If a building becomes architecture, then it is art. Clearly, if a building is not functionally and technically in order, then it isn't architecture either – it's just a building.
Arne Jacobsen

Mechanical Engineering
Lighting Design
Sustainable Design
Electrical Engineering

Copenhagen
London
Sydney
Canberra
Hong Kong
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SUSTAINABLE DESIGN

STEENSEN VARMING

Barker College - Ecologically Sustainable Development (ESD) SSDA (SSD-31822612)

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1.0 Executive Summary

This report has been prepared for The Alterations and Additions to Barker College (Application Number SSD-31822612), in response to the SSDA General Requirement 8.0 – Ecologically Sustainable Development (ESD).

The report provides an overview of how the proposed design is responding to sustainable planning, through all stages of design, construction, and operation of the facility.

The project is targeting a 4 Star Green Star Rating, with the new Green Star Buildings tool.

For the current design stage, please refer to **Section 6** - In demonstrating 'as a minimum', the intended compliance with 4 Star Green Star Buildings.

2.0 Project Background

2.1 Scope of Project

The scope of the project is as follows:

- Demolition of school buildings;
- New performing arts and exam centre with basement carpark
- New aquatic and tennis centre with basement carpark
- New maintenance shed and associated car-parking
- Upgrade of campus infrastructure facilities
- New landscape strategy

2.2 Site description

The State Significant Development Application (SSDA) is part of the Barker College located on Clarke Road at Hornsby.

The development is bordered by:

- Clarke Road to the south;
- Unwin Road to the East;
- The barker college campus to the north.

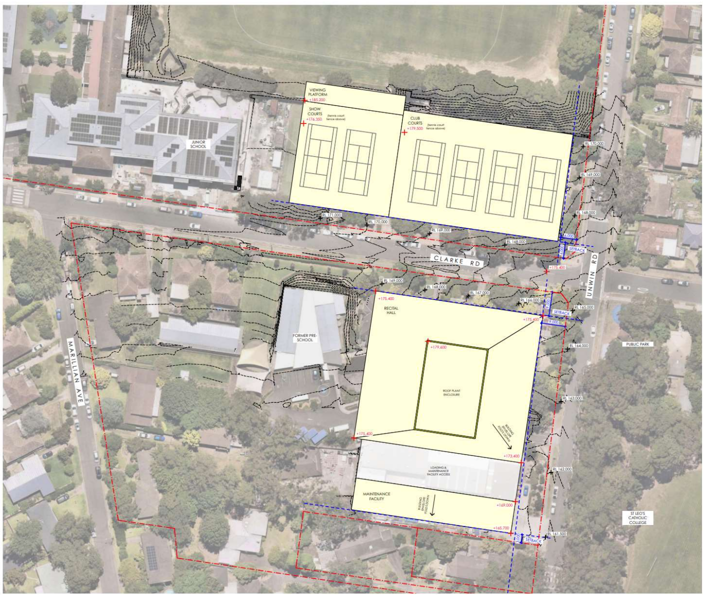

Image: Barker College Site Plan

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3.0 Introduction

3.1 Response to SEARs

The Alterations and Additions to Barker College Street SEARs Report is required by the Secretary's Environmental Assessment Requirements (SEARs). This table identifies the relevant SEARs requirement/s and corresponding reference/s within this report.

Table 1 – SEARs Requirement 8.0 and Relevant Reference

SEARs Items	Project Response to SEARs
A) Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Regulation) will be incorporated in the design and ongoing operation phases of the development.	The ESD initiatives proposed for the project aims to reduce the environmental impacts typically associated with buildings during the construction and ongoing operation of the building. The project utilises a resource hierarchy approach, with emphasis on avoiding, then reduction of energy, water, waste, materials etc. The outcome of the resource hierarchy approach is to ensure the project aligns with the ecological sustainable development principles of Clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 (Refer to Section 3.2). The strategies in response to this have been captured in Section 6.0.
B) Outline how the concept development will meet or exceed the relevant industry recognised building sustainability and environmental performance standards and integrate environmental design strategies in accordance with the Environmental Design in Schools Manual.	The project is targeting a 4 Star Green Star Buildings Rating. Principles listed in the 'Environmental Design in Schools Manual' are discussed in the following section and will be applied to the relevant space types. Primary principles include light, air quality, comfort, noise, water, energy, landscape, and materials. The strategies in response to this have been captured in Section 4.0 & 6.0 or this document.

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SEARs Items	Project Response to SEARs
C) Outline how the concept development minimises greenhouse gas emissions (reflecting the Government's goal of net zero emissions by 2050) and consumption of energy, water (including water sensitive urban design) and material resources.	Consumption of energy, water (Including water sensitive urban design) and material resources addressed in Section 6.0 of the ESD Report

3.2 Project Response to SEARS clause 7 (4)

The ESD initiatives proposed for the Barker College Project aim to reduce the environmental impacts typically associated with buildings during the construction and ongoing operation of the building. The project utilises a resource hierarchy approach, with emphasis on avoiding, then reducing the use of energy, water, materials etc.

The outcome of the resource hierarchy approach is to ensure the school aligns with the ecological sustainable development principles of Clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 and the four key principles listed below.

- The precautionary principle
    - If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
    - Decisions should be guided by :
      (i) Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment;
      (ii) An assessment of the risk-weighted consequences of various options.

- Inter-Generational Equity
    - The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

- Conservation of Biological Diversity Ecological Integrity
    - Conservation of biological diversity and ecological integrity should be a fundamental consideration.

- Improved Valuation, Pricing and Incentive Mechanisms
    - Environmental factors should be included in the valuation of assets and services, such as:
      (i) Those who generate pollution and waste should bear the cost of containment, avoidance, or abatement,
      (ii) The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,
      (iii) Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

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4.0 Targets / Benchmarks

In addition to the Secretary's Environmental Assessment Requirements (SEARs), the following environmental targets are aspired by this project:

- Exceed the requirements of Section-J of the National Construction Code (NCC) for energy-efficiency in building fabric and building services / systems.
- Incorporate appropriate and sensible sustainable design initiatives that would align with the building's functional and operational requirements, for a high-quality / physical education and teaching environment. Seek guidance from the experience within the design team, and of local and international Environmental Rating Standards / Best Practice Guidelines.
- Demonstrate good design through early-stage analysis and guidance, in general accordance with the best practice standards such as Green Star;
- Review against pool specific design requirements and recommendations from standards such as:
  - CIBSE GPG 219 Energy efficiency in swimming pools;
  - Sport England swimming pool;
- Align with new Government Architects NSW school standards such as:
  - Environmental Design in Schools (2018);
  - Better Placed Design Guide (2018).

4.1 NCC Section-J

Section-J of the National Construction Code (Previously known as the Building Code of Australia) 2019 relates to "energy efficiency of buildings". Section J is a minimum performance target for standard buildings and specifies minimum performance targets known as deemed-to-satisfy (DTS) requirements, for building fabric and services.

The proposed Sport Complex project aims to exceed the DTS requirements of Section-J where practical. A JV3 methodology is being applied for the project to demonstrate the improvement beyond DTS.

4.2 Green Star

As a minimum, achieve a 4 Star Green Star Buildings Rating. This is defined by Green Star as the following:

"A 4 Star rated building is a Best Practice environmental performer. It builds on the minimum expectations to deliver a building that is either net zero carbon in operations or a higher performer in energy, water, and health related issues".

There are eight categories representing the issues that will define the next decade of the built environment (see below). In targeting a formal Green Star rating, the project is committed to working towards these.

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There are eight categories representing the issues that will define the next decade of the built environment.

Responsible

Recognises activities that ensure the building is designed, procured, built and handed over in a responsible manner.

Healthy

Promotes actions and solutions that improve the physical and mental health of occupants.

Resilient

Encourages solutions that address the capacity of the building to bounce back from short-term shocks and long-term stresses.

Positive

Encourages a positive contribution to key environmental issues of carbon, water and the impact of materials.

Places

Supports the creation of safe, enjoyable, integrated and comfortable places.

People

Encourages solutions that address the social health of the community.

Nature

Encourages active connections between people and nature and rewards creating biodiverse green spaces in cities.

Leadership

Recognises projects that set a strategic direction, build a vision for industry or enhance the industry's capacity to innovate.

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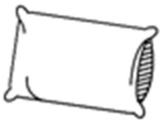
5.0 Sustainability Approach

Sustainable building design involves a holistic and integrated design approach, which builds on an increased awareness of site opportunities, form and function, to encompass and target a broad range of sustainable design initiatives.

The project will endeavour to demonstrate through all aspects of design a strong commitment to sustainability, through adhering to the following key sustainable design initiatives:

- **Healthy** (Indoor air quality & access to natural daylight)

- **Comfortable** (Thermal Visual and Acoustic Comfort)



- **Efficient** (Energy, Material & Water)

- **Easy to maintain and operate**

- **Environmentally responsive** (To changing climatic conditions)

- **Correctly commissioned** (System optimisation / Ensure building performance)

- **Be a teaching tool** (Showcase the buildings sustainable attributes)

- **Safe and secure:** for staff, students and visitors

- **A community resource**

- **Be of stimulating architecture** (Invoke a sense of pride)

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In expanding on some of those initiatives outlined previously:

The promotion of quality natural daylight – There is a direct correlation between access to daylight and student performance, attention, productivity, and general wellbeing. Glare potential is a significant issue for safety in pools, players' performance during a game, and spectators' visual comfort to provide a positive experience;

Excellent Indoor Air Quality (IAQ) – In a similar manner to daylight, there is proven correlation between user's performance, occupant wellbeing, student attendance and staff retention. Principle strategies include:

- Increased levels of outside air through the promotion of mixed mode or natural ventilation strategies, and increased outdoor air allowances;
- Mould prevention through the avoidance of thermal bridges, condensation and effective strategies in ventilation, odour and pollution control;
- Low pollutant emitting materials selections such as low VOC paints, adhesives, sealants, composite woods etc.

Excellent Thermal, Visual and Acoustic comfort – To address:

- Thermal comfort: To ensure coaches, students, administrators and casual users of the complex are not subject to unacceptable extremes in temperature as they train, teach, learn, perform and work;
- Visual comfort: To ensure the quality of light is supportive of specific tasks. In design for natural daylight, consideration must be given to daylight uniformity, penetration depth, solar heat ingress and glare control;
- Acoustic comfort: To ensure effective communication can always be achieved, noise from ventilation systems, external and internal disruptive noise affecting classrooms is minimised.

Resource conservation (energy, water and waste) – In delivering on the functional demands of a training and performing facility (high levels of daylight, thermal comfort, visual comfort, and IAQ), incurs resource use through the optimisation of these attributes. These are to be supported with minimal consumption of energy and water resources, or the generation of waste and pollution in demolition, construction, and operation of the building. Our approach to resource conservation is based on applying a "hierarchy" methodology as outlined in the following section. (See section 6.0).

The creation of an integrated community resource – Both the sports complex and recital hall can play a role within the local community through the use of shared facilities (pools, play courts, music spaces, and car parking outside of school hours).

The development of the building and surrounds as a teaching tool – Students develop greater knowledge retention, understanding and awareness, when they have the opportunity to interact directly with their environment through the mediums of touch, sight and feel, compared to the traditional textbook learning.

The above approach has been taken to ensure the ESD strategies proposed meet the SEARs and targets/benchmarks discussed in the previous section.

The following sections provide a high-level overview of some of the strategies being considered.

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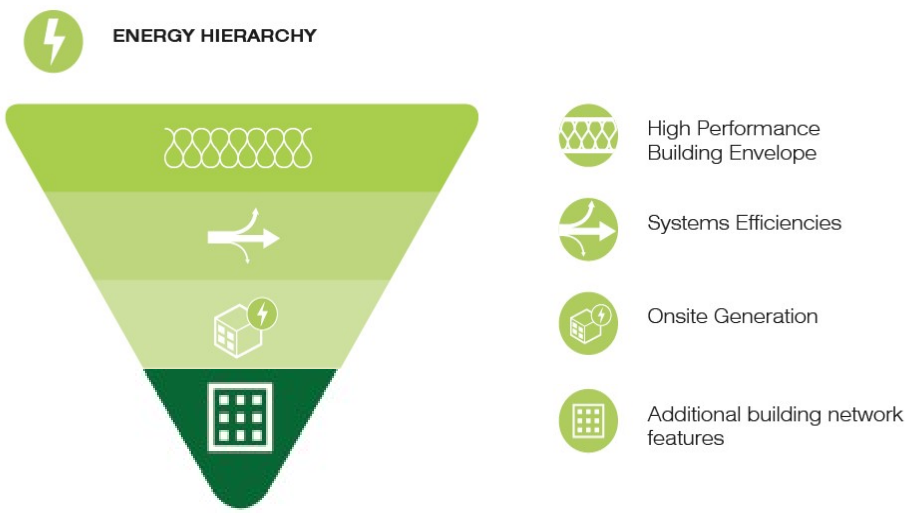
6.0 Resource Conservation

In reflecting the Government's goal of net zero emissions by 2050) and consumption of energy, water (including water sensitive urban design) and material resources. This section provides a further breakdown of our approach to resource conservation.

6.1 Energy

The proposed approach to sustainability and energy related systems is based on applying an "energy hierarchy" methodology.

This methodology has the reduction of energy use as its priority, and then seeks to meet the remaining energy demand by the most efficient means available, before the inclusion of on-site generation and importation of green power.



The following energy initiatives have been proposed and their individual merits will be assessed further during future design stages:

- **Building Form** has been designed with consideration of façade access for greater access to natural daylight and opportunity for natural ventilation, within the constraints of the site.
- **Passive design principles** will be employed to respond to environmental conditions of the building including orientation, solar access, prevailing winds, seasonal and diurnal temperatures changes.
- **Building envelope performance** (airtightness and thermal) will be enhanced by prefabrication where possible.
- **A Mixed Mode Ventilation strategy** will be accessed for improved indoor air quality, whilst also reducing energy consumption associated with air-conditioning. When external and internal conditions are favourable, external windows to each building / space can open to facilitate natural ventilation.

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- **Building energy performance improvement -** Energy modelling will be performed in development of a design that betters current minimum standards.
- **Energy efficient LED lighting, zoning, controls and site co-ordination** for both internal and external lighting systems are to be designed.
- **Occupancy controls** will be provided to spaces so that AV, lighting and mechanical systems can be shut down both manually and automatically when unoccupied where appropriate.
- **Performance glazing** – Glazing should be selected to optimise performance, admitting as much daylight as possible, while controlling the transmission of solar heat and thermal conduction
- **Glazing ratio** – Glazing ratios need to achieve an equilibrium between allowing daylight to enter buildings while reducing solar and conductive heat gains
- **Glazing position** – Windows should be positioned to block unwanted solar radiation, while allowing visible light and possibility for natural ventilation
- **External Shading** – Helps restrict unwanted heat gains within spaces, while allowing daylight access. Deciduous trees can also help shade direct solar ingress
- **Building air tightness** – Doors should be designed to close automatically to reduce unwanted heat transfer during peak summer and winter conditions. Consider revolving doors where applicable to maintain air tightness
- **Thermal Mass** – Exposed thermal mass can reduce the rate of change of temperatures within buildings and reduce the peak heating and cooling demands
- **A Solar photovoltaic (PV) array** can be located on rooftops. Energy generated onsite can be reused onsite.
- **High efficiency HVAC (Heating, Ventilation & Air-conditioning)** systems to be incorporated;
- **Energy Recovery:** Through both air and water-based systems, energy recovery and reuse will be a priority.
- **CO2 monitoring** in the appropriate control of outdoor air provisions.
- **Metering and Monitoring** of energy, water and air quality to promote healthy environment and save energy and resources.
- **Building Management Systems** to link to sensors and meters, with the ability to control lighting, hydraulic and mechanical systems and reduce energy usage.
- **Comprehensive System Commissioning** to ensure the building functions as designed.
- **Promote** the switch to renewable energy and building electrification.

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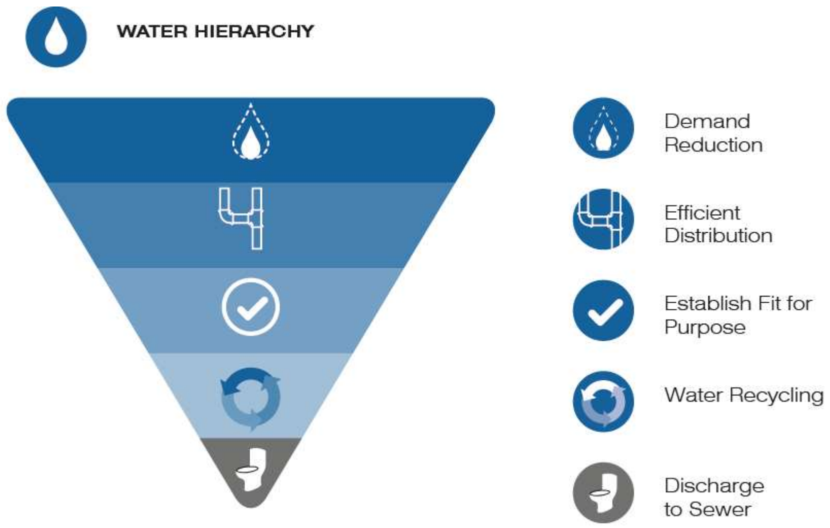
6.2 Water

The following hierarchy and strategies will be applied:



The following water initiatives have been proposed and their individual merits will be assessed further during future design stages:

- **Water efficient fixtures / fittings will be specified.** These include fittings such as taps, showerheads, toilets, zip taps, dishwashers etc certified under the WELL rating scheme.
- **Sensors** within water networks to identify possible leaks and act quickly to reduce losses;
- **Rainwater Reuse** - Rainwater collection and reuse systems will be accessed. Reuse options include landscape irrigation and toilet flushing;
- **Fire Systems test water** capture and storage for re-use using the rainwater tank will be accessed;
- **Efficient water management in the aquatic area** including water reuse, wastewater management, leaks detection, water monitoring and managing;
- **Drip and demand-controlled irrigation** to optimise irrigation supply;
- **Safe water treatment in the aquatic area.**

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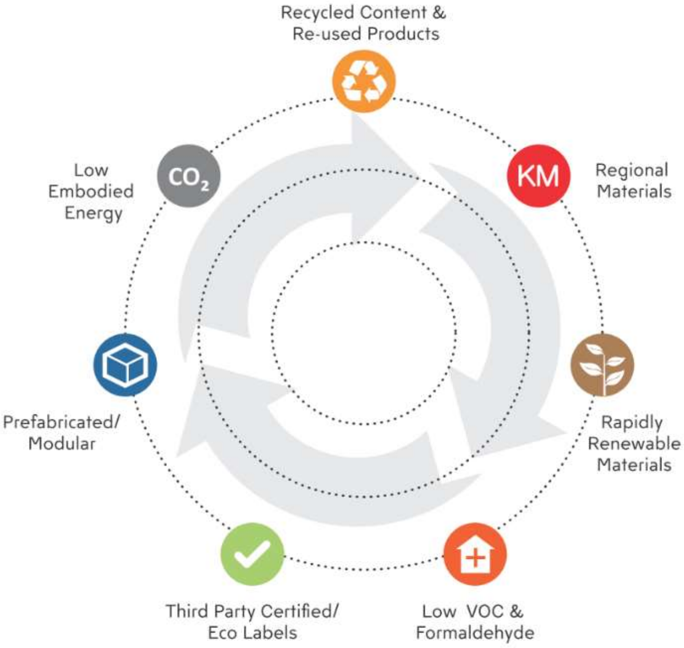
6.3 Materials and Construction Waste

Selection of environmentally preferable materials is a key priority for the project, because building materials consume energy and natural resources during its manufacture and for their transportation to the construction site. Choices of materials and construction methods can significantly change the amount of energy embodied in the structure of a building.



Low-impact construction methods such as offsite prefabrication/preassembly shall be applied where applicable. Prefabricated structures built in purpose-built factories are less labour intensive, more time efficient, and produce less waste compared to traditional onsite construction methods. Raw materials and construction elements are not exposed to the elements, which ensures high quality in the final building, and the construction process is less weather dependant.

Preference will be given to materials that contain high-recycled content and/or are highly recyclable. The following water initiatives have been proposed and their individual merits will be assessed further during future design stages:

- **Use sustainable timber** – Timber products used for concrete formwork, structure, wall linings, flooring and joinery will be sourced where possible from reused, post-consumer recycled or FSC-certified, or PEFC certified timber.
- **Steel** – will be specified to meet specific strength grades, energy-reducing manufacturing technologies, and off-site fabrication. Steel will also be sourced with a proportion of the fabricated structural steelwork via a steel contractor accredited by the Environmental Sustainability Charter of the Australian Steel Institute.
- **Recycled concrete** – The project aims to reduce the use of Portland cement through substitutions. Fine and coarse aggregate inputs are to be sourced from

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manufactured sand or other alternative materials, and the amount of Portland cement will be reduced within the concrete mix.

- **High recycled content or recyclability** – Furniture items with high recycled or recyclability content to be considered.
- **Site waste management plan**. During the demolition and construction phase, a project-specific site waste management plan (WMP) will be developed and implemented, for recycling of demolition and construction waste.

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6.4 Healthy

The following initiatives have been proposed and their individual merits will be assessed further during future design stages:

Key strategies included:

- Regulate air, thereby having a positive health impact on people.
- Account for circadian rhythms with regards to lighting.
- Reduce harmful exposure to toxins from building materials and finishes.
- Maintain acoustic levels that reduce physical and mental stress.
- Provide dedicated rooms that maximise amenity and convenience for occupants.
- Foster connection with nature through the instillation of greenery or through nature-inspired design Building massing and space planning optimization.

Operational Activities

- Minimise the pollutants and provide a high level of fresh air.
- Provide great artificial lighting and access to daylight.
- Carry out an acoustic comfort strategy.
- Low VOC paints and products.
- Provide good views and indoor plants.

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6.5 Resilience

The project will seek to identify and develop strategies to increase the resilience of the Campus in response to potential risks arising from climate change.
The latest available global climate models show that in the coming decades,

Australia is projected to experience the following:

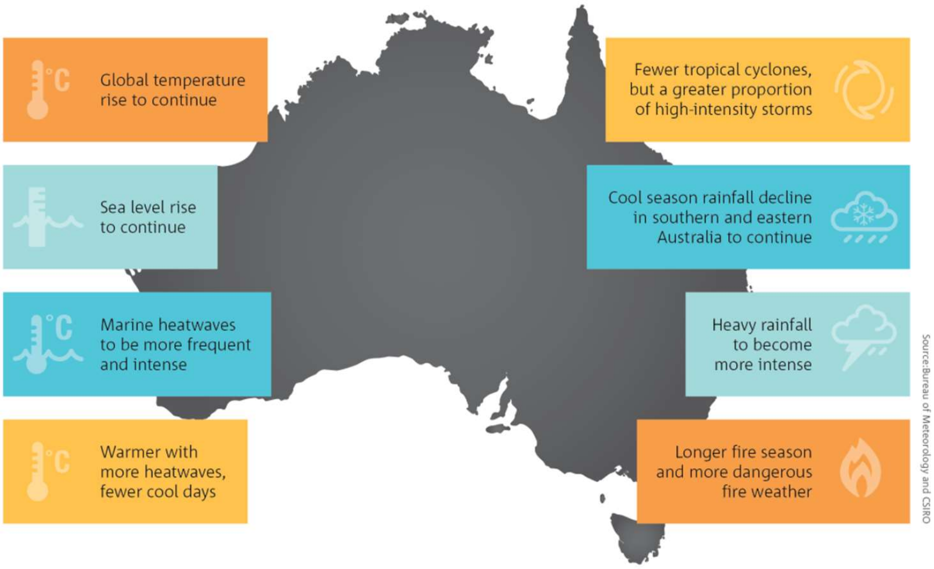

Figure 4: Summary diagram of climate projections for Australia. CSIRO and Bureau of Meteorology. Source: CSIRO

The below climatic variables will be considered to develop a resilience strategy for the Campus.

- Temperature
- Precipitation
- Fire weather/Bushfires
- Drought
- Flood
- Solar Radiation
- Relative Humidity
- Evapotranspiration
- Soil Moisture
- Wind
- Sea-level rise
- Cyclones

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Considering the above, the project will analyse key risks arising from climate change projections for the parts of the project affected, as well as mitigation strategies to eliminate or reduce such risks as much as possible.

Key strategies to consider include:

- Passive Design Optimisation for buildings. (Increasing insulation R-values / Glazing ratios and performance / Shading / Air tightness / Heat recovery / etc.)
- Allow for natural ventilation and good air flow in indoor and outdoor areas to allow for some increase in temperatures during peak times while maintaining comfortable conditions.
- Increase in plant capacity in buildings to accommodate increased temperatures.
- Provision of trees and covered walkways for shading to connect outdoor spaces with buildings.
- Use of soft landscape to reduce the heat island effect and improve outdoor thermal comfort. Were possible include cool paving with high albedo surface and hardscaping and roofing materials with high Solar Reflectance Index (SRI) being mindful of glare.
- Include planting around parking and other areas adjacent to hardscaped areas to improve shading and to reduce the heat island effect.
- For landscaping, select native species with low water requirements.
- Include Water Sustainable Urban Design features such as bioswales, raingardens, permeable paving, and attenuation tanks in paving systems to contribute towards natural absorption and water detention against potential increased storm events.
- Collect and reuse rainwater from roofs to be used for irrigation and potentially other uses if possible.
- Reduce Water consumption through efficient irrigation systems and efficient water fixtures.
- Design hardscape levels to allow for passive irrigation.
- Selection of robust materials.
- Include shading around external plant areas for improved cooling performance.
- Maximise landscaping to provide passive filtration and removal of air contaminants through absorption of CO2 and release of O2.
- Include onsite energy generation where possible (On roofs and other structures such as shading).

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6.6 Additional Key Measures

- **Environmental Management Plan (EMP)** – An EMP has been considered for the school. This measure is intended to reduce the environmental impacts associated with the construction of new buildings. The EMP will be developed and implemented for the construction stage, including demolition and excavation, to address environmental, worker health and safety and community risks. The EMP is a project specific plan and developed using State and Federal Guidelines and standards. The main contractor will implement an Environmental Management System certified to the ISO 14001 standard to ensure the objectives of the EMP are met.

Consider additional GBCA approved requests which could be claimed as innovation points:

Market Transformation

- Implement a building solution or process.

Leadership Challenges

- Meet the requirements of a Leadership Challenge developed by the GBCA.