual total rainfall	Potable water pricing Indirect: Decrease in annual total rainfall may result in water restrictions and pricing impacts on tenants, running costs of water cooled systems for building owners.		- Require in developer design guidelines: onsite water capture and recycling, and rainwater tanks for building use (toilet flushing, non-potable uses), water efficient fixtures and fittings. - Ensure that community facilities are freely available to act as areas of respite for residents.	Sydney Olympic Park Authority Architect Hydraulic Engineer Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
73	Drought	Decrease in annual total rainfall	Wetland wildlife - loss of breeding and lifecycle supporting habitat Direct: Drought conditions reduce stormwater storage, leading to a loss of natural and irrigation water available for freshwater ecosystems (ponds, wetlands). This leads to a loss of habitat for amphibian, bird, and reptile species that rely on wetlands for key parts of their lifecycle, including the endangered green and golden bell frog and Latham's snipe.	- SOPA have an environmental program and management team that exists to protect and monitor ecosystems.	- Ensure that key wetlands and ponds are supplied by water and maintained at an ecologically operational level during periods of drought. - Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future drought impacts. - Provision of habitat within urban footprint. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint. - Monitor creek water levels and the impact on flora and fauna.	Sydney Olympic Park Authority Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
74	Wind	Increased wind speeds	Debris Direct: Increasing wind speeds during extreme weather events may dislodge loose furniture or equipment (including vegetation) damaging exposed plant equipment and facades, people, private property, and/or making the public domain unsafe.	- Wind modelling has been completed for the site based on average wind speeds.	- Conduct modelling for extreme weather events, utilising the RCP 8.5 scenario. - Ensure design allows for outdoor furniture and fixtures to meet the recommended design standards, as per the wind modelling. - Develop an extreme weather event management plan that advises tenants how to respond during an extreme wind weather event.	Sydney Olympic Park Authority Wind Modellers Architects	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
75	Wind	Increased wind speeds	Wind driven rain Direct: Increasing wind speeds coupled with greater frequency of higher intensity rainfall events may lead to wind driven rain flooding upper levels and penetrating facades.	- Wind modelling has been completed for the site based on average wind speeds.	- Require in developer design guidelines: high performance facades eliminate thermal bridging, condensation, and water penetration. - Conduct modelling to identify key risk areas. - Develop an extreme weather event management plan.	Sydney Olympic Park Authority Wind Modellers Architects	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
76	Wind	Increased wind speeds	Pedestrian and bicyclist comfort and safety - wind tunnels Direct: Increasing wind speeds exacerbated by tall buildings and the Plaza may lead to wind tunnel conditions making the public realm uncomfortable, inaccessible, and potentially unsafe.	- Wind modelling has been completed for the site based on average wind speeds.	- Complete wind modelling in line with RCP 8.5 climate projections. - Plan building heights throughout the development to respond to modelling. - Develop an extreme weather event management plan.	Sydney Olympic Park Authority Wind Modellers Architects	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
77	Wind	Increased wind speeds	Electrical assets Direct: Wind damage to electrical circuitry (overhead wiring) may result in disruption to services and increase maintenance costs.	- Wind modelling has been completed for the site based on average wind speeds.	- All electrical and ICT wiring underground. - Above ground electrical assets/structures designed to withstand RCP 8.5 wind scenarios. - Develop an extreme weather event management plan.	Sydney Olympic Park Authority Wind Modellers Civil engineers Electrical engineers	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
78	Wind	Increased wind speeds	Public realm assets - leachate systems Direct: Wind damage to antennas required for transmitting radio signals between landfill sites which can cause communication failures resulting in malfunctions and potentially pollution incidents.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Infrastructure design should take into account future extreme wind and weather projections (RCP 8.5). - Ensure back-up power is available. - Develop a management plan for leachate events.	Sydney Olympic Park Authority Landscape Architect Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Possible	High - 18
79	Wind	Increased wind speeds	Public realm assets Direct: Wind damage to shade structures, kiosks, and other items in the parks and public domain.	- Wind modelling has been completed for the site based on average wind speeds.	- Infrastructure design should take into account future extreme wind and weather projections (RCP 8.5). - Develop an extreme weather event management plan.	Sydney Olympic Park Authority Wind Modellers Landscape Architect Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
80	Wind	Increased wind speeds	Landscape Direct: Wind damage to shade trees, including downed branches and whole trees.	- Wind modelling has been completed for the site based on average wind speeds.	- Trees selected for resilience to wind when mature. - Trees provided with support while growing. - Trees not located over critical infrastructure or shelter. - Develop an extreme weather event management plan.	Sydney Olympic Park Authority Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
81	Extreme storms	Increase in frequency and severity of storms	Hail storms Direct: Increase in extreme hailstorm events may damage to cladding, exposed plant and services, landscapes, entryways and horizontal/sloped glazing.		- Design public realm to withstand extreme hail events. - Provide shelter for people in the public realm. - Include requirements in developer design guidelines to select building materials designed to withstand hail events. - Develop an extreme weather management plan.	Sydney Olympic Park Authority Landscape Architect Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
82	Extreme storms	Increase in frequency and severity of storms	Dust storms Direct: Dust storms caused by a combination of drought, hot weather and westerly wind. Increased risk of systems damage and occupant respiratory illness.	- Increased landscaping in public realm will help capture particulate matter.	- Significant public domain landscaping to capture particulate matter (including greenspace/landscaping targets). - Include in developer design guidelines: building airtightness detailing to prevent uncontrolled dust ingress, and improved HVAC intake filtration. - Early warning system to allow residents to take cover. - Extreme weather event management plan. - Use community facilities as respite centres for residents.	Sydney Olympic Park Authority Landscape Architect Mechanical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
83	Extreme storms	Increase in frequency and severity of storms	Windstorms/small tornadoes Direct: Increase in micro-burst windstorms small tornados, compromising life-safety of anyone in public realm and in buildings insufficiently resistant to extreme winds.		<ul style="list-style-type: none"> – Obviously located and easily accessible shelter in place facilities, most effective if underground – Extreme wind design criteria for public buildings. - Include extreme wind design criteria in developer design guidelines. - Create an extreme weather event management plan. - Use community facilities as respite centre for residents. 	Sydney Olympic Park Authority Structural Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
84	Extreme storms	Increase in frequency and severity of storms	Windstorms/small tornadoes - leachate systems Direct: Damage to antennas required for transmitting radio signals between landfill sites which can cause communication failures resulting in malfunctions and potentially pollution incidents.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	<ul style="list-style-type: none"> - Infrastructure design should take into account future extreme weather projections (RCP 8.5). - Ensure back-up power is available. - Develop a management plan for leachate events. 	Sydney Olympic Park Authority Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Possible	High - 18
85	Extreme storms	Increase in frequency and severity of storms	Displacement Indirect: Increase in frequency and severity of storms may result in damage to properties, causing displacement and disruption of tenant / business activity during clean up and repair.		<ul style="list-style-type: none"> – Design public realm to withstand extreme weather events. - Include requirements in developer design guidelines to design buildings to withstand extreme storm events. - Develop an extreme weather management plan (include clean-up processes). - Provide a respite/evacuation centre for residents at a community facility (eg. library, sharing hub). 	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
86	Extreme storms	Increasing frequency of electrical storms and lightning strikes	Loss of communications - infrastructure and pollution Direct: Storms and wind cause decline in quality of radio communication between landfill sites. This can cause malfunctions of critical infrastructure which can result in a pollution incident.		<ul style="list-style-type: none"> - Infrastructure design should take into account future extreme weather projections (RCP 8.5). - Ensure back-up power is available. - Develop a management plan for pollution events. 	Environmental Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
87	Extreme storms	Increasing frequency of electrical storms and lightning strikes	Lightning strike Direct: Increasing frequency of electrical storms and lightning strikes can damage building elements, public infrastructure, natural habitat (trees and mangroves) and electrical systems either directly or indirectly through fire.		<ul style="list-style-type: none"> – Require the earthing of all structures, surge protection for all power supply and ICT cabling, surge protection for all public domain structures (i.e. lighting, security, sensing) and surge protection for all on electricity site generation and power storage. - Include in developer design guidelines. - Ensure generators/back-up power is provided. 	Sydney Olympic Park Authority Structural Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
88	Extreme storms	Increasing frequency of electrical storms and lightning strikes	Lightning strike - leachate systems Direct: Increasing frequency of electrical storms and lightning strikes can damage leachate collection and transfer infrastructure which can cause system failure and pollution incidents.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Infrastructure design should take into account future extreme weather projections (RCP 8.5). - Ensure back-up power is available. - Develop a management plan for leachate events.	Sydney Olympic Park Authority Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Possible	High - 18
89	Extreme storms	Increase in frequency and severity of storms	Homeless and vulnerable people displacement Direct: Severe storms affect people sleeping rough or otherwise seeking shelter in public realm.		- Compassionate infrastructure supports increased use by vulnerable people. - Durable materials and maintenance strategies to support increased use. - Inclusive public domain that intentionally does not integrate hostile architecture. - Integrate diverse physical social infrastructure facilities (e.g. health, education, arts and culture). - Encourage community-led support programs. - Build a sharing hub that provides support to vulnerable people.	Sydney Olympic Park Authority Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
90	Extreme storms	Changes to east coast cyclone patterns	Infrastructure damage Direct: Changing cyclone weather patterns bring tropical cyclones further down the east coast of Australia. Infrastructure not built to cyclone standards, with damage occurring during these events.		- Ensure that all buildings and infrastructure are required to be designed to future cyclone standards. This should be based on RCP 8.5 modelling.	Sydney Olympic Park Authority Wind Consultant Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Major	Unlikely	Medium - 12
91	Extreme storms	Changes to East Coast cyclone patterns	Risk to life Direct: Changing cyclone weather patterns bring tropical cyclones further down the east coast of Australia. Infrastructure not built to cyclone standards, resulting in risk to human life.		- Ensure that all buildings and infrastructure are required to be designed to future cyclone standards. This should be based on RCP 8.5 modelling. - Ensure that a community facility is provided with the capacity to host all residents during a disaster event (eg. sharing hub). - Create a disaster/extreme weather event management plan.	Sydney Olympic Park Authority Wind Consultant Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12

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92	Humidity	Changes to relative humidity	Maintenance Direct: Build-up of mould and condensation leading to increased operations and maintenance requirements and costs, as well as poor health outcomes for residents.	- WSUD helps to manage water pooling and build up.	- Design of public domain ensures adequate drainage of excess water, no standing water, and enhances evaporation from sun and wind. - Put in place management plans to prevent the development of mould in airconditioners etc. and associated health risks. Require in developer design guidelines: - All new buildings provide enhanced ventilation capability for indoor spaces including natural ventilation, high rate of outdoor air supply, and highly filtered recirculated air. - High performance facades eliminate thermal bridging, condensation, and water penetration. - Specify mould resistant materials in areas prone to increased humidity.	Sydney Olympic Park Authority Landscape Architect Architect Mechanical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
93	Humidity	Changes to relative humidity	Plant pollination and vigour Direct: Increases in humidity and unseasonal relative humidity can impair plant pollination time periods and extent, and vigour.	- SOPA have a an environmental program and management team that exists to protect and monitor ecosystems.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
94	Humidity	Changes to relative humidity	Heritage assets Direct: Accelerated building aging, build-up of mould and condensation leading to increased operations and maintenance requirements and costs.		- Ensure upgrades/retrofits are designed to consider impacts of mould and condensation. - Develop mould and condensation management plans.	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
95	Humidity	Changes to relative humidity	Deterioration Direct: Accelerated carbonation of concrete structures.		- Design of concrete structures to consider RCP 8.5 climate scenarios. - Ensure that design of buildings and infrastructure takes into account carbonation and materials are selected/initiatives put in place to reduce its effect.	Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Moderate	Possible	Medium - 14

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							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
96	Humidity	Changes to relative humidity	Thermal comfort Direct: Changes in relative humidity resulting in decreasing thermal comfort resulting in health impacts or decreased productivity.	- Green space throughout development.	<ul style="list-style-type: none"> - Extensive shading in the public realm from tree canopy and buildings. - Consider tree canopy targets. - Integrate fans and other methods of mechanically moving air in the public domain. <p>Specify in developer design guidelines:</p> <ul style="list-style-type: none"> - High performance facades to eliminate thermal bridging, condensation, and water penetration. - Design buildings and public domain to capture cool breezes during summer months when relative humidity is highest. 	Sydney Olympic Park Authority Landscape Architect Mechanical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Moderate	Possible	Medium - 14
97	Humidity	Changes to relative humidity	Pest species distribution Indirect: Changes in humidity may increase encroachment pest species, as well as increases in species breeding, causing damage to natural ecosystems.	- SOPA have a an environmental program and management team that exists to protect and monitor ecosystems.	<ul style="list-style-type: none"> - Prioritise cultural, mechanical, biological, and biorational management of pests in the landscape so as not to encourage the development of pesticide resistance. - Regular landscape maintenance and monitoring to ensure optimal growth and health of landscapes, and identification of any issues. - Specify durable, pest resistant materials in the public domain and other areas prone to pest encroachment. - Design landscapes and infrastructure for easy inspection. - Effectively seal or screen off all openings to exclude pests and eliminate potential harbourage. - Engineer slabs and foundations to minimise pest entry. - Design buildings to be unattractive to pests. 	Sydney Olympic Park Authority Landscape Architect Architect Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Unlikely	Low - 06
98	Humidity	Changes to relative humidity	Disease transmission - waterborne diseases Indirect: Changes in humidity may increase the spread of waterborne diseases.		<ul style="list-style-type: none"> - Design of public domain ensures adequate drainage of excess water, and enhances evaporation from sun and wind. - All new buildings should be required (design guidelines) to provide enhanced ventilation capability for indoor spaces including natural ventilation, high rate of outdoor air supply, and highly filtered recirculated air. - Develop a disease management plan. 	Sydney Olympic Park Authority Stormwater Engineer Civil Engineer Architect Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
99	Humidity	Changes to relative humidity	Disease transmission - fungal diseases Indirect: Changes in humidity may increase the spread of fungal diseases that impact flora and fauna. Could disproportionately impact endangered species, particularly amphibians.	- SOPA have an environmental program and management team that exists to protect and monitor ecosystems.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
100	Humidity	Changes to relative humidity	Energy costs Indirect: Increase in relative humidity may lead to an increase in energy demand and associated utility costs.		Require in developer design guidelines: - Building design prioritises passive design and world's best practice energy efficiency. - Precinct and buildings incorporate energy storage. - Onsite renewable energy generation.	Sydney Olympic Park Authority Architect Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Minor	Possible	Medium - 13
101	Bushfire	Increase in risk of bushfires	Air quality Direct: Increase in number of severe fire weather risk days leading to exposure to smoke and particulate pollution for workers and visitors, that may cause respiratory distress, as well as reduced visibility.	- Fire emergency response information included in Resilience Plan.	- Require emergency medical equipment (defibrillators) in building lobbies. - Developer design guide requirement for HVAC systems to be able to either shut-off outdoor air supply and/or provide space allowance for additional filters to be able to be dropped in when required. - Freely available areas of respite for visitors (eg. sharing hub). - Public help points for people requiring medical assistance. - Develop a bushfire management plan with health impacts considered.	Sydney Olympic Park Authority Mechanical Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Almost Certain	Medium - 16
102	Bushfire	Increase in risk of bushfires	Infrastructure damage Increased frequency and severity of bushfire events leads to increased incidence of blackouts due to electricity supply infrastructure damage. Public domain lighting and operational equipment is compromised.		- Provision of microgrids. - Space considerations for future battery storage or backup either at building or precinct-scale. - Passive design specified in design guidelines. - On-site energy storage as a minimum, explore on site generation on roofs, facades and integrated into public realm structures. - Buildings designed to operate during network blackout. - Provide resident evacuation/respice centre with facilities to allow them to stay for more extended periods (eg. kitchens, bathrooms).	Sydney Olympic Park Authority Civil Engineer Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
103	Bushfire	Increase in risk of bushfires	Ash and debris Direct: Airborne ash and debris from bushfires around Sydney could foul waterways, degrade landscape, impose maintenance burden on built environment.	- Fire emergency response information included in Resilience Plan.	- Require emergency medical equipment (defibrillators) in building lobbies. - Developer design guide requirement for HVAC systems to be able to either shut-off outdoor air supply and/or provide space allowance for additional filters to be able to be dropped in when required. - Develop a bushfire management plan with environmental impacts considered.	Sydney Olympic Park Authority Mechanical Engineer Architect Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
104	Bushfire	Increase in risk of bushfires	Damage to electrical and control equipment - leachate systems Direct: Fire directly causes damage to electrical and control equipment of leachate collection and transfer infrastructure resulting in failures and malfunctions and potentially in pollution incidents.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Infrastructure design should take into account future bushfire projections (RCP 8.5). - Ensure back-up power is available. - Develop a management plan for leachate events.	Sydney Olympic Park Authority Civil Engineer Electrical Engineer Enironmental Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Possible	High - 18
105	Bushfire	Increase in risk of bushfires	Trees as fire risk Direct: Tree species vulnerable to heat and drought, creating local fire hazard, damage to property and risk to life.	- Vegetation management plans. - Selection of fire resistant species. - Irrigation plans.	- Careful selection of plant species to reduce fire risk. - All vegetated areas easily accessible by Fire Department. - Passive surveillance to ensure fires are visible and can be responded to quickly.	Sydney Olympic Park Authority Ecologist Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Possible	High - 18
106	Bushfire	Increase in risk of bushfires	Loss of ecosystem functioning, biodiversity loss and habitat availability Loss of ecosystem functioning, biodiversity and habitat due to bushfire. This includes both natural areas, and extending into the parklands and town centre.	- Important habitats are identified at a high level in current master plan.	- Complete a bushfire risk assessment for the project that takes into account RCP 8.5 climate scenarios - Included habitat protection and restoration in emergency fire response plans. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint. - Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species.	Sydney Olympic Park Authority Bushfire Consultant Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Likely	High - 19

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
107	Bushfire	Increase in risk of bushfires	Remediated lands - fire pollution Risk of more bushfire events increasing likelihood of fire breaking out over remediated or landfill areas, resulting in localised air pollution and/or risk to human health, including risk of explosion of landfill gas.	- Fire emergency response information included in Resilience Plan.	- Require emergency medical equipment (defibrillators) in building lobbies. - Developer design guide requirement for HVAC systems to be able to either shut-off outdoor air supply and/or provide space allowance for additional filters to be able to be dropped in when required. - Freely available areas of respite for visitors (eg. sharing hub). - Public help points for people requiring medical assistance. - Develop a bushfire management plan with health impacts considered.	Bushfire Consultant Environmental Consultant Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
108	Bushfire	Increase in risk of bushfires	Soil health Direct: Soil microbe assemblages may be negatively impacted by fire, for example earthworm populations - which are natural bio-turbulators of soil.	- Important habitats are identified at a high level in current master plan.	- Complete a bushfire risk assessment for the project that takes into account RCP 8.5 climate scenarios - Included habitat protection and restoration in emergency fire response plans. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint. - Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species.	Sydney Olympic Park Authority Bushfire Consultant Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
109	Bushfire	Increase in risk of bushfires	Localised bushfire vulnerability Direct: Greater frequency of bushfires leads to threat to life and damage to property at Newington Forest and Woo-La-Ra, as well as other specifically vulnerable sites.		- Conduct bushfire vulnerability mapping of the site in line with RCP 8.5 climate scenarios to identify vulnerable areas of the project. - Plan and design appropriate uses of those areas to reduce bushfire risk. - Develop site-specific bushfire management plans for at risk areas.	Sydney Olympic Park Authority Bushfire Consultant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
110	Bushfire	Increase in risk of bushfires	Small vegetation as fire risk Direct: Understory and ground cover planting and on rooftops vulnerable to heat and drought, creating local fire, damage to property and risk to life.	- Fire emergency response information included in Resilience Plan.	- Careful selection of plant species to reduce fire risk. - All vegetated areas easily accessible by Fire Department. - Passive surveillance to ensure fires are visible and can be responded to quickly. - Develop a fire management plan. - Ensure that building materials are selected to be resistant to fire impacts/stop the spread.	Sydney Olympic Park Authority Ecologist Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

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111	Solar radiation	Increase in level of UV	Life cycle Direct: Increased levels of UV could contribute to the increased rate of photo-oxidation and result in a shorter expected life of materials, especially polymer based products.		- Membranes and any photosensitive exterior products, especially wiring, protected from solar exposure.	Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Insignificant	Likely	Medium - 09
112	Solar radiation	Increase in level of UV	Human health Direct: Increased levels of UV could contribute to increased skin damage and increased skin cancer risks for people in parks and public realm.	- Tree canopy extensive throughout design.	- Significant constructed or natural shade throughout public domain. - Community and municipal facilities offer free sunscreen to public. - Provide signage or other educational resources about daily UV levels. - Ensure that community facilities are freely available to encourage use to reduce sun exposure.	Sydney Olympic Park Authority Landscape Architect Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
113	Waterway Health	Declining Waterway Health	Infrastructure Direct: The increasing extreme weather conditions over time, rainfall intensity, drought, rising temperature and UV radiation is likely to lead to declining waterway health and could result in the need to retrofit additional hydraulic or landscape infrastructure.	- WSUD and bio-retention swales included in design.	- Design of hydraulic infrastructure takes into account RCP 8.5 climate scenarios. - Stormwater pollution flowing to Parramatta River cleaned beyond best practice guidelines. - A combination of the above should be modelled in the Stormwater report to mitigate these issues. - Ensure waterways are landscaped with local species to prevent erosion and other contributing factors.	Stormwater Engineer Civil Engineer Landscape Architect Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
114	Waterway Health	Declining Waterway Health	Infrastructure Direct: Declining waterway health could result in overwhelm of stormwater management infrastructure, including litter boom/baskets and GPTs.	- WSUD can reduce pressure on municipal systems.	- Design stormwater management infrastructure to naturally clean as much as possible. - Implement waterway clean-up systems and/or events (eg. Volunteer days).	Environmental Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
115	Waterway Health	Declining Waterway Health	Discharge Licence Indirect: The increasing extreme weather conditions over time, rainfall intensity, drought, rising temperature and UV radiation is likely to lead to declining waterway health and could result in increasing and more stringent discharge obligations with greater operational cost implications.	- WSUD and bio-retention swales included in design.	- Design of hydraulic infrastructure takes into account RCP 8.5 climate scenarios. - Stormwater pollution flowing to Parramatta River cleaned beyond best practice guidelines. - A combination of the above should be modelled in the Stormwater report to mitigate these issues. - Ensure waterways are landscaped with local species to prevent erosion and other contributing factors.	Stormwater Engineer Civil Engineer Landscape Architect Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
116	Soil	Soil health	Contaminated soils Direct: Contaminated/remediated soils could expose people to unhealthy chemicals, other dangers. Indirect: Contaminated/remediated soils could compromise built environment material integrity over time.	- Some areas of the development have previously been remediated.	- Develop a management plan for leachate events and contaminated lands that takes into account RCP 8.5 scenarios.	Sydney Olympic Park Authority Civil Engineer Electrical Engineer Environmental Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Possible	High - 18

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
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117	Soil	Soil moisture Ground stability	Infrastructure and buildings Direct: Reduced soil moisture over time leading to movement and destabilisation of soils, putting buildings and infrastructure at risk of damage.		- Infrastructure design should take into account the potential for drying soils. - Building design should take into account the potential for drying soils (specify in developer design guidelines).	Sydney Olympic Park Authority Soil/Geological Consultant Civil Engineer Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Moderate	Unlikely	Medium - 11
118	Soil	Soil moisture Ground stability	Infrastructure and buildings Direct: Increase in soil moisture over time leading to saturation of soils, putting buildings and infrastructure at risk of damage.		- Infrastructure design should take into account the potential for saturated soils. - Building design should take into account the potential for saturated soils (specify in developer design guidelines).	Sydney Olympic Park Authority Soil/Geological Consultant Civil Engineer Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Moderate	Unlikely	Medium - 11
119	Soil	Ground stability	Infrastructure and buildings Direct: Decrease soil moisture leading to erosion of soils, putting buildings and infrastructure at risk of damage.	- Landscaping in public realm should help to reduce erosion risk.	- Infrastructure design should take into account the potential for soil erosion. - Building design should take into account the potential for soil erosion (specify in developer design guidelines). - Set tree canopy and landscaping targets. - Hold tree planting days/programs to involve the community in action.	Sydney Olympic Park Authority Soil/Geological Consultant Civil Engineer Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
120	Soil	Ground stability	Infrastructure and buildings Direct: Remediated soils move/become unstable, resulting in damage to buildings and infrastructure.		- Infrastructure design should take into account the potential for soil movement. - Building design should take into account the potential for soil movement (specify in developer design guidelines). - Put in place remediated/contaminated soils management plan and implement continuous monitoring.	Sydney Olympic Park Authority Soil/Geological Consultant Civil Engineer Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
121	Soil	Runoff	Environmental health Direct: Increase in soil moisture over time leading to saturation of soils, leading to excess runoff into waterways.	- WSUD helps to promote natural water flows and potentially reducing soil saturation/pollutant loads.	- Conduct flood and rainfall modelling (RCP 8.5) to identify key risks. - Identify key risk waterways. - Actively manage waterways to improve species resilience. - Involve public in citizen science programs around waterway health.	Sydney Olympic Park Authority Soil/Geological Consultant Ecologist Civil Engineer Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
122	Soil	Ground stability	Infrastructure and buildings Direct: Unplanned settling of remediated soils, leading to building and infrastructure damage.		- Infrastructure design should take into account the potential for soil movement. - Building design should take into account the potential for soil movement (specify in developer design guidelines). - Put in place remediated/contaminated soils management plan and implement continuous monitoring.	Sydney Olympic Park Authority Soil/Geological Consultant Civil Engineer Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Moderate	Possible	Medium - 14

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123	Soil	Groundwater level	Infrastructure and buildings Direct: Rising groundwater levels leading to building and infrastructure damage.		- Infrastructure design should take into account the potential for rising groundwater. - Building design should take into account the potential for rising groundwater (specify in developer design guidelines).	Sydney Olympic Park Authority Soil/Geological Consultant Civil Engineer Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Moderate	Possible	Medium - 14
124	Soil	Groundwater level	Soil pollution Direct: Rising groundwater levels leading to loss of leachate from remediated landfills containment cell remediated soils into surrounding soils.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Infrastructure design should take into account future climate projections (RCP 8.5). - Develop a management plan for leachate events. - Use smart technology to monitor groundwater levels.	Sydney Olympic Park Authority Civil Engineer Electrical Engineer Environmental Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Possible	High - 18
125	Soil	Groundwater level	Infrastructure and buildings Direct: Reduced groundwater levels leading to soil movement and building and/or infrastructure damage.		- Infrastructure design should take into account the potential for reduced groundwater. - Building design should take into account the potential for reduced groundwater (specify in developer design guidelines).	Soil/Geological Consultant Ecologist Civil Engineer Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Moderate	Unlikely	Medium - 11
126	pH	Soil pH	Flora species Soil pH changes result in some plant species' growth habits being impacted negatively, leading to losses in landscaping and natural ecosystems.	- Important habitats are identified at a high level in current master plan.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Ensure all new species in public realm are selected to consider pH changes. - Complete a risk assessment for the project that takes into account RCP 8.5 climate scenarios - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Bushfire Consultant Ecologist	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Insignificant	Unlikely	Low - 03
127	pH	Freshwater pH	Ecosystems Direct: Water pH changes result in some aquatic species' habitat being impacted negatively, as well as algal blooms, leading to losses in biodiversity.	- An environmental program exists to protect and monitor, and educate about the natural areas at Sydney Olympic Park.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future pH changes. - Provision of habitat within urban footprint. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist Landscape Architect Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
128	Evapotranspiration	Increased evapotranspiration	Water shortages Increased evapotranspiration may result in reduced groundwater recharge and surface water outflows into dams, resulting in water shortages.	- WSUD helps to manage water sources.	- Conduct site-wide water modelling to determine future needs and shortfalls under an RCP 8.5 scenario. - Ensure other sources of water are provided throughout the development (eg. Rainwater tanks). - Develop a drought management plan.	Sydney Olympic Park Authority Hydraulic Engineer Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11

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129	Evapotranspiration	Increased evapotranspiration	Impairment of bioretention Direct: Extreme evapotranspiration impairs the bioretention systems that serve the purpose of WSUD balance.	- WSUD helps to manage water sources.	- Conduct site-wide water modelling to determine future needs and shortfalls under an RCP 8.5 scenario. - Ensure other sources of water are provided throughout the development (eg. Rainwater tanks). - Develop a drought management plan.	Sydney Olympic Park Authority Hydraulic Engineer Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
130	Fog	Increased frequency fog events	Interruptions to transport operations An increase in major fog events leads to interruptions in public transport operations, leading to lack of access to the site by commuters, visitors and event patrons.	- Public transport connections (light rail and Metro) increase accessibility during fog events.	- Develop an extreme weather event management plan.	Sydney Olympic Park Authority				<input checked="" type="checkbox"/>	Insignificant	Unlikely	Low - 03
131	Fog	Increased frequency fog events	Impaired plant pollination and fertilisation Direct: An increase in major fog events leads to impairment of plant pollination and natural fertilisation, especially in case of mangroves that are impacted by frost associated with fog.	- An environmental program exists to protect and monitor, and educate about the natural areas at Sydney Olympic Park.	- Ecosystem assessment to establish presence of at-risk species. - Active management of at risk species. - Creation of an ecosystem management plan that considers future fog pattern changes. - Provision of habitat within urban footprint. - Education programs to help residents understand and protect local ecosystems, as well as embrace them as they are integrated into the urban footprint.	Sydney Olympic Park Authority Ecologist Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Rare	Low - 04
132	Seismicity	Earthquake	Shaking Direct: Shaking and ground rupture resulting in damage to or collapse of buildings and other rigid structure.		- Ensure all buildings and infrastructure are designed to earthquake standards. - Develop an emergency response plan that includes events like earthquakes and tsunami.	Sydney Olympic Park Authority Seismologist Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12
133	Seismicity	Earthquake	Remediated soils - movement Direct: Shaking and ground rupture resulting in movement of remediated/polluted soils which then become uncontained resulting in loss of containment of contaminated soils.		- Develop a management plan for leachate events. - Ensure remediated soil infrastructure has been built/will be built to withstand earthquake events.	Sydney Olympic Park Authority Seismologist Environmental Consultant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12
134	Seismicity	Earthquake	Liquefaction Direct: Shaking of water-saturated granular material (such as reclaimed land) temporarily loses its strength and transforms from a solid to a liquid causing buildings and rigid structures to tilt or sink into the liquified deposits.		- Ensure remediated soil infrastructure has been built/will be built to withstand earthquake events.	Sydney Olympic Park Authority Seismologist Structural Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Extreme	Unlikely	High - 17
135	Seismicity	Earthquake	Collapse of waste containment systems Direct: Shaking of land leads to the collapse of waste containment systems and infrastructure.		- Develop a management plan for pollution events. - Ensure waste containment system have been built/will be built to withstand earthquake events.	Seismologist Environmental Consultant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Major	Unlikely	Medium - 12

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136	Seismicity	Tsunami	Tidal wave Direct: Tidal wave damages floating structures, buildings, rigid structures, and landscapes either directly through the force of the wave, or indirectly through debris or erosion.		- Model impacts of a tsunami reaching the Paramatta River. - Ensure all on-river infrastructure and waterway adjacent structures are built to withstand tsunami waves.	Geological Scientist Structural Engineer Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Major	Unlikely	Medium - 12
137	Seismicity	Tsunami	Remediated and contaminated soils - inundation Direct: Tidal wave inundated remediated and contaminated soils leading to soil and water pollution.	- Current practices in place for leachate management (but not modelled on RCP 8.5 scenario).	- Management plans should take into account future flood projections (RCP 8.5). - Infrastructure should be built at a level that reduces risk of spread of contaminated soils.	Environmental Engineer Flood Consultant Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Extreme	Unlikely	High - 17
138	Seismicity	Tsunami	Strong currents Direct: Currents significantly stronger than normal lead to increased erosion of sea walls, and cause impact damage to ferries, cruise ships, and other water craft.		- Ensure all on-river infrastructure and waterway adjacent structures are built to withstand strong currents waves. - Run tree planting programs along waterways.	Environmental Engineer Flood Consultant Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
139	Civil Disturbance	Shocks identified by Resilient Sydney	Terror attack - physical damage Direct: Physical damage to buildings and infrastructure from targeted blasts or explosions.	- Crime prevention through environmental design (CPTED) strategies.	- Develop an emergency management plan that considers this risk. - Ensure that major events venues have sufficient security in place to prevent attacks. - Require all buildings and infrastructure to incorporate CPTED principles and be built to a level that withstands blasts/explosions (dependent of their individual risk level). - Zone the building communication system so that it is capable of delivering explicit instructions, and has back-up power.	Sydney Olympic Park Authority Security Consultant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12
140	Civil Disturbance	Shocks identified by Resilient Sydney	Terror attack - pathological damage Direct: Potential public health effects from chemical or other biological attack requiring isolation, quarantine, decontamination.	- Crime prevention through environmental design (CPTED) strategies.	- Develop an emergency management plan that considers this risk. - Ensure that major events venues have sufficient security in place to prevent attacks. - Designate a quarantine zone within the development. - Isolate separate HVAC zones and return air systems. - Use positive pressurisation of primary egress routes, safe havens, and/or other critical areas. - Zone the building communication system so that it is capable of delivering explicit instructions, and has back-up power.	Sydney Olympic Park Authority Security Consultant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12

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141	Civil Disturbance	Shocks identified by Resilient Sydney	Civil unrest Direct: Localised effects of lawlessness around the asset leading to the need to temporarily shelter in place for building occupants and business interruption to tenants.	– Crime prevention through environmental design (CPTED) strategies. - Mass Care Facility on site.	– Include a respite centre for residents in design (sharing hub). - Develop an emergency management plan that considers this risk. - Build community connection through facilities, events and groups to reduce the risk of unrest.	Sydney Olympic Park Authority Security Consultant	☑	☑		☑	Moderate	Unlikely	Medium - 11
142	Civil Disturbance	Shocks identified by Resilient Sydney	Cyber attack Direct: Data connections to the asset or tenant become compromised and may lead to Building Control Management System being compromised and interrupting business operations.		– Develop a Cyber Security and Risk Mitigation Plan.	Sydney Olympic Park Authority Security Consultant	☑	☑		☑	Moderate	Unlikely	Medium - 11
143	Civil Disturbance	Stressors identified by Resilient Sydney	Disease pandemic Direct: Interruptions to use of commercial offices during public health movement controls affecting business continuity leading to inefficient building operations at part loads and low occupancy.	– Access to public space for preventative health. – Active transport paths.	Require in developer design guidelines: – Contactless building access and sanitary facilities. – Floor by floor air-handling to prevent cross-floor transmission of airborne contaminants. – Building design to incorporate occupancy sensors and partial floor shut-downs. – Very low turndown HVAC equipment, including screw chiller and smart controls. – Double air lock building entries allow potential for sanitisation / public health screening. – Flexibility of internal space for social distancing. – Design control for enhanced ventilation.	Sydney Olympic Park Authority Architect Mechanical Engineer Landscape Architect	☑	☑			Moderate	Likely	High - 19
144	Civil Disturbance	Stressors identified by Resilient Sydney	Diminishing community cohesion Indirect: People more at risk when they don't know each other.		- Encourage casual social connection through public realm design. - Help establish community groups and events to build connection. - Build a community hub to allow for self-governance and building connection. It should allow for space hire, facility hire (kitchens, IT equipment, teaching rooms), and other activities. – Mitigating rising local inequality – deliver initiatives to address disadvantage.	Sydney Olympic Park Authority Architect Landscape Architect	☑	☑	☑	☑	Moderate	Unlikely	Medium - 11

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145	Civil Disturbance	Stressors identified by Resilient Sydney	Financial crisis Indirect: Local or global economic disturbance can lead to negative effects on asset value and utility, and becoming stranded.	- Mixed use precinct, allowing for multiple income streams.	- Diversity of program types and associated users. - Buildings designed for second- and third-life uses allow for easy retrofit or reconfiguration. - Commercial floorplates adaptable for big multi-floor tenants, or multiple single floor tenants. - Develop a management plan for economic disturbance, identifying back-up income streams or ways to built community livelihoods outside of the current economic paradigm (local currencies, sharing economy etc.)	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
146	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Digital network outages Direct: As business and social models shift, the reliance on internet infrastructure for work and social communication will increase. Failure of this network could result in stranded residents.		- Multiple and secure cabling entry points in buildings. - Ensure that the electrical grid is designed to allow for future internet use capacity growth. - Ensure internet connections allow for fast speeds.	Sydney Olympic Park Authority Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Unlikely	Low - 06
147	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Waste Direct: Critical infrastructure to deal with residential waste when the municipal garbage trucks fail to collect them on schedule.		- Appropriate sizing of waste facilities. - Create a circular economy hub to reduce waste quantities, and build community economic and social resilience.	Sydney Olympic Park Authority Waste Consultant Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
148	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Electrical network outages Direct: As utility transitions to a smart grid and away from baseload coal and gas generation more grid instability is likely in the short to medium term as involuntary load shedding occurs over peak days.		- Ensure backup power is provided.- Passive strategies to reduce cooling demand of critical infrastructure and increase thermal autonomy (include in developer design guidelines).- Battery-ready buildings and/or precinct (include in developer design guidelines).- Develop an electricity source transition management plan.	Sydney Olympic Park Authority Electrical Engineer Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Moderate	Possible	Medium - 14
149	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Water quality Direct: Drinking water quality can be affected by periods of low rain or bushfire smoke and runoff into dams leading to 'boil water' alerts to prevent water borne infections.		- Precinct water treatment for potable use. - Requirement for rainwater tanks (design guidelines). - Monitor chemical and biological water quality. - Develop an emergency response management plan that considers this risk.	Sydney Olympic Park Authority Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
150	Critical Infrastructure Failure	Shocks identified by Resilient Sydney	Transport network failures Direct: Road and/or public transport services are interrupted leading to commuters being stranded.	<ul style="list-style-type: none"> – Access to a diversity of public transport types (train, bus, metro, light rail). – Significant comfortable public domain to provide respite to stranded commuters. 	<ul style="list-style-type: none"> – Provision of mechanically cooled, freely accessible community facilities (such as play areas, libraries etc) and commercial areas to provide protected areas of respite for stranded commuters. – End of trip facilities to encourage and facilitate active personal mobility. – All buildings accessible by pedestrian and cycle routes. 	Sydney Olympic Park Authority Landscape Architect Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Almost Certain	Medium - 16
151	Critical Infrastructure Failure	Additional acute shocks	Logistics failure Direct: Closure of loading docks and access roads limiting supply of goods and services to public and private tenants and users.		<ul style="list-style-type: none"> – Diversity in ingress and egress routes for small and large freight access. – Dynamic loading dock signage to advise status and procedures. – Consolidated servicing / hub, potentially below surface level. 	Sydney Olympic Park Authority Transport Consultant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
152	Critical Infrastructure Failure	Additional acute shocks	Development volume - major services Direct: A high volume of development in a short period of time leads to pressures on major service infrastructure and provision.		<ul style="list-style-type: none"> - Stage development based on modelling of impacts. - Create a development management plan to mitigate the negative impacts of rapid growth. 	Civil Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
153	Critical Infrastructure Failure	Additional acute shocks	Development volume - transport infrastructure Direct: A high volume of development in a short period of time leads to pressures on transport infrastructure, leading to advanced depreciation.		<ul style="list-style-type: none"> - Stage development based on modelling of impacts. - Create a development management plan to mitigate the negative impacts of rapid growth. - Ensure infrastructure is designed to accommodate growth in population. 	Transport Consultant Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
154	Critical Infrastructure Failure	Additional acute shocks	Development volume - drainage system and waterways Direct: A high volume of development in a short period of time leads to pressures on drainage systems and waterways.		<ul style="list-style-type: none"> - Stage development based on modelling of impacts. - Create a development management plan to mitigate the negative impacts of rapid growth. - Ensure infrastructure is designed to accommodate growth in population. 	Civil Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
155	Critical Infrastructure Failure	Additional acute shocks	Loss of telecommunications Direct: Loss of telecommunications from any shock and/or stress leads to business losses, impacts on security, and social stress.		<ul style="list-style-type: none"> - Design communications infrastructure to withstand extreme weather events and growth in population. - Monitor equipment performance and ensure replacement/upgrades as necessary. 	Civil Engineer Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
156	Critical Infrastructure Failure	Additional acute shocks	Delivery delays Direct: Delays in infrastructure delivery resulting from any shock and/or stress leading to impact on quality of life, and overuse of existing assets. This in turn leads to expedited deterioration of existing assets.		<ul style="list-style-type: none"> - Stage development based on modelling of impacts. - Create a development management plan to mitigate the negative impacts of rapid growth. - Ensure existing infrastructure is maintained to a high standard. 	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
157	Critical Infrastructure Failure	Additional acute shocks	Stormwater system failure Direct: localised flooding resulting from failing stormwater infrastructure.	- Bio-retention swales included in design. - WSUD encourages natural flows of water (which could also negatively impact some areas of the development).	- Stormwater modelling should account for this under a RCP 8.5 scenario. - Ensure stormwater infrastructure is regularly checked and maintained. - Ensure the development is designed to withstand flood events. - Develop a flood management plan.	Sydney Olympic Park Authority Stormwater Consultant Civil Engineer Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Rare	Low - 04
158	Critical Infrastructure Failure	Additional acute shocks	Inability to secure infrastructure funding Direct: Being unable to secure funding to build infrastructure that is responsive to climate and resiliency risk mitigation measures results in a lack of implementation. During development and construction, project leads being unable to secure funding. This leads to all risks in this risk assessment being amplified.		- Ensure that developer and builder selection processes are conducted in line with regulatory requirements and include assessment of ability to deliver required climate adaptation and resiliency infrastructure. - Diversify funding sources.	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Major	Unlikely	Medium - 12
159	Critical Infrastructure Failure	Additional acute shocks	Sewer system failure Direct: Public health compromised by failure of sewer system to remove waste, or failure of water supply system to provide water to remove waste.	- WSUD helps to reduce pollutants in stormwater.	- Ensure sewerage and stormwater infrastructure is designed to withstand rainfall events under an RCP 8.5 scenario, and is built to consider future population growth. - Develop an emergency management plan that considers this risk.	Sydney Olympic Park Authority Civil Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Rare	Low - 04
160	Shift in Business Models	Shocks identified by Resilient Sydney	Shift in mobility systems Indirect: Electrification of personal transport results in large shift demand profiles on electricity grid.	- EV charging is being considered in current master plan.	- Energy demand modelling includes increase EV charging loads. - 100% of parking to EV charging. - Loading docks to have infrastructure for future charging of logistics vehicles. - EOT facilities to support charging of personal micromobility.	Electrical Engineer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			Moderate	Possible	Medium - 14
161	Shift in Business Models	Stressors related to social changes	Changing demographics Indirect: Changes in expected or projected demographics for the precinct, city or region result in shift in demand for public space and amenity type.	- Current and projected demographic trends included in master plan reports.	- Ensure public spaces and community facilities are designed for flexibility and change of use. - Diversity of program types and associated users. - Encourage contractors to build for flexible use/use changes (design guidelines). - Provide a sharing hub that allows for community members of all demographics to build connection.	Sydney Olympic Park Authority Architect Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Insignificant	Likely	Medium - 09

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
162	Shift in Business Models	Stressors related to social changes	Changing demographics Indirect: Changes in expected or projected demographics for the precinct, city or region result in shift in job market and programmatic needs.	- Current and projected demographic trends included in master plan reports.	- Buildings designed for second- and third-life uses allow for easy retrofit or reconfiguration (design guidelines). - Commercial floorplates adaptable for big multi-floor tenants, or multiple single floor tenants (design guidelines). - Prepare for more circular economy businesses with a circular economy hub.	Sydney Olympic Park Authority Architect Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
163	Shift in Business Models	Stressors related to social changes	Shift in workplace needs Indirect: Long term changes in business models and operations leads to major changes in workplace requirements and buildings requiring substantial retrofits to be fit for purpose.	- Current and projected demographic trends included in Master Plan reports.	- Buildings designed for second- and third-life uses allow for easy retrofit or reconfiguration (design guidelines). - Commercial floorplates adaptable for big multi-floor tenants, or multiple single floor tenants (design guidelines). - Prepare for more circular economy businesses with a circular economy hub.	Sydney Olympic Park Authority Architect Landscape Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
164	Shift in Business Models	Stressors related to social changes	Ageing population Indirect: Ageing population leads to increasing demand for healthcare and allied wellbeing services along with potential reductions in workforce.	- Current and projected demographic trends included in Master Plan reports.	- Housing supports ageing in place and multigenerational families. - Diversity of commercial space types supports variety of health and wellbeing tenants. - Sharing hub allows facilities for retraining/reskilling. - Ensure good connectivity with surrounding healthcare facilities.	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
165	Shift in Business Models	Stressors related to governance changes	Carbon pricing Indirect: The introduction of carbon pricing for business operations leads to elevated operational costs for businesses who may seek alternative accommodation with reduced carbon footprints.		- Require contractors to have net zero carbon targets. - All buildings to be passively designed (design guidelines). - Carbon offset mechanism built into leasing structure. - All-electric building operations eliminates gas price risk. - Space for future energy storage to replace diesel generators.	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
166	Shift in Business Models	Stressors related to social changes	Increased demand for low carbon living Consumer preferences shift towards low carbon living.		- All buildings to be passively designed (design guidelines). - Carbon offset mechanism built into leasing structure. - All-electric building operations eliminates gas price risk. - Space for future energy storage to replace diesel generators. - Opportunity to position development as a leader in low carbon living.	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
167	Shift in Business Models	Stressors related to social changes	Changing residential models Indirect: Shifts in demand for housing types leads to increased vacancies and stranded assets.	- Apartments included in the master plan design.	- Diversity of housing types supporting all stages of life, ageing in place, multi-generational families, social, affordable, and community housing, build-to-rent, rent-to-buy.	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
168	Shift in Business Models	Stressors related to economic changes	Lack of infrastructure provision capacity Indirect: Developers don't have the capacity or ability to meet the requirements set out by SOPA to mitigate and manage the impacts of climate and resiliency risks. This results in provision of lower quality infrastructure with limited adaptive capacity.		- Create developer briefs and design guidelines that are clear in what is required to be completed as part of the climate and resiliency risk mitigation strategy (eg. Modelling, design standards etc.). Include in contracts. - Ensure that contractor vetting processes include the ability of builders to deliver outcomes.	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Major	Unlikely	Medium - 12
169	Social Stressors	Stressors related to development	Development volume - traffic Direct: A high volume of development in a short period of time leads to significant impacts on traffic and accessibility leading to pressures on existing infrastructure and resident frustrations.	- Interim transport measures are being considered as part of the master plan.	- Ensure extensive stakeholder engagement to prepare residents for transport interruptions. - Provide interim transport options, particularly for vulnerable populations. Consider on-demand shuttle buses.	Transport Consultant Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Minor	Almost Certain	Medium - 16
170	Social Stressors	Stressors related to social changes	Development volume - health and environment Direct: A high volume of development in a short period of time leads to extended periods of time where environmental impacts are experienced including excessive noise and dust, leading to negative impacts on human and ecosystem health.		- Ensure all developers and builders have in place environmental management plans that consider all environmental and health impacts.	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Likely	Medium - 15
171	Social Stressors	Stressors related to social changes	Changing political environment Indirect: Political extremism, or unstable governments, could compromise project delivery or operations.		- Promote community connection to build resilience.	Sydney Olympic Park Authority	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Unlikely	Low - 06

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
172	Social Stressors	Stressors related to social changes	Increasing inequality Indirect: Increasing economic inequality leads to reciprocal problems of increased vacancy rates and crime.		<ul style="list-style-type: none"> - Diversity of program types and associated users. - Integrate diverse physical social infrastructure facilities (e.g. health, education, arts and culture) deemed desired by the local community and as noted in the social infrastructure analysis report. - Buildings designed for second- and third-life uses allow for easy retrofit or reconfiguration. - Provide multi-family homes. - Generate community building through programs and facilities (eg. sharing hub). 	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
173	Social Stressors	Stressors related to social changes	Housing affordability Indirect: Decreasing housing affordability leads to increased vacancy rates for residential buildings and population shift to other cities.	- Affordable housing is a priority in the master plan.	<ul style="list-style-type: none"> - Diversity of housing types supporting all stages of life, ageing in place, multigenerational families, social, affordable, and community housing, build-to-rent, rent-to-buy. 	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Possible	Medium - 14
174	Social Stressors	Stressors related to social changes	War Indirect: Conflict directly or indirectly involving the region or population which has a consequential effect on potential precinct use.		<ul style="list-style-type: none"> -Generate community building through programs and facilities (eg. sharing hub). - Develop an emergency management plan that addresses the impacts of war. 	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Moderate	Likely	High - 19
175	Social Stressors	Stressors related to social changes	Mass care facility SOPA fails to prepare for role in MOU for Sydney Mass Care Facility at SOP, resulting in reputational damage to SOPA.		- Ensure that the Mass Care facility is integrated into a wider NSW Centre of Resilience Excellence.	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Unlikely	Medium - 11
176	Social Stressors	Stressors related to social changes	Homelessness Indirect: Increasing homelessness results in reduced demand for residential programs, and increasing pressure on public domain services.		<ul style="list-style-type: none"> - Diversity of housing types supporting all stages of life, ageing in place, multigenerational families, social, affordable, and community housing, build-to-rent, rent-to-buy. - Compassionate infrastructure support increased use by homeless people. - Durable materials and maintenance strategies to support increased use. - Sharing hub is built to provide facilities and support to vulnerable populations. 	Sydney Olympic Park Landscape Architect Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13
177	Social Stressors	Stressors related to social changes	Economic collapse Indirect: Global or National financial and economic downturn leads to increased vacancy rates from reduced capital inflows. Organisation collapse of bespoke third-party service providers.		<ul style="list-style-type: none"> - Diversity of program types and associated users. - Buildings designed for second- and third-life uses allow for easy retrofit or reconfiguration. - Establish a range of localised income streams (circular economy hub) as well as supporting infrastructure (local currencies). - Ensure that residents are supported during times of hardship through community programs and facilities (sharing hub). 	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Moderate	Likely	High - 19

Risk ID	Element	Variable	Potential Impact	Incumbent adaptation measures	Potential additional adaptation measures	Design Measure Responsibility	Mitigation Stage				Reassessed Risk - 2040		
							Precinct Planning	Detailed Design	Procurement	Operations	Consequence	Likelihood	Reassessed Risk
178	Social Stressors	Stressors related to social changes	Financial collapse Indirect: Organisational collapse of bespoke third-party service provider leaves precinct without critical service(s), and additional pressure on public services to fill the gap.		<ul style="list-style-type: none"> – Efficient building and public domain systems use as little external resources as possible, and prioritise passive systems. – Diversity and redundancy built into systems to allow for operation at a reduced scale. – Quick connects for external plug-and-play systems allows for temporary operations on separate systems. – Diversity of program types and associated users. – Buildings designed for second- and third-life uses allow for easy retrofit or reconfiguration. - Establish a range of localised income streams (circular economy hub) as well as supporting infrastructure (local currencies). - Ensure that residents are supported during times of hardship through community programs and facilities (sharing hub). 	Sydney Olympic Park Authority Architect	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minor	Possible	Medium - 13

7.0 Monitoring and review

This CAP is a living document and will continue to be revised as climate change risks and associated opportunities change over time. Many of the proposed actions focus on improving Sydney Olympic Park Authority's monitoring and management of climate risks and integrating climate change adaptation into both the Sydney Olympic Park 2050 Master Plan, as well as current and future governance and operations.

To ensure that the development's adaptation responses and approaches remain valid and relevant to local priorities and climatic conditions, as a minimum:

- The risk assessment should be reviewed **annually** to ensure all potential threats and vulnerabilities have been captured and the consequential risk levels remain valid; and
- The entire CAP should be reviewed and updated through a collaborative process with relevant stakeholders **every five years** as per standard risk management process.

These reviews should also re-assess the development's risk profile in consideration of changes to climate change information, policy, assets, and activities. Consideration should be given to the potential opportunities and benefits that may arise as a result of the changing climate and policy environment (e.g., new funding sources, opportunities for the development of renewable energy or green business precincts). Reviews may also cover monitoring the progress of adaptation actions.

Regular and ongoing monitoring of the project's climate change adaptation performance is critical to inform decision making and motivate changes in behaviour. Integration of climate and resiliency risks into Sydney Olympic Park's broader risk management frameworks should be prioritised to ensure that everyone is aware of their responsibilities and action is taken to continuously mitigate and reduce risks. Consideration in annual budgets, internal reporting and communication is recommended to ensure that decision-makers, staff, and the community are aware of progress in implementing the adaptation actions outlined in this CAP.

8.0 Assurance

8.1 Green Star Communities

The following table indicates documentation requirements for Green Star Communities v1.1 Credit 04 – Adaption and Resilience:

Requirements	Included	Reference
4.1.1 The CAP must be developed in accordance with a recognised standard by a suitably qualified professional.		
Provide the name and contact details of the Suitably Qualified Professional with a formal tertiary environmental science or planning qualification	✓	11.2 CV, p. 128
The Climate Adaptation Plan has been developed using one of the following recognised standards:		
<ul style="list-style-type: none"> – ISO 31000:2009 and the Australian Greenhouse Office (AGO) Climate Change Risks and Impacts: A Guide for Government and Business 2006. – Australian Standard AS 5334:2013 Climate change adaptation for settlements and infrastructure - A risk-based approach. 	✓	2.2 Guiding instruments, p. 16
4.1.2 The CAP must and contain at least the following information:		
e. Summary of the project site’s characteristics.	✓	3.1 Project, p. 20
f. A list of identified assets or asset classes.	✓	Table 3.4: Asset or Asset Class – AS 5334-2013 (Standards Australia 2013), p. 24
g. Assessment of climate change impacts on the project site using at least two-time scales.	✓	5 – Risk Assessment, p. 15
h. Identification of the potential risks (likelihood and consequence) for each identified asset or asset class and the potential risks to people.	✓	5 – Risk Assessment, p. 15
i. A list of actions and responsibilities for all high and extreme risks identified.	✓	156 – Adaptation Plan
j. Details of stakeholder consultation undertaken during plan preparation and how these issues have been incorporated.	✓	Table 2.2: Stakeholder engagement activities, p. 19
4.1.3 The risk identification has considered the resilience of key project assets and key infrastructure.	✓	5 – Risk Assessment, p. 15

Requirements	Included	Reference
4.1.4 The CAP includes a timetable for regular review and requires updates where necessary. As a minimum the plan will be reviewed whenever the base information required to develop the relevant climate change scenarios is updated.	✓	7.0 Monitoring and review, p. 110
4.1.5 The climate change scenarios used were sourced from the Intergovernmental Panel on Climate Change (IPCC) endorsed Global Circulation Models (GCMs) and may include Commonwealth Scientific and Industrial Research Organisation (CSIRO), State or Federal climate projections or more detailed climate modelling software.	✓	2.3 Data sources, p. 18
Provide details of, and justify the use of, the climate change scenarios used by the project for the Climate Adaptation Plan.	✓	Table 4.2: Development time scales descriptions, p. 27
4.1.6 The assessment of climate change impacts addresses a minimum of two appropriate time scales (e.g. 2030, 2040, 2050 and 2070) for the primary and secondary effects.	✓	5 – Risk Assessment, p. 15
The following primary effects are addressed in the Climate Adaptation Plan for the two selected timescales:		
Air temperature	✓	5 – Risk Assessment, p. 15
Solar radiation	✓	
Precipitation	✓	
Sea surface temperature	✓	
Humidity	✓	
Wind	✓	
The following secondary effects are addressed in the Climate Adaptation Plan for the two selected timescales:		
Relative humidity	✓	5 – Risk Assessment, p. 15
Bushfire weather	✓	
Sea level rise	✓	
Coastal inundation	✓	
Cyclones	✓	
Flood	✓	
Heatwave	✓	
Drought	✓	
4.1.7 Implementation of the Climate Adaptation Plan.		
A minimum of two risk items identified in the risk assessment component of the Climate Adaptation Plan have been addressed by specific design responses.	✓	6 – Adaptation Plan

Requirements	Included	Reference
All risk items identified as 'high' or 'extreme' have been addressed by specific design responses.	<input checked="" type="checkbox"/>	6 – Adaptation Plan
Copy of CV of suitably qualified professional who developed the plan	<input checked="" type="checkbox"/>	11.2 CV, p. 128
Evidence demonstrating the design responses to the Climate Adaptation Plan	<input type="checkbox"/>	Not included

9.0 Implementation

Beyond the 176 individual risk items identified and the numerous embedded and potential future adaptation measures for each, here we provide a more targeted exploration of holistic resilience outcomes and high value strategic initiatives for Sydney Olympic Park.

These resilience priorities are synthesised from the Sydney Olympic Park 2050 Master Plan Vision, as well as the Sustainability Vision for the development.



FIGURE 9.1: SYDNEY OLYMPIC PARK 2050 MASTER PLAN VISION STRATEGIC DIRECTIONS

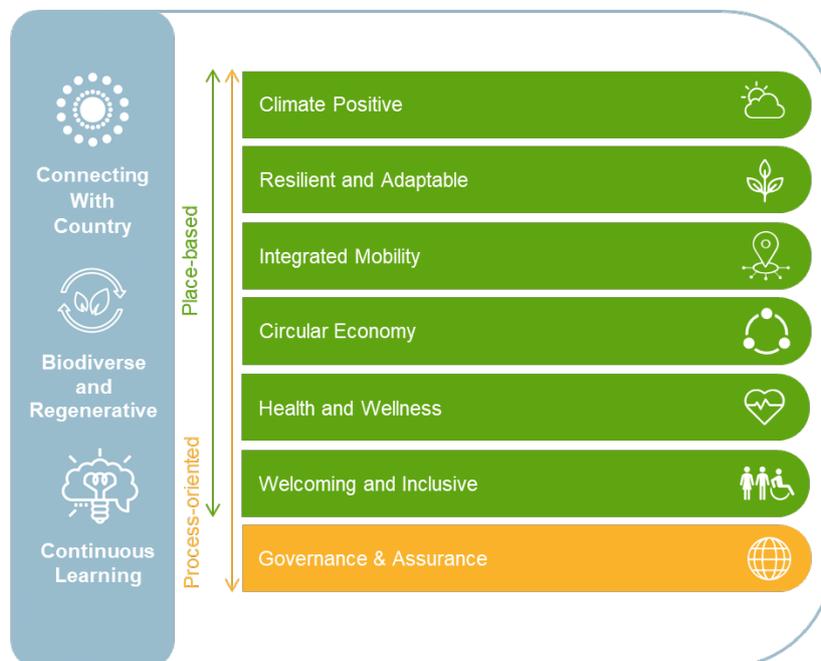
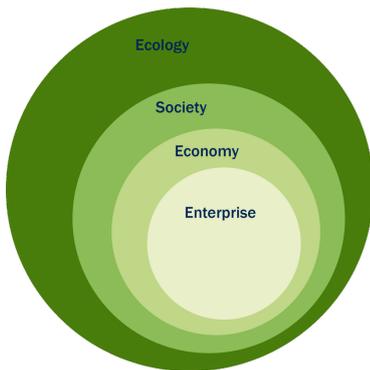


FIGURE 9.2: SYDNEY OLYMPIC PARK SUSTAINABILITY THEMES AND APPROACH, OVERLAYED WITH CLIMATE ADAPTATION/RESILIENCE STRATEGIC INITIATIVE THEMES (PROCESS-ORIENTED, PLACE-BASED AND INTEGRATED)

9.1 Priorities

Based on an analysis of Sydney Olympic Park’s 2050 Master Plan strategic documents, project-specific supporting technical reports, stakeholder engagement, and the risk assessment process documented, we propose a series of five resilience priorities for Sydney Olympic Park. These priorities describe the outcomes of a place that is socially, environmentally, and economically resilient.

These resilience priorities are additionally influenced by two key strategic approaches to sustainable development:



Ecological Economics

Ecological Economics is an interdisciplinary and transdisciplinary field dedicated to the science and management of sustainability that aims to create a bridge across ecology and economics, and other social sciences, natural sciences, and humanities. It draws upon other non-academic experiences and expertise in its holistic analyses to address complex environmental, social, and economic sustainability problems. Ecological Economics addresses the interdependence and co-evolution of human economies and natural ecosystems, acknowledging that the economy is embedded in society which in turn is embedded within the biosphere of the Earth, and focuses on how the economy can serve humans to improve their quality of life, while maintaining a healthy and thriving ecological foundation on which humans and the rest of nature depend on to exist.

Doughnut Economics

Developed by University of Oxford economist Kate Raworth, the Doughnut Economics framework for sustainable development combines the concept of planetary boundaries with the complementary concept of social needs. The framework regards the performance of an economy by the extent to which the needs of people are met without overshooting Earth’s ecological ceiling. In this model, an economy is considered prosperous when all twelve social foundations are met without overshooting any of the nine ecological ceilings. This situation is represented by the area between the two rings, considered by its creator as the safe and just space for humanity.



All resilience priorities and initiatives for Sydney Olympic Park have been developed around the critical concept of ‘**co-benefits**’. Defined by AS 5334-2013 as “an additional benefit from an action that is undertaken to achieve a particular purpose that is not directly related to that purpose”, the Sydney Olympic Park Climate Adaptation Plan seeks to prioritise resilience initiatives that produce co-benefits for the community, environment, and local economy. This includes co-benefits around biodiversity protection and enhancement, and community education and connection.

The resilience priorities for Sydney Olympic Park are covered on the following page.



Connection with Country and thriving natural ecosystems

Healthy functioning ecosystems enable the built environment to adapt and respond to disruption naturally, while further mitigating future climate impacts. Celebrating cultural heritage supports sense of place, belonging, and collective identity.

- Care for waterways and terrestrial ecosystems at Sydney Olympic Park in a way that enables flora and fauna to thrive now and into the future.
- Actively regenerate and expand ecosystems for human engagement and non-human communities.
- Communicate the meaning and value of ecosystems to residents, workers, and visitors to ensure ongoing stewardship.
- Make decisions about ecosystem management based on both Traditional



Growing a safe, connected, and inclusive community

Equitable and inclusive communities are typically more resilient. Diverse and well-connected communities are better able to prepare for, and recover from, shocks and stresses. Protecting life during disaster events is essential to the development of a successful place.

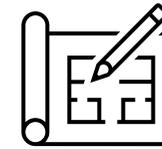
- Deliver diverse and accessible social infrastructure and programs, informed by the community to meet needs and expectations.
- Public realm is designed to encourage informal social interaction.
- Public realm is protected from key resiliency risks (e.g., heat island effect).
- Built form is flexible and responds to current and future community needs (e.g., accessible, affordable and multi-generational housing, co-working spaces).



Creating a living laboratory for future resilience

As a provider of a Mass Care Facility, Sydney Olympic Park is uniquely placed to help build the resilience of the wider Sydney region. From collaborating with universities to gain a deep understanding of local risks, through to running on-site programs for students, SOPA can leverage education and demonstration to increase the adaptive capacity of Sydney and beyond.

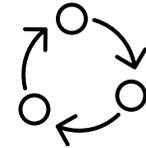
- Sydney Olympic Park is viewed as a climate adaptation and resiliency education hub for the broader Sydney region.
- New development responds to future resiliency risks and opportunities and leads the way in demonstrating how urban development can contribute to increasing resiliency.
- Educational programs focus on how urban ecology and First Nations knowledge can help to build resiliency.
- Smart data systems are utilised to monitor key resiliency risks.



Planning and design at Sydney Olympic Park embeds resiliency from start to finish.

Mitigating risk and increasing resiliency is everyone's responsibility, and it helps to ensure that adaptation initiatives are embedded into every stage of the project. By working holistically across disciplines, the Sydney Olympic Park 2050 Master Plan project and design team can ensure that the precinct is able to bounce back from shocks and stresses.

- Planning has considered future climate scenarios and other resiliency risks, and has assigned safe, flexible and appropriate uses for each area of the site.
- The design of buildings, infrastructure and public spaces responds to resiliency risks to produce a flexible, comfortable and safe built form.
- Nature based solutions have been considered throughout the design to allow for adaptation initiatives to work in harmony with nature.
- The precinct's design helps the community quickly and safely respond during local and regional disruption.



Resiliency is embedded into Sydney Olympic Park's operations.

Sydney Olympic Park plays an important role in increasing resiliency throughout Sydney and NSW. As the authority overseeing the operations of the development, it is essential that Sydney Olympic Park Authority are aware of all resiliency risks, are continually monitoring and reassessing risk levels, and leading the way in mitigation and adaptation.

- A risk framework with supporting policies and management plans is embedded into Sydney Olympic Park Authority's wider operations.
- Performance against resiliency goals is measured against assurance indicators.
- Contaminated lands and related health risks are a key priority area for embedding resiliency.
- Developers engaged to work on the Sydney Olympic Park 2050 Master Plan are aware of their responsibilities and are encouraged to maximise innovation opportunities.

RATIONALE

OBJECTIVES



Connection with Country and thriving natural ecosystems

Knowledge systems and scientific research and ensure that actions align with community values.



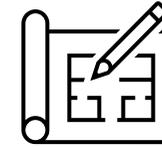
Growing a safe, connected, and inclusive community

- SOPA engages with existing and incoming communities to foster the development of a new integrated community.
- Residents, workers, visitors, and commuters remain safe during extreme events.



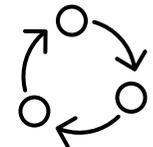
Creating a living laboratory for future resilience

- Sydney Olympic Park is embraced as a place of immersive and experimental learning in the natural and built environment.



Planning and design at Sydney Olympic Park embeds resiliency from start to finish.

- Built form is designed to withstand extreme events under future climate scenarios, and residents able to safely shelter in place for extended periods.



Resiliency is embedded into Sydney Olympic Park's operations.

9.2 Strategic Initiatives – ‘Big Moves’

This climate adaptation and community resilience process has already addressed:

- Incumbent adaptation measures in the Sydney Olympic Park 2050 Master Plan.
- Potential future adaptation measures for delivery and operational stages.
- Recommendations for future technical studies to inform adaptation measures.

Sydney Olympic Park Authority is seeking direction on high value initiatives with the greatest resilience benefits. Here we explore in more detail a series of strategic initiatives which aim to deliver holistic resilience across physical and temporal scales, and different stakeholder groups. These initiatives can generally be categorised as:

- Place-based – actively shape the public domain and place experience
- Process-oriented – require an ongoing operational commitment
- Integrated – both shape the place and require ongoing support

9.2.1 Thriving Country and Ecosystems

Objectives

- To develop and implement a regeneration-based program, led by Traditional Custodians and Sydney Olympic Park Authority, that aims to centre nature as the heart of Sydney Olympic Park.
- To reconnect people with nature and recognise that we are a part of the local ecosystem.

Opportunities

- Setting goals and targets for the percentage of the site to be dedicated to functioning ecosystems.
- Expand existing natural spaces into the urban core.
- Conservation of existing ecosystems.
- Regeneration of new natural spaces.
- Partnerships with First Nations traditional knowledge holders.
- Initiatives centred on habitat creation.
- Development of a nature-based education program.
- Integration of program into living lab/smart city initiatives.
- Partnerships with conservation volunteer organisations to develop site-wide citizen science and regeneration activities.
- Developing a case study to contribute towards global knowledge.

Challenges

- Developing partnerships with Traditional Custodians, education providers and conservation organisations.
- Funding for the program, as well as initiatives implemented under the program.
- Monitoring the success of the program.
- Limited resources to develop and implement the program.

9.2.2 Sharing Economy Hub

Objectives

- To establish a community-centric sharing economy hub, managed by Sydney Olympic Park Authority.
- To strengthen community connections whilst increasing economic, social and environmental resilience.

Opportunities

- Include a space within the master plan to be the physical location of the hub.
- Sharing physical items that residents may only need on an occasional basis – books, toys, appliances, tools, bicycles and maintenance equipment, hobby equipment (photography etc.).

- Include shared spaces within the hub –community gardens, meeting rooms, commercial scale kitchens, co-working spaces, music/recording rooms, makerspaces, innovation spaces (e.g., 3D printing equipment).
- Provide community-led education programs to improve community adaptive capacity – workshops around gardening, cooking, using computers.

Challenges

- Resourcing the items for the hub.
- Finding community members willing to lead initiatives and facilitate education programs.
- Ongoing funding channels.

9.2.3 Circular Repair Hub

Objectives

- To establish a circular repair hub that attracts innovative businesses to the precinct, as well as services the needs of the wider Sydney area.
- To increase resilience through creating alternative economies, as well as reducing environment impact and increasing social connection.

Opportunities

- Include a space within the master plan to be the physical location of the hub.
- Attracting circular economy businesses to Sydney Olympic Park.
- Provide services to the wider Sydney area including item repurposing, furniture upcycling/reselling, bicycle repair facilities, food waste processing into usable garden compost.
- Provide education programs to improve community adaptive capacity in the circular space.
- Consider innovative initiatives to implement within Sydney Olympic Park, such as local currencies.

Challenges

- Attracting established businesses and circular economy start-ups.
- Establishing Sydney Olympic Park as a circular economy leader.
- Finding implementation partners.

9.2.4 Smart City

Objectives

- To develop Sydney Olympic Park as a ‘smart city’ that utilises technology to improve resiliency outcomes.
- To increase resilience through monitoring and managing key sustainability outcomes.

Opportunities

- Implement monitoring technologies to improve resiliency (e.g., heat island mapping and monitoring equipment, smart water and energy efficiency systems, biodiversity monitoring (eDNA)).
- Integrate smart technologies and smart city programs into wider education programs.
- Use outputs of monitoring programs to produce case studies and position Sydney Olympic Park as a leader of resilience excellence.
- Connect with the activities of the Australian Centre of Resilience Excellence to improve knowledge and innovation in the resiliency space.

Challenges

- Internal resourcing to manage data.
- Data security and management.
- Personal privacy laws.

9.2.5 NSW Centre of Resilience Excellence

Sydney Olympic Park Authority are already leaders in resiliency action, with strong organisational capacity and a significant body of place-based adaptive knowledge. Existing initiatives include:

- Sydney Olympic Park being home to the NSW Rural Fire Service State Operational Command Centre and the NSW Reconstruction Authority (formerly Resiliency NSW)
- Hosting the NSW Health Pandemic Response/Metropolitan Vaccination Centre (2020-2021)
- Sydney Olympic Park being home to the Sydney Wetland Institute and WET education programs
- They development of the 'Fit with Strategic Place Framework'
- Leading adaptive research such as NSW Digital Restart funding of SIMP@CT – *Smart Irrigation for Parks and Cools Towns*
- Growing engagement with tertiary learning programs and CPD activities building capacity and sharing knowledge in place-based climate change adaptation.

This initiative seeks to build upon the extensive base of knowledge and experience held by Sydney Olympic Park Authority, and to formalise and expand it into a Centre of Resilience Excellence.

Objectives

- To establish an Australian Centre of Resilience Excellence at Sydney Olympic Park.
- To increase the resilience of Sydney and beyond through an innovative approach to interactive learning and education.

Opportunities

- Include a physical facility within the boundaries of Sydney Olympic Park to serve as the resilience centre.
- Partner with leading education providers and innovators to research resiliency issues, as well as educate and train future resiliency leaders.
- Embrace and promote all levels of education, from early learning through to citizen science projects.
- Connect with the Mass Care Facility providers to generate innovative solutions to local problems.

Challenges

- Internal resourcing.
- Establishing partnerships with education providers.

Potential Partnership Opportunities

As public and private bodies become increasingly aware of their own climate and sustainability risks, opportunities for Sydney Olympic Park Authority to partner with other organisations will increase. Within the NSW Government, there are a number of organisations such as the NSW Reconstruction Authority, emergency service departments, NSW Environment and Heritage, and NSW Health who could be approached for partnership opportunities on initiatives that provide co-benefits in their respective fields.

In the private sector, tertiary education providers (both universities and TAFE) could serve as crucial partners for both research and implementation initiatives. Within the built environment industry, developers, builders, consultants, and industry body groups (GBCA, WGBC, ISCA) could all serve as both research and delivery partners for initiatives that further resiliency in the urban environment.

9.3 Operational resiliency

To ensure that climate risks are managed appropriately, a climate risk management process should be integrated into Sydney Olympic Park Authority's existing risk framework. This should be developed around the concept of **'building-back-better'**, which seeks to learn from climate change risks and impacts, and to improve internal resiliency processes. Opportunities to fund adaptive works and mainstream adaptation through asset budgets, integrate climate risk registers, asset condition audits and asset management plans, should also be explored. Climate risks should be reviewed on a regular basis (at least annually) and in line with the latest science.

The risk management framework should cover responsibilities for each risk, as well as actions to be taken at important project trigger points (e.g. design stage, construction, planning etc.). It should be developed in line with ISO 3100-2018 and include at least:

- Risk gap analysis
- Risk management vision statement
- Risk management plan
- Risk management policies
- Risk management procedures
- Responsibilities for risk management
- Performance indicators and assurance methods.

There are also important adaptation triggers for action to be considered at each stage of the Sydney Olympic Park 2050 Master Plan. These are covered in Figure 9.3.

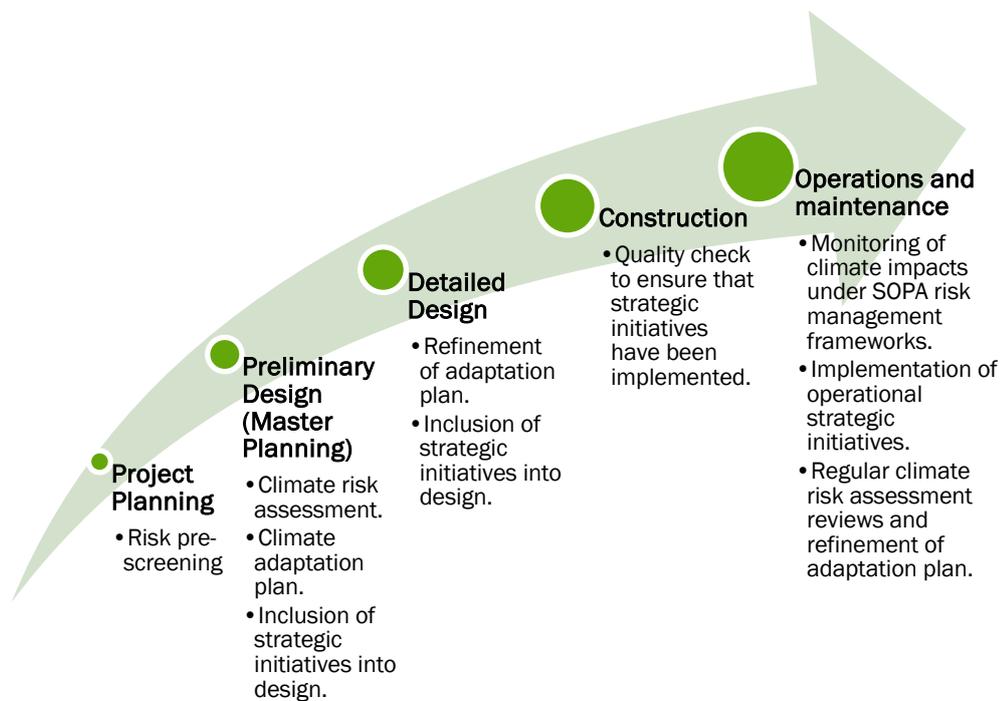


FIGURE 9.3: ADAPTATION CONSIDERATIONS AT EACH STAGE OF THE SYDNEY OLYMPIC PARK 2050 MASTER PLAN

10.0 Conclusion

This Sydney Olympic Park Climate Adaptation Plan features a risk assessment in accordance with the Australian Standard AS 5334-2013 'Climate change adaptation for settlements and infrastructure' and with further guidance from ISO 31000-2009 – Risk Management – Principles and Guidance; and AGO, Climate Change Risks and Impacts: A Guide for Government and Business.

The assessment of climate change impacts has addressed two-time scales relevant to anticipated building lifespan for the primary effects of temperature, precipitation, and sea-level rise, mid future 2040 and far future 2090. The risk assessment has also considered the secondary effects of relative humidity, drought/flood, wind, cyclones, and bushfire. In addition to the climate related impacts a series of social, cultural, economic and political disturbances have been addressed, based on those identified in Resilient Sydney (2018).

All 176 potential risks identified for the year 2040 in the risk assessment component of the Climate Adaptation Plan have been addressed by incumbent and potential design and operational adaptation measures to reduce the likelihood of that event occurring. All 18 'very high' risks have been mitigated, but 22 'high risks' remain. Most (144) risks are now considered medium, and 10 are low.

It is important to note that, should potential design and operational initiatives not be implemented as per the risk assessment table, then the 2040 risks will be higher than estimated below.

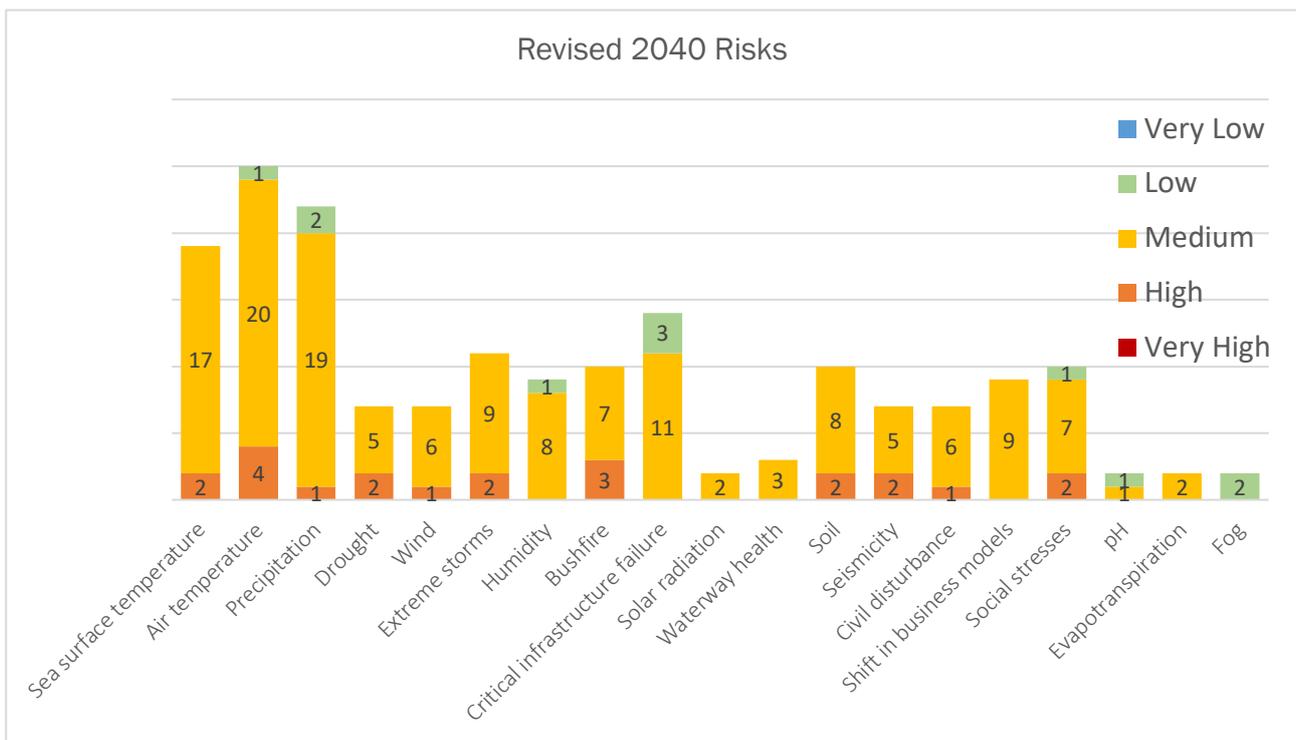


FIGURE 10.1: REVISED 2040 CLIMATE RISKS FOR SYDNEY OLYMPIC PARK

11.0 Appendices

11.1 Climate Data

11.1.1 Temperature

Average annual temperature

Maximum temperatures are projected to rise by an average of 1.94°C by 2070. The greatest increases are occurring in Blackheath and the far south-west. There are no declines in maximum temperatures across all models for Metropolitan Sydney.

TABLE 11.1: NARCLIM MEAN MAX. AND MIN. TEMPERATURES

Sydney Olympic Park (Archery Centre) Lat: -33.83 °S Lon: 151.07 °E		Baseline 2011-2023	2020-2039		2060-2079	
		BOM (local)	Average Change	Range	Average Change	Range
Mean Max Temperature (°C)	Period	23.90 °C	+0.69 °C	+0.35 to +0.98 °C	+1.94 °C	+1.57 to +2.48 °C
	Highest Outright	47.10 °C				
Mean Min Temperature (°C)	Period	13.00 °C	+0.64 °C	+0.41 to +0.76 °C	+2.02 °C	+1.44 to +2.47 °C
	Min. Outright	-0.90 °C				

In 2070 the mean maximum temperature will be approximately 25.84 °C based on the local baseline.

Minimum temperatures are also projected to rise by 2.02 °C by 2070. The greatest increases projected are from Campbelltown to north of Wiseman's Ferry, while large increases are also predicted around Mount Victoria and Blackheath. Sydney will see an increase in minimum temperature of at least 1.44 °C. All models show there are no declines in minimum temperatures across the Metropolitan Sydney.

In 2070 the mean minimum temperature will be approximately 15.02 °C based on the local baseline.

Extreme temperature events

Days in which the maximum temperature is over 35 °C are projected to increase across Sydney by an average of 11 days per year by 2070. The greatest increases are seen in the central part of greater Sydney from Picton to north of Wiseman's Ferry and out to Katoomba. These regions are projected to have an additional 10-20 hot days per year. Parramatta will see at least 5-10 more days over 35 °C by 2070.

In 2070 the number of hot days will be approximately 21 based on the local baseline.

Nights in which the minimum temperature is under 2 °C are projected to decrease across the Sydney by an average of 12 nights per year by 2070. The greatest decreases are seen in the Blue Mountains during winter. These regions are projected to experience more than 40 fewer cold nights per year.

By 2070 Parramatta will see 1-5 fewer cold nights under 2 °C.

TABLE 11.2: NARCLIM NUMBER OF HOT DAYS AND COLD NIGHTS

Sydney Olympic Park (Archery Centre) Lat: -33.83 °S Lon: 151.07 °E		Baseline 2011-2023		2020-2039		2060-2079	
		BOM (local)	Average Change	Range	Average Change	Range	
Number of Hot Days (Days max temp >35°C)	Period yearly average	9.8 days	+3.90 days	+0.24 to +5.63 days	+10.40 days	+3.91 to +14.91 days	
Number of Cold Nights (Nights min temp <2°C)	Period yearly average	1.3 days	-4.50 days	-5.85 to -3.42 days	-10.90 days	-12.36 to +8.97 days	

11.1.2 Precipitation

Average annual rainfall

As shown in Table 11.3 below, annual rainfall is projected to increase by an average of 8.90% by 2070. Large increases of around 18% are projected across the whole of Sydney throughout summer and autumn. Winter and spring rainfall is more variable and may see decreases of around 8%.

In 2070 the mean annual rainfall will be approximately 992.95 mm based on the local baseline.

TABLE 11.3: NARCLIM MEAN MONTHLY RAINFALL

Sydney Olympic Park (Vis Meter) Lat: -33.85 °S Lon: 151.06 °E		Baseline 1996-2011		2020-2039		2060-2079	
		BOM (local)	Average Change	Range	Average Change	Range	
Mean Monthly Rainfall (mm)	Period yearly average	911.8 mm					
	Highest Rainfall	1322 mm (2007)	+1.70%	-12.99 to +18.03 %	8.90%	-8.67 to +24.18%	

Extreme rainfall events

The Floodplain Risk Management Guidelines Practical Consideration of Climate Change (DECC 2007) recommends hydraulic modelling sensitivity analyses for the following rainfall intensities: +10%, +20% and +30% in peak rainfall and storm volume. Climate change related sensitivity analyses should be in addition to the usual sensitivity analyses involved in food and FRM studies undertaken in accordance with the Manual.

These parameters for modelling purposes are further supported by Book 1 of the ARR (Ball et al. 2019) where following the relationship between temperature and humidity, a 5% increase in rainfall intensity per degree of projected surface temperature increase is recommended. Therefore, an average increase of approximately 2°C relates to 10% increase in rainfall intensity (the range projected for the Sydney Metro region is 1.57 to 2.48°C by 2070 NARCLim).

Drought

Drought occurrence is measured using the rainfall-based metric known as the Standardised Precipitation Index (SPI) and duration of time spent in drought and changes to the duration and frequency of drought were calculated for different levels of severity (mild, moderate, severe, and extreme) for projections collated out by the CSIRO (Dowdy et al. 2015).

Projected changes to drought share much of the uncertainty of mean rainfall change, and there is no clear indication on changes to drought conditions for the East Coast region, particularly for RCP 4.5 projections (Dowdy et al. 2015).

Meteorological drought will continue to be a regular feature of regional climate for the East Coast region, and while it may change its characteristics as the climate warms, there is low confidence in projecting how the frequency and duration of extreme drought may change (Dowdy et al. 2015).

11.1.3 Extreme storms

Gales and extreme wind events

As shown in Table 11.4 below projections show a decreasing trend and that there is a very small likelihood of any increases in wind speed. The reductions in East Coast South are likely related to a projected southward movement of storm tracks and the sub-tropical ridge. This would lead to a weakening of westerly winds in the East Coast South sub-cluster. In 2090 the mean 9am and 3pm wind speed will be approximately 10.3 km/h and 16.3 km/h respectively based on the local baseline.

TABLE 11.4: CHANGE IN WIND SPEED

Sydney Olympic Park (Vis Meter) and Sydney Olympic Park (Archery Centre) Lat: -33.85 °S Lon: 151.06 °E		Baseline			2030, RCP 4.5		2090, RCP 4.5	
		BOM (local)			Average Change	Range	Average Change	Range
		max wind gust speed	mean 9am wind speed	mean 3pm wind speed				
Wind Speed (%) Change	Annual	91 km/h	10.4 km/h	16.3 km/h	-0.5 %	-2 to +1.2%	0%	-2.1 to +1.6%

Storms (cyclones)

Tropical cyclones in the Australian region are influenced by a number of factors, and in particular variations in the El Niño – Southern Oscillation (ENSO). In general, more tropical cyclones cross the coast during La Niña years, and fewer during El Niño years (BoM 2016). Cyclones have a complex link to ocean surface temperatures, characteristics of a region and global climate patterns such as the El-Niño Southern Oscillation, meaning that predicting frequency of cyclone and other extreme weather events can be difficult. This results in discrepancies in cyclone frequencies between different climate models (DERM 2009).

The Australian Bureau of Meteorology states (2007):

While tropical cyclones do not impact NSW very often, they have caused flooding, destructive winds, storm surges and loss of life. When a tropical cyclone is affecting NSW the Brisbane Tropical Cyclone Warning Centre (TCWC) will issue a TC Advice for NSW and a Tropical Cyclone Forecast Track Map. Both these products will appear under [Current Warnings for NSW](#) on the Bureau's Website. Information is also available via the Bureau's Telephone Weather Services: [Tropical Cyclone Warnings 1300 659 212](#).

It is likely that [Severe Weather Warnings](#) and [Flood Warnings](#) will also be current before, during and after tropical cyclone warnings.

Hail size and location

Hail severity may increase in most regions of the world while Australia and Europe are expected to experience more hailstorms as a result of climate change (Raupach et al. 2021). A global summary of hail trends from past observations and projected future trends from simulations and models led to the general expectation that hailstorm frequency will decrease in East Asia and North America, while increasing in Australia and Europe, and that hailstorm severity will increase in most regions.

On balance, the hail threat is likely to increase in Australia, especially in Australia's south-east including the Sydney area (Raupach et al. 2021).

However, current and future climate change effects on hailstorms remain highly uncertain, in part due to a lack of long-term observations and limited modelling studies.

Dust storms

Dust storms occur in a very sporadic nature across Australia depending on the amount of rainfall that the arid and semi-arid parts of the country have received (BoM 2006). In prolonged dry periods, dust storms are a frequent occurrence, whilst in the wetter periods dust storms are very uncommon due to the increase in vegetation and soil moisture binding dust particles to the surface.

The most recent dust storms to hit the eastern states occurred on (BoM 2019):

- **3 February 2005.** A strong cold front brought very cold air up from the south breaking many minimum temperature records. As well as the extreme temperatures, dust storms were recorded in many places west of the divide due to the intense winds. At Bourke, visibility was reduced to 500m, and Moree, visibility reduced to 600m.
- **23 October 2002.** This storm was one of the most severe on record. It was also caused by the passage of a strong cold front. This, combined with high temperatures and the prolonged drought in the region, resulted in a massive dust storm which swept across the eastern states. In Sydney, visibility was reduced to a few kilometres and pilots reported that the dust extended up 3km into the atmosphere. West of the divide experienced the most severe conditions, with many areas experiencing visibilities of just 300m. In the suburb of Roma, in southwestern Queensland, visibility was reduced to just 100m.
- **23 September 2009.** Sydney residents awoke to a thick red haze blanketing the city—it was a huge dust storm that was quickly dubbed 'Red Dawn'. The dust was so thick that visibility was reduced to below 1 km for four hours, and at the peak of the storm you could only see 400 m. The massive dust storm was 3000 km long and 2500 m high. It affected as far north as Cairns and dust from it settled as far away as New Zealand! The storm is estimated to have carried approximately 15 million tonnes of dust at its peak.

11.1.4 Bushfire

Fire danger index

Fire weather is classified as 'severe' when the FFDI is above 50, and most of the property loss from major fires in Australia has occurred when the FFDI reached this level (Blanchi et al. 2010). FFDI values below 12 indicate low to moderate fire weather, 12-25 high, 25-49 very high, 50-74 severe, 75-99 extreme and above 100 catastrophic.

Long-term FFDI estimates are available for two weather stations in the region, Sydney Airport and Richmond. The average annual FFDI for the period 1990–2009 is 5.5 at Sydney Airport and 7.1 at Richmond.

TABLE 11.5: NARCLIM SEVERE FIRE WEATHER RISK

	1990–2009		2020-2039		2060-2079	
	Baseline Average annual		Average Change	Range	Average Change	Range
Severe Fire Weather Risk (FFDI >50)	5.5 days Sydney Airport		0	-0.78 to +1.15	0.6	-0.72 to +2.03
	7.1 days Richmond					
	Summer		0.1	-0.28 to +0.92	0.1	-0.25 to +0.45
	Autumn		0	-0.03 to 0.00	0	-0.02 to +0.01
	Winter		0	-0.01 to +0.01	0	-0.01 to 0.00
	Spring		0	-0.50 to 0.24	0.5	-0.48 to 1.83

11.1.5 Radiation

Shown in the table below, solar radiation projections show little change for 2030 and a slight increase of 1% for 2090. However, an Australian evaluation suggested that some models are not able to adequately reproduce the climatology of solar radiation. CMIP2 and CMIP5 models appear to underestimate trends in certain regions of southeast coast.

TABLE 11.6: NARCLIM SEVERE FIRE WEATHER RISK

Sydney Olympic Park (Archery Centre) Lat: -33.83 °S Lon: 151.07 °E		Baseline	2030, RCP 4.5		2090, RCP 4.5	
		BOM (local) Mean daily solar exposure	Average Change	Range	Average Change	Range
Solar Radiation (%)	Annual	16.0 (MJ/m ²)	0.6%	-0.6 to +1.6%	1%	-0.2 to +2.9%
Change						

11.1.6 Waterway health

Discharge runoff

Climate change may alter the current patterns of diffuse source water pollution due to projected changes in the seasonality, frequency, intensity and duration of rainfall (IPCC (Intergovernmental Panel on Climate Change) 2014). For example, more intense storms can lead to enlargement of streams through bed and bank erosion, thus releasing significant volumes of sediment downstream. The total annual load of sediment and contaminants that attach to sediment particles is frequently dominated by one or two large storms (Drewry, Newham & Croke 2005). Therefore, climate change could further exacerbate an already significant diffuse source water pollution problem, particularly in areas that become subject to more frequent and intense storms (DECC 2009).

The cumulative impact of frequent, low volume runoff is also significant and can contribute to long periods in which waterways are unfit for use (Harhcegani & Cornish 2003).

11.2 CV – Stewart Monti

“My interest is in projects which combine local aspirations with global responsibility, seeking to regenerate places, ecologies, and communities, and contribute climate positive outcomes.”

Stewart Monti

Associate

Projects

Qiddiya eGames Precinct | Riyadh, Kingdom of Saudi Arabia
Qiddiya Investment Company | Cox | Project Manager | Mixed-Use Precinct

Stewart led the climate resilience and thermal comfort strategy for the Qiddiya eGames Precinct, supporting both LEED for Cities & Communities and LEED BD+C certifications. The work included UTCI modelling and extreme heat mitigation across public realm and building interfaces, addressing walkability, shade, material selection, and operational continuity in one of the world's most extreme climates. Strategies were aligned with ASHRAE 189.1 and Qiddiya's Nature First theme, supporting precinct-wide LEED Gold targets.

Confidential Giga-Project | Jeddah, Kingdom of Saudi Arabia
Public Investment Fund (PIF) | Project Director | Mixed-Use Precinct

Stewart led the Climate Adaptation and Resilience Plan for a major coastal precinct near Jeddah, addressing extreme heat and humidity, sea level rise, and ecological conservation using the latest SSP-RCP scenarios from IPCC AR6. The strategy supported certification pathways across LEED Cities & Communities, LEED BD+C, Envision, and IFC EDGE, embedding long-term climate resilience into all development typologies from early planning through to construction and operations.

Bays West Stage 1 Master Plan | Sydney, NSW
Placemaking NSW | Cox | Project Director | Mixed-Use Precinct

Stewart led the development of the Green Star Communities Credit 4 – Adaptation and Resilience compliant Climate Adaptation Plan for Bays West Stage 1. The process centred First Nations engagement, integrating Caring for Country principles, economic self-determination, and cultural heritage protection into climate resilience planning. Outcomes included operationally focused resilience strategies for future precinct users, urban heat mitigation through green infrastructure, support for biodiversity and urban ecology, and initiatives that enhance place experience and cultural connection.

Lismore Campus Masterplan | Lismore, NSW
Southern Cross University | Terroir | Project Director | Education Campus

Stewart led the Climate Adaptation and Community Resilience Plans for this sub-tropical campus, which also functions as the designated evacuation centre for the flood-prone region. The strategy focused on long-term recovery and emergency management, incorporating off-grid shelter capability, nested systems of essential services, and design measures to mitigate compounding risks from extreme rainfall, overland flow, and heat.

Port Kembla Land Transformation | Port Kembla, NSW
BlueScope | BIG | Project Manager | Mixed-Use Precinct

Stewart developed the Green Star Communities Credit 4 – Adaptation and Resilience compliant Climate Adaptation Plan for the Port Kembla Master Plan. The strategy addressed flood risk, heat stress, coastal exposure, and legacy contamination across a complex brownfield site, using phytoremediation and landscape-based systems to support land rehabilitation. The work also accounted for heavy industry, port operations, cultural



Trained as an Architect and researcher, Stewart is an Environmental Designer at Atelier Ten focused on masterplans and multidisciplinary projects.

He has a varied history across design, construction, and research in the built environment both locally and internationally. Stewart's passion and expertise lies in ecological urbanism and resilience.

Industry Leadership

Circular Australia
Precincts & Infrastructure Taskforce Member
Green Building Council of Australia
Expert Reference Panel Member, Nature and Biodiversity
Green Building Council of Australia
Green Star Accredited Professional,
Buildings & Communities

Qualifications

M. Arch.
University of Technology Sydney
B. Des. (Arch.)
University of Technology Sydney
Dip. Des. (Visual Communication)
University of Technology Sydney,

Experience

Atelier Ten Australia
Associate, 2019 – present
Hanze University of Applied Sciences
Research Associate, 2019 – 2020
University of Technology Sydney
Research Assistant, 2018 – 2019
Royal Zoological Society of NSW
Executive Officer, 2013 – 2019

heritage, and future community use—supporting the precinct’s transition from industrial waterfront to resilient urban place.

Macquarie Park Innovation Precinct Stage 1 | Macquarie Park, NSW

NSW Department of Planning | AJC | Project Director | Mixed-Use Precinct

Stewart led the Climate Adaptation Plan and Climate Risk Assessment for this established mixed-use centre undergoing transformation into a future innovation precinct. The strategy integrated 2040 and 2090 climate horizons and addressed overland flow, extreme heat, and public transport disruption, while also planning for precinct-wide shelter-in-place capability, urban tree canopy targets, and operational continuity for major employers, education providers, and hospitals.

Broadmeadow Precinct | Newcastle, NSW

City of Newcastle | NSW Department of Planning | Cox | Project Director | Mixed-Use Precinct

Stewart led the Climate Adaptation and Resilience Plans for Broadmeadow Precinct, a flood-prone entertainment and sporting precinct undergoing major transformation. The strategy responded to compound risks including extreme heat, overland flow, and the presence of an underground aviation fuel pipeline. Key initiatives included delineating safe egress during floods, climate-robust public domain and mobility infrastructure, and risk mitigation for large-scale event operations—ensuring resilience of both everyday community use and peak crowd conditions.

Central Station Precinct Renewal Program | Sydney, NSW

Transport for NSW | Architectus | Project Manager | Mixed-Use Precinct

Stewart authored the Green Star Communities Credit 4 – Adaptation and Resilience compliant Climate Adaptation Plan for this over-rail precinct. The strategy integrated Transport for NSW’s Climate Risk Assessment Tool to address climate exposure across a 120-year lifespan, while ensuring continuity of operations at Australia’s busiest terminal during construction. Key outcomes included flood-adaptive podium design, resilient infrastructure coordination, shelter-in-place functionality, and landscape-led heat mitigation across mixed-use, transport, and public domain interfaces.

Russell Square | Perth, WA

City of Perth | PLACE Lab | Project Director | Public Open Space

Stewart led the resilience strategy for the revitalisation of Russell Square, addressing typical urban risks such as heat and flooding while placing specific focus on the biological threat posed by Polyphagous Shot-Hole Borer (PSHB). The strategy informed tree succession planning, species selection, and long-term vegetation management to ensure ecological resilience, preserve canopy cover, and protect public amenity in the face of this emerging risk.

Fulcrum | Green Square, NSW

Toga | Bates Smart | Project Manager | Commercial Office

Stewart authored the Green Star Design & As Built Credit 3 – Adaptation and Resilience compliant Climate Adaptation Plan for this high-performance office building in inner-metropolitan Sydney. The strategy addressed extreme heat, overland flow risk, and power continuity through a suite of integrated measures including high-performance façades, shaded and vegetated podium terraces, storm-resilient drainage pathways, and battery-ready infrastructure to support operational continuity and occupant comfort under future climate conditions.

Blue & William | North Sydney, NSW

Third I | Woods Bagot | Resilience Lead | Commercial Office

Stewart authored the Green Star Design & As Built Credit 3 – Adaptation and Resilience compliant Climate Adaptation Plan, addressing physical climate risks and site-specific threats including adjacency to the blast-hardened US Consulate. The strategy integrated storm-adaptive drainage, heat mitigation through façade and landscape design, and future-ready rooftop infrastructure. The plan was reviewed by Lendlease and Keppel REIT

as part of acquisition due diligence and supported the asset's climate resilience credentials during international investment assessment.

Brookhollow Place | Norwest, NSW

Mulpha | 3XN | Project Manager | Commercial Office

Stewart led the development of a comprehensive resilience strategy for Brookhollow Place under Green Star Buildings v1, addressing the following credits: Credit 3 – Climate Change Resilience, Credit 4 – Operational Resilience, Credit 5 – Community Resilience, and Credit 6 – Urban Heat Resilience. The process included climate risk modelling to 2045 and 2080 under RCP8.5, passive survivability planning for power outage scenarios, and design strategies to support long-term occupant wellbeing and community functionality under future climate conditions.

Local: Kensington | Kensington, VIC

Local: | Hayball | Resilience Lead | Residential Precinct

Stewart developed the Green Star-compliant Climate Adaptation Plan for this flood-prone build-to-rent precinct, guiding design teams through risk identification and integration of resilient infrastructure. The strategy prioritised passive heat resilience, water supply continuity, and targeted flood mitigation through elevated design and robust stormwater systems.

175 Liverpool Street | Sydney, NSW

Bates Smart | Resilience Lead | Mixed-Use Tower

Stewart prepared the Climate Adaptation and Resilience Plan for the redevelopment of 175 Liverpool Street into a mixed-use development with residential, commercial workplace, and retail uses. The project targeted Green Star Buildings certification and was subject to PCA A-Grade office requirements and Design Excellence obligations. The adaptation plan addressed flood risk, vertical shelter-in-place, and operational resilience across both towers and podium levels.

Iglu UNSW | Kingsford, NSW

Iglu | Bates Smart | Resilience Lead | Student Accommodation

Stewart led the development of the Climate Adaptation Plan for UNSW's new inner-city student accommodation building in Sydney. The plan focused on urban heat, flash flooding, and energy reliability, with detailed shelter-in-place measures—including off-grid-capable common areas—and formal relocation agreements with local hotels. The strategy addressed the unique needs of student residents and contributed to the project's Green Star Design & As Built certification.

Bradfield Central Park | Western Sydney, NSW

Bradfield Development Authority | Aspect | Project Director | Public Open Space

Stewart led the Climate Adaptation and Resilience Plans for Bradfield Central Park—an exposed, elevated civic parkland at the centre of Western Sydney's new city. The work addressed heat, wind, and overland flow risks through integrated design strategies including passive shelter, resilient planting for extreme conditions, and sponge-city landscape systems. Stewart's plans ensured resilience was embedded in early design decisions and coordinated with wider Bradfield City Centre infrastructure delivery.

Strategic

Urban Heat and Resilience Study | Sydney, NSW

Government Architect NSW | Resilience Lead | Urban Heat Policy

Stewart supported the development of urban heat mitigation strategies for GANSW's Urban Heat and Resilience Study, supporting future policy updates to the Sustainable Buildings SEPP. His work included targeted research into the international planning context and best-practice case studies, culminating in detailed final recommendations on staged policy implementation, disclosure requirements, and building-scale performance metrics.

Renaturing for Resilience | USA

NSW Architects Registration Board | Project Lead | Independent Applied Research Project

Stewart led the Renaturing for Resilience research project as the recipient of a Byera Hadley Travelling Scholarship, investigating how ecological urbanism supports community and climate resilience. The study explored leading projects across North America—spanning urban biodiversity corridors, waterfront regeneration, and nature-positive infrastructure—translating international best practice into recommendations for Australian urban planning and design.

M-NEX | Sydney, NSW

Belmont Forum & JPI Urban Europe | Project Manager | Academic Research Project

Stewart managed the Sydney Living Lab for the international M-NEX (Food–Energy–Water Nexus) collaborative research project, funded by the Belmont Forum and led by Tokyo University. He coordinated cross-disciplinary research across government, academia, and industry to explore integrated design strategies that enhance urban resilience, resource security, and community wellbeing in Western Sydney and Greater Sydney.

Publications

Renaturing for Resilience

NSW Architects Registration Board, 2025

Towards fossil free cities – Emission assessment of food and resources consumption with the FEWprint carbon accounting platform

Cleaner Environmental Systems, 2022

Nature Driven Planning for the FEW-Nexus in Western Sydney

Springer, 2021

Where Do We Stand? A Survey of Resilient Design Measures for Building Envelope and HVAC&R Systems

Ecolibrium, 2020

Nature-Inclusive Cities: Concepts and Considerations

Springer, 2020

Antifragile: What makes HVAC&R systems resilient?

Ecolibrium, 2019

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