ARUP

Department of Education (DoE)

Melrose Park High School

ESD REF Report

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1. Introduction

This ESD Report has been prepared by Arup on behalf of the Department of Education (DoE) to assess the potential environmental impacts that could arise from the construction and use of the new Melrose Park High School project (the **Activity**) at 37 Hope Street, Melrose Park. This report supports the assessment of the proposed Activity under Part 5 of the *Environmental Planning and Assessment Act 1979*. The Activity is proposed by the DoE to meet the growth in educational demand in the Melrose Park precinct.

This report has been prepared to describe how the proposal will incorporate the principles of ecologically sustainable development in the design, construction and ongoing operation of the activity.

1.1 Summary of the Activity

The proposed activity involves the construction and use of a new high school in two stages for approximately 1,000 students.

Stage 1 of the proposed activity includes the following:

- Site preparation works.
- Construction of Block A – a six-storey (with additional roof/plant level) school building in the south-western portion of the site containing staff rooms and General Learning Spaces (GLS).
- Construction of Block B – a one storey (double height) hall, gymnasium, canteen and covered outdoor learning area (COLA) building in the south-eastern portion of the site.
- Construction of Block C – a single storey plant and storage building at the north-eastern portion of the site.
- Associated landscaping.
- Construction of on-site car parking.
- Provision and augmentation of services infrastructure.
- Associated public domain infrastructure works to support the school, including (but not limited to):
  - Provision of kiss and drop facilities along Wharf Road, and widening of the Wharf Road footpath.
  - Raised pedestrian crossings on Wharf Road and Hope Street.

Stage 2 of the proposed activity includes the following:

- Construction of Block D – a five-storey (with additional roof/plant level) school building in the north-western portion of the site containing staff rooms and GLS:
- Additional open play spaces within the terrace areas of Building D.
- Minor layout amendments to Block A.

The Review of Environmental Factors prepared by Ethos Urban provides a full description of the proposed works.

1.2 Site Description

The site is located at 37 Hope Street, Melrose Park within the Parramatta LGA. The school covers an approximate area of 9,500m^2 and is generally rectangular in shape. The site is currently cleared and vacant. The site is located approximately 8km east of the Parramatta CBD.

1.3 Significance of Environmental Impacts

Based on the identification of potential issues, and an assessment of the nature and extent of the impacts of the proposed development, it is determined that:

- The extent and nature of potential impacts are low and will not have significant impact on the locality, community and/or the environment.
- Potential impacts can be appropriately mitigated or managed to ensure that there is no significant impact on the environment.

1.4 REF Reporting Requirements

Requirement	Relevant Report Section
Ecologically sustainable development	
Does the ESD Report set sustainability targets for the activity in line with the department's commitments, including: • Green Star Buildings certification for projects with >1000m2 new building and >$10m EDC of 5 Star for Sydney, Wollongong and Newcastle metro or 4 Star for rest of NSW • Operational energy and potable water intensity targets for the activity?	Section 2.3, Section 2.7
If Green Star Buildings certification is required, does the ESD Report include: • the Green Star registration number for the project, and • a Green Star Building pathway showing how activity will achieve the required number of credit points to certify?	Section 2.3, Appendix A.1
If applicable under the Sustainable Buildings SEPP, has an NABERS embodied emissions material form been included in the ESD Report?	Provided by separate submission of NABERS Materials reporting template.
Does the ESD report include a Climate Change Risk Assessment and Adaptation Plan?	Section 2.6, Appendix A.2
For sites identified as any high or extreme risks in the Climate Change Risk Assessment and Adaptation Plan, have design responses been identified to been incorporated into the project to mitigate the risks?	Appendix A.2
Does the ESD Report adequately address how the activity will: • minimise waste from associated demolition and construction; • minimise peak electricity demand; • minimise overall energy use through passive design; • generate and store renewable energy; • minimise consumption of potable water; and • meter and monitor energy and water consumption and energy generation?	Section 2
Does the ESD Report include a Net Zero Action Plan / Net Zero in operations plan (exact name TBA) that adequately addresses how the activity has been designed to eliminate use of fossil fuels during	Provided by separate submission of ESD-MPH-REP-005 Net Zero Statement.

Requirement	Relevant Report Section
operations, or how the use of fossil fuels will be minimised and will be eliminated by 2035?	

2. Sustainability and ESD Strategy

The project has developed a comprehensive ESD strategy to address the minimum requirements set out in the following:

- Clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation
- SINSW Education Facilities Standard and Guidelines (EFSG)
- Government Architect NSW (GANSW) Design Guide for Schools and Environmental Design in Schools Manual
- NSW Government Resource Efficiency Policy (GREP)
- NSW State Environmental Planning Policy for Sustainable Buildings (Sustainable Buildings SEPP)
- National Construction Code (NCC) 2022 Section J Part J4 and J5

The strategy is reflected in a registration for a Green Star Buildings third-party certification, with a minimum rating target of 5 Stars. This target performance is considered "Australian Excellence" level by the Green Building Council of Australia (GBCA). The Green Star rating is currently pursued for the Stage 1 works only, with the rating of Stage 2 works to be coordinated in the future.

This document outlines the ESD initiatives that are being considered within the building's design to achieve the above aims and targets.

2.1 Sustainable Buildings SEPP Requirements

The following requirements apply to non-residential developments under Section 3.2 of the Sustainable Buildings SEPP:

Table 1 Sustainable Buildings SEPP requirements

Issue and Assessment Requirements		Addressed within section of this ESD report
Consideration of whether the design enables…	The minimisation of waste from associated demolition and construction, including by the choice and reuse of building materials	Section 2.4
	A reduction in peak demand for electricity, including through the use of energy efficient technology	Section 2.7
	A reduction in the reliance on artificial lighting and mechanical heating and cooling through passive design	Sections 2.5, 2.7
	The generation and storage of renewable energy	Section 2.7
	The metering and monitoring of energy consumption	Section 2.4
	The minimisation of the consumption of potable water	Section 2.7
Quantification of the embodied emissions attributable to the development		Quantities of key construction materials reported by separate submission of NABERS Materials reporting template

2.2 NCC 2022 Section J Compliance

The activity is committing to exceed the Deemed-to-Satisfy (DTS) requirements of NCC 2022 Section J. In line with the EFSG requirements, the activity is targeting a 10% reduction in energy consumption, in comparison to a minimum NCC 2022 DTS compliant building, excluding any contribution from renewable energy (e.g. rooftop solar PV). A Section J Part J4 minimum DTS compliance assessment was conducted in

Schematic Design stage, which sets out the minimum required fabric performance in order to meet a 10% improvement above DTS provisions. Section J report is submitted by separate submission of ESD-MPH-REP-001.

2.3 Green Star Rating

The project is registered with the GBCA under the Green Star Buildings v1 rating tool and is being designed to a minimum Green Star 5 Star rating. It is registered as:

- GS-13034B New High School in Melrose Park: Stage 1.

The following sections detail best practice sustainability initiatives currently integrated in the design, based on the credits currently targeted within the Green Star Buildings framework. As the design is further developed, the targeted credits may me removed or substituted, or new credits added. Green Star Buildings framework categories presented in the following sections also encompass the requirements of the EFSG.

2.4 Responsible

The following initiatives are currently included in the sustainability strategy:

- Green Star accredited professional has been contractually engaged to provide advice, support and information.
- Environmental targets for the activity and a system in place to measure results:
    - 20% reduction in energy use compared to reference building
    - 45% reduction in potable water use compared to reference building
    - 20% reduction in upfront carbon emissions compared to reference building
    - Airtightness target of 4 $m^3/h.m^2$ (AP50) based on ATTMA TSL2
- Design for optimum ongoing management through appropriate metering and monitoring systems. Services and maintainability reviews to be conducted, and commissioning and tuning of building systems to ensure systems are operating as intended.
- Provision of building information to facilitate operator and user understanding of all building systems, and their specific operation and maintenance requirements and/or environmental targets.
- Responsible construction practices to be put in place by the Contractor, including development of project-specific best-practice environmental management plan (EMP). Implementation of a formalised approach to planning, implementing and auditing during construction to ensure conformance with the EMP.
- Minimum of 90% of waste generated from construction and demolition to be reused or recycled, to limit the amount of waste going to landfill. Waste management plans to be developed by the Contractor for demolition, construction and operation of the site.
- An operational waste management plan (OWMP) has been developed by Elephant's Foot for the REF submission. OWMP principles to be incorporated into the design in future project phases, including separation of waste streams (general, recycling, and organics or other) and design of adequate waste storage area.
- Selection of internal building finishes products to have GBCA recognised sustainability certification or similar (e.g. GECA, EPD, FSC, ECS Carpet Standard).

2.5 Healthy

The following initiatives are currently included in the sustainability strategy:

- Pollutants entering the building are minimised and a high level of outdoor air (50% improvement above AS1668.2) is provided to the regularly occupied spaces.

- Best-practice lighting is provided to improve lighting comfort via flicker-free, high-quality lighting that accuracy addresses the perception of colour within the space, and glare from light sources is limited.
- High levels of daylight and external views are provided to regularly occupied learning and administration areas, to support high levels of visual comfort for building occupants. Detailed daylight modelling will be undertaken in future project phases.
- The building's acoustic design aims to deliver acoustic comfort through achieving maximum internal noise levels, providing acoustic separation, and controlling reverberation.
- Internal air pollutants have been reduced via selection of materials with low or no volatile organic compound (VOC) levels and low formaldehyde concentrations.
- On-site TVOC and formaldehyde tests to verify levels are within concentration limits.

2.6 Resilient

The following initiatives are currently included in the sustainability strategy:

- Design to respond to future climate impacts as identified by a climate change risk assessment. A climate adaptation risk register has been developed for the building to address specific climate risks of the design and how they might be mitigated to reduce risk. Adaptation responses to address high and extreme risks have been proposed within the project's Climate Resilience Plan (see Appendix A.2).
- Strategies to minimise the urban heat island effect including light-coloured roofing and external finishes, as well as maximising the extent of landscaping elements.

2.7 Positive

The following initiatives are currently included in the sustainability strategy:

- The activity is to align with the SINSW Commitment to Sustainability Goals for 2030 (net zero emissions in operations) and the Sustainable Buildings SEPP requirements (fossil fuel free by 2035). The design team's current inclusions are as follows:
  - 100% electric services including heat pumps for heating and domestic hot water
  - No piped gas connection; only gas bottles provision for Bunsen burners in science laboratory and welding in Workshops. Bottled gas use intended to allow future transition away from gas.
  - Refer to ESD-MPH-REP-005 Net Zero Statement prepared to support REF
- Passive design principles, including high-performance building envelope, effective shading and building orientation, and natural ventilation openings to support comfortable and low-energy indoor environment quality.
- Exceeding NCC 2022 Section J minimum DTS requirements. The EFSG Section DG02.03 requires the activity to target a 10% reduction in energy consumption, in comparison to a minimum NCC 2019 DTS compliant building, excluding any contribution from renewable energy (e.g. rooftop solar PV). The project proposes to verify this via NCC 2022 Section J DTS calculations. No energy or thermal modelling has been scoped.
- Effective shading devices which reduce solar heat gains to conditioned spaces.
- Energy-efficient lighting (typically LED) will be provided throughout, and high efficiency heating and cooling.
- Fully electric building. Any gas used in lab/workshops equipment or emergency power is to be offset for the first five years of operation.

- Roof mounted solar photovoltaic (PV) system in accordance with EFSG requirements.
- All refrigerants with Global Warming Potential (GWP) above 10 to have their initial charges offset.
- Enhance the water efficiency of the proposed activity and reduce potable water consumption associated with the major uses:
    - Selection of water-efficient sanitary fittings and fixtures in line the Green Star and EFSG requirements;
    - Rainwater harvesting and water reuse system for irrigation and toilet flushing;
    - No water-based heat rejection systems for air conditioning (no cooling towers).
- Reduction of Portland cement content and aggregates in all structural concrete.

2.8 Places

The following initiatives are currently included in the sustainability strategy:

- End-of-trip facilities for staff to encourage active transport modes of commuting. Facilities to be safe and protected.
- Traffic engineer to carry out a transport assessment in line with the SINSW requirements.
- School infrastructure designed to encourage access by public transport and site walkability.
- Provision of bicycle parking facilities.
- Design to reflect and celebrate local culture, heritage and identity, informed by meaningful engagement with community groups.

2.9 People

The following initiatives are currently included in the sustainability strategy:

- Contractor's construction practices to promote diversity and reduce physical and mental health impacts.
- Through collaboration with the Connecting with Country consultant, incorporate Indigenous design elements into the project design, addressing each of the principles from the Australian Indigenous Design Charter (AIDC). Aboriginal and Torres Strait Islander communities to be engaged throughout. The school is to be designed in such a manner as to acknowledge and recognise the Indigenous culture of the site, and information on the reconciliation and cultural values made available to the public visitors and users of the building.
- Universal design principles implemented to provide safe, equitable and dignified access for persons with disabilities.
- The activity implements a social procurement plan and generates employment opportunities for disadvantaged and under-represented groups.

2.10 Nature

The following initiatives are currently included in the sustainability strategy:

- Appropriate internal and external lighting design to reduce light pollution. External lighting to be designed such that the Upward Light output Ratio (ULOR) <5%.
- Incorporate an appropriate landscape area that includes a diversity of species and prioritises the use of climate-resilient and Indigenous plants. A site-specific Biodiversity Management Plan to be developed.

- Landscaping and rainwater harvesting to support Water Sensitive Urban Design and limit stormwater pollutants leaving the site.
- On-site detention (OSD) tank to reduce peak discharge to the sewer.

3. Conclusion

This report identifies the sustainability measures being pursued by the project team, in alignment with the frameworks and requirements applicable to the activity. The sustainability strategy includes holistic design and operational initiatives, to encourage best practice design towards energy, water, and waste reduction; as well as providing improved indoor environmental quality and a positive impact on nature and the community.

Subject to implementing the recommendations/mitigation measures set out in Sections 2.4 to 2.10 of this report, the conclusion of this assessment is that the proposed Activity is not likely to significantly affect the environment in relation to ecologically sustainable development matters.

3.1 Mitigation Measures

Table 2 Mitigation Measures

Mitigation Number/Name	Aspect/Section	Mitigation Measure	Reason for Mitigation Measure
Green Star Strategy	Prior to commencement of any construction work	Finalisation and demonstration of all Green Star strategy targeted credits, through the award of a Green Star Design Review certification.	The credits forming the Green Star strategy aim to enhance sustainability of the project and minimise impact on the locality, community and/or the environment.
Sustainability Strategy	Prior to commencement of any construction work	If any departures from the sustainability strategy described in this report arise, a review of the strategy is required.	Ensure the proposed activity still meets the ESD initiatives and targets.
Section 2.3 Responsible – Metering and Monitoring	During design finalisation	Services and maintainability reviews to be conducted.	Design for optimum ongoing management and operations.
Section 2.3 Responsible – Contractor EMP	Prior to commencement of any construction work	Responsible construction practices to be put in place by the Contractor, including development of project-specific best-practice environmental management plan (EMP).	Construction practices to reduce impacts and promote opportunities for improved environmental and social outcomes.
Section 2.3 Responsible – Construction and Demolition Waste Management	Prior to commencement of any construction work	Waste management plans to be developed by the Contractor for demolition, construction and operation of the site.	Construction practices to reduce impacts and promote opportunities for improved environmental and social outcomes.
Section 2.3 Responsible – OWMP	During design finalisation	Design of waste facilities in response to REF OWMP.	Management of operational waste in a safe and efficient manner.
Section 2.8 People – Contractor inclusive policies	Prior to commencement of any construction work	Demonstration of Contractor policies that promote diversity and reduce physical and mental health impacts.	Construction practices to promote diversity and reduce physical and mental health impacts.
Section 2.9 Nature – Biodiversity Management Plan	During design finalisation	Develop a site-specific Biodiversity Management Plan.	Ensure biodiversity is maintained during operations.

A.1 Green Star Pathway

The Green Star strategy targets points as per the pathway below, including the credits referenced in Section 2, however credits may be added, removed, or substituted in the further design development while retaining a target rating of minimum 5 Stars.

Credit	Name	Credit Type	Points	Minimum Requirement	Climate Positive Pathway (5-star)	Targeted credits (5-Star)	Risk	Criteria
1	Industry Development	Credit Achievement	1			✓	L	The building owner or developer appoints a Green Star Accredited Professional, discloses the cost of sustainable building practices to the GBCA, and markets the building's sustainability achievements.
2	Responsible Construction	Minimum Expectation	0			✓	L	The builder or head contractor has an environmental management system and plan in place to manage its environmental impacts on site; The builder diverts at least 80% of construction and demolition waste from landfill; The head contractor provides training on the sustainability targets of the building.
		Credit Achievement	1			✓	L	90% of construction and demolition waste is diverted from landfill, and waste contractors and facilities comply with the Green Star Construction and Demolition Waste Reporting Criteria.
3	Verification + Handover	Minimum Expectation	0			✓	L	The building has set environmental performance targets, designed and tested for airtightness, been commissioned, and will be tuned. The building was set up for optimum ongoing management due to its appropriate metering and monitoring systems. The project team create and deliver operations and maintenance information to the facilities management team at the time of handover. Information is available to building users on how to best use the building.
		Credit Achievement	1			✗	L	An independent level of verification is provided to the commissioning and tuning activities through the involvement of an independent commissioning agent, or through a soft landings approach that involves the future facilities management team. For large projects (building services value >$20M), both must occur.
4	Responsible Resource Management	Minimum Expectation	0			✓	L	The project team must demonstrate the building is designed to allow effective management of operational waste by: • Separating waste streams; • Providing a dedicated and adequately sized waste storage area; and • Ensuring efficient and safe access to waste storage areas for both occupants and waste collection contractors.
5	Responsible Procurement	Credit Achievement	1			✗	M	• The building's design and construction procurement process follows ISO 20400 Sustainable Procurement - Guidance and at least 10 items and identified supply chain risk and opportunity are addressed. • A responsible procurement plan is developed
6	Responsible Structure	Credit Achievement	3			✗	M	50% of all structural components (by cost) meet a Responsible Products Value score of at least 10.
		Exceptional Performance	2			✗	H	In addition to the Credit Achievement, one of the following is met: • 10% of all products in the structure (by cost) meet a Responsible Products Value score of at least 15; OR • 80% of all products in the structure (by cost) meet a Responsible Products Value score of at least 10.
7	Responsible Envelope	Credit Achievement	2			✗	M	30% of all building envelope components (by cost) meet a Responsible Products Value score of at least 10.

		Exceptional Performance	2			✗	H	In addition to the Credit Achievement, one of the following is met: • 10% of all products in building envelope (by cost) meet a Responsible Products Value score of at least 15; OR • 60% of all products in the building envelope (by cost) have an average Responsible Products Value score of at least 10.
8	Responsible Systems	Credit Achievement	1			✗	H	20% of all active building systems (by cost) meet a Responsible Products Value score of at least 6.
		Exceptional Performance	1			✗	H	In addition to the Credit Achievement, one of the following is met: • 5% of all active building systems (by cost) meet a Responsible Products Value score of at least 11; OR • 35% of all active building systems (by cost) have an average Responsible Products Value score of at least 6.
9	Responsible Finishes	Credit Achievement	1			✓	M	40% of all internal building finishes (by cost) meet a Responsible Products Value score of at least 7.
		Exceptional Performance	1			✗	H	In addition to the Credit Achievement, one of the following is met: • 10% of all internal building finishes (by cost) meet a Responsible Products Value score of at least 12; OR • 60% of all internal building finishes (by cost) have an average Responsible Products Value score of at least 7.
10	Clean Air	Minimum Expectation	0			✓	L	Pollutants entering the building are minimised, and a high level of fresh air (50% greater than AS1668) is provided to ensure levels of indoor pollutants are maintained at acceptable levels; OR Performance based approach showing CO2 maintained below 800 ppm in regularly occupied areas.
		Credit Achievement	2			✗	M	The building's ventilation systems allow for easy maintenance, and high levels of outdoor air (100% greater than AS1668) are provided.
11	Light Quality	Minimum Expectation	0			✓	L	The building provides adequate levels of daylight and good lighting levels suitable for the typical tasks in each space.
		Credit Achievement	2			✓	L	The building provides either best practice Artificial Lighting OR best practice access to daylight.
		Exceptional Performance	2			✗	H	The building provides both best practice Artificial Lighting AND best practice access to daylight.
12	Acoustic Comfort	Minimum Expectation	0			✓	L	An Acoustic Comfort Strategy is prepared to describe how the building and acoustic design aims to deliver acoustic comfort to the building occupants.
		Credit Achievement	2			✓	M	The building is designed and tested to achieve minimum acoustic performance requirements aligned with the Acoustic Comfort Strategy.
13	Exposure to Toxins	Minimum Expectation	0			✓	L	The building's paints adhesives, sealants, carpets, and engineered wood products are low or non-toxic. Occupants are not exposed to banned or highly toxic materials in the building.
		Credit Achievement	2			✓	L	On-site tests verify the building has low Volatile Organic Compounds (VOC) and formaldehyde levels.

14	Amenity and comfort	Credit Achievement	2			✗	L	The building has at least one dedicated amenity room to act as parent room, a relaxation room, or an exercise room. Rooms must be accessible to all staff and occupants. Minimum size 1m2 per every 10 staff or occupants. Must be separate from bathrooms.
15	Connection to Nature	Credit Achievement	1			✗	H	• The building provides views (60% of regularly occupied areas); AND (• Includes indoor plants and incorporates nature-inspired design; OR • 5% of the building's floor area is allocated to nature in which occupants can directly engage with.)
		Exceptional Performance	1			✗	H	• The building provides views (60% of regularly occupied areas); AND • Includes indoor plants and incorporates nature-inspired design; AND • 5% of the building's floor area is allocated to nature in which occupants can directly engage with.
16	Climate Change Resilience	Minimum Expectation	0			✓	L	The project team completes the climate change pre-screening checklist. The project team communicates the building's exposure to climate change risks to the applicant.
		Credit Achievement	1			✓	L	The project team develops a project-specific climate change risk and adaptation assessment for the building. Extreme and high risks are addressed.
17	Operations Resilience	Credit Achievement	2			✗	L	• The project team undertakes a comprehensive review of the acute shocks and chronic stresses likely to influence future building operations. • The building's design and future operational plan addresses any high or extreme system-level interdependency risks. • The building's design maintains a level of survivability and design purpose in a blackout.
18	Community Resilience	Credit Achievement	1			✗	M	The project team undertakes a needs analysis of the community, identifies shocks and stresses that impact the building's ability to service the community, and develops responses to manage these.
19	Heat Resilience	Credit Achievement	1			✓	M	At least 75% of the whole site area comprises of one or a combination of strategies that reduce the heat island effect.
20	Grid Resilience	Credit Achievement	3			✗	M	The building meets one or several of the following to reduce peak electricity demand by 10%: • Provides active generation and storage systems; • Has the infrastructure to deliver an appropriate demand response strategy; or • Has reduced its electricity consumption through passive design.
21	Upfront Carbon Emissions	Minimum Expectation	0			✓	M	The building's upfront carbon emissions are at least 10% less than those of a reference building
		Credit Achievement	3			✓	H	The building's upfront carbon emissions are at least 20% less than those of a reference building, and offset existing building demolition works
		Exceptional Performance	3			✗	H	The building's upfront carbon emissions are at least 40% less than those of a reference building, and all remaining emissions from Modules A1 – A5 are offset.
22	Energy Use	Minimum Expectation	0			✓	L	The building's energy use is at least 10% less than a reference building
		Credit Achievement	3			✓	L	The building's energy use is at least 20% less than a reference building. (Minimum requirement for 5 Stars)
		Exceptional Performance	3			✗	H	The building's energy use is at least 30% less than a reference building
23	Energy Source	Minimum Expectation	0			✓	L	The building provides a Zero Carbon Action Plan.
		Credit Achievement	3			✓	L	100% of the building's electricity comes from renewable electricity

		Exceptional Performance	3			✔	L	100% of the building's energy comes from renewables; all elecric building (Minimum requirement for 5 Stars)
24	Other Carbon Emissions	Credit Achievement	2			✔	L	The building owner eliminates (GWP<10) or offsets emissions from refrigerants. (Minimum requirement for 5 Stars)
		Exceptional Performance	2			✘	M	All other emissions not captured in the Positive category are eliminated or offset.
25	Water Use	Minimum Expectation	0			✔	L	The building installs efficient water fixtures or uses 15% less potable water compared to a reference building.
		Credit Achievement	3			✔	M	The building uses 45% less potable water compared to a reference building.
		Exceptional Performance	3			✘	H	The building uses 75% less potable water compared to a reference building.
26	Life cycle Impacts	Credit Achievement	2			✘	H	The project demonstrates a 30% reduction in life cycle impacts when compared to standard practice.
27	Movement and Place	Minimum Expectation	0			✔	L	The building includes showers and changing facilities for building occupants that are accessible, inclusive and located in a safe and protected space.
		Credit Achievement	3			✘	H	The building's design and location prioritises walking, cycling, and transport options that reduce the need for private fossil fuel powered vehicles.
28	Enjoyable Places	Credit Achievement	2			✘	M	The building delivers memorable, beautiful, vibrant communal or public places where people want to gather and participate in the community. The spaces are inclusive, safe, flexible and enjoyable.
29	Contribution to Place	Credit Achievement	2			✘	M	The building's design contributes to the liveability of the wider urban context and enhances the public realm; or independent reviews are held during design development
30	Culture, Heritage, Identity	Credit Achievement	1			✔	M	The building's design reflects and celebrates local demographics and identities, the history of the place, and any hidden or minority entities; or this outcome was arrived through meaningful engagement with community groups early in the design process.
31	Inclusive Construction Practices	Minimum Expectation	0			✔	L	During the building's construction, the head contractor provides gender inclusive facilities and protective equipment. The head contractor also installs policies on-site to increase awareness and reduces instances of discrimination, racism and bullying.
		Credit Achievement	1			✔	L	The head contractor provides high quality staff support on-site to reduce at least five key physical and mental health impacts relevant to construction workers. They must also carry out a needs analysis, and evaluate the effectiveness of their interventions.
32	Indigenous Inclusion	Credit Achievement	2			✔	M	The building's design and construction celebrates Aboriginal and Torres Strait Islander people, culture and heritage by incorporating design elements using the Indigenous Design and Planning principle
33	Procurement and Workforce Inclusion	Credit Achievement	2			✔	L	Through the implementation of a social procurement strategy, at least 2% of the building's total contract value has been directed to generate employment opportunities for disadvantaged and under-represented groups.
		Exceptional Performance	1			✘	M	Through the implementation of a social procurement strategy, at least 4% of the building's total contract value has been directed to generate employment opportunities for disadvantaged and under-represented groups.

34	Design for Inclusion	Credit Achievement	2			✔	L	The building is designed and constructed to be inclusive to a diverse range of people with different needs. Includs equitable and safe access to the building, diverse wayfinding, and inclusive spaces (e.g. parents room, family restrooms)
		Exceptional Performance	1			✖	M	Engagement with target groups to conduct a needs analysis, which informs the inclusive design.
35	Impacts to Nature	Minimum Expectation	0			✔	L	The building was not built on, or significantly impacted, a site with a high ecological value. Light pollution is minimised.
		Credit Achievement	2			✖	H	• The building's design and construction conserves existing natural soil, hydrological flows and vegetation elements; and • If deemed necessary by an Ecologist, at least 50% of existing site with high biodiversity value is retained
36	Biodiversity Enhancement	Credit Achievement	2			✔	M	• The building's site includes an appropriate landscape area; • The landscaping includes a diversity of species and prioritises the use of climate-resilient and indigenous plants; and • The project team develops a site-specific Biodiversity Management Plan and provides it to the building owner or building owner representative.
		Exceptional Performance	2			✖	H	• A greater area of landscaping is provided; and • The landscaping includes critically endangered and/or endangered plant species native to the bioregion.
37	Nature Connectivity	Credit Achievement	2			✖	H	The site must be built to encourage species connectivity through the site, and to adjacent sites. If the project sits within a blue or green grid strategy it must contribute to the goals of the strategy.
38	Nature Stewardship	Credit Achievement	2			✖	H	The building owner, as part of the project's development, undertakes activities that protects or restores biodiversity at scale beyond the development's boundary. Area of restoration or protection must be equivalent to GFA.
39	Waterway Protection	Credit Achievement	2			✔	M	The building demonstrates an annual average flow reduction (ML/yr) of 40% compared to pre-development levels and meets specified pollutants targets.
		Exceptional Performance	2			✖	H	The building demonstrates an annual average flow reduction (ML/yr) of 80% compared to pre-development levels and meets specified pollutants targets.
40	Market Transformation	Credit Achievement	1			0	H	The project demonstrates: • How a building solution or process is considered leading in their targeted sector, nationally or globally; or • That the technology or process is not commonly used within Australia's building industry; or globally, depending on the context of the innovation claimed.
41	Leadership Challenges - Climate Positive Pathway	Credit Achievement	1			1	L	1 point is awarded if the Climate Positive Pathway is achieved.
	Leadership Challenges - Fossil Fuel Free Construction Sites	Credit Achievement	3			0	H	• The project has achieved specific credits within the relevant rating tool • 20% of high emitting construction equipment on a high emitting construction activity is fossil fuel free • The site offices are powered by 100% renewable energy • All electricity used by the construction site is 100% renewable.

A.2 Climate Change Resilience Plan

Climate Resilience Plan

Melrose Park High School

November 2024

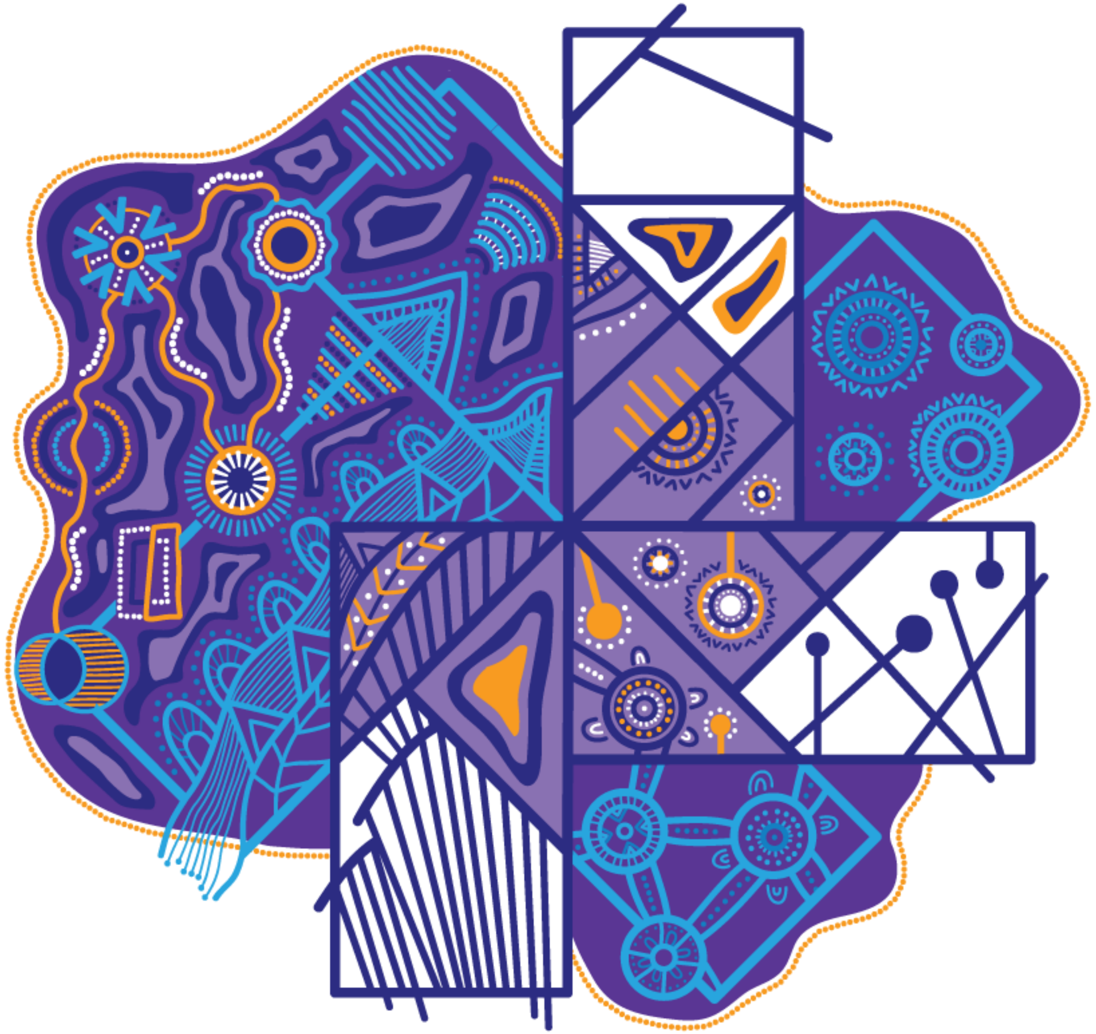
Document Verification

Project name: SINSW GROUP 1 – MELROSE PARK			30339200		
Climate Resilience Plan			Climate resilience plan_Melrose Park High School		
Schools Infrastructure NSW					
Version	Date				
V01	14/112024	Description	Climate Resilience Plan for Melrose Park High School		
			Prepared by	Checked by	Approved by
		Name	Lalita Garg	Amelia Tomkins	Amelia Tomkins

Acknowledgement of Country

Arup acknowledges the Traditional Owners across all lands, waters, and skies our firm may reach; we acknowledge their wisdom, resilience, and rich cultural heritage. We pay our respects to the Elders, past and present, and to all Aboriginal and Torres Strait Islander peoples.

We recognise the ongoing journey of healing and reconciliation, and Arup commits to walking alongside First Nations peoples, to acknowledge their teachings and foster a future of unity and respect.



‘Continuing to Shift to shape an even better world’ original artwork by Tarni O’Shea of Gilimbaa and updated by David Williams of Gilimbaa.

Contents

Appendices

Background and approach

Background

Melrose Park High School development

The subject site falls within the Local Government Area of the City of Parramatta Council (COPC). The site is bounded by a combination of low-height residential developments and future high rise residential developments. The new school development is intended to service an expected growth in population in the City of Parramatta.

To the west along Hope Street, future high-rise developments are planned. On the eastern frontage along Wharf Road low-rise residential houses are being maintained and future development is not proposed. Similarly, the proposed site is bounded by existing buildings on the south and a proposed communal sports field to the north.

Climate change and education

The climate has already changed over the past decades impacting both the built and natural form in Australia, through a hotter and drier climate, increased intensity of extreme weather events, and sea level rise.

Climate change is profoundly impacting schools and education systems, both directly and indirectly. Directly, extreme weather events – such as floods and heatwaves – can damage school infrastructure and interdependent infrastructure, disrupt learning environments, and threaten student and staff safety. If not well-adapted for future climate conditions, schools may incur higher operational costs due to enhanced climate control systems and increased maintenance as well as capital costs of recovery.

Indirectly, the effects of a more volatile climate lead increased health risks, including heat-related illnesses and respiratory problems from worsening air quality, which can result in higher absenteeism and decreased student engagement. Furthermore, the socioeconomic challenges faced by families due to climate impacts – such as housing instability and job loss – can affect community cohesion, health, and school attendance.

Projected changes in the climate are predicted to further exacerbate these risks, meaning that what is designed, built and operated today needs to be more resilient to future climate conditions and service needs.

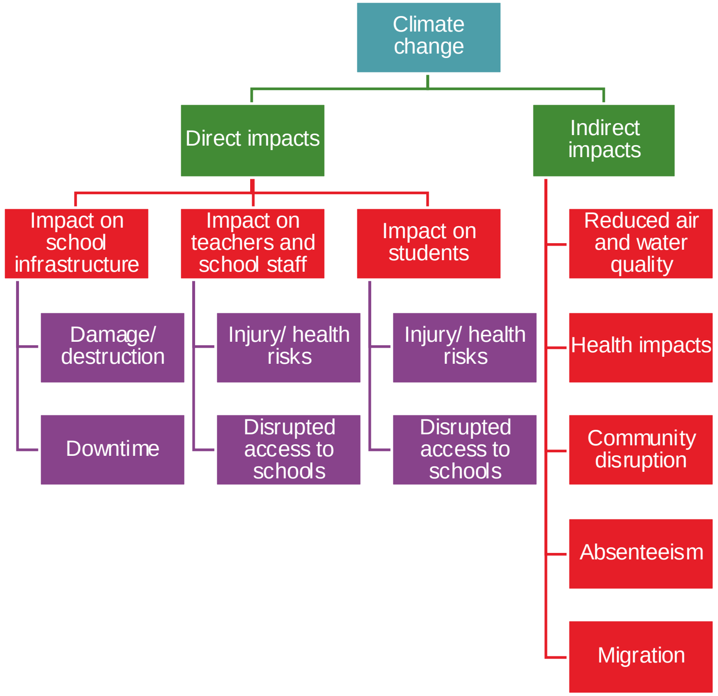


Figure 1: Direct and indirect impacts of climate change on education

Purpose

Purpose of this document

The purpose of this Climate Resilience Plan is to provide an overview of the climate change risk assessment undertaken for the Melrose Park High School. It sets out the future climate context, priority climate-related risk impacts for the development over the design life, and appropriate design and operational adaptation measures to manage and mitigate risks.

This plan has been developed in accordance with AS5334 *Climate change adaptation for settlements and infrastructure—A risk based approach* and Green Star Buildings credit 16: Climate Change Resilience.

It also responds to the Education Facilities Standards and Guidelines.

SINSW is committed to operating in a manner consistent with Sustainable Development principles (Bruntland, 1987 and UN SDGs), federal and state legislation requirements, and industry best practice. The NSW Department of Education has committed to five sustainability principles, including:

- **Build resilience:** equip school communities to withstand and adapt to change.

Managing uncertainty

Current design standards and codes are based on historical conditions and are unfit for the shifting climate which will see an increase in mean conditions, and more extreme conditions and devastating weather events. Disruption from climate change will reduce the useful life of assets unless they are adequately adapted for future climate conditions.

There is significant uncertainty in climate adaptation planning. To better understand the future impacts of climate change, projections aligned with the latest scenarios from the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6) have been adopted. These scenarios, known as Shared Socio-economic Pathways (SSPs), explore how social, technological, and economic changes could affect emissions over time.

The NSW Government recommends using SSP3-7.0 as a high emissions scenario, where CO2 emissions are projected to double by 2100 without further climate policies, leading to an increase of approximately 4 degrees.

For this project, climate-related risks have been assessed under the high emissions scenario (SSP3-7.0) across three relevant time frames.

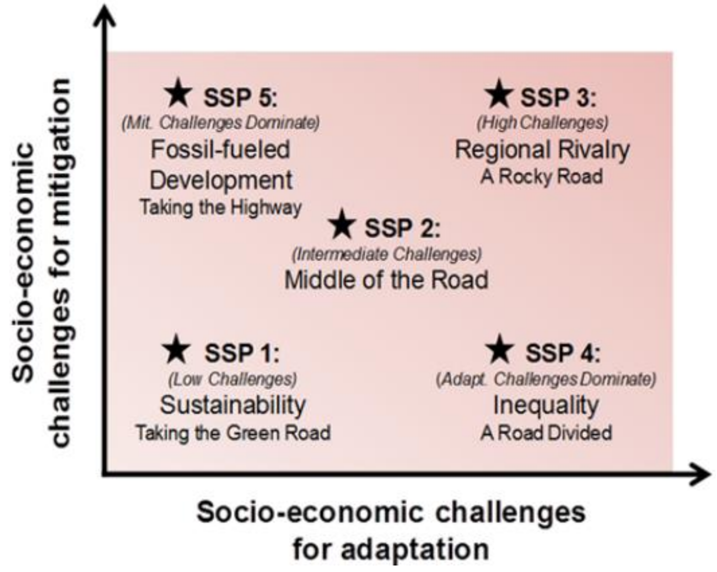


Figure 2: IPCC Shared Socio-economic Pathways (Source: UNFCCC)

Approach to climate risk and adaptation assessment

Three-staged approach

There are three main stages in the climate risk assessment approach: Establishing the context; Understanding risks; and Risk treatment.

1. Establishing the context for the project

Level of risk to assets, operations and people are based on projected changes in climate as well as site specific factors which may alleviate or exacerbate climate-related impacts. Historical and projected climate data was collated, in addition to natural and physical characteristics of the site.

2. Understanding risks

The next stage involved the identification of potential impacts on the project arising from projected changes in climate variables in future time horizons. A preliminary risk assessment was undertaken to analyse and evaluate the consequence and likelihood of climate-related project impacts under a high emissions scenario (SSP3-7.0) for three time horizons (2030, 2050, 2070). Analyses was informed by technical reports and stakeholder engagement, using AS5334 criteria matrices.

3. Risk treatment

The final stage was the identification and prioritisation of appropriate adaptation measures to treat priority risks. This included a residual risk assessment to ensure no high or extreme risks remain.

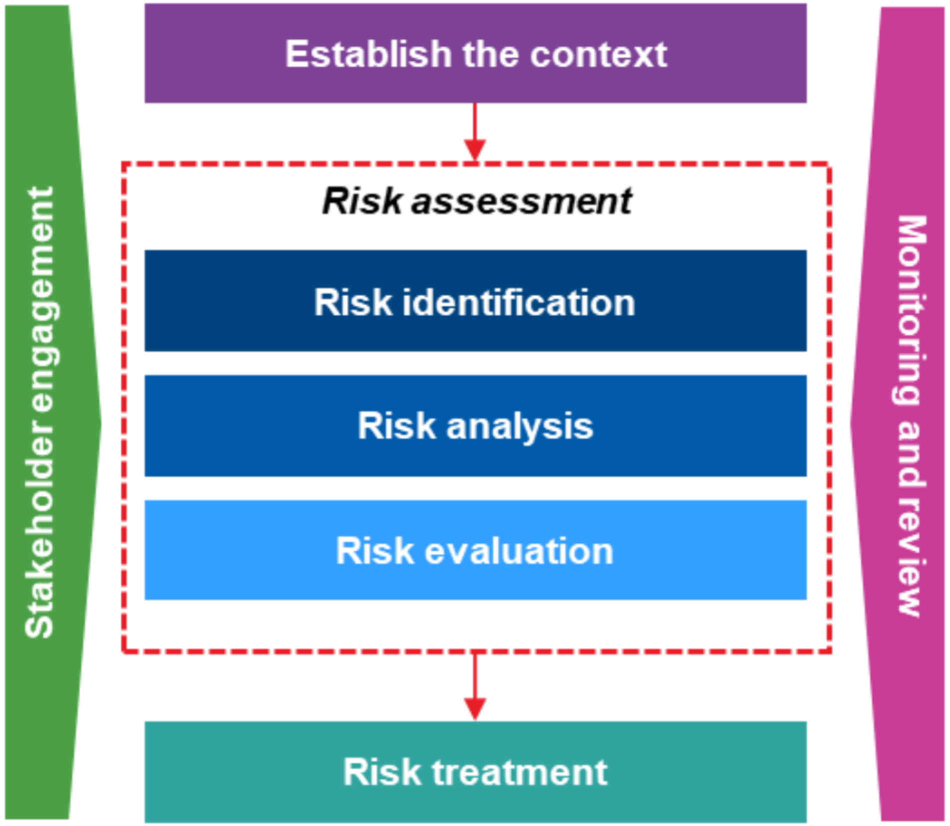


Figure 3: Risk assessment approach based on AS5334: *Climate change adaptation for settlements and infrastructure—A risk based approach*

Stakeholder engagement

Climate risk and adaptation workshop

This plan was developed in collaboration with project stakeholders to identify and validate priority risks and determine appropriate adaptation measures for implementation in design.

A Climate Risk and Adaptation Workshop was held on 22nd October 2024.

The purpose of this workshop was to introduce the climate context for the project, validate priority climate-related risk to the development, identify and prioritise appropriate design and operational adaptation options for inclusion in future design stages.

Risk impacts and adaptation opportunities were considered for architecture, building services, civil, structural, landscaping, transport, utilities, operations, and human health.

Participants

The key stakeholders of the project are listed below:

- Jo Hole: Project Director, SINSW
- Nathan Martin: Project Manager, SINSW
- Joshua De Angelis: Project Manager, SINSW
- Tim Henderson: Civil
- Jose Fernandez: Civil
- Trevor Eveleigh: Architecture
- Tamara Podgorsek: Architecture
- Aiden Lee: Structures
- Luke Morgan: Building Services
- Ed Cain: Building Services
- Kenisha Pundun: Building Services
- Julia Manrique: Landscaping
- Enda Seyama-Heneghan: Sustainability
- Maeve Molins: Operations

Figure 4: Snapshot of workshop Miro board

Site context

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Proposed development

Melrose Park High School

- The site is located on the boundary of Parramatta and Ryde, approximately 14 km north-west of Sydney's Central Business District.
- The site comprises a single land parcel on the corner of Hope Street and Wharf Road, which occupies approximately 9918 square metres.
- The project will comprise the construction of a three-storey building for General Learning Areas (GLA), staff rooms, other educational facilities, a new library and hall building. The proposal will also include landscaping embellishments, construction of various play features and multi-purpose fields, accessible parking, signage, new services and upgrades to the public domain.
- The subject site falls within the Local Government Area of the City of Parramatta Council (COPC). The site is bounded by a combination of low-height residential developments and future high rise residential developments. The site area is north of the Parramatta River and west of Archer's Creek. There is an existing bus route, cycle pathway, train station, and a proposed light rail station (2031).

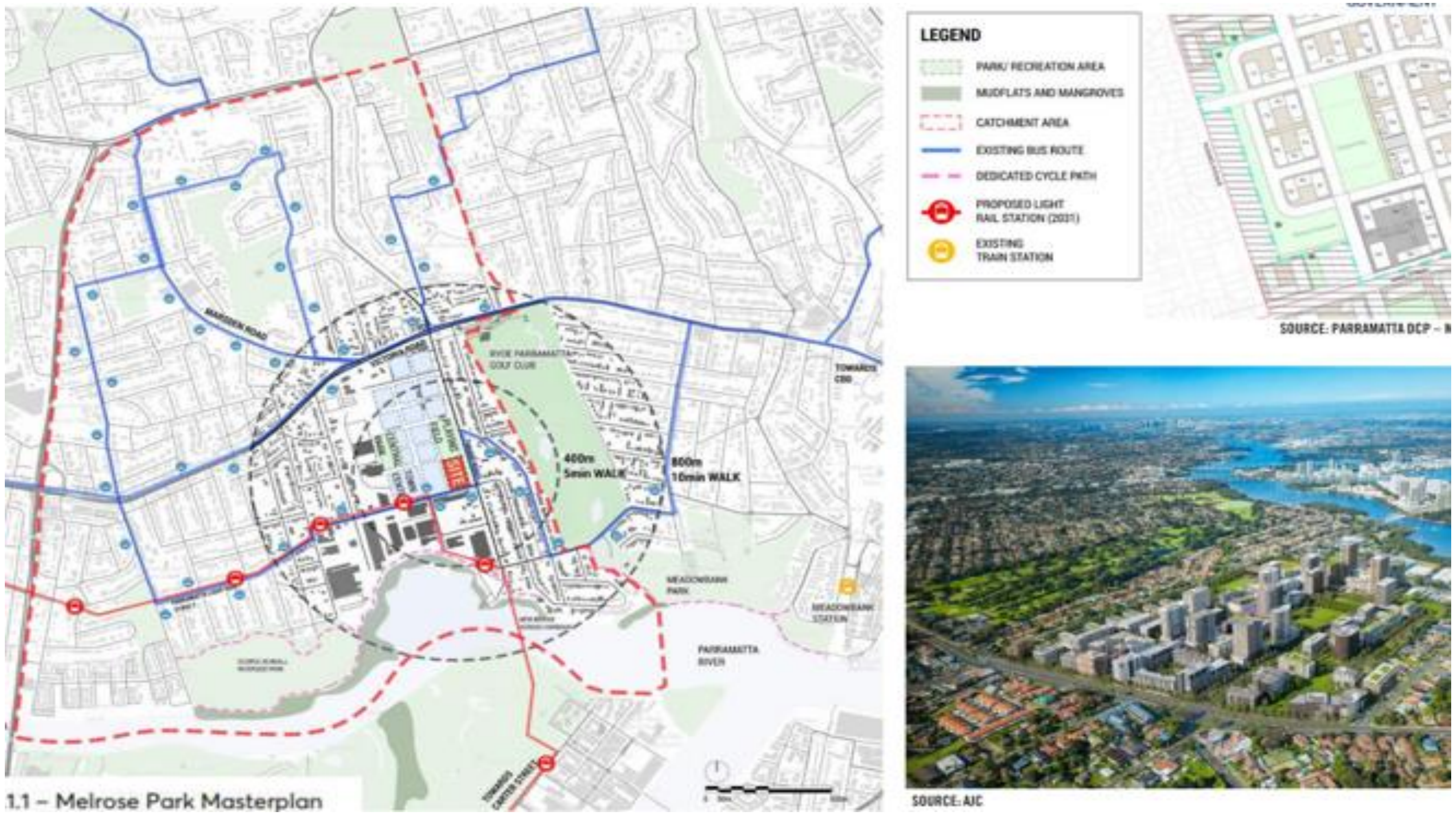

Figure 5: Melrose site location and surrounding infrastructure.

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Site context

Natural and physical characteristics

- The subject site falls within the Local Government Area of the City of Parramatta Council (COPC). The site is bounded by a combination of low-height residential developments and future high rise residential developments. To the west along Hope Street, future high-rise developments are planned. On the eastern frontage along Wharf Road low-rise residential houses are being maintained and future development is not proposed. Similarly, the proposed site is bounded by existing buildings on the south and a proposed communal sports field to the north. The total size of the site is approximately 0.99 hectares.
- The site's topography generally slopes down to the northwest of the site at a relative constant slope of 0.5-1%. The maximum level is approximately RL 16.55 (m AHD) in the north-east corner and the minimum level is approximately RL15.25 (m AHD) in the north-west corner.
- This site is not within a bushfire prone area. However, there is a Category 1a and 3 bushfire prone area approximately 5km east which could cause bushfire effects such as ash and smoke exposure to the site. There are vegetation pockets to the south and east from Archer Park and Archer Creek. But these vegetation pockets will not be affected by site plans.
- Based on a flood study undertaken by Lyall & Associates for Melrose Park North Precinct (Job No. FG486.006, dated 06/10/23), it is understood that the proposed site is subject to flood risk along the site's northern and western boundaries (Civil Concept Design Report). Drainage is to be designed to ensure that site facilities are available for students' use in all weather conditions up to a 1% AEP storm event.
- Based on wind data for Sydney Olympic Park (BoM weather station: 066212), the prevailing wind direction is north-westerly. The site experiences damaging winds (>8m/s) 0.6% of the year, which is considered unlikely.

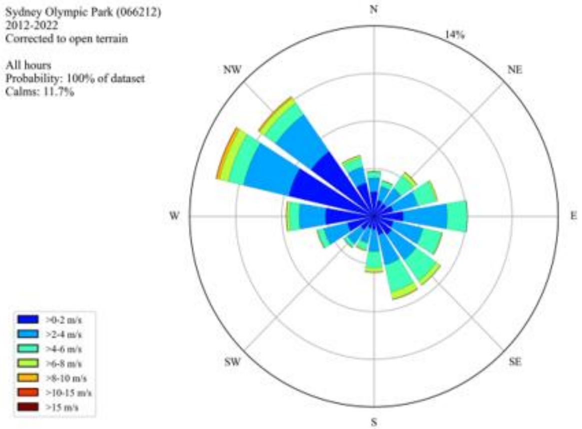

Figure 6: Wind data for Sydney Olympic Park (BoM).

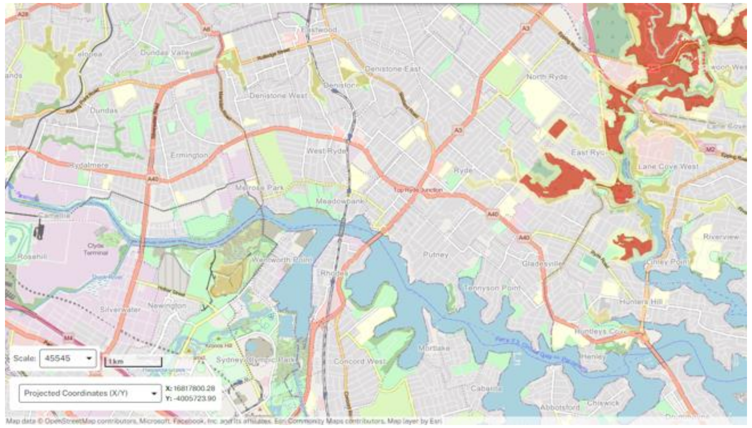

Figure 7: Category 1a and 3 bushfire prone area (NSW Fire Service).

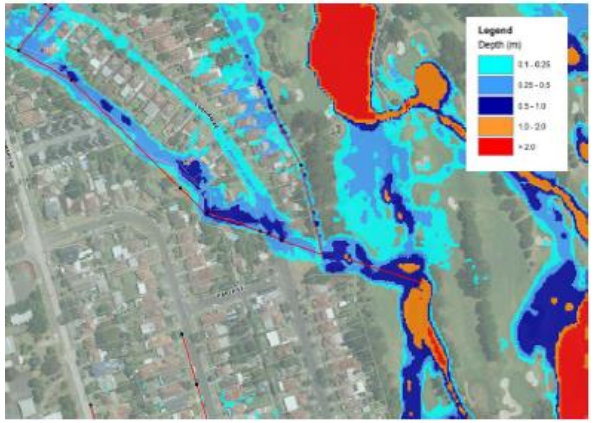

Figure 8: Cobham Avenue, Melrose Park with 1% AEP Flood depth (City of Ryde).

Figure 9: Observed surface water flooding and waterways (Geoscience Australia Portal).

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Existing climate characteristics

Melrose Park High School

The following figures illustrate the climate statistics from the Bureau of Meteorology (BoM) between 1965 and 2024 for Parramatta North (weather station number: 66124).

Key observations of existing climate characteristics for this site include:

- Annual mean maximum and minimum temperatures are 23.4ºC and 12.2ºC, respectively.
- The total annual mean rainfall is 978.1mm.
- Mean relative humidity at 9am and 3pm ranges between 62-80% and 46-60%, respectively.
- The highest recorded temperature was 47ºC, recorded on 4th January 2020.

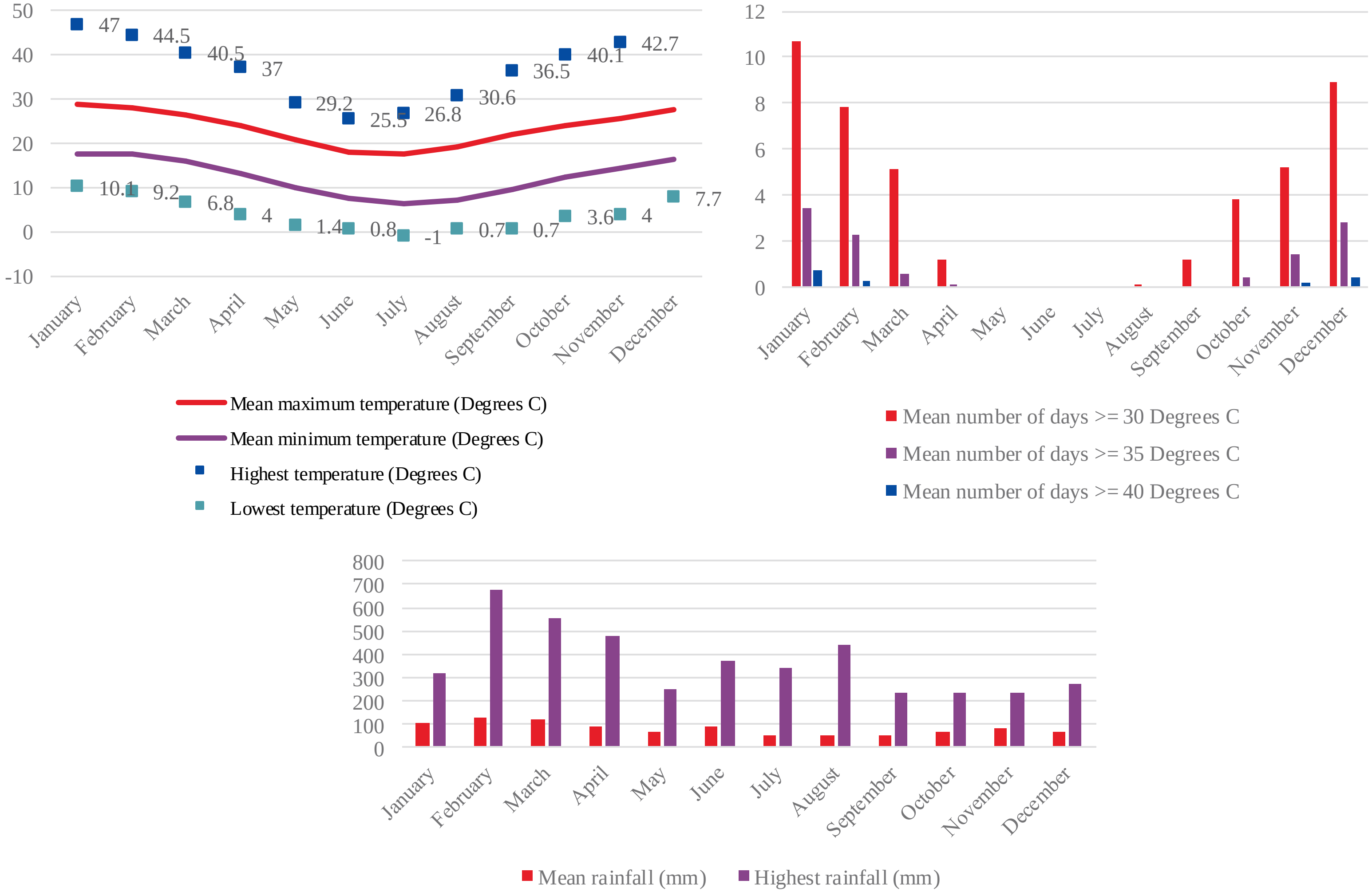
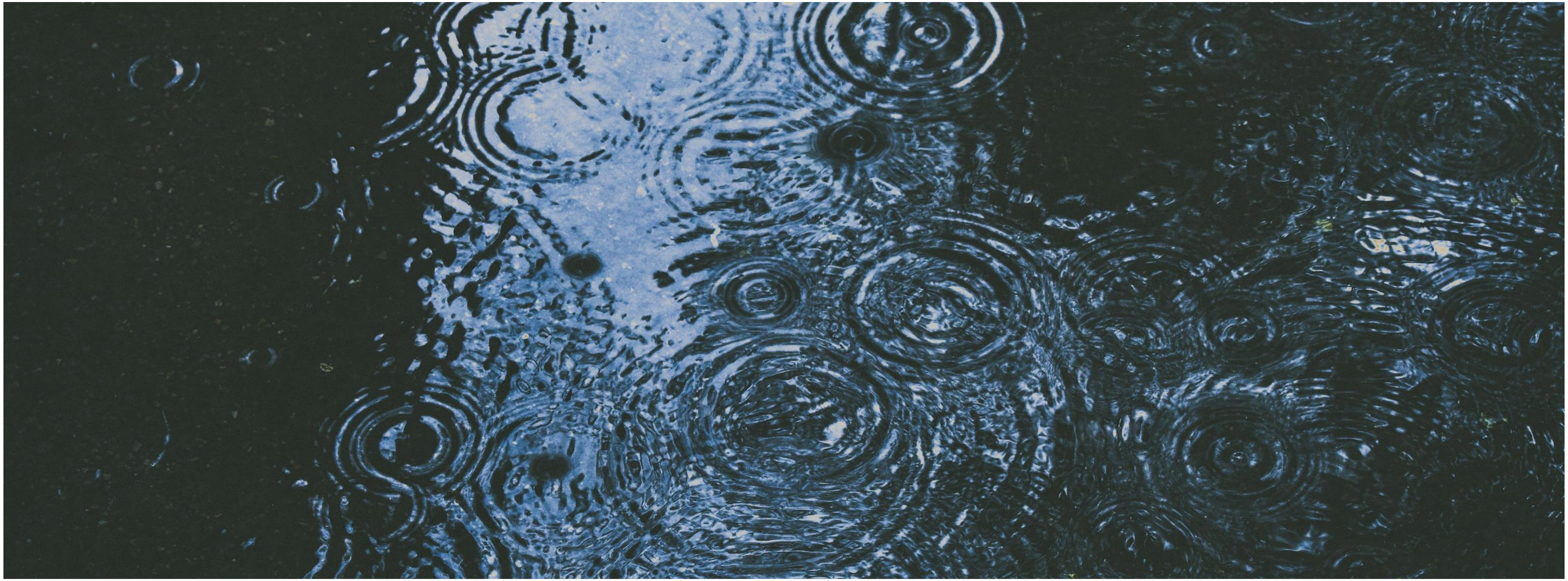


Figure 10: Historical climate statistics sourced from BoM.

Future climate



Climate change scenarios

Overview of climate data

Climate change scenarios provide coherent, plausible, and simplified descriptions of potential future climate conditions, serving as the foundation for climate projections.

The Intergovernmental Panel on Climate Change (IPCC), in its Sixth Assessment Report (AR6), introduced a new set of pathways known as Shared Socio-economic Pathways (SSPs). These pathways explore how changes in social, technological, and economic factors may influence greenhouse gas emissions over time. The climate change projections for the SSPs draw on the latest round of coordinated global climate models known as CMIP6, among many other lines of evidence.

The NSW Government has identified SSP3 as a high-emission scenario for planning purposes. Under SSP3, carbon dioxide emissions are expected to double by 2100 if no additional climate policies are implemented, potentially leading to an increase of approximately 4°C in global temperatures.

For this assessment, climate projections have been sourced from the NSW and Australian Regional Climate Modelling (NARCliM) project version 2.0, which offers high-resolution data at a 4 km grid cell scale.

This data has been supplemented with downscaled projections from the previous round of global climate models, CMIP5, published in the Fifth Assessment Report (AR5) and consolidated from the Climate Change in Australia (CCIA) Climate Futures datasets.

Adopted time horizons

According to the Australian Building Codes Board (ABCB), the design life for a normal building is 50 years. Depending on the accessibility and cost to replace or repair different sub-systems of a building, the design life ranges from 5 to 25 years. Therefore, climate change projections have been collated for 2030 and 2070 time periods.

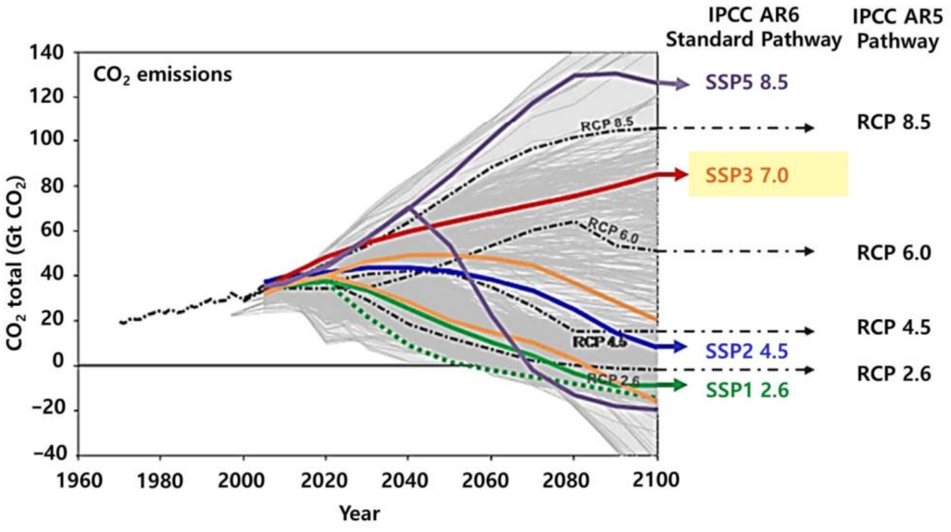


Figure 11: IPCC AR5 and AR6 climate change scenarios

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Climate change projections

Future climate hazards

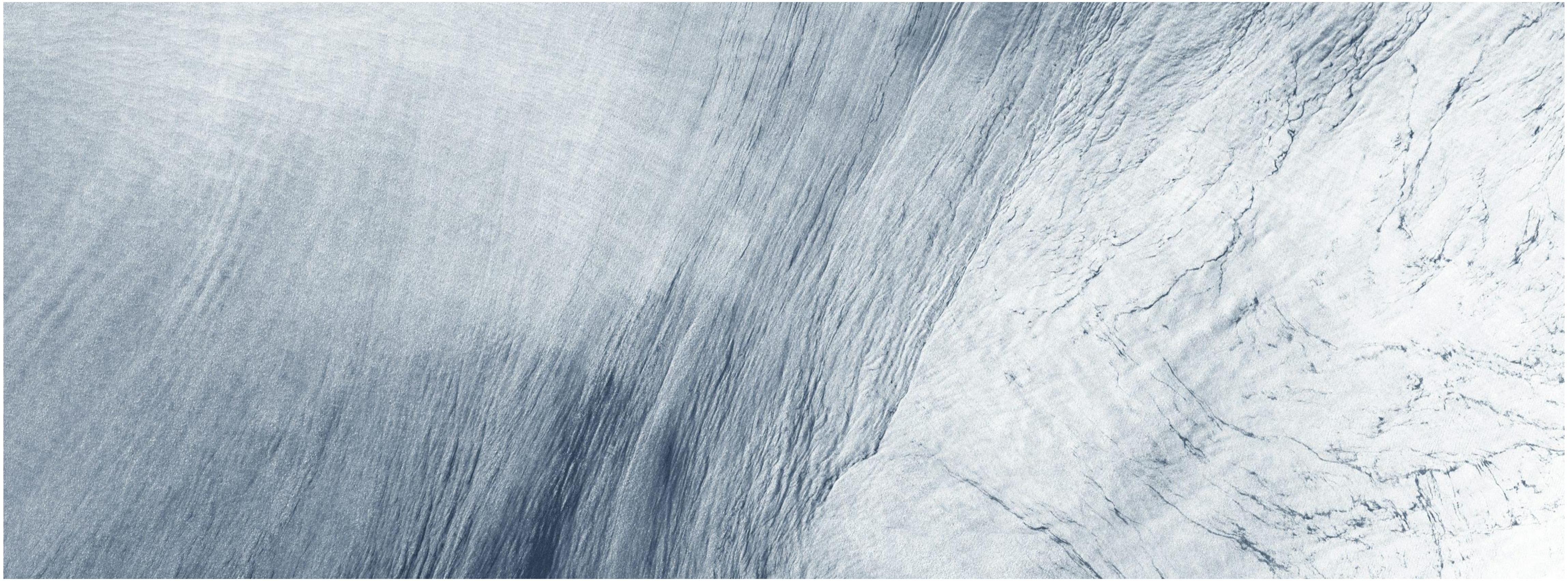
Climate hazards	Indicator *	Baseline (1965 - 2024, Parramatta North)	Projections				
			Unit	SSP3-7.0 2030	SSP3-7.0 2050	SSP3-7.0 2070	Data source
Ambient air temperature increase	Mean surface temperature (annual) °C	17.6	*Absolute change (ºC)*	0.72	1.69	2.42	NARCliM2.0, 4km gridded data. New South Wales, Climate Change Snapshot.
	Mean maximum temperature (annual) °C	23.4	*Absolute change (ºC)*	0.73	1.71	2.4	NARCliM2.0, 4km gridded data
Extreme heat	Average days per year above 35ºC	11	*Days per annum*	2.92	6.83	11.45	NARCliM2.0, 4km gridded data
	Average days per year above 40ºC	1.6	*Days per annum*	Not available	Not available	Not available	New South Wales, Climate Change Snapshot.
	Number of heatwave days	9	*Days per annum*	12.5	Not available	27.6	New South Wales, Climate Change Snapshot.
	Hottest day, ºC	47	*Absolute change (ºC)*	Not available	Not available	Not available	New South Wales, Climate Change Snapshot.
Extreme cold	Average days per year below 2ºC	2.1	*Absolute change (days per annum)*	-1.04	-1.06	-1.84	NARCliM2.0, 4km gridded data
Flooding	Rainfall intensity climate change factor for <1hr duration	Not available	*Percentage change (%)*	18	29	42	Australian Rainfall & Runoff Data Hub. Updated climate change factors for IFD Initial loss and continuing loss based on IPCC AR6 temperature increases from the updated Climate Change Considerations (Book 1: Chapter 6) in ARR (Version 4.2). Climate change factors under SSP3-7.0 have been utilised for consistency with NARCliM 2.0 high emission projections. Climate change factors to be applied to 2016 IFD.
	Rainfall intensity climate change factor for 6hr duration	Not available	*Percentage change (%)*	12	19	28	
	Rainfall intensity climate change factor for >24hr duration	Not available	*Percentage change (%)*	10	15	21	

Climate change projections

Future climate hazards

Climate hazards	Indicator *	Baseline (1965 - 2024, Parramatta North)	Projections						
			Unit	SSP3-7.0 2030	SSP3-7.0 2050	SSP3-7.0 2070	RCP 8.5 2030	RCP8.5 2070	Data source
Drought	Mean annual precipitation (mm)	978.1	*Percentage change (%)*	-4.89	-15.08	-7.84	Not applicable	Not applicable	NARCliM2.0, 4km gridded data
	Mean Summer precipitation (mm)	304.3	*Percentage change (%)*	-7.37	-20.63	-6.95	Not applicable	Not applicable	NARCliM2.0, 4km gridded data
	Mean Autumn precipitation (mm)	339.1	*Percentage change (%)*	9.53	-9.04	-2.73	Not applicable	Not applicable	NARCliM2.0, 4km gridded data
	Mean Winter precipitation (mm)	194.1	*Percentage change (%)*	-26.14	-28.88	-22.05	Not applicable	Not applicable	NARCliM2.0, 4km gridded data
	Mean Spring precipitation (mm)	202.7	*Percentage change (%)*	-0.98	1.14	-1.49	Not applicable	Not applicable	NARCliM2.0, 4km gridded data
Humidity	Annual near-surface relative humidity (%)	73	*Percentage change (%)*	Not available	Not available	Not available	-0.59	-1.42	Climate Change in Australia. East Coast sub-cluster. 50th percentile data. RCP8.5, CMIP5 data.
Solar radiation	Annual surface downwelling shortwave radiation (MJ/m^2)	16.1	*Percentage change (%)*	Not available	Not available	Not available	0.838	1.092	Climate Change in Australia. East Coast (South) sub-cluster. 50th percentile data. RCP8.5, CMIP5 data.
Bushfire	Number of severe fire danger days (where FFDI > 50) per year	8.3	*Number of days*	0.81	1.49	2.30	Not applicable	Not applicable	NARCliM2.0, 4km gridded data. New South Wales, Climate Change Snapshot.
Damaging winds	Annual average near-surface (2 metres) wind speed (ms^{-1})	3.6	*Percentage change (%)*	Not available	Not available	Not available	-0.5	-0.6	Climate Change in Australia. East Coast (South) sub-cluster. 50th percentile data. RCP8.5, CMIP5 data.
	Annual total time above 8 m/s (%)	0.6 (Sydney Olympic Park, 066212)	*N/A*	Not available	Not available	Not available	Not available	Not available	BoM weather station

Climate risk assessment



Asset component categories

Climate risks affect several asset categories

Climate-related risks have been identified across several aspects of the Melrose Park High School development. These are groups into key asset component categories to enable targeted risk treatment through effective adaptation measures.

Asset category	Indicative life of asset category	Description
Architecture	50 years	The overall aesthetic design of the building, including internal layouts, external facades, finishes, and functional aspects of the building's spaces.
Building services	15-30 years	Systems that ensure the building functions properly, including electrical, HVAC (heating, ventilation, air conditioning), plumbing, and fire safety systems.
Civil	50 years	The external works related to site infrastructure such as roads, drainage, and other site development works required for access and utility services.
Structural	50 years	Core systems providing support and stability to the building, including beams, columns, foundations, and load-bearing elements.
Landscaping	20 years	External elements like gardens, lawns, pathways, retaining walls, and other features that enhance the outdoor aesthetic and function of the site.
Transport	30-50 years	Connectivity to transport systems including roads, public transport, carparks.
Utilities	30-50 years	Infrastructure for water, electricity, gas, telecommunications, and waste management systems that connect the building to external networks.
Operations	50 years	Operations of site including asset management.
Human health	N/A	Aspects of building design and operation that impact occupants' physical and mental health, including indoor air quality, lighting, noise, ventilation, and safety.

Climate change risk assessment

Approach

This section outlines the priority climate change impacts relating to each of the asset components categories. Priority risks impacts are those with 'medium', 'high' or 'extreme' risk levels. The assessment has been informed by the climate change projections, relevant project plans, and input from the project team and wider stakeholders. *All risks have been documented and are available in Appendix B.*

For each potential climate impact, the consequence and likelihood of occurrence were assessed using the criteria matrices in Appendix A. Overall risk level is determined by the product of consequence and likelihood, and these assessments are based on no existing adaptation measures being incorporated into design and operations.

In total the assessment has identified 48 risks, of which 0 were 'extreme', 5 were 'high', 31 were 'medium', and 12 were 'low'.

The assessment includes both direct and indirect risks:

- Direct risks are impacts (attributable to climate change) that cause damage, extra costs, accelerated deterioration or disruption of services provided.
- Indirect risks are impacts on another system or organisation which disrupt the direct supply of goods or services that the development critically relies upon such as energy, water, transport, and telecommunications.

		Consequence				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Almost Certain**	Medium	Medium	High	Extreme	Extreme
	Likely	Medium	Medium	High	Extreme	Extreme
	Possible	Low	Medium	Medium	High	Extreme
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Medium	Medium	High

Figure 12: Risk matrix.

Priority climate-related risks

5 high risks were identified in the climate risk assessment which require effective adaptation responses.

Risk ID	Hazard	Risk impact	Impacted asset component	SSP3-7.0 2030	SSP3-7.0 2050	SSP3-7.0 2070	Justification
12	Extreme Heat	Thermal mass absorbs and emits heat resulting in increased ambient air temperatures in outdoor areas causing adverse impact on amenity for staff and students.	Human Health	Medium	High	High	Urban heat island effects reduces outdoor thermal comfort for students, staff and visitors, resulting in moderate service impact consequence multiple times per year due to reduced capacity for recreation and socialisation in outdoor areas. Likelihood of disruption from heatwaves increases from 2030 to 2070 due to increasing duration, frequency, and amplitude of heatwaves.
26	Flooding	Localised flooding causes damage to buildings (e.g. ground floor structures, assets, and systems) and temporary disruption to building access.	Architecture	High	High	High	Intense downpours resulting in longer duration of low-levels of inundation may cause major personal injury due to slipping every few years if not mitigated through drainage design and floor surface selection. Damage to buildings would result in moderate financial consequence.
28	Flooding	Extreme rainfall events leading to debris and sediment runoff, causing blockage to drainage systems. Blockage may result in flooding and resulting effects.	Civil	High	High	High	The inability of stormwater to drain due to blockages cause by stormwater debris is possible as flooding intensity and frequency is increasing over time. Drainage is to be designed to ensure that site facilities are available for students' use in all weather conditions up to a 1% AEP storm event. The drainage does not account for climate change impacts. Therefore, these blockages can have major consequences to operation, financial costs incurred due to damages to drainage, and health and safety of students, staff and visitors.
32	Flooding	Extreme rainfall events leading to sewer flooding, debris and sediment runoff, causing blockage to drainage systems	Utilities	High	High	High	Sewer flooding and drain blockages due to stormwater flooding intensity and frequency is increasing over time. These blockages can have major consequences to operation and financial costs incurred due to damages to drainage and sewer flooding.
47	Flooding	Extreme rainfall events can cause the school to be isolated from the community.	Human Health	High	High	High	It is possible that localised flooding can cause inaccess and isolation of the school from the rest of the community during extreme weather events which can have major consequences to the health, safety, and wellbeing of students, staff and visitors.

Priority climate-related risks

31 medium risks were identified in the climate risk assessment which require effective adaptation responses.

Risk ID	Hazard	Risk impact	Impacted asset component	SSP3-7.0 2030	SSP3-7.0 2050	SSP3-7.0 2070	Justification
1	Ambient air temperature increase	Accelerated degradation of materials in outdoor areas including building façades and hardscaping, due to increased ambient air temperature, extreme heat, and increased solar radiation.	Architecture	Low	Medium	Medium	Accelerated degradation and reduced durability of building assets and materials results in minor consequences to operations, health, safety, and financial costs associated with more frequent replacement than expected. Average air temperatures have been increasing over time, therefore the likelihood of accelerated outdoor asset degradation will be possible by 2070.
2	Ambient air temperature increase	Increased HVAC system energy consumption, resulting in higher greenhouse gas emissions and higher operational costs.	Building Services	Medium	Medium	Medium	Mean average and maximum temperatures are projected to increase under both climate scenarios, therefore it is almost certain that energy consumption will increase with increased HVAC system power demand. The financial consequence of this is minor, and therefore there is a minor consequence level. The carbon impact of slightly increased energy use is also a minor consequence level.
3	Ambient air temperature increase	Increased pooling of air deteriorating air quality in outdoor spaces, affecting human health and safety for staff and students.	Human Health	Low	Medium	Medium	Temperature increase can occur during low wind days increasing pooling of air and more concentrated pollution, resulting in minor health and safety consequence.
4	Ambient air temperature increase	Temperature and humidity impacting on air quality through increased pollen, increasing health impacts and associated respiratory disorders.	Human Health	Low	Medium	Medium	Increased pollen and similar particles can be more prevalent during warmer months which reduce overall outdoor air quality, resulting in minor health and safety consequence.
7	Ambient air temperature increase	Need for more frequent waste disposal to reduce pest, disease, and nuisance risk from waste holding in warmer/ wetter conditions.	Utilities	Medium	Medium	Medium	The presence of pests, diseases, rodents and other nuisances can result in minor consequences to the health and safety of students, staff and visitors, and can have minor financial costs associated with remediation and clean up. Warmer and wetter conditions are increasing over time, and therefore the associated risk of pests and tropical diseases will be likely by 2070.
8	Ambient air temperature increase	Heat impacts on water demand for site (landscaping, general school use).	Utilities	Low	Medium	Medium	Increased water demand for landscaping and school use during heatwaves results in insignificant financial consequence.
9	Extreme heat	Heating of external materials and surfaces, such as handrails, results in burn risk for students.	Architecture	Low	Medium	Medium	Increased temperatures of external building features such as handrails, bike parks, etc. during heatwave conditions can cause minor health and safety concerns for students and staff .
10	Extreme heat	Increased peak event temperatures and numbers of extreme heat days, leading to increased peak demand from cooling and ventilation systems and reduced ability for cooling and ventilation systems to maintain internal set points.	Building Services	Medium	Medium	Medium	Increased peak temperatures and extreme heat days elevate cooling and ventilation demand and increase risk that internal temperature set points are not maintained. Risk of power outage is addressed in Risk ID #13. Failing to meet set points results in a minor social consequence for students, staff and visitors, with increasing likelihood as extreme heatwaves become more frequent.

Priority climate-related risks

31 medium risks were identified in the climate risk assessment which require effective adaptation responses.

Risk ID	Hazard	Risk impact	Impacted asset component	SSP3-7.0 2030	SSP3-7.0 2050	SSP3-7.0 2070	Justification
11	Extreme Heat	Increased thermal discomfort and risk of heat stress for building occupants.	Human Health	Medium	Medium	Medium	Increased incidence and amplitude of extreme heat days by 2070 may result in reduced thermal performance of building envelope at least annually. Vulnerable students, staff and visitors may require medical treatment for heat-related illnesses which is a moderate consequence.
13	Extreme Heat	Increased external temperatures may lead to increased load on the existing electricity grid causing power outages. School buildings may be without power or internet for an extended period.	Utilities	Medium	Medium	Medium	Without backup power, network power outages may have a temporary moderate impact on students and staff. Temperatures have been increasing over time, therefore there is a possibility of power outages occurring in the future.
46	Extreme Heat	Heat-related anti-social behaviour in non-air-conditioned spaces	Human Health	Medium	Medium	Medium	Temperature has been increasing over time and it is likely that they will continue to increase into the future. Anti-social behaviours in non-air-conditioned spaces can have some consequences to the health, safety, and wellbeing of students, staff and visitors.
16	Bushfire	Bushfires in the surrounding area may lead to poor indoor and outdoor air quality, affecting health and safety of students, staff and visitors.	Human Health	Medium	Medium	Medium	The site location is not near a bushfire zone; therefore, it is unlikely that smoke and ash could be experienced by students, staff and visitors. However, there are some moderate consequences of smoke and ash to health, and safety if there is a significant bushfire event occurring nearby.
18	Bushfire	Bushfire events may result in power restrictions and/or power failure. School buildings may be without power or internet for an extended period.	Utilities	Medium	Medium	Medium	This site is not near a bushfire zone; therefore, it is unlikely that power outages caused by bushfires can have any significant consequences on students and staff.
22	Drought	Increased need for maintenance/ irrigation for landscaped areas, including watering and replacement of vegetation, especially during periods of water restrictions.	Operations	Medium	Medium	Medium	Failure of vegetation and an increase in watering landscape due to increase in drought conditions over time is possible, however it will reult in minor consequences to water demand, financial costs, and operation.
23	Drought	Less water availability for onsite water catchments and reuse systems (e.g. rainwater harvesting), increasing the reliance on mains water supply.	Operations	Low	Medium	Medium	It is possible that by 2070, there will be increased pressure on the mains water supply due to the increase in the intensity and frequency of drought conditions. These pressures can have minor impacts on the operation, financial cost, and health and safety of students and staff.
27	Flooding	Localised flooding impacting building system services and connection to utilities.	Building Services	Medium	Medium	Medium	It is possible for low level of innundation can restrict access to buildings and utilities which can cause some financial, operational and health and safety consequences to students, staff and assets.

Priority climate-related risks

31 medium risks were identified in the climate risk assessment which require effective adaptation responses.

Risk ID	Hazard	Risk impact	Impacted asset component	SSP3-7.0 2030	SSP3-7.0 2050	SSP3-7.0 2070	Justification
29	Flooding	Wet conditions can attract pests such as mosquitoes, rodents, and insects. These pests can carry diseases and create additional health risks for building occupants.	Human Health	Medium	Medium	Medium	Increased rainfall intensity may bring higher influxes of unwanted pests resulting in moderate health impacts and minor financial consequences for pest control and structural damage reparations.
30	Flooding	Localised flooding causes disruption to carpark access, public transport, and access roads, including for emergency vehicles.	Transport	Medium	Medium	Medium	It is possible that localised flooding can cause inaccess to carparks, vehicles, emergency services which can have minor consequences to health, safety, operations and financial costs.
33	Damaging winds	Increased effects of wind tunnelling affecting the usability, amenity and safety of outdoor areas, rooftop play and external spaces.	Architecture	Low	Medium	Medium	Wind tunnelling can have minor impacts on the usability, operation, safety and durability of outdoor spaces. Depending on the layout of massing, wind tunneling may occur during high wind events (which currently occur 0.6% of the year) if not adequately considered in design. Wind speeds could increase in the future due to the proposed development of tall buildings to the west of Melrose Park, therefore likelihood has increased by 2070.
34	Damaging winds	Damaging winds affect secure attachment of building materials, roofing structures, PV panels (if included in design) etc.	Architecture	Medium	Medium	Medium	Winds at high speeds can have moderate impacts on the building features as it can cause them to break, fall and require replacement and maintenance which can have up to moderate financial, operational and heat and safety concerns. Wind loading should be adequately considered in design in accordance with structural standards.
35	Damaging winds	Storm events result in communications and security system failure (e.g. security surveillance, access control, internet, phone line, mobile) impacting school communications.	Buildings Services	Medium	Medium	Medium	Failure of security and electrical assets can have moderate consequences to the health and safety of students, staff and visitors. These power outages will be possible by 2070 as storm events become increasingly frequent and intense.
36	Damaging winds	Falling trees and branches, impacting people, facades and/ or external assets, and access	Landscape	Medium	Medium	Medium	Falling debris and limbs are possible in high-wind events, causing moderate consequences to health and safety of students, staff and visitors. The likelihood of falling tree limbs increases with drought conditions in the future.
37	Damaging winds	Increased structural load on structures and buildings.	Structural	Medium	Medium	Medium	Structural damage to buildings is rare, assuming compliance with structural standards and associated wind loading considerations. These damages can have moderate consequences to the strutures, buildings, health and safety of students, staff and visitors.
38	Damaging winds	Storms causing acute/extended power outages requiring extended use of power redundancy measures (e.g. generators)	Utilities	Medium	Medium	Medium	It is possible that power outages due to increased wind speeds and storm events will increase by 2070. These can have moderate consequences to the operation, financial costs, health and safety of students, staff and visitors.

Priority climate-related risks

31 medium risks were identified in the climate risk assessment which require effective adaptation responses.

Risk ID	Hazard	Risk impact	Impacted asset component	SSP3-7.0 2030	SSP3-7.0 2050	SSP3-7.0 2070	Justification
39	Hail	Hail causing damage to building façade, rooftop structures, and exposed assets.	Architecture	Medium	Medium	Medium	Hail can damage building façades and rooftop structures, leading to costly repairs (up to $1 million), potential structural weaknesses, and compromised weather protection, thus impacting overall building integrity and safety. This may occur multiple times in a generation.
40	Sea level rise	Saline intrusion causes corrosion of underground utilities (electric, cables, pipes).	Civil	Medium	Medium	Medium	There can be minor operational, maintenance, and replacement costs associated with damages to underground utilities such as electric equipment, telecommunications, electrical cables, drainage pipes, and hydraulic pipes every few years due to saltwater corrosion.
41	Sea level rise	Saline intrusion impacting soil shrink and swell, pressure, and reactivity, affecting the stability of building foundations and causing structural damage.	Structural	Medium	Medium	Medium	Due to the increased frequency of storm surges occurring because of climate change, saline intrusion are possible and can have some impacts on soil characteristics and therefore have minor consequences to structures, assets, and financial costs.
42	Multi hazard	Lightning increases safety risk for school building users outside requiring potential closure of outdoor spaces.	Human Health	Medium	Medium	Medium	It is possible that lightening can cause restrictions to using outdoor areas, however, there is a minor consequence to health and safety of students and staff, minor financial and operational costs associated with closure of outdoor spaces.
43	Multi hazard	Sand and dust storms leading to poor indoor air quality affecting occupant health and safety.	Human Health	Medium	Medium	Medium	Sand and dust storms are unlikely to occur in the future, but they can have some moderate consequences to health and safety of students and staff.
44	Multi hazard	Extreme weather events (such as increased temperature, storms and precipitation) impacting vegetation health and increasing the chances of debris and/or limbs causing injury and damage.	Landscaping	Medium	Medium	Medium	Extreme weather events can cause trees to die or drop limbs, posing moderate safety risks to staff, students, and visitors through injury and minor inconvenience due to creating roadblocks/ obstacles.
45	Multi hazard	Extreme weather events can disrupt supply chains, affecting delivery of supplies.	Operations	Medium	Medium	Medium	Extreme weather events in Australia disrupt supply chains, hindering the delivery of medical supplies and food. Without adequate redundancy in supplies, this could cause moderate health and safety impacts for students and reduce amenity.

Adaptation planning

Adaptation measures

Design and operational responses to manage risks

This section sets out the proposed adaptation measures for addressing priority risks. Adaptation measures include both design and operational measures.

Design measures: Physical measures that mitigate risk through design- or infrastructure-led responses are typically developed and incorporated for project completion (e.g., high-performance glazing) but may also be incorporated or triggered later as needed (e.g., installation of high-grade filters to manage worsening bushfire smoke).

Operational measures: Non-physical measures that mitigate risk through procedural, educational, or organisational responses are typically developed and finalised in the design stage for project completion and should be reviewed and updated periodically for ongoing benefit throughout the project's operational life.

Adaptation measures listed are prior to development and shall be implemented by various responsible owners, as indicated. Some adaptation measures are already underway.

Each intervention has been prescribed an adaptation identification number (i.e. D (Design) 01, or O (Operation) 01). The risk impacts are then aligned with the appropriate adaptations.

Adaptation measures

Design adaptation measures

Adaptation ID #	Design adaptation measures	Relevant priority risks (Risk ID #)
D01	Ensure appropriate selection of durable materials in compliance with EEFSG, considering various aspects of materials including colour, durability, feasibility, etc.	1
D02	Create spaces for natural ventilation, shading, etc. to reduce load on AC systems for cooling and capital cost.	2, 3, 4, 10, 13, 46
D03	Plans in place for power generator to be installed in the future to cope with power demand for systems.	2, 13, 18, 38
D04	Incorporate ventilation systems and air circulation by installing windows and fans in/near indoor areas.	4, 11
D05	Use of native plants and resilient plant species to lower water consumption.	8, 22
D06	Ensure a maintenance and landscaping plan is in place to communicate drought risk.	8, 22, 23
D07	Minimise the use of metal surfaces in unshaded areas and ensure a balance between external shading and trees.	9
D08	Incorporate access to water fountains for student bottle refill and zip taps for cold water in staff rooms.	11, 12
D09	Select landscaping, urban, and architectural strategies (high solar reflectance index roofing, green landscaping) aligning with the industry benchmark Green Star Buildings Credit 19 Heat Resilience, to reduce urban heat island effect.	12
D10	Increased shading for external/outdoor areas, and early procurement of trees to ensure trees are mature during planting and landscaping stage across the site, including accessible shelters for respite from weather, evenly distributed across outdoor areas.	12
D11	Smoke detection in outside fresh air systems can be considered to reduce circulation of environmental pollutants.	16
D12	Ensure school and essential infrastructure such as substation is above flood levels. Flood modelling has considered 0.5% AEP floods which shows no impact on school buildings.	26, 27
D13	Incorporate large gutter and downpipe sizes to account for future rainfall intensity flow and stormwater drainage.	27, 28, 30, 32

Adaptation measures

Design adaptation measures

Adaptation ID #	Design adaptation measures	Relevant priority risks (Risk ID #)
D14	Consider alternate access eg new bridge over Parramatta River as part of upcoming light rail.	48
D15	Building details to be designed as per EFSG and AS1170.1 Permanent, Imposed and Other Actions. Wind and earthquake loads are as per AS1170.2 Wind Actions and AS1170.4 Earthquake Actions.	33, 34, 37
D16	ICT to include mobile phone backup for key systems and security equipment to have integrated batteries.	35
D17	Power storage options should be considered.	38
D18	Structural design considers swell of soils with elevated Ground Slab. Ground floor slab can be designed as a suspended ground slab supported by foundation piles, by having collapsible void former underneath the slab.	41
D19	Retractable roof design proposed to provide protection from hail, rain, wind and storm events.	42, 43, 44
D20	Design for automated PV panels to avoid hail, rain and extreme weather events.	42, 43, 44
D21	Avoid water ponding opportunities, ensure good drainage, and insect screening.	29
D22	Select robust finishes to withstand hail damage.	39
D23	Ensure species selection to minimise use of species that tends to drop limbs, resistant and native species.	36
D24	Locate trees that are prone to drop limbs away from student areas and set back from building and roofs	36
D25	Ensure a maintenance and landscaping plan is in place to communicate drought risk.	36

Adaptation measures

Operational adaptation measures

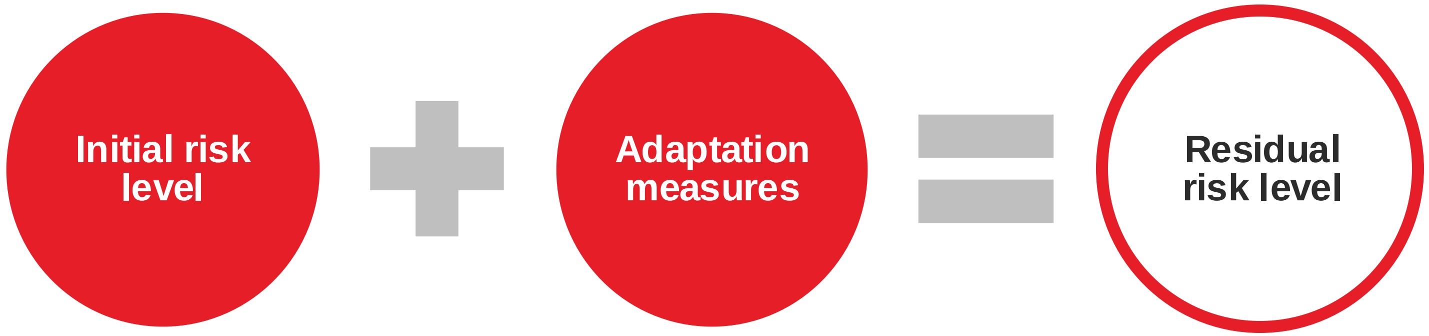
Adaptation ID #	Operational adaptation measures	Relevant priority risks (Risk ID #)
O01	Monitoring and maintenance of adjoining open space and drainage systems of the school.	28
O02	Identify alternative or preferred roadway access during extreme weather events and emergencies.	30
O03	Ensure maintenance of drainage systems at regular intervals and after considerable storm events.	32
O04	Ensure timetabling measures are active to manage student occupancy of play spaces	33
O05	Ensure maintenance plans and proactive maintenance is occurring efficiently.	44
O06	Develop an emergency management plan with a strategy for supply chain management, including stockpiling critical equipment or using secondary suppliers in case of events impacting goods and services delivery.	45
O07	Maintain an established emergency management taskforce at Ryman Healthcare to reduce impacts through rapid responses.	45
O08	Establish relationships with external stakeholders for fuel, food, and medicine supplies.	45

Residual risk levels for priority risks

Reducing risk level as low as practicable

Residual risk describes the remaining risk level after adaptation measures have been adopted. A residual risk assessment has been undertaken to determine the efficacy of adaptation measures in reducing or mitigating priority risks.

Residual risk levels are determined based on the assumption of full adoption of adaptation measures. All extreme and high risks have been treated to a medium level or below. Residual risk levels are available in Appendix B.



Monitoring and evaluation

Monitor and review

Reducing risk level as low as practicable

A comprehensive climate risk assessment and subsequent adaptation workshop has been conducted that outlines the appropriate design and operational interventions that will reduce the overall risk level of priority risks.

Responsibility for carrying out adaptation measures outlined in this report lies with identified nominated adaptation measure owners. These are summarised in the following section.

To manage climate-related risks for Melrose Park High School, it is important that progress is tracked and that 'road-blocks' preventing risk treatment are identified and resolved. Owners are responsible for the implementation, monitoring, reporting and improvement of measures to address key climate risks for the development.

This Climate Resilience Plan is a 'living document' that will need to be updated to include emerging information and aligned programs, and changes to base information informing climate change scenarios.

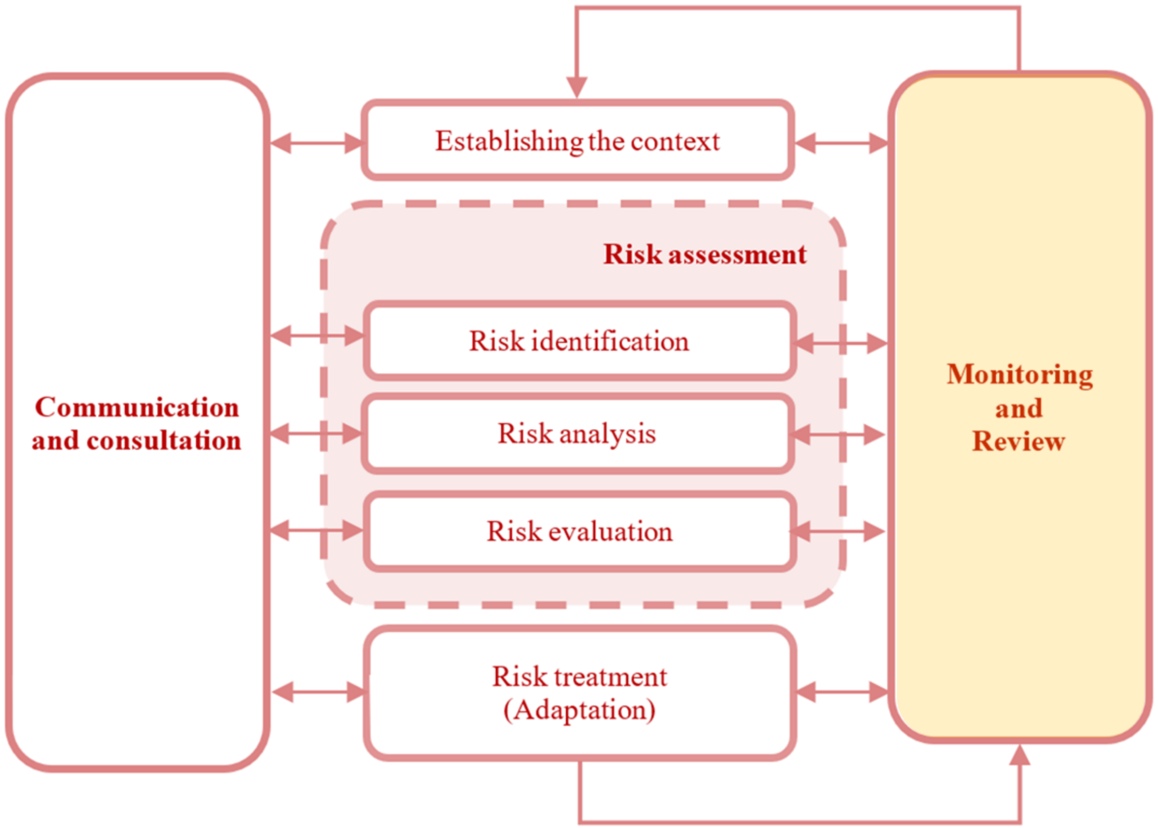


Figure 13: Risk assessment and management approach (AS5334-2013)

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Implementation plan

Nominated responsible owners for design adaptation measures

Adaptation ID #	Nominated owner	Relevant priority risks (Risk ID #)
D01	Buildings services	1
D02	Mechanical Engineer	2, 3, 4, 10, 13, 46
D03	Electrical Engineer	2, 13, 18, 38
D04	Buildings services	4, 11
D05	Landscape	8, 22
D06	Landscape	8, 22, 23
D07	Architect	9
D08	Architect, Landscaping and Hydraulics	11, 12
D09	Architect, Landscaping and Hydraulics	12
D10	Architect, Landscaping and Hydraulics	12
D11	Mechanical Engineer	16
D12	Hydraulics	26, 27
D13	Hydraulics	27, 28, 30, 32

Adaptation ID #	Nominated owner	Relevant priority risks (Risk ID #)
D14	Operations	48
D15	Buildings/Structural Engineer	33, 34, 37
D16	Utilities/Operations	35
D17	Electrical Engineer	38
D18	Structural Engineer	41
D19	Buildings/Structural Engineer	42, 43, 44
D20	Buildings/Structural Engineer	42, 43, 44
D21	Landscape	29
D22	Architect	39
D23	Landscape	36
D24	Landscape	36
D25	Landscape	36

Next steps

Melrose Park High School development

The following steps should be undertaken to ensure the delivery of the adaptation measures and resilience of the development to future climate change.

- Design adaptation measures should be assessed for feasibility.
- Any design measures excluded from the design due to feasibility, should not materially impact the risk level for the identified risk impacts. Alternative measures should be identified if there is a material impact to risk levels.
- Feasible design measures should be implemented at subsequent design stages and during construction.
- Proposed operational adaptation measures should be included in site-specific operational plans.
- Risk owners should take responsibility for implementation of proposed measures during relevant design stages and ensure any required handovers are undertaken.
- Adaptation measures should be adequately considered in asset management.

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Appendix A

AS5334: 2013 consequence and likelihood criteria matrices

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Appendix A

Consequence criteria matrix

Rank	Adaptive Capacity	Infrastructure/ Services	Social/Cultural	Governance	Financial	Environmental	Economy
Insignificant	No change to the adaptive capacity	No infrastructure damage, little 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	Localized 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. Changes to management 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.
Catastrophic	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 disruptions to employees, customers or neighbours. Emergency response at a major level.	Major policy shifts. Change to legislative requirements. Full change of management control.	Extreme financial loss >90%	Very significant loss to the environment. May include localized 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.

Appendix A

Likelihood criteria matrix

Rating	Descriptor	Recurrent or event risks	Long term risks
Almost certain	Could occur several times per year	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	May arise about once per year	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	Maybe a couple of times in a generation	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	Maybe once in a generation	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	Maybe once in a lifetime	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

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Appendix B

Climate change risk register

Refer to attached Excel register

Risk ID	Climate hazard								Risk identification														Risk treatment and residual risk					
				Climate change projection									SSP3-7.0 2030			SSP3-7.02050			SSP3-7.02070				Proposed Treatments and Timing		Residual Risk SSP3-7.0 2070			
Risk ID	Hazard	Climate variable	Baseline (1965 - 2024)	Unit	SSP3-7.0 2030	SSP3-7.0 2070	RCP8.5 2030	RCP8.5 2070	Risk impact	Impacted asset component	Asset component design life	Direct/ Indirect	Likelihood	Consequence	Risk level	Likelihood	Consequence	Risk level	Likelihood	Consequence	Risk level	Justification	Planning/Design	Operational	Likelihood	Consequence	Risk level	Responsibility
1	Ambient air temperature increase	Mean surface temperature (annual) ºC	17.6	Absolute change (ºC)	0.72	1.69	2.42	Not applicable	Accelerated degradation of materials in outdoor areas including building façades and hardscaping, due to increased ambient air temperature, extreme heat, and increased solar radiation.	Architecture	50 years	Direct	Unlikely (2)	Minor (2)	Low	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Accelerated degradation and reduced durability of building assets and materials results in minor consequences to operations, health, safety, and financial costs associated with more frequent replacement than expected. Average air temperatures have been increasing over time, therefore the likelihood of accelerated outdoor asset degradation will be possible by 2070.	[D01] Ensure appropriate selection of durable materials in compliance with EEFSG, considering various aspects of materials including colour, durability, feasibility, etc.		Unlikely (2)	Minor (2)	Low	Buildings services
2	Ambient air temperature increase	Mean surface temperature (annual) ºC	17.6	Absolute change (ºC)	0.72	1.69	2.42	Not applicable	Increased HVAC system energy consumption, resulting in higher greenhouse gas emissions and higher operational costs.	Building services	15-30 years	Indirect	Possible (3)	Minor (2)	Medium	Likely (4)	Minor (2)	Medium	Likely (4)	Minor (2)	Medium	Mean average and maximum temperatures are projected to increase under both climate scenarios, therefore it is almost certain that energy consumption will increase with increased HVAC system power demand. The financial consequence of this is minor, and therefore there is a minor consequence level. The carbon impact of slightly increased energy use is also a minor consequence level.	[D02] Create spaces for natural ventilation, shading, etc. to reduce load on AC systems for cooling and capital cost. [D03] Plans in place for power generator to be installed in the future to cope with power demand for systems.		Possible (3)	Insignificant (1)	Low	Mechanical Engineer Electrical Engineer
3	Ambient air temperature increase	Mean surface temperature (annual) ºC	17.6	Absolute change (ºC)	0.72	1.69	2.42	Not applicable	Increased pooling of air deteriorating air quality in outdoor spaces, affecting human health and safety for staff and students.	Human health	N/A	Indirect	Unlikely (2)	Minor (2)	Low	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Temperature increase can occur during low wind days increasing pooling of air and more concentrated pollution, resulting in minor health and safety consequence.	[D02] Create spaces for natural ventilation, shading, etc. to reduce load on AC systems for cooling and capital cost.		Possible (3)	Insignificant (1)	Low	Mechanical Engineer
4	Ambient air temperature increase	Mean surface temperature (annual) ºC	17.6	Absolute change (ºC)	0.72	1.69	2.42	Not applicable	Temperature and humidity impacting on air quality through increased pollen, increasing health impacts and associated respiratory disorders.	Human health	N/A	Indirect	Unlikely (2)	Minor (2)	Low	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Increased pollen and similar particles can be more prevalent during warmer months which reduce overall outdoor air quality, resulting in minor health and safety consequence.	[D02] Create spaces for natural ventilation, shading, etc. to reduce load on AC systems for cooling and capital cost. [D04] Incorporate ventilation systems and air circulation by installing windows and fans in/near indoor areas.		Possible (3)	Insignificant (1)	Low	Mechanical Engineer Buildings services
5	Ambient air temperature increase	Mean surface temperature (annual) ºC	17.6	Absolute change (ºC)	0.72	1.69	2.42	Not applicable	Increased range of diurnal ground temperatures affecting thermal expansion and contraction and associated structural cracking.	Structural	50 years	Direct	Rare (1)	Minor (2)	Low	Rare (1)	Minor (2)	Low	Rare (1)	Minor (2)	Low	Depending on soil type (determined through geotechnical assessments of site), extreme heat is very unlikely to result in structural damage to buildings and hardscaping. If damage did occur, this would cause minor financial consequences with damages up to $5million for building and drainage infrastructure repairs.	None identified		Rare (1)	Minor (2)	Low	
6	Ambient air temperature increase	Mean surface temperature (annual) ºC	17.6	Absolute change (ºC)	0.72	1.69	2.42	Not applicable	Warmer temperatures lead to increased risk of legionella growth in the water systems.	Utilities	30-50 years	Direct	Rare (1)	Minor (2)	Low	Rare (1)	Minor (2)	Low	Rare (1)	Minor (2)	Low	It is very unlikely that extreme heat will result in increased growth of legionella in the water systems. If growth does occur, upon early detection, it can have minor consequences to financial costs, health and safety of students and staff. Late detection can result in moderate consequences to health and safety of students and staff.	None identified		Rare (1)	Minor (2)	Low	
7	Ambient air temperature increase	Mean surface temperature (annual) ºC	17.6	Absolute change (ºC)	0.72	1.69	2.42	Not applicable	Need for more frequent waste disposal to reduce pest, disease, and nuisance risk from waste holding in warmer/ wetter conditions.	Utilities	30-50 years	Direct	Possible (3)	Minor (2)	Medium	Likely (4)	Minor (2)	Medium	Likely (4)	Minor (2)	Medium	The presence of pests, diseases, rodents and other nuisances can result in minor consequences to the health and safety of students, staff and visitors, and can have minor financial costs associated with remediation and clean up. Warmer and wetter conditions are increasing over time, and therefore the associated risk of pests and tropical diseases will be likely by 2070.	None identified		Likely (4)	Minor (2)	Medium	
8	Ambient air temperature increase	Mean surface temperature (annual) ºC	17.6	Absolute change (ºC)	0.72	1.69	2.42	Not applicable	Heat impacts on water demand for site (landscaping, general school use).	Utilities	30-50 years	Direct	Possible (3)	Insignificant (1)	Low	Likely (4)	Insignificant (1)	Medium	Likely (4)	Insignificant (1)	Medium	Increased water demand for landscaping and school use during heatwaves results in insignificant financial consequence.	[D05] Use of native plants and resilient plant species to lower water consumption. [D06] Ensure a maintenance and landscaping plan is in place to communicate drought risk.		Possible (3)	Insignificant (1)	Low	Landscape
9	Extreme heat	Average days per year above 35ºC	11	Absolute change (days per annum)	2.92	6.83	11.45	Not applicable	Heating of external materials and surfaces, such as handrails, results in burn risk for students.	Architecture	50 years	Direct	Unlikely (2)	Minor (2)	Low	Likely (4)	Minor (2)	Medium	Likely (4)	Minor (2)	Medium	Increased temperatures of external building features such as handrails, bike parks, etc. during heatwave conditions can cause minor health and safety concerns for students and staff .	[D07] Minimise the use of metal surfaces in unshaded areas and ensure a balance between external shading and trees.		Possible (3)	Insignificant (1)	Low	Architect
10	Extreme heat	Average days per year above 35ºC	11	Absolute change (days per annum)	2.92	6.83	11.45	Not applicable	Increased peak event temperatures and numbers of extreme heat days, leading to increased peak demand from cooling and ventilation systems and reduced ability for cooling and ventilation systems to maintain internal set points.	Building services	15-30 years	Direct	Possible (3)	Minor (2)	Medium	Likely (4)	Minor (2)	Medium	Likely (4)	Minor (2)	Medium	Increased peak temperatures and extreme heat days elevate cooling and ventilation demand and increase risk that internal temperature set points are not maintained. Risk of power outage is addressed in Risk ID #13. Failing to meet set points results in a minor social consequence for students, staff and visitors, with increasing likelihood as extreme heatwaves become more frequent.	[D02] Create spaces for natural ventilation, shading, etc. to reduce load on AC systems for cooling and capital cost.		Possible (3)	Insignificant (1)	Low	Mechanical Engineer
11	Extreme heat	Average days per year above 35ºC	11	Absolute change (days per annum)	2.92	6.83	11.45	Not applicable	Increased thermal discomfort and risk of heat stress for building occupants.	Human health	N/A	Direct	Unlikely (2)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Increased incidence and amplitude of extreme heat days by 2070 may result in reduced thermal performance of building envelope at least annually. Vulnerable students, staff and visitors may require medical treatment for heat-related illnesses which is a moderate consequence.	[D04] Incorporate ventilation systems and air circulation by installing windows and fans in/near indoor areas. [D08] Incorporate access to water fountains for student bottle refill and zip taps for cold water in staff rooms.		Possible (3)	Insignificant (1)	Low	Buildings services
12	Extreme heat	Average days per year above 35ºC	11	Absolute change (days per annum)	2.92	6.83	11.45	Not applicable	Thermal mass absorbs and emits heat resulting in increased ambient air temperatures in outdoor areas causing adverse impact on amenity for staff and students.	Human health	N/A	Direct	Possible (3)	Moderate (3)	Medium	Likely (4)	Moderate (3)	High	Likely (4)	Moderate (3)	High	Urban heat island effects reduces outdoor thermal comfort for students, staff and visitors, resulting in moderate service impact consequence multiple times per year due to reduced capacity for recreation and socialisation in outdoor areas. Likelihood of disruption from heatwaves increases from 2030 to 2070 due to increasing duration, frequency, and amplitude of heatwaves.	[D08] Incorporate access to water fountains for student bottle refill and zip taps for cold water in staff rooms. [D09] Select landscaping, urban, and architectural strategies (high solar reflectance index roofing, green landscaping) aligning with the industry benchmark Green Star Buildings Credit 19 Heat Resilience, to reduce urban heat island effect. [D10] Increased shading for external/outdoor areas, and early procurement of trees to ensure trees are mature during planting and landscaping stage across the site, including accessible shelters for respite from weather, evenly distributed across outdoor areas.		Likely (4)	Insignificant (1)	Medium	Architecture Landscape Hydraulics
13	Extreme heat	Average days per year above 35ºC	11	Absolute change (days per annum)	2.92	6.83	11.45	Not applicable	Increased external temperatures may lead to increased load on the existing electricity grid causing power outages. School buildings may be without power or internet for an extended period.	Utilities	30-50 years	Indirect	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Without backup power, network power outages may have a temporary moderate impact on students and staff. Temperatures have been increasing over time, therefore there is a possibility of power outages occurring in the future.	[D02] Create spaces for natural ventilation, shading, etc. to reduce load on AC systems for cooling and capital cost. [D03] Plans in place for power generator to be installed in the future to cope with power demand for systems.		Possible (3)	Insignificant (1)	Low	Mechanical Engineer Electrical Engineer
14	Humidity	Annual near-surface relative humidity (%)	73	Percentage change (%)	Not available	Not available	Not available	-0.59	Humidity causing mould, condensation, and decreased thermal performance of buildings.	Architecture	50 years	Direct	Rare (1)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Mould and condensation on buildings can have minor financial and health concerns if detected early. With increased rainfall and damp conditions becoming more persistent over the years, it is unlikely for mould to significantly affect buildings.	None identified		Unlikely (2)	Minor (2)	Low	
15	Bushfire	Number of severe fire danger days (where FFDI > 50) per year	8.3	Number of days	0.81	1.49	2.3	Not applicable	Bushfires in the surrounding area may lead to an accumulation of ash in roof drainage, leading to drainage and structural issues. .	Civil	50 years	Direct	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	The site location is not near a bushfire zone, therefore it is unlikely that ash would cause any significant consequences on buildings, operations, finances and health and safety.	None identified		Unlikely (2)	Minor (2)	Low	
16	Bushfire	Number of severe fire danger days (where FFDI > 50) per year	8.3	Number of days	0.81	1.49	2.3	Not applicable	Bushfires in the surrounding area may lead to poor indoor and outdoor air quality, affecting health and safety of students, staff and visitors.	Human health	N/A	Direct	Unlikely (2)	Moderate (3)	Medium	Unlikely (2)	Moderate (3)	Medium	Unlikely (2)	Moderate (3)	Medium	The site location is not near a bushfire zone, therefore it is unlikely that smoke and ash could be experienced by students, staff and visitors. However, there are some moderate consequences of smoke and ash to health, and safety if there is a significant bushfire event occurring nearby.	[D11] Smoke detection in outside fresh air systems can be considered to reduce circulation of environmental pollutants.		Unlikely (2)	Minor (2)	Low	Mechanical Engineer
17	Bushfire	Number of severe fire danger days (where FFDI > 50) per year	8.3	Number of days	0.81	1.49	2.3	Not applicable	Bushfire events require increased cleaning of infrastructure and façades to remove smoke particulates and ash accumulation.	Operations	50 years	Direct	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	The site location is not near a bushfire zone, therefore it is unlikely that smoke and ash can cause significant damage to buildings and infrastructure. Therefore, minor consequences can be expected to buildings, operation and finances.	None identified		Unlikely (2)	Minor (2)	Low	
18	Bushfire	Number of severe fire danger days (where FFDI > 50) per year	8.3	Number of days	0.81	1.49	2.3	Not applicable	Bushfire events may result in power restrictions and/or power failure. School buildings may be without power or internet for an extended period.	Utilities	30-50 years	Indirect	Unlikely (2)	Moderate (3)	Medium	Unlikely (2)	Moderate (3)	Medium	Unlikely (2)	Moderate (3)	Medium	This site is not near a bushfire zone, therefore it is unlikely that power outages caused by bushfires can have any significant consequences on students and staff.	[D03] Plans in place for power generator to be installed in the future to cope with power demand for systems.		Unlikely (2)	Minor (2)	Low	Electrical Engineer
19	Bushfire	Number of severe fire danger days (where FFDI > 50) per year	8.3	Number of days	0.81	1.49	2.3	Not applicable	Bushfires in the surrounding area may lead to falling ash contaminating water catchments and retention systems.	Utilities	30-50 years	Indirect	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	This site is not near a bushfire zone, therefore it is unlikely that ash contamination can have any significant consequences to the water supply.	None identified		Unlikely (2)	Minor (2)	Low	
20	Drought	Mean annual precipitation (mm)	978.1	Percentage change (%)	-4.89	-15.08	-7.84	Not applicable	Prolonged dry conditions cause cladding and other building materials to dry out and shrink, potentially leading to cracks and gaps.	Architecture	50 years	Direct	Rare (1)	Insignificant (1)	Low	Rare (1)	Insignificant (1)	Low	Rare (1)	Insignificant (1)	Low	Most façade materials used in NSW can withstand periods of intense drought, and therefore this risk is rare and any minor damages would have insignificant financial consequences of less than $1 million for repairs.	None identified		Rare (1)	Insignificant (1)	Low	
21	Drought	Mean annual precipitation (mm)	978.1	Percentage change (%)	-4.89	-15.08	-7.84	Not applicable	Death of existing vegetation and failure of new green space.	Landscaping	20 years	Direct	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	It is possible that NSW will experience severe drought by 2070. This will result in minor impacts to school vegetation and landscaping.	None identified		Unlikely (2)	Minor (2)	Low	
22	Drought	Mean annual precipitation (mm)	978.1	Percentage change (%)	-4.89	-15.08	-7.84	Not applicable	Increased need for maintenance/ irrigation for landscaped areas, including watering and replacement of vegetation, especially during periods of water restrictions.	Operations	50 years	Direct	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Failure of vegetation and an increase in watering landscape due to increased in drought conditions over time is possible, however it will result in minor consequences to water demand, financial costs, and operation.	[D05] Use of native plants and resilient plant species to lower water consumption. [D06] Ensure a maintenance and landscaping plan is in place to communicate drought risk.		Possible (3)	Insignificant (1)	Low	Landscape
23	Drought	Mean annual precipitation (mm)	978.1	Percentage change (%)	-4.89	-15.08	-7.84	Not applicable	Less water availability for onsite water catchments and reuse systems (e.g. rainwater harvesting), increasing the reliance on mains water supply	Operations	50 years	Direct	Unlikely (2)	Minor (2)	Low	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	It is possible that by 2070, there will be increased pressure on the mains water supply due to the increase in the intensity and frequency of drought conditions. These pressures can have minor impacts on the operation, financial cost, and health and safety of students and staff.	[D06] Ensure a maintenance and landscaping plan is in place to communicate drought risk.		Possible (3)	Insignificant (1)	Low	Landscape
24	Drought	Mean annual precipitation (mm)	978.1	Percentage change (%)	-4.89	-15.08	-7.84	Not applicable	Decreased annual average rainfall may require more frequent cleaning of building façades to maintain appearance.	Operations	50 years	Direct	Unlikely (2)	Insignificant (1)	Low	Unlikely (2)	Insignificant (1)	Low	Unlikely (2)	Insignificant (1)	Low	Insignificant consequence on students, staff, and reputation due to reduced aesthetic and need for additional maintenance. Increasing likelihood overtime; it is possible that NSW will experience severe drought by 2070.	None identified		Unlikely (2)	Insignificant (1)	Low	
25	Drought	Mean annual precipitation (mm)	978.1	Percentage change (%)	-4.89	-15.08	-7.84	Not applicable	Increased soil movement and load on foundations due to fluctuation in soil moisture and groundwater.	Structural	50 years	Direct	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Depending on soil type (determined through geotechnical assessments of site), drought is unlikely to result in structural damage to buildings and hardscaping. If damage did occur, this would cause minor financial consequences .	None identified		Unlikely (2)	Minor (2)	Low	
26	Flooding	Rainfall intensity climate change factor for <1hr duration	Not available	Percentage change (%)	18	29	42	Not applicable	Localised flooding causes damage to buildings (e.g. ground floor structures, assets, and systems) and temporary disruption to building access.	Architecture	50 years	Direct	Possible (3)	Major (4)	High	Possible (3)	Major (4)	High	Possible (3)	Major (4)	High	Intense downpours resulting in longer duration of low-levels of inundation may cause major personal injury due to slipping every few years if not mitigated through drainage design and floor surface selection. Damage to buildings would result in moderate financial consequence.	[D12] Ensure school and essential infrastructure such as substation is above flood levels. Flood modelling has considered 0.5% AEP floods which shows no impact on school buildings.		Possible (3)	Minor (2)	Medium	Hydraulics
27	Flooding	Rainfall intensity climate change factor for <1hr duration	Not available	Percentage change (%)	18	29	42	Not applicable	Localised flooding impacting building system services and connection to utilities.	Building services	15-30 years	Direct	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	It is possible for low level of inundation can restrict access to buildings and utilities which can cause some financial, operational and health and safety consequences to students, staff and assets.	[D12] Ensure school and essential infrastructure such as substation is above flood levels. Flood modelling has considered 0.5% AEP floods which shows no impact on school buildings. [D13] Incorporate large gutter and downpipe sizes to account for future rainfall intensity flow and stormwater drainage.		Possible (3)	Insignificant (1)	Low	Hydraulics
28	Flooding	Rainfall intensity climate change factor for <1hr duration	Not available	Percentage change (%)	18	29	42	Not applicable	Extreme rainfall events leading to debris and sediment runoff, causing blockage to drainage systems. Blockage may result in flooding and resulting effects.	Civil	50 years	Direct	Possible (3)	Major (4)	High	Possible (3)	Major (4)	High	Possible (3)	Major (4)	High	The inability of stormwater to drain due to blockages cause by stormwater debris is possible as flooding intensity and frequency is increasing over time. Drainage is to be designed to ensure that site facilities are available for students' use in all weather conditions up to a 1% AEP storm event. The drainage does not account for climate change impacts. Therefore, these blockages can have major consequences to operation, financial costs due to damages to drainage, and health and safety of students, staff and visitors.	[D13] Incorporate large gutter and downpipe sizes to account for future rainfall intensity flow and stormwater drainage.	[O01] Monitoring and maintenance of adjoining open space and drainage systems of the school.	Possible (3)	Minor (2)	Medium	Hydraulics Parramatta City Council
29	Flooding	Rainfall intensity climate change factor for <1hr duration	Not available	Percentage change (%)	18	29	42	Not applicable	Wet conditions can attract pests such as mosquitoes, rodents, and insects. These pests can carry diseases and create additional health risks for building occupants.	Human health	N/A	Indirect	Unlikely (2)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Increased rainfall intensity may bring higher influxes of unwanted pests resulting in moderate health impacts and minor financial consequences for pest control and structural damage repairations.	[D21] Avoid water ponding opportunities, ensure good drainage, and insect screening.		Possible (3)	Insignificant (1)	Low	Landscape

30	Flooding	Rainfall intensity climate change factor for <1hr duration	Not available	Percentage change (%)	18	29	42	Not applicable	Localised flooding causes disruption to carpark access, public transport, and access roads, including for emergency vehicles.	Transport	30-50 years	Direct	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	It is possible that localised flooding can cause in access to carparks, vehicles, emergency services which can have minor consequences to health, safety, operations and financial costs.	[D13] Incorporate large gutter and downpipe sizes to account for future rainfall intensity flow and stormwater drainage.	[O02] Identify alternative or preferred roadway access during extreme weather events and emergencies.	Possible (3)	Insignificant (1)	Low	Hydraulics
31	Flooding	Rainfall intensity climate change factor for <1hr duration	Not available	Percentage change (%)	18	29	42	Not applicable	Increased rainfall intensity causing damage to road surface (increased stripping rate, likelihood of pot-holing from moisture entering cracks in surface), reducing access to the school.	Transport	30-50 years	Direct	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Due to site topography, the likelihood of exceeding the drainage system capacity is unlikely and would likely only result from a significant flood event. Due to some trafficability, there will be some impacts to staff and students and insignificant financial impact to repair the access roads.	None identified		Unlikely (2)	Minor (2)	Low	
32	Flooding	Rainfall intensity climate change factor for <1hr duration	Not available	Percentage change (%)	18	29	42	Not applicable	Extreme rainfall events leading to sewer flooding, debris and sediment runoff, causing blockage to drainage systems	Utilities	30-50 years	Direct	Possible (3)	Major (4)	High	Possible (3)	Major (4)	High	Possible (3)	Major (4)	High	Sewer flooding and drain blockages due to stormwater flooding intensity and frequency is increasing over time. These blockages can have major consequences to operation and financial costs incurred due to damages to drainage and sewer flooding.	[D13] Incorporate large gutter and downpipe sizes to account for future rainfall intensity flow and stormwater drainage.	[O03] Ensure maintenance of drainage systems at regular intervals and after considerable storm events.	Possible (3)	Minor (2)	Medium	Hydraulics
33	Damaging winds	Annual average near-surface (2 metres) wind speed (ms^{-1})	3.6	Percentage change (%)	Not available	Not available	Not available	-0.5	Increased effects of wind tunnelling affecting the usability, amenity and safety of outdoor areas, rooftop play and external spaces.	Architecture	50 years	Direct	Unlikely (2)	Minor (2)	Low	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Wind tunnelling can have minor impacts on the usability, operation, safety and durability of outdoor spaces. Depending on the layout of massing, wind tunnelling may occur during high wind events (which currently occur 0.6% of the year) if not adequately considered in design. Wind speeds could increase in the future due to the proposed development of tall buildings to the west of Melrose Park, therefore likelihood has increased by 2070.	[D15] Building details to be designed as per EFSG and AS1170.1 Permanent, Imposed and Other Actions. Wind and earthquake loads are as per AS1170.2 Wind Actions and AS1170.4 Earthquake Actions.	[O04] Ensure timetabling measures are active to manage student occupancy of play spaces	Possible (3)	Insignificant (1)	Low	Buildings/Structural Engineer
34	Damaging winds	Annual average near-surface (2 metres) wind speed (ms^{-1})	3.6	Percentage change (%)	Not available	Not available	Not available	-0.5	Damaging winds affect secure attachment of building materials, roofing structures, PV panels (if included in design) etc.	Architecture	50 years	Direct	Unlikely (2)	Moderate (3)	Medium	Unlikely (2)	Moderate (3)	Medium	Unlikely (2)	Moderate (3)	Medium	Winds at high speeds can have moderate impacts on the building features as it can cause them to break, fall and require replacement and maintenance which can have up to moderate financial, operational and heat and safety concerns. Wind loading should be adequately considered in design in accordance with structural standards.	[D15] Building details to be designed as per EFSG and AS1170.1 Permanent, Imposed and Other Actions. Wind and earthquake loads are as per AS1170.2 Wind Actions and AS1170.4 Earthquake Actions.		Unlikely (2)	Minor (2)	Low	Buildings/Structural Engineer
35	Damaging winds	Annual average near-surface (2 metres) wind speed (ms^{-1})	3.6	Percentage change (%)	Not available	Not available	Not available	-0.5	Storm events result in communications and security system failure (e.g. security surveillance, access control, internet, phone line, mobile) impacting school communications.	Building services	15-30 years	Direct	Unlikely (2)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Failure of security and electrical assets can have moderate consequences to the health and safety of students, staff and visitors. These power outages will be possible by 2070 as storm events become increasingly frequent and intense.	[D16] ICT to include mobile phone backup for key systems and security equipment to have integrated batteries.		Possible (3)	Minor (2)	Medium	Utilities/Operations
36	Damaging winds	Annual average near-surface (2 metres) wind speed (ms^{-1})	3.6	Percentage change (%)	Not available	Not available	Not available	-0.5	Falling trees and branches, impacting people, facades and/ or external assets, and access	Landscaping	20 years	Direct	Unlikely (2)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Falling debris and limbs are possible in high-wind events, causing moderate consequences to health and safety of students, staff and visitors. The likelihood of falling tree limbs increases with drought conditions in the future.	[D23] Ensure species selection to minimise use of species that tends to drop limbs, resistant and native species. [D24] Locate trees that are prone to drop limbs away from student areas and set back from building and roofs [D25] Ensure a maintenance and landscaping plan is in place to communicate drought risk.		Possible (3)	Minor (2)	Medium	Landscape
37	Damaging winds	Annual average near-surface (2 metres) wind speed (ms^{-1})	3.6	Percentage change (%)	Not available	Not available	Not available	-0.5	Increased structural load on structures and buildings.	Structural	50 years	Direct	Rare (1)	Moderate (3)	Medium	Rare (1)	Moderate (3)	Medium	Rare (1)	Moderate (3)	Medium	Structural damage to buildings is rare, assuming compliance with structural standards and associated wind loading considerations. These damages can have moderate consequences to the structures, buildings, health and safety of students, staff and visitors.	[D15] Building details to be designed as per EFSG and AS1170.1 Permanent, Imposed and Other Actions. Wind and earthquake loads are as per AS1170.2 Wind Actions and AS1170.4 Earthquake Actions.		Rare (1)	Minor (2)	Low	Buildings/Structural Engineer
38	Damaging winds	Annual average near-surface (2 metres) wind speed (ms^{-1})	3.6	Percentage change (%)	Not available	Not available	Not available	-0.5	Storms causing acute/extended power outages requiring extended use of power redundancy measures (e.g. generators)	Utilities	30-50 years	Indirect	Unlikely (2)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	It is possible that power outages due to increased wind speeds and storm events will increase by 2070. These can have moderate consequences to the operation, financial costs, health and safety of students, staff and visitors.	[D03] Plans in place for power generator to be installed in the future to cope with power demand for systems. [D17] Power storage options should be considered.		Possible (3)	Insignificant (1)	Low	Electrical Engineer
39	Hail	Hail size and frequency of hailstorms	Not available	Qualitative description only	Not available	Not available	Not available	Not available	Hail causing damage to building façade, rooftop structures, and exposed assets.	Architecture	50 years	Direct	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Hail can damage building façades and rooftop structures, leading to costly repairs (up to $1 million), potential structural weaknesses, and compromised weather protection, thus impacting overall building integrity and safety. This may occur multiple times in a generation.	[D22] Select robust finishes to withstand hail damage.		Possible (3)	Insignificant (1)	Low	Architect
40	Sea level rise	Sea level rise (mm/yr)	3.7	Absolute change (cm)	16	Not available	50	Not applicable	Saline intrusion causes corrosion of underground utilities (electric, cables, pipes).	Civil	50 years	Direct	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	There can be minor operational, maintenance, and replacement costs associated with damages to underground utilities such as electric equipment, telecommunications, electrical cables, drainage pipes, and hydraulic pipes every few years due to saltwater corrosion.	None identified		Possible (3)	Minor (2)	Medium	
41	Sea level rise	Sea level rise (mm/yr)	3.7	Absolute change (cm)	16	Not available	50	Not applicable	Saline intrusion impacting soil shrink and swell, pressure, and reactivity, affecting the stability of building foundations and causing structural damage.	Structural	50 years	Direct	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Due to the increased frequency of storm surges occurring as a result of climate change, saline intrusion are possible and can have some impacts on soil characteristics and therefore have minor consequences to structures, assets, and financial costs.	[D18] Structural design considers swell of soils with elevated Ground Slab. Ground floor slab can be designed as a suspended ground slab supported by foundation piles, by having collapsible void former underneath the slab.		Possible (3)	Insignificant (1)	Low	Structural Engineer
42	Multi-hazard	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Lightning increases safety risk for school building users outside requiring potential closure of outdoor spaces.	Human health	N/A	Direct	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	Possible (3)	Minor (2)	Medium	It is possible that lightening can cause restrictions to using outdoor areas, however, there is a minor consequence to health and safety of students and staff, minor financial and operational costs associated with closure of outdoor spaces.	[D19] Retractable roof design proposed to provide protection from hail, rain, wind and storm events. [D20] Design for automated PV panels to avoid hail, rain and extreme weather events.		Possible (3)	Insignificant (1)	Low	Buildings/Structural Engineer
43	Multi-hazard	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Sand and dust storms leading to poor indoor air quality affecting occupant health and safety.	Human health	N/A	Direct	Unlikely (2)	Moderate (3)	Medium	Unlikely (2)	Moderate (3)	Medium	Unlikely (2)	Moderate (3)	Medium	Sand and dust storms are unlikely to occur in the future but they can have some moderate consequences to health and safety of students and staff.	[D19] Retractable roof design proposed to provide protection from hail, rain, wind and storm events. [D20] Design for automated PV panels to avoid hail, rain and extreme weather events.		Unlikely (2)	Minor (2)	Low	Buildings/Structural Engineer
44	Multi-hazard	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Extreme weather events (such as increased temperature, storms and precipitation) impacting vegetation health and increasing the chances of debris and/or limbs causing injury and damage.	Landscaping	20 years	Direct	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Extreme weather events can cause trees to die or drop limbs, posing moderate safety risks to staff, students, and visitors through injury and minor inconvenience due to creating roadblocks/ obstacles.	[D19] Retractable roof design proposed to provide protection from hail, rain, wind and storm events. [D20] Design for automated PV panels to avoid hail, rain and extreme weather events.	[O05] Ensure maintenance plans and proactive maintenance is occurring efficiently.	Possible (3)	Insignificant (1)	Low	Buildings/Structural Engineer
45	Multi-hazard	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Extreme weather events can disrupt supply chains, affecting delivery of supplies.	Operations	50 years	Indirect	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Extreme weather events in Australia disrupt supply chains, hindering the delivery of medical supplies and food. Without adequate redundancy in supplies, this could cause moderate health and safety impacts for students and reduce amenity.		[O06] Develop an emergency management plan with a strategy for supply chain management, including stockpiling critical equipment or using secondary suppliers in case of events impacting goods and services delivery. [O07] Maintain an established emergency management taskforce at Ryman Healthcare to reduce impacts through rapid responses. [O08] Establish relationships with external stakeholders for fuel, food, and medicine supplies.	Possible (3)	Insignificant (1)	Low	
46	Extreme heat	Average days per year above 35°C	11	Absolute change (days per annum)	2.92	6.83	11.45	Not applicable	Heat-related anti-social behaviour in non air-conditioned spaces	Human health	N/A	Direct	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (3)	Medium	Temperature has been increasing over time and it is likely that they will continue to increase into the future. Anti-social behaviours in non air-conditioned spaces can have some consequences to the health, safety, and wellbeing of students, staff and visitors.	[D02] Create spaces for natural ventilation, shading, etc. to reduce load on AC systems for cooling and capital cost.		Possible (3)	Insignificant (1)	Low	Mechanical Engineer
47	Bushfire	Number of severe fire danger days (where FFDI > 50) per year	8.3	Number of days	0.81	1.49	2.3	Not applicable	Bushfire ash can impact output of PV cells causing further impacts to non-renewable power consumption	Architecture	50 years	Direct	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	Unlikely (2)	Minor (2)	Low	This site is not near a bushfire zone, therefore it is unlikely that ash and debris fall can have any significant consequences to the PV panels.	None identified		Unlikely (2)	Minor (2)	Low	
48	Flooding	Rainfall intensity climate change factor for <1hr duration	Not available	Percentage change (%)	18	29	42	Not applicable	Extreme rainfall events can cause the school to be isolated from the community.	Human health	N/A	Direct	Possible (3)	Major (4)	High	Possible (3)	Major (4)	High	Possible (3)	Major (4)	High	It is possible that localised flooding can cause in access and isolation of the school from the rest of the community during extreme weather events which can have major consequences to the health, safety, and wellbeing of students, staff and visitors.	[D14] Consider alternate access e.g. new bridge over Parramatta River as part of upcoming light rail.		Possible (3)	Minor (2)	Medium	Operations

Suitably qualified professional

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