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

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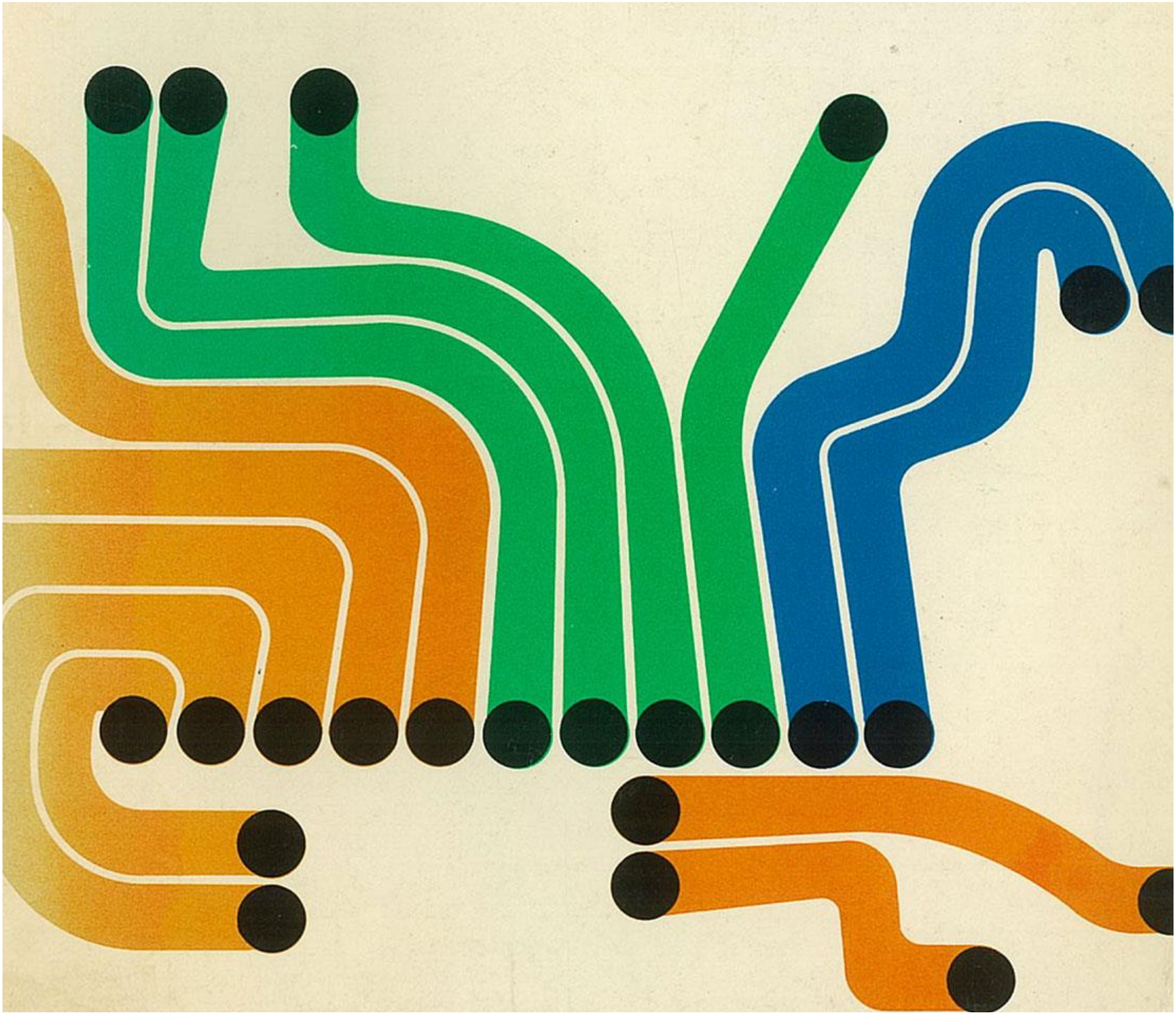
SUSTAINABLE DESIGN

STEENSEN VARMING

The Forest High School (FHS)

ESD Report for SSDA



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1.0 Executive Summary

This report has been prepared by Steensen Varming on behalf of the NSW Department of Education (NSW DoE), the Applicant. It accompanies an Environmental Impact Statement (EIS) in support of State Significant Development Application (SSDA) for The Forest High School (FHS).

The purpose of this report is to summarise the Environmentally Sustainable Design (ESD) initiatives adopted for the FHS, and to explain how the project has addressed the SEARs and, provide an overview of how the proposed design is responding to sustainable planning.

The sustainability targets and commitments for the project include:

- Exceeding the National Construction Code (NCC) Section-J Energy efficiency requirements by at least 10%
- Meet the sustainability requirements outlined in the School Infrastructure New South Wales (SINSW) Educational Facilities Standards and Guidelines
- Registered with the Green Building Council of Australia (GBCA) for a formal 5 Star Green Star certification, under the Green Star Design and As Built v1.3 tool.

2.0 Introduction

2.1 Project Scope

The proposed FHS project involves development of a new High School.

The FHS project will cater for a total student population of up to 1,500 and include the construction of seven new buildings. These buildings range from one to two storeys and contain a variety of uses including general learning spaces, library, amenities, staff rooms and combined canteen, Out of School Hours Care (OSHC), gym and hall. The construction also includes basement vehicle and bicycle parking and a waste loading area, On-Site Detention (OSD) tank and staff carpark.

Associated civil works and landscape works are proposed including tree removal and planting areas.

Figure 1: The Forest High School Scope of Project and Proposed Masterplan (Source: Architectus; Scale: Not to scale)

2.2 Site description

The SSDA is for the FHS site, located at Allambie Road, Allambie Heights. The site is located in the suburb of Frenchs Forest at approximately 20km northwest of Sydney Central Business District (CBD).

Figure 3: Existing site (Scale: Not to scale)

The project development includes the design of a new high school located on the corner of Allambie Road & Aquatic Drive Frenchs Forest. The surrounding area is predominantly characterised by low density residential dwellings. The site is bordered by:

- Residential development to the north, south, east and west;
- Allambie Road to the north and east (Allambie Road is the only access road to the FHS).

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3.0 Response to SEARs

The proposed FHS development is required to address the Secretary's Environmental Assessment Requirements (SEARs). Table-1 identifies the relevant SEARs requirement/s and corresponding reference/s within this report.

Table 1 – SEARs Items and Relevant Response and References

SEARs Items	Project Response and References
A) Identify how ESD principles (as defined in section 193 of the EP&A Regulation) are being incorporated in the design and ongoing operation of the development.	The sustainability approach considered for the FHS project aims to reduce the environmental impacts typically associated with school buildings, spanning across the phases of construction and ongoing operation of the building. The project utilises a resource efficiency approach, with emphasis on avoiding, then reducing the consumption of energy, water, waste, materials etc. Guidance for this resource efficiency approach is obtained using the Green Star Design & As-Built V1.3 framework. The outcome of this approach ensures that the project aligns with the principles of ecological sustainable development (Section 193) of the Environmental Planning and Assessment Regulation 2021. Refer to **Section 3.1 and 5.0** for further details.
B) Demonstrate how the 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 will achieve a certified 5 Star rating under the Green Star D&AB v1.3 tool, certified by the Green Building Council of Australia (GBCA). Design guidance has also been obtained from the Government Architect New South Wales (GANSW) 'Environmental Design in Schools Manual'. This guidance Manual also shares goals and targets that overlap with the EFSG and Green Star, both of which have been considered for this project. In accordance with the SINSW Educational Facilities Standard and Guidelines (EFSG), the proposed design is also addressing initiatives from the Green Star framework, using the Design and As-Built v1.3 tool as a guidance document. Refer to **Section 4.0 and 5.0** for details on relevant strategies that are being considered
C) Demonstrate how the 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.	The minimisation of GHG emissions and consumption of energy, water and material resources are demonstrated in **Section 5.0.**

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3.1 Project Response to section 193 of the EP&A Regulation 2021

The ESD initiatives proposed for the FHS 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.

To ensure a sustainable outcome, the following are key strategies that are incorporated in the current design:

- Design high quality spaces to promote comfortable and productive learning environments, while supporting the functional demand of the building, i.e. a learning / teaching environment. Key design emphasis is on achieving optimised Indoor Environmental Quality (IEQ) and occupant comfort (including optimised indoor air quality, thermal, acoustic and visual comfort)
- Incorporate a high-performance building envelope, to ensure energy efficiency as well as occupant comfort (including thermal, visual, and acoustic comfort)
- Incorporate appropriate passive and active design strategies to ensure a low-energy as well as low-maintenance design outcome
- Adopt water sensitive urban design principles
- Adopt practices to minimise demolition, construction and operational waste including recycling of demolition and construction waste.
- Utilise environmentally preferable materials

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 and the four key principles and our response listed below.

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Principle	Project Response
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.	The landscape strategy has been developed to enhance the environmental performance of the land, including integration of native plant species and incorporation of water sensitive urban design features to passively manage storm water falling on the site and enhance biodiversity.
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.	The FHS project will minimise the impact on the environment through: ▪ Resource efficiency measures and selected low embodied carbon materials and using recycled materials where possible ▪ Energy, water and waste reduction and conservation measures to reduce consumption of resources. ▪ Landscape strategies and WSUD features to enhance biodiversity and the site's ability to passively control stormwater ▪ Connection to country – Integration of indigenous and aboriginal design considerations and features.
Conservation of Biological Diversity and Ecological Integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	The landscape strategy considers the protection of existing ecological features, and the design will maintain the overall biodiversity and ecological performance of the site through mitigation measures.
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.	A sustainability strategy has been developed for the project to assess a wide range of sustainability strategies between the client, design team and stakeholders. Strategies have been developed to achieve the highest sustainability and environmental performance while aiming to remain within budget and minimise high costs.

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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 the FHS:

- Exceed the requirements of Section-J of the National Construction Code (NCC) 2019 for energy-efficiency in building fabric and building services / systems.
- Demonstrate good design through early-stage modelling and guidance, in general accordance with the best practice standards and guidelines.
- Align with new Government Architects NSW school standards such as:
  - Better Placed: An Integrated Design Policy for the Built Environment of NSW;
  - Environmental Design in Schools;
  - Greener Places;
  - Aligning movement and place;
- Align with the SINSW's EFSG targets
- The proposed design is also addressing requirements of the Green Star Design and As-Built v1.3 tool, to achieve a certified 5 star rating,

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 school project will exceed the DTS requirements of Section-J by at least 10%, in accordance with the EFSG DG 02 requirements.

4.2 Green Star

The FHS's project target of a certified 5 Star Green Star Design and As Built v1.3 Rating is considered by the GBCA as Australian Best Practice outcome. The Green Star rating tool is comprised of 9 sustainability categories, and a minimum score of 60 points is required for a 5 Star rating. Below table outlines FHS's targeted score.

CATEGORY	POINTS AVAILABLE	POINTS TARGETED
Management	14	12
Indoor environment quality	17	11
Energy	22	6
Transport	10	10
Water	12	5
Materials	14	8
Land Use and Ecology	6	4
Emissions	5	4
Innovation	10	6
TOTAL	**110**	**63**

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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.

For the FHS, the key priorities to support the functional demand i.e. a learning / teaching environment, are as follows:

- The promotion of natural daylight;
- High levels of IAQ (Indoor Air Quality);
- Thermal, Visual and Acoustic comfort;
- Resource conservation (energy, water, and waste);
- The creation of an integrated community resource; and
- The development of the building and surrounds as a teaching tool.

The promotion of natural daylight – There is a direct correlation between access to daylight and student performance, attention, productivity, and general wellbeing.

Excellent Indoor Air Quality (IAQ) – In a similar manner to daylight, there is proven correlation between student 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:

- Thermal comfort: To ensure teachers, students and administrators are not subject to unacceptable extremes in temperature as they teach, learn and work.
- Visual comfort: To ensure the quality of light is supportive of visual tasks such as reading and presenting. 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 an educational building (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 sections.

The creation of an integrated community resource – The Schools can play a role within the local community through the use of shared facilities (library's, auditoriums, sport facilities and open spaces), facilitating events such as farmers markets, community gatherings, and integration of community gardens.

The development of the building and surrounds as a teaching tool – Students develop greater knowledge retention, understanding and awareness, when they can 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 the strategies considered.

5.1 Resource Conservation

This section provides an overview of the resource conservation measures.

5.1.1 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 procurement of green power.

Figure 4: Energy hierarchy

The following energy initiatives have been considered:

- **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** are employed to maximise energy efficiency, and include orientation, solar access, prevailing winds, seasonal and diurnal temperatures changes.
- **Building envelope performance** (airtightness and thermal) will be enhanced by prefabrication where possible.
- **Building energy performance improvement –** By exceeding the minimum NCC compliance by 10%.
- **Energy efficient LED lighting, zoning, controls and site co-ordination** for both internal and external lighting systems have been addressed in the design.
- **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 selection is based on optimising performance, admitting as much daylight as possible, while controlling the transmission of unwanted solar heat and thermal conduction
- **Glazing ratio** – Glazing ratios are aimed at achieving an equilibrium between allowing daylight to enter buildings while reducing solar and conductive heat gains
- **Glazing position** – Windows are 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.
- **Thermal Mass** – Exposed thermal mass would assist in reducing the rate of change of temperatures within the building, and reduce the peak heating and cooling demands
- **A 99kW Solar photovoltaic (PV) array** is included in the current design, as a roof-mounted on-site renewable generation system.
- **CO_2 monitoring** is included for the appropriate control of outdoor air provisions.
- **Metering and Monitoring** of energy, water and air quality is included in accordance with NCC 2019 Amendment-1, Section-J8 requirements to monitor resource consumption.
- **Energy 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** will be implemented to ensure the building functions as designed.
- The project aims to promote the switch to renewable energy and building electrification.

5.1.2 Water

The following hierarchy and strategies will be applied:

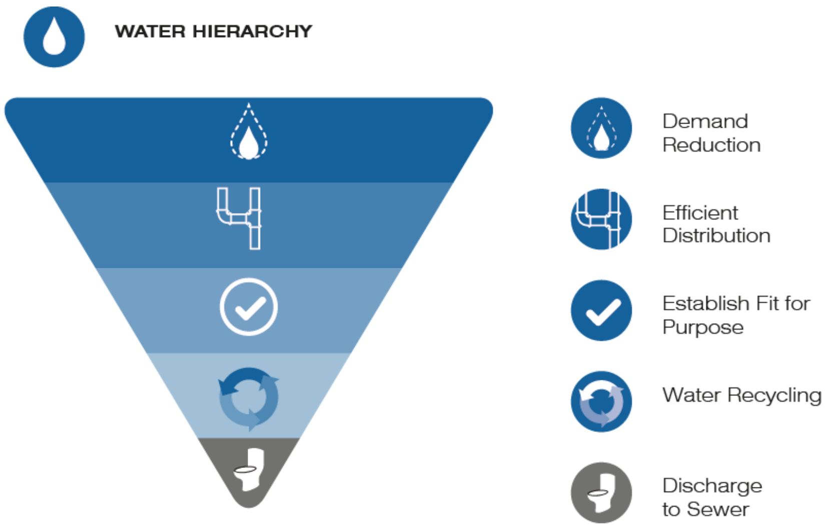

Figure 5: Water hierarchy

The following water initiatives have been addressed in the current design:

- **Water efficient fixtures / fittings have been specified.** These include fittings such as taps, showerheads, toilets, zip taps, dishwashers etc certified under the WELS rating scheme, rated as within one-star of the best available rating.
- **Rainwater Reuse** - Rainwater harvesting is incorporated in the project, and the captured water is reused for landscape irrigation.
- **Fire Systems test water** is also captured for re-use. The rainwater and fire-system test water are both collected in a common tank.
- **Efficient water management** including water reuse, wastewater management, leaks detection, water monitoring and managing.
- **Drip and demand-controlled irrigation** to optimise irrigation supply.
- **Native species of plants** and low water demand landscape design strategies have been incorporated.

5.1.3 Materials and Construction Waste

Selection of environmentally preferable materials is a key priority for the FHS project. Building materials consume energy and natural resources during their manufacturing process and for their transportation to the construction site. The project stakeholders are committed to make informed choices of materials and construction methods, as these would significantly impact the amount of energy embodied in the structure of a building.

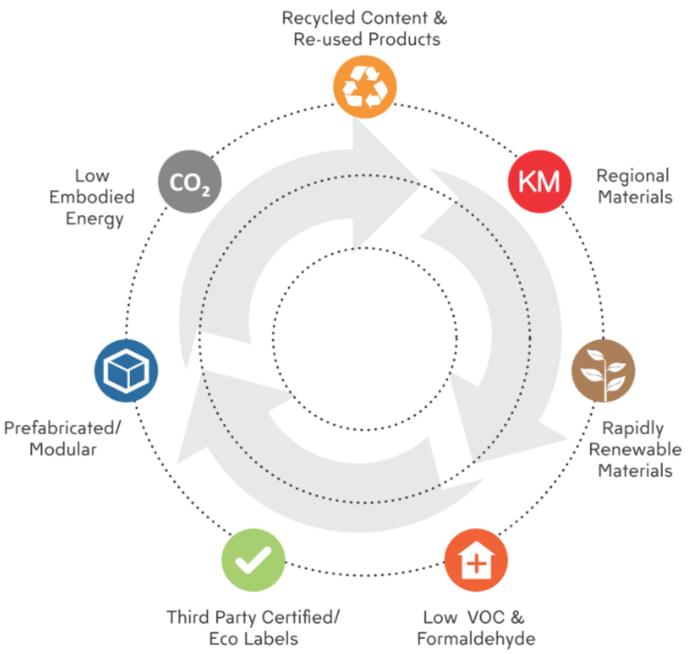

Figure 6: Materials and waste strategies

Low-impact construction methods of prefabrication (DfMA / MMC) is being applied on the FHS project, through the SINSW's model kit of parts approach. 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 is given to materials that contain high-recycled content and/or are highly recyclable. The following initiatives have been addressed in the current material selections for the FHS project:

- **Sustainable timber** – Timber products used for concrete formwork, structure, wall linings, flooring and joinery are specified to be sourced where possible from reused, post-consumer recycled or FSC-certified, or PEFC certified timber.
- **Steel** – 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 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 are specified in the Furniture Fittings and Equipment (FFE) schedule.

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- **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, to divert a minimum of 80% of the construction waste from going to landfill.

5.2 Emissions

The proposed design aims to reduce all forms of emissions, including watercourse pollution, light pollution, and ozone depletion. The following initiatives have been addressed in the current design:

- **Water Sensitive Urban Design (WSUD)** integrates water cycle management with urban planning and design. As part of the WSUD, the FHS development has incorporated rainwater reuse and storm water management. The aim of WSUD is to manage the impacts of storm water run-off from the development to protect and improve waterway health by replicating the natural water cycle.
- **Storm water pollution prevention -** This includes implementation of measures to prevent storm water contamination, to control sedimentation and erosion during construction and operation of the building. The storm water drainage system prevents storm water contamination, control sedimentation and erosion during construction and operation of the building.
- **Pollution of night sky** will be minimised by ensuring that the electric lighting within the site will not cause any direct beam of light into the night sky. Light pollution can disturb the habitat of migratory birds and impacts the behaviour of nocturnal animals in the site vicinity.

5.3 Resilience

The project has identified and developed strategies to increase the resilience of the FHS 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 risks (Refer Fig:7).

Australia's climate has seen gradually increasing average temperatures over the past century, with an increase of just over 1°C since 1910. Most of this increase has occurred since 1950 and 8 of Australia's top ten warmest years on record have occurred since 2005. It has also seen an increase in the number of extreme temperature days (days where temperatures exceed the 99th percentile of each month from 1910-2017).

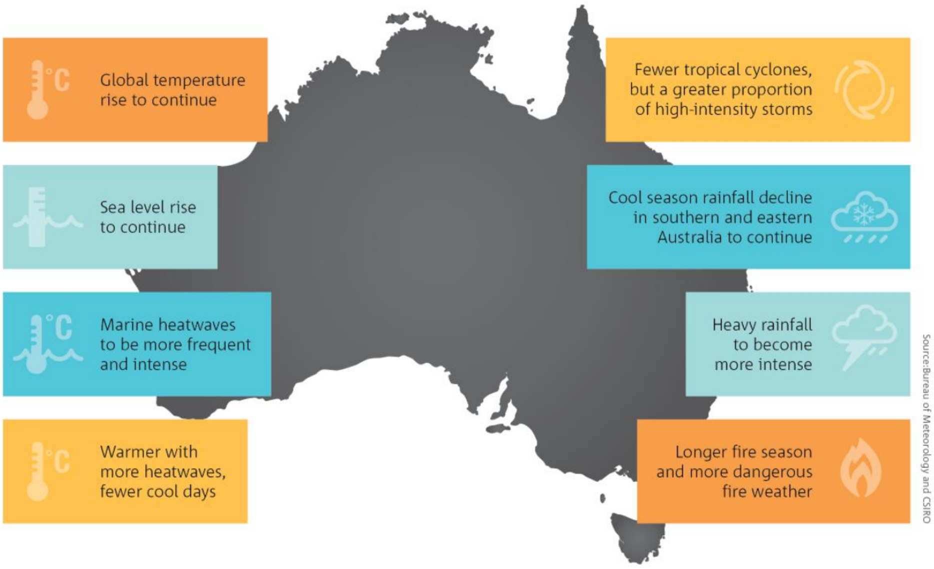

Figure 7: Summary diagram of climate projections for Australia (Source: CSIRO and Bureau of Meteorology)

This trend is predicted to continue, and the extent of the warming will be based on global emissions scenarios. The current projections are as follows:

Projected **temperature** changes	
Maximum temperatures are projected to increase in the near future by 0.3–1.0°C	Maximum temperatures are projected to increase in the far future by 1.6–2.5°C
Minimum temperatures are projected to increase in the near future by 0.4–0.8°C	Minimum temperatures are projected to increase in the far future by 1.4–2.5°C
The number of hot days will increase	The number of cold nights will decrease
Projected **rainfall** changes	
Rainfall is projected to decrease in spring and winter	Rainfall is projected to increase in summer and autumn
Projected **Forest Fire Danger Index (FFDI)** changes	
Average fire weather is projected to increase in spring by 2070	Severe fire weather days are projected to increase in summer and spring by 2070

Figure 8: Summary of climate projections for NSW (Source: Adapt NSW)

A high-level assessment of possible Climate Change impacts has been carried out by the design team to assess how the building design and services strategy will respond to above projections. The following strategies have been identified as risk mitigation strategies to eliminate or reduce such risks as much as possible.

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Key climate change risk-mitigation strategies for FHS include:

- Passive Design Optimisation for buildings. (Increasing insulation R-values / Glazing ratios and performance / Shading / Air tightness / Heat recovery / etc.)
- 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.
- Inclusion of planting around parking and other areas adjacent to hardscaped areas to improve shading and to reduce the heat island effect.
- For landscaping, selection of native species with low water requirements.
- Inclusion of Water Sustainable Urban Design features such as permeable paving, to contribute towards natural absorption and water detention against potential increased storm events.
- Collect and reuse rainwater from roofs to be used for landscape irrigation
- 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.
- Include 99kW photovoltaic array, as an onsite energy generation system

5.4 Additional Key Measures

The following measures are also being implemented on the FHS project. These measures are intended to reduce the environmental impacts associated with the construction of new buildings.

- **Environmental Management Plan (EMP)** – An 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.
- **Site waste management plan** – During the demolition and prior construction phase, the development of a project-specific site waste management plan (WMP) will be assessed to reduce recycling of demolition and construction waste.
- **Waste storage** will be provided dedicated to the separation and collection of recyclable waste.