ESD REPORT

Richmond Agricultural Centre

College Drive, Richmond NSW 2753

PREPARED FOR
Richard Crookes Constructions
Level 3 / 4 Broadcast Way
Artamon NSW 2064
Tel: 02 9902 4700

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ESD Report

Revision Schedule

Date	Revision	Issue	Prepared By	Approved By
11.12.2024	1	DRAFT	G. Lauriola	I. Van Eerden
18.12.2024	2	Final	G. Lauriola	I. Van Eerden
04.02.2025	3	Final (Updated)	G. Lauriola	I. Van Eerden
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09.04.2025	5	REF (For Review)	G. Lauriola	I. Van Eerden
08.05.2025	6	REF (Final)	G. Lauriola	I. Van Eerden
26.05.2025	7	REF (Final – Updated Project Description)	G. Lauriola	I. Van Eerden

Northrop Consulting Engineers Pty Ltd

ACN 064 775 088 | ABN 81 094 433 100

Level 10, 400 George Street, Sydney NSW 2000

02 9241 4188 | sydney@northrop.com.au | www.northrop.com.au

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Executive Summary

This report describes how ESD principles (as defined in Section 193 of the Environmental Planning and Assessment Regulation 2021) will be incorporated in the design and ongoing operation phases of the Richmond Agricultural Centre project, how the project incorporates measures to minimise consumption of water and energy, how it will reduce its ecological impact and how the project will achieve alignment to the GANSW Environmental Design in Schools Manual. This report also outlines how the Educational Facilities Services Guide (EFSG) has been used to benchmark the project to industry best practice. In addition, the project is targeting 5 Star Green Star Design & As-Built, demonstrating Australian excellence.

Specifically, the outcomes of the report can be summarised within the following categories.

- The precautionary principle – through the implementation of environmental management, maintainability and climate change adaption planning the project is actively including adaptability and resilience within the project. These plans and corresponding design responses demonstrate that the design is actively considering the concepts behind the precautionary principle to create a space that can both accommodate changes that may eventuate in the future and one that carefully evaluates and avoids serious or irreversible damage to the environment.
- Inter-generational equity to ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations – through the inclusion of zero ozone depleting materials, sustainably sourced timber, low impact steel and concrete, alongside a focus on native vegetation, water sensitive urban design and support for better connection with nature, the project demonstrates a strong commitment to the preservation of environmental health, diversity an productivity for future generations.
- Conservation of biological diversity and ecological integrity – through the planting of endemic native vegetation, improvement of stormwater runoff from the site and use of landscaping that blends with the surrounding parklands, the project will act to improve, conserve and support the local biological diversity and integrity.

The development integrates a range of key Environmentally Sustainable Design (ESD) features to improve environmental performance and support occupant wellbeing. These include, but are not limited to:

- Incorporation of passive design strategies, such as thermal mass to moderate indoor temperatures and roof overhangs to reduce solar heat gains in summer.
- Installation of an on-site renewable energy system to reduce reliance on the electricity grid.
- Use of energy-efficient air-conditioning systems to minimise energy consumption.
- Provision of ample access to natural daylight to reduce reliance on artificial lighting.
- Installation of LED lighting to improve energy efficiency.
- Specification of water-efficient fixtures to reduce potable water use.
- Integration of a rainwater harvesting system for non-potable uses, including toilet flushing and irrigation.

By incorporating the above measures and the additional sustainability initiatives outlined in this report, the project demonstrates a clear commitment to sustainable design and is suitably equipped for long-term operation, meeting both statutory requirements and the internal sustainability targets set by the Department of Education.

1. Introduction

This ESD Report has been prepared by Northrop on behalf of the Department of Education (DoE) (the Proponent) to assess the potential environmental impacts that could arise from the activities associated with the Richmond Agricultural Centre development at 2 College Street Richmond (Part Lot 2 DP1051798) (the site).

This report accompanies a Review of Environmental Factors (REF) that seeks approval for the construction and operation of the agricultural centre which will provide facilities for a specialist agricultural curriculum at the site. The activities associated with establishing the Richmond Agricultural Centre involves the following works:

- The removal of trees and fencing
- Construction of a general learning hub
- Construction of a science hub
- Construction of a multipurpose hall
- Construction of an administration building
- Construction of canteen and amenities building
- Construction of a new parking area (including accessible spaces) driveway and kiss and drop facilities
- The provision of outdoor agricultural learning areas comprising:
    - Agricultural plots
    - Aboriginal enterprise
    - Agricultural shed and greenhouse
    - Animal plots with associated stock yard, animal shelters, troughs and stock lane
    - Gravel access road with wash bay
- Landscaping including new trees, entry forecourt, village green and kitchen garden
- Ancillary services and infrastructure upgrades including new substation and HV Works, sewer pump station, water booster, dual carriage vehicle access and pedestrian paths
- Wayfinding and school identification signage

For a detailed project description, please refer to the Review of Environmental Factors (REF) prepared by EPM Projects.

Figure 1 – Proposed Site plan

1.1 Sustainability Objectives

Northrop has been engaged to provide input to the Richmond Agricultural Centre project to meet the objectives outlined by the Department of Education. The project is targeting the following sustainability outcomes:

- Compliance with the Educational Facilities Standards and Guidelines (EFSG) by the Department of Education (DoE).
- Exceeding the requirements of Section J of the National Construction Code (NCC) by 10% as per the Government Resource Efficiency Policy.
- Incorporation of Ecologically Sustainable Development principles considered to be best practice within the Australian building industry.
- Demonstration of how ESD principles will be incorporated into the design and ongoing operation of the development.
- Detail proposed measures to minimise consumption of resources, water (including water sensitive urban design) and energy.
- Detail how the future development would be designed to consider and reflect national best practice sustainable building principles and improve environmental performance and reduce ecological impact; and
- Detail how environmental design will be achieved in accordance with the GANSW Environmental Design in Schools Manual (GANSW 2018).

As the EFSG requirements provide a project specific design guide benchmarked to Australian Best Practice ESD. This standard will ensure that the project is designed to address future climate related events and allows the project to address the above.

The project team is harnessing the strong alignment between all the targeted goals and will use the EFSG framework alongside Green Star to demonstrate how this facility both incorporates industry recognised best practice sustainability and ESD, as defined in Section 193 of the Environmental Planning and Assessment Regulation 2021.

1.2 Disclaimer

Due care and skill have been exercised in the preparation of this advice. No responsibility or liability to any third party is accepted for any loss or damage arising out of the use of this report by any third party. Any third party wishing to act upon any material contained in this report should first contact Northrop for detailed advice, which will take into account that party's particular requirements.

2. Sustainability Initiatives

The following section describes how ESD principles (as defined in Section 193 of the Environmental Planning and Assessment Regulation 2021) will be incorporated in the design and ongoing operational phases of the project. These initiatives illustrate how the project will address the following.

- The precautionary principle – through the implementation of environmental management and building maintainability, the project will incorporate a focus on adaptability and resilience into the project design. The concept behind the precautionary principle is to create spaces that can both; accommodate for changes, which may eventuate in the future, and avoid the risk of serious or irreversible damage to the environment.
- Inter-generational equity to ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations – through the inclusion of zero ozone depleting refrigerants, best practice PVC and low impact paints, sealants and adhesives, alongside a focus on providing greater vegetation and support for the buildings connection with nature, the project will demonstrate a strong commitment to the preservation of environmental health, diversity and productivity of the local area.
- Conservation of biological diversity and ecological integrity – through the planting of native vegetation, reduction of stormwater runoff from the site and use of integrated landscaping, the project will act to improve, conserve and support the local biological diversity and integrity.
- Improved valuation, pricing and incentive mechanisms - the project will involve significant input from the Quantity Surveyor who will be involved to ensuring that the project both remains on budget and effectively considers environmental factors in the valuation of assets and services.

Through the inclusion of the above and the sustainability initiative outlined within this report the project clearly addresses the ESD Principles as defined in Section 193 of the Environmental Planning and Assessment Regulation 2021. Further details of the general sustainability initiatives are outlined below.

2.1 Energy Efficiency

Energy efficiency has been considered throughout the project design phases and will continue to heavily influence the design development process with the following improvements already considered as part of the design process.

2.1.1 Natural Ventilation of Circulation Spaces

Most circulation areas within the project will be able to operate as naturally ventilated spaces exploiting the buildings design to promote flow of air. The slim buildings and distributed nature of the design allows air to flow throughout the campus and provide free cooling of most spaces.

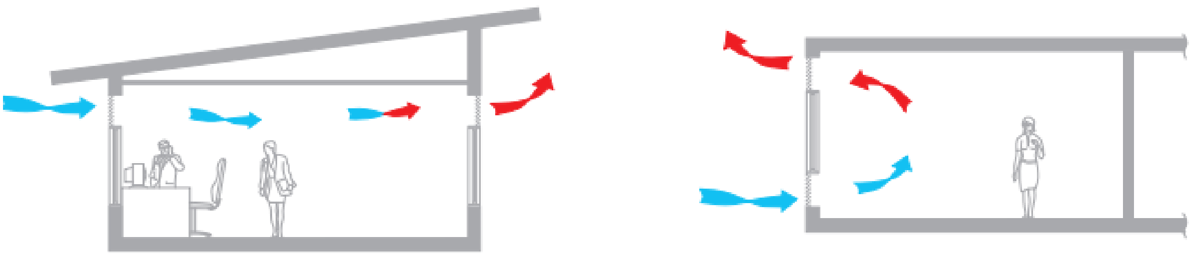


Figure 2 - Different types of ventilation within a dwelling

2.1.2 Improved building fabric and glazing performance.

The building envelope comprises several different façade types, with the proposed scheme using a combination of building materiality and glazing to lower heat gains throughout summer while maintaining good views and daylighting throughout of the building. The operable windows and doors on the façade will also contribute strongly to the natural/mixed mode ventilation strategy allowing for minimal use of space conditioning across the year.

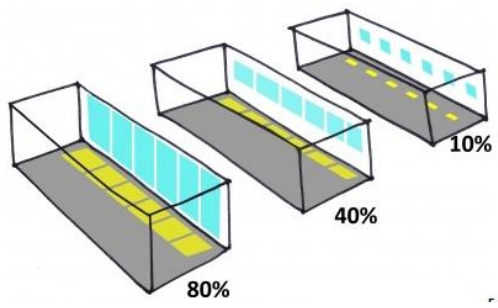


Figure 3 - Window to wall ratio

The use of high-performance glazing and building materials will assist the projects targets for energy efficiency, acoustic separation, and thermal comfort. Additionally, the selection of pale roofing and façade elements will help to limit heat gain throughout the school's operational periods falling within summer. It is noted that school holidays generally occur over the hottest periods of summer, and this provides the design some flexibility in optimising for the shoulder seasons.

2.1.3 Mixed Mode HVAC

The mechanical systems are to be mixed mode to account for opportunities to use the operable windows, cross ventilation, and adaptive thermal comfort approach to the site. Space conditioning will still be provided to accommodate heating and cooling during peak periods across the year, but the systems design will be to minimise its use when external conditions are able to meet the occupant comfort needs.

The project team has been investigating the provision of fan coil units and heat recovery heat exchangers (for high density GLAs). The outside airflow rates will be adjusted to meet the project needs. When the ambient condition is suitable, the rooms will be provided with natural ventilation which will contribute to reduce the building energy demand.

2.1.4 HVAC System Control

The proposed HVAC system incorporates individual room control for thermal comfort conditions allowing building occupants to maintain comfort conditions suitable to the use and occupancy of spaces. This system assists in optimising the sites energy efficiency while maintaining comfortable conditions within the conditioned areas and ensures that vacant spaces are not conditioned. The multipurpose hall will not be provided with air-conditioning system and will rely on natural ventilation.

2.1.5 Adaptive Thermal Comfort Control

Through consideration of space uses and expected clothing use when HVAC systems are active, they will be set to drift within a larger than standard dead band to reduce overcooling and heating of spaces. These set points will be determined for each space through consideration of the expected comfort bands across the year, considering things such as external temperatures, school uniforms, activity, and room layouts.

2.1.6 Energy Metering and Monitoring

An energy metering and monitoring strategy will be provided to effectively monitor the main energy uses within the project, alongside the lighting and small power use. This aims to provide high level fault detection and monitoring of the different areas of the project.

2.1.7 Improved outdoor air provision.

The project will improve the outdoor air provided to regularly occupied spaces in line with the Green Star Design & As Built v1.3 – Credit 9.2 Provision of Outdoor Air requirements. Through the provision of outdoor air and the installation of CO_2 sensors, CO_2 build-up will be minimised and cognition for the building occupants improved.

2.1.8 Highly efficient lighting system

The installation of LED lighting throughout all areas of the building will assist in the minimisation of lighting energy use. Improved lighting energy also reduces the heat loads within the spaces and therefore lowers the energy used to condition the buildings.

2.1.9 Onsite Renewable Energy

The project will include a 70kW rooftop solar array in line with the EFSG requirements, providing energy production onsite to both reduce energy costs and provide educational outcomes for students and staff.

2.1.10 Passive Design Measures

A focus has been placed on good passive design within the building and shading systems for the project. Examples of this includes the following:

- Inclusion of roof overhangs to reduce solar heat gains during summer.
- Use of well-designed glazed areas to exploit overshadowing of the circulation balcony areas for peak occupancy periods.
- Strong use of thermal mass to regulate temperatures. This is achieved through the selection of a concrete materiality for the external circulation and structural elements.
- Integration of landscaping into the building designs to minimise heat islanding and promote passive cooling through transpiration.
- Use of high-performance thermal and acoustic insulation for the project facades.

2.2 Indoor Environment Quality

Indoor environment quality is always an important consideration in educational projects. The following initiatives have been included as part of the building design.

2.2.1 Daylight Access

The design of the building allows for good daylight penetration into both internal and external spaces. This access to daylight throughout the building will both minimise energy used for lighting and will improve occupant connection to their external environment.

2.2.2 Interior noise level control

Internal noise levels have been actively considered with the building layout and systems design, considering how noise will reverberate through the building. The use of acoustic insulation and sound isolation will ensure that interior noise levels are maintained below acceptable limits.

2.2.3 Access to views

Access to external views allows the switch between short and long focal lengths reducing eye strain for students. There is significant evidence to support that eyestrain and related health problems can be significantly reduced in situations where the eyes can be refocussed periodically on a distant object. This is easier to achieve where there is a nearby window with a view.

The overall design of the project provides good access to views for the majority of the classrooms where students are expected to concentrate for extended periods of time.

2.2.4 Material selection

Materials selection for the project will improve the internal environment of the site with materials with low volatile organic compound and formaldehyde content that help minimising respiratory issues for building occupants. Additionally, the use of natural materials such as stone, timber, rubber floors will be prioritized during the detailed design, these materials help to facilitate a biophilic response in occupants and have been shown to improve educational outcomes.

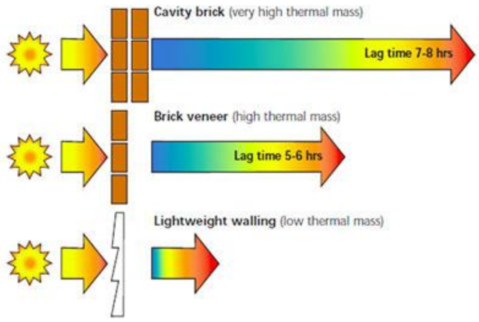


Figure 4 - Thermal mass stores heat during day and releases this at night (yourhome.gov.au)

Maximum TVOC limits for paints, adhesives and sealants are detailed in the table below.

Table 1 - Maximum TVOC Limits for Paints, Adhesives and Sealants

Product Category	Max TVOC content in grams per litre (g/L) of ready to use product
General purpose adhesives and sealants	50
Interior wall and ceiling paint, all sheen levels	16
Trim, varnishes and wood stains	75
Primers, sealers and prep coats	65
One and two pack performance coatings for floors	140
Acoustic sealants, architectural sealant, waterproofing membranes and sealant, fire retardant sealants and adhesives	250
Structural glazing adhesive, wood flooring and laminate adhesives and sealants	100

All engineered wood products used in the building will meet the relevant limits specified in the table below as per the specified test protocol or have product specific evidence that it contains no formaldehyde.

Table 2 - Formaldehyde Emission Limit Values for Engineered Wood Products

Test Protocol	Emission Limit/Unit of Measurement
AS/NZS 2269:2004, testing procedure AS/NZS 2098.11:2005 method 10 for Plywood	≤1mg/ L
AS/NZS 1859.1:2004 - Particle Board, with use of testing procedure AS/NZS 4266.16:2004 method 16	≤1.5 mg/L
AS/NZS 1859.2:2004 - MDF, with use of testing procedure AS/NZS 4266.16:2004 method 16	≤1mg/ L
AS/NZS 4357.4 - Laminated Veneer Lumber (LVL)	≤1mg/ L
Japanese Agricultural Standard MAFF Notification No.701 Appendix Clause 3 (11) - LVL	≤1mg/ L

Test Protocol	Emission Limit/Unit of Measurement
JIS A 5908:2003- Particle Board and Plywood, with use of testing procedure JIS A 1460	≤1mg/ L
JIS A 5905:2003 - MDF, with use of testing procedure JIS A 1460	≤1mg/ L
JIS A1901 (not applicable to Plywood, applicable to high pressure laminates and compact laminates)	≤0.1 mg/m²hr
ASTM D5116 (applicable to high pressure laminates and compact laminates)	≤0.1 mg/m²hr
ISO 16000 part 9, 10 and 11 (also known as EN 13419), applicable to high pressure laminates and compact laminates	≤0.1 mg/m²hr (at 3 days)
ASTM D6007	≤0.12mg/m³
ASTM E1333	≤0.12mg/m³
EN 717-1 (also known as DIN EN 717-1)	≤0.12mg/m³
EN 717-2 (also known as DIN EN 717-2)	≤3.5mg/m²hr

2.3 Water Efficiency

A strong focus has been put on the effective management of water within the building with the following initiatives being included in the design in all areas throughout the project.

2.3.1 Water efficient fixtures and fittings

Water Efficient fixtures and fitting will reduce the water consumption of the site. As an indication, the following is to be targeted.

- Wash hand basin taps 6-star WELS.
- General taps 6-star WELS
- Toilets dual flush 5-star WELS (other than DDA toilets)
- Urinals 4-star WELS
- Shower heads 4.5-6 L per minutes 3-star WELS

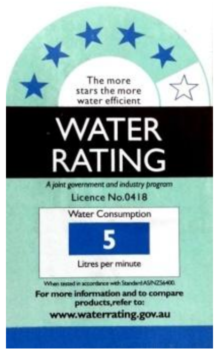


Figure 5 - WELS Label

2.3.2 Use of low maintenance landscaping

The site's landscaping incorporates native and low-maintenance vegetation where possible, which will significantly reduce the potable water consumption of the site. This use of native vegetation will also help support local flora and fauna, create a strong connection to space and incorporate learning opportunities for the school community.

2.3.3 Water Sensitive Urban Design

The project incorporates a strong focus on water sensitive urban design with the external landscape design assisting to minimise water use for irrigation. The inclusion of vegetation also assists in the reduction of site stormwater discharge and in the management of the project's broader impact on stormwater flows. A rainwater storage system and a permeable landscaping design have been included. The collected rainwater will be used to serve toilet flushing and landscape irrigation, to further reduce potable water consumption.

2.4 Improved Ecology

Through planting native vegetation and promoting improved interaction with the natural environment, the project will improve the site’s ecology and minimise its ongoing environmental impact. The project will also minimise light spill from the facility which impacts on migratory animals and insects. In addition, the stormwater design will reduce the dissolved pollutants discharged from the site.

2.5 Sustainable Transport

The project is well located to support the use of active and sustainable transport. The site is walkable, with proximity to Richmond East train station for trains and busses, the project will include some parking as part of the development however will use the proximity to the station and connection of the site with footpaths to promote the use of active and public transport.

The project will also include the provision of Bike parking spaces and end of trip facilities for the staff. In addition car-pooling for staff and students should be encouraged to further reduce the use of private vehicles.

2.6 Waste Management

Effective waste management throughout construction and operation of the site will help to promote resource efficiency and minimise the adverse environmental impacts of the project. The following will be considered as part of the design process:

2.6.1 Operational Waste

The provision of separated waste and recycling streams will allow for more effective recycling of the projects' operation waste. Providing separate bins for landfill waste, food waste, soft-plastic recycling, comingled recycling, glass recycling and refundable containers will improve the buildings' operational efficiency and result in significant environmental benefits. Refer to the Operational Waste Management Plan for further details and recommendations on how the project intends to decrease the amount of operational waste sent to landfills.

Figure 6 - Waste bin colours

2.6.2 Construction Waste Minimisation

The project will also limit the amount of construction waste sent to landfill, with the aim of at least 90% of all waste produced to be sent to recycling facilities or reused onsite, in line with the Green Star Design & As-built v1.3 – Credit 22 Construction and Demolition Waste requirements.

2.7 Massing and Site Layout

The proposed design has considered the likely operation of the project and how the overall site massing and layout could affect sustainability outcomes. The massing and site layout has looked to consider and balance the often-competing outcomes of daylighting, comfort, energy consumption and useability of the site.

2.7.1 Orientation

The building orientation has considered the site solar access across the day with the idea of creating a balanced solar access with daylight entry promoted over each of the site's spaces across the day. This variation in daylight entry helps to ensure that all there is change in daylight levels throughout the day in all areas and that spaces are not over lit when occupied. The orientation has also considered the connection of the project to the adjacent roads to create a good grounding of the site within the broader area.

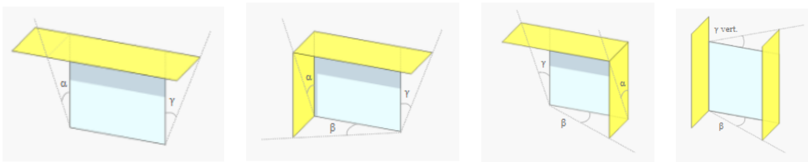
2.7.2 Shading

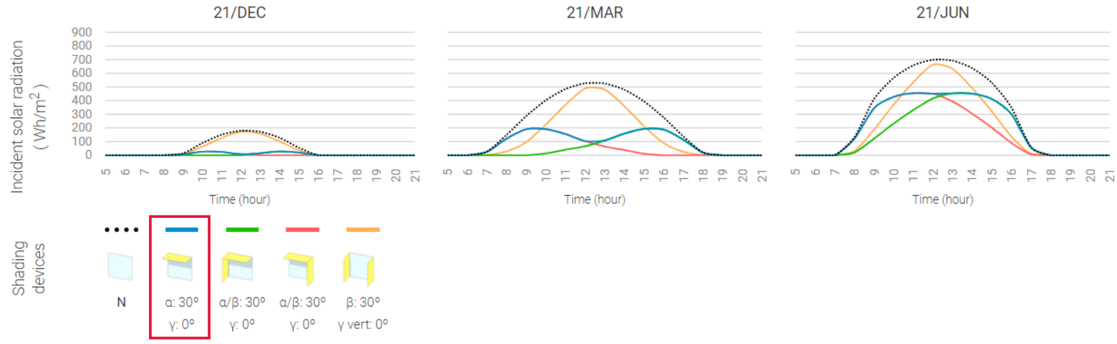
To accommodate the requirements for site connection and the passive ventilation needs, an optimised shading analysis was completed to consider good glare and heat control during occupied periods.

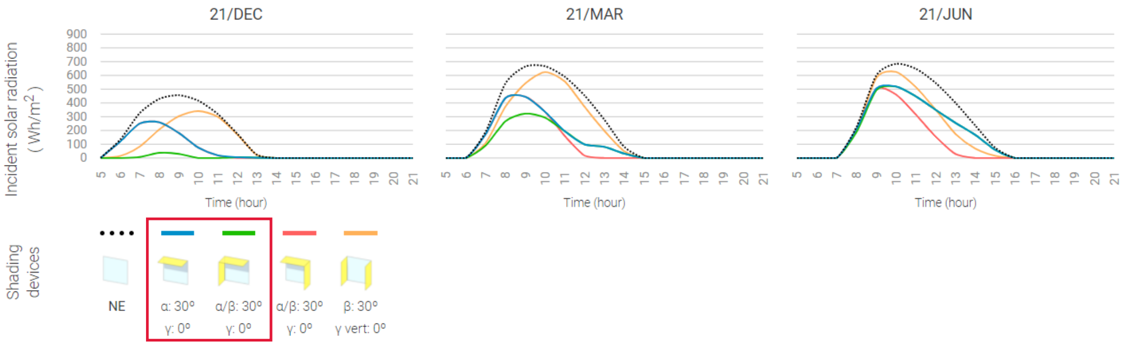
α = overhang vertical projection

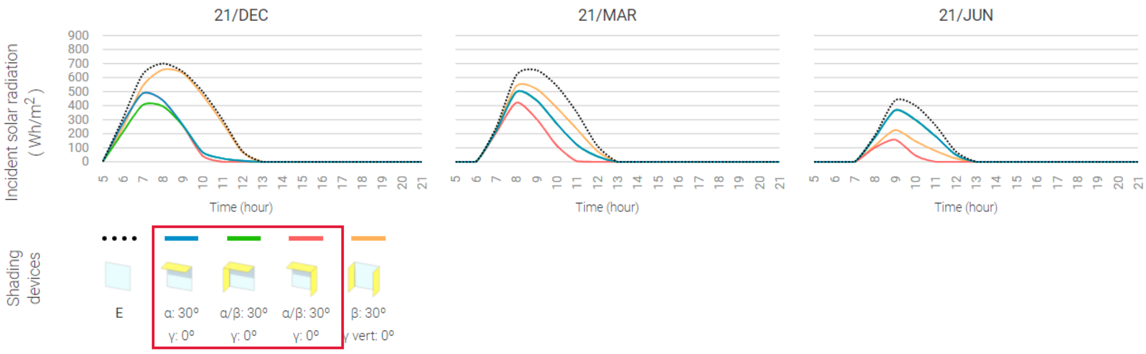
β = vertical shading projection

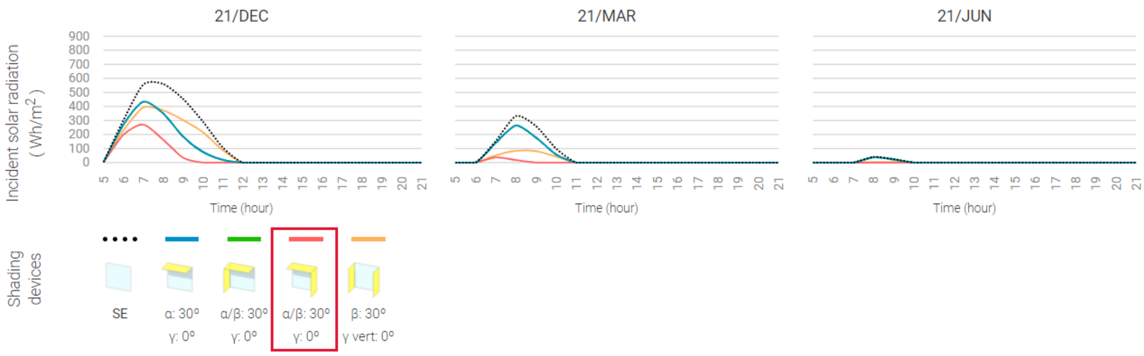
γ = overhang depth











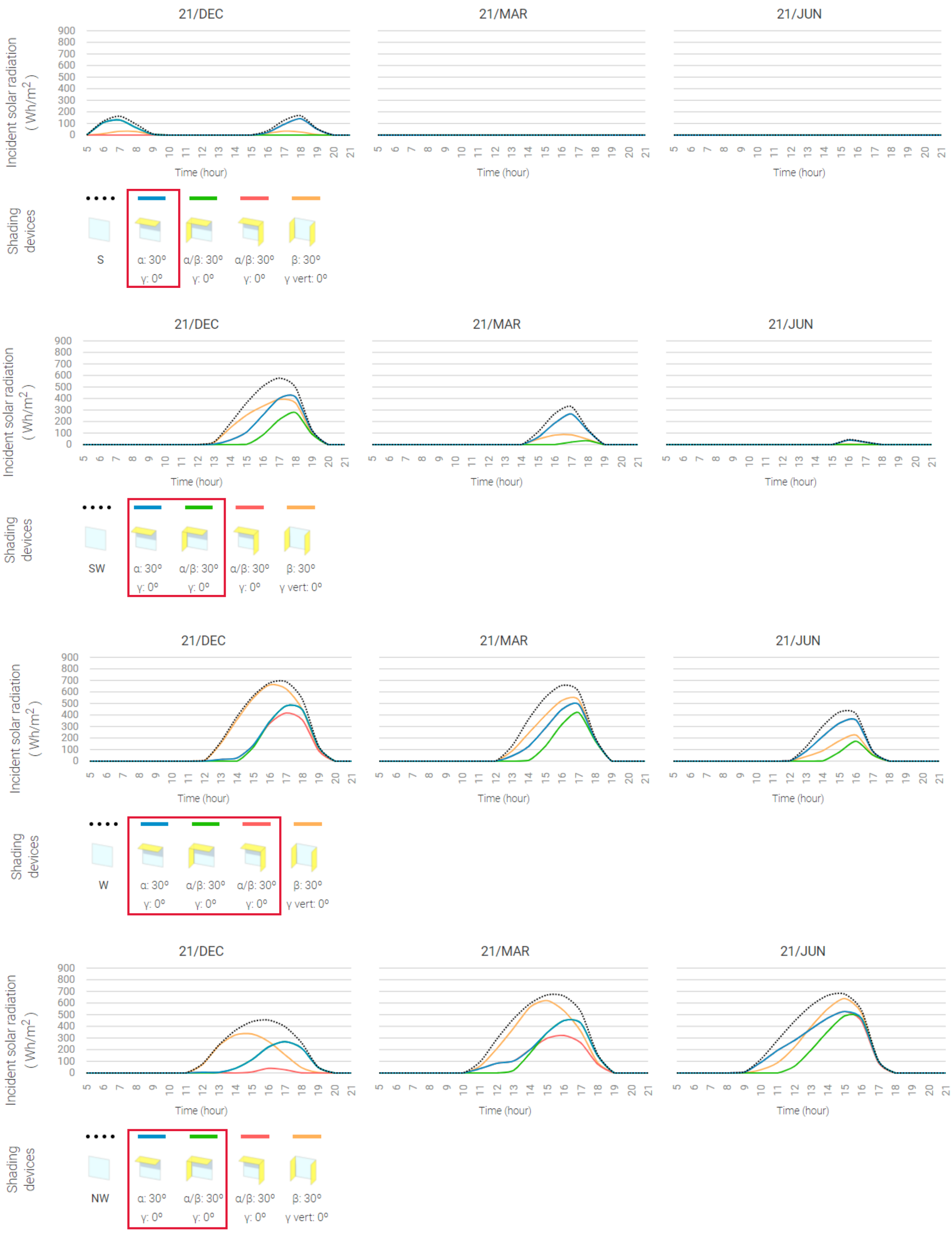


Figure 7 - Comparative assessment of the hourly profile of direct beam radiation between eight facade orientations (from the top of the figure: N, NE, E, SE, S, NW, W, NW)

Given the sites Mild Temperate climate (Zone 6 – Refer to Figure 12 on page 39) the use of horizontal shading that blocks significant heat gains throughout summer during school hours (until 3pm) but allows this entry during winter helps to minimise heating load in summer while still allowing diffuse daylight to penetrate the space. This consideration informed the inclusion of roof overhangs, providing horizontal shading while balancing daylight access and thermal comfort, specifically tailored to the needs of this school project.

The above analysis shows the horizontal shading provided to the east and west controls glare and heat gains almost entirely between the hours of 9am and 3pm.

3. EFSG Sustainability Requirements

3.1 Overview

The Educational Facilities Standards and Guidelines (EFSG) have been developed by the NSW Department of Education (DoE) to assist the management, planning, design, construction, and maintenance of new and refurbished school facilities. The EFSG is to be treated as a reference guide that provides a benchmark framework to allow for a consistent best practice standard of delivery across various types of school developments.

The EFSG Design Guide considers a framework incorporating several aspects of design including extensive Ecologically Sustainable Development (DG02) requirements. The following categories are covered within the EFSG DG02 Design Guide:

- NSW Government Resource Efficiency Policy
- Environmental Design Policies
- Environmental Design Features of Educational Facilities
- Insulation
- Ventilation
- Pesticides
- Water Conservation

The proceeding sections outline the requirements for the above categories of the EFSG DG02 Design Guideline.

3.2 NSW Government Resource Efficiency Policy (GREP)

The GREP aims to both lead by example and reduce the Government's operating costs by increasing resource productivity. This policy drives resource efficiency by Government agencies in energy, water and waste and reducing harmful air emissions from associated operations.

The policy ensures to:

- Meet the challenge of rising prices expected for energy, fuel, water and waste management.
- Use purchasing power to drive down cost of resource efficient technologies and services.
- Demonstrate leadership by incorporating resource efficiency in decision making.
- Design Buildings that achieve a 10% reduction on a minimum National Construction Code Complaint Building. This will generally be exceeded for an EFSG compliant school.

3.3 Environmental Design Policies

3.3.1 Green Building Design and Green Star

The project has been registered by SINSW under the Green Star Design & As-Built v1.3 tool. The details of this tool are included in Section 5 of this report.

3.3.2 Framework Requirements

The DoE requires that any new school building on a new or existing site achieve best practice sustainability within the Australian building industry. Policies set out by the EFSG are expected to achieve this standard against the GBCA framework most relevant to the project.

A potential compliance pathway has been developed and its implementation is being considered as part of the design development process to ensure that the Richmond Agricultural Centre project incorporates the Australian Best Practice Sustainability. The measures under consideration are outlined in Section 5 of this report to address areas not covered by the EFSG.

3.3.3 Environmental Management Plan

It is mandatory that all new projects prepare a site-specific Environmental Management Plan (EMP) prior to the commencement of the relevant site works. Contractors will be required to prepare an EMP as a condition of contract.

For projects equal to $10 million or greater, including projects under $10 million which are environmentally sensitive, contractors will be required to develop a corporate Environmental Management System (EMS) accredited by an NSW government construction agency.
The head contractor is also required to implement an environmental management system certified to ISO14001.

3.3.4 Timber

The project is to contain no rainforest timbers (unless plantation grown), no timbers from high conservation forests and use only recycled timber, engineered and glued timber composite products, timber from plantations or sustainably managed regrowth forests.

This requirement will be included in the project specifications to ensure that compliance is achieved.

3.3.5 Ecologically Sustainable Development

The project must:

- Ensure the preservation, maintenance, and sustainable use of the community's natural and mineral assets.
- Protect and support biological and ecological diversity.
- Restrict the flow of pollutants into our natural environments.

Through planting native vegetation and promoting improved interaction with the natural environment, the project is aiming to improve the site's ecology and minimise the ongoing environmental impact of the project.

The project is currently implementing the following:

- Selection of native vegetation endemic to the local area;
- Minimisation of light spill from the facility which impacts on migratory animals and insects; and
- Reduced dissolved pollutants in stormwater discharged from the site.

3.3.6 Environmentally Friendly Materials / Products

The project must encourage the use of materials and products which:

- Adequately and economically perform their intended functions while having low adverse environmental impacts throughout their life cycle.
- Contain reduced or no hazardous substances (low VOC)
- Reduce the demand for rare or non-renewable resources.
- Are made form or contain recycled materials or can be recycled at the end of their useful life.

3.3.7 Conservation of Biological Diversity

The project must conserve for future generations, the biological diversity of genetic materials, species and ecosystems. Project and purchasing impacts must be assessed on the natural environment during all project phases and adopt a precautionary approach where risk is high.

3.3.8 Pesticides

No chemical pesticides and/or termiticides will be used on the project. Physical termite barriers will be used where required to prevents termite access.

3.3.9 Waste

The EFSG DG02 requires consideration to eliminate unnecessary waste by better planning and more efficient use of natural and manufactured resources. The project will incorporate several waste initiatives as part of the detailed design.

Effective waste management throughout construction and operation of the site will help to promote resource efficiency and minimise the adverse environmental impacts of the project. The following should be implemented as part of the design:

- Dedicated waste recycling spaces;
- Provision of accessible water sources for drinking water to reduce the use of bottled water on site;
- Provision of waste education resources linking with waste companies;
- Minimisation of construction and demolition waste sent to landfill; and
- Provision of separated waste streams for recycling and general waste.

3.4 Environmental Design Features of Educational Facilities

3.4.1 Natural Light

The intention of incorporating good daylighting is to minimise energy consumption and ongoing running costs and ultimately provide natural light to the students and staff. Natural daylight improves the indoor environmental quality of spaces and encourages beneficial learning. The EFSG DG02 Design Guideline requires that:

- Natural daylight is to be provided to all teaching spaces unless otherwise identified.
- Natural daylight can be provided via windows, skylights and roof-lights. Where a room is required to have a brownout function, roof-lights and skylights will need to include a method to sufficiently adjust light levels.
- Include daylight sensors to rooms to reduce light output or turn off lights when sufficient daylight is provided within the space.
- When the space is large, it is recommended that perimeter lighting adjacent to windows be on a separate zone to make maximum use of daylight.

3.4.2 Sun Shading

On exposed facades of the project which are subject to direct sunlight, external window shading should be considered as part of the building design to ensure energy efficiency and thermal comfort.

3.4.3 Period Bells

Energy consumption should be minimised in the development where possible. An area that is to be addressed as part of the new development is to include the following initiatives as part of the period bells design:

- Period Bell Light switching systems are to be in all new schools, major conversions and additions.
- All luminaries in rooms are to automatically turn off five minutes after the period bell rung and all students have left the room. Alternatively, systems should be in place to turn off lights in a room when not in use.
- A conscious decision is required to turn the lights on again.

3.4.4 Appliances and Equipment

Minimum standards for new electrical appliances and equipment are to be compliant with the NSW Government Resource Efficiency Policy Part E3 and must have the minimum Greenhouse and Energy Minimum Standards (GEMS) star ratings as stipulated in the policy.

3.4.5 Air Cooling and Heating Systems

Air cooling and heating systems for the project are to include the following:

- Timed or sensor operation functionality for all air-cooling systems.
- Centralised control of HVAC plant with programmable schedules for the school year.
- Consider one single infrastructure for heating and cooling where it demonstrates whole life cycle cost savings.

3.4.6 Electricity Meters

Electricity meters for the project are to be installed with capacity for monitoring in order to lower electricity maintenance costs by selecting a fit-for-purpose meter and allowing better access to energy consumption data at the school.

3.4.7 Renewable Energy Generation

A photovoltaic (PV) solar power grid-connect rooftop system will be provided to reduce power consumption and costs. The EFSG Design Guide section DG66.3.1 recommends a system capacity of up to 99kW depending on the size of the student population. The designer and/or installer of the PV system must be fully accredited by the Clean Energy Council of Australia and adhere to the system design requirements given in within the EFSG Design Guideline.

3.5 Insulation

Insulation is to be compliant with the Building Code of Australia under Section J, Part J1 – Building Fabrics of the National Construction Code. It is required that the project utilise passive building elements such as insulation to keep heat out of classrooms during summer and reduce heat loss during winter.

3.6 Ventilation

Natural ventilation is to be used where possible to maintain good environmental air quality through all school areas. Natural ventilation principals are required to be incorporated into the project design where possible. Mechanical ventilation should only be used in areas where natural ventilation cannot be achieved, such as school performances spaces, duplicating rooms, dark rooms and internal toilets.

Single loaded covered walkways are encouraged as a means of maximizing cross ventilation, while roof turbo ventilators can be employed to enhance natural ventilation of a single storey or upper storey of a multi-storey building.

3.7 Pesticides

The project should be designed, constructed and maintained, without using chemicals for termite and other pest control. See section 3.3.8.

3.8 Water Conservation

The EFSG requires that measures be taken to implement practical water conservation systems for new educational facilities. These include:

- All fixtures and fittings are to have a minimum WELS rating as given in W3 of the NSW Government Resource Efficiency Policy.
- Internal flow controllers that minimise water usage for staff amenities.
- Timed flow taps for student facilities.
- Dual flushing cisterns with a minimum WELS rating of 4 stars in all toilets.
- Manual flushing systems are preferred.
- Rainwater harvesting and storage tank facilities for non-potable end uses.

4. National Construction Code 2022 – Section J

The Deemed-to-Satisfy (DTS) provisions of Section J apply to building elements forming the envelope of the building. The development is located in NCC Climate Zone 6 and is classified as a Class 9b assembly building / Class 5 Office. The DTS requirements for Section J1 (building fabric & glazing) are described in the following sections.

4.1 Building Fabric

4.1.1 Roofs and Ceilings

The roof areas of conditioned spaces must achieve a minimum total R-Value of 3.2 m2.K/W for a downward direction of heat flow and solar absorptance is not more than 0.45.

4.1.2 Envelope Walls

The external envelope walls of the conditioned spaces must achieve a minimum Total R-Value of 1.4 m2.K/W inclusive of the impacts of thermal bridging. This will be confirmed in the next phase of the project.

4.1.3 Floors – Suspended Slab

Floors require a minimum Total R-Value of 2.0 m2/K/W in the downwards heat flow direction.

4.2 Glazing

The glazing in the external fabric facing each orientation will be assessed separately in accordance with the DTS Glazing Calculators as issued by the BCA.

Compliance is determined by the glazing area, the façade orientation, the area of the facade, horizontal shading provided, and the glazing performance. Vertical shading cannot be entered into the Glazing Calculator. Glazing performance is measured by Total U-Value (the total U-Value for the glazing unit including the frame) and the Solar Heat Gain Coefficient (SHGC).

The design aims to deliver a high-performance single-glazing solution applied uniformly across the school. The targeted glazing performance parameters are a U-value of 4.2 W/m²K and a Solar Heat Gain Coefficient (SHGC) of 0.45.

This will be confirmed in design development JV3 modelling during the detailed design phases of the project.

5. Green Star Framework

5.1 Overview

The Green Building Council of Australia's provides an internationally recognised system to assess sustainable outcomes throughout the life cycle of the built environment. It was developed by the Australian Building Industry through the Green Building Council of Australia (GBCA), which is now the nation's leading authority on sustainable buildings and communities. Although the Project is utilizing the EFSG to benchmark the project to Industry Best Practice Sustainability there are several initiatives covered by the Green Star tool that are additional to the requirement of the EFSG. As such the project is looking to implement some additional elements drawn from this tool to address some elements of Ecologically Sustainable Design Principles more holistically.

This section provides a summary of the additional elements drawn from the Green Star tool being applied at the Richmond Agricultural Centre project . The Green Star system incorporates ESD principals across nine major categories:

- Management
- Indoor Environment Quality
- Energy
- Transport
- Water
- Materials
- Land Use and Ecology
- Emissions
- Innovation

It is noted that the project has been registered under the Green Star Design & As-Built v1.3 rating tool (Project Number GS-6844DA) and is targeting a certified 5 Star Green Star rating.

5.2 Targeted Score Card

Category	Points Targeted	Points Available
Management	12	14
Indoor Environment Quality	13	17
Energy	13	22
Transport	10	10
Water	5	12
Materials	7	12
Land Use & Ecology	1	6
Emissions	2	5
Innovation	3	10
Total	**66.0**	**100**

5.3 Management

The credits within the Management category promote the adoption of environmental principles from project inception, design and construction phase, to commissioning, tuning and operation of the building and its systems. The following credits are currently being considered for incorporation.

5.3.1 Accredited Professional

The project team have engaged an accredited professional to provide advice, support and information related to sustainability principles and processes, at all stages of the project.

5.3.2 Commissioning and Tuning

Implement commissioning, handover and tuning initiatives that ensure all building services operate to their full potential.

5.3.2.1 Environmental Performance Targets

The project team will establish and document environmental performance targets for the project, including specific goals for energy and water consumption.

5.3.2.2 Services and Maintainability Review

The project team will perform a comprehensive services and maintainability review led by the head contractor or the owner's representative (or the ICA) during the design stage and prior to construction.

The services and maintainability review is to facilitate input from the design team, the facilities manager and operations staff, and any relevant suppliers and subcontractors. The review looks to address the following aspects of the project:

- Commissionability;
- Controllability;
- Maintainability;
- Operability, including 'Fitness for Purpose'; and
- Safety.

5.3.2.3 Building Systems Tuning

The head contractor will undertake a building tuning process following practical completion and before occupation. This includes quarterly adjustments and measurements during the first 12 months, a review of system warranties, and a tuning period based on the scope of works. The process will involve analysing monitoring data, gathering occupant feedback, and addressing identified system deficiencies.

5.3.2.4 Independent Commissioning Agent

The ICA is responsible for advising, monitoring, and verifying the commissioning and tuning of nominated building systems throughout the design, tender, construction, commissioning, and tuning phases. The SINSW Commissioning and Temporary Schools Program Team will be utilised instead of engaging a dedicated Independent Commissioning Agent (ICA), in accordance with the GBCA Technical Question R-14422.

5.3.3 Adaption and Resilience

5.3.3.1 Implementation of a Climate Action Plan

The project will consider the impacts of climate change through identifying and addressing all high and extreme risks posed over the expected lifecycle of the Richmond Agricultural Centre project. This will be done through the creation of a Climate Adaption Plan.

The Climate Adaption Plan will contain as a minimum the following information:

- Summary of project's characteristics (site, location, climatic characteristics);
- Assessment of climate change scenarios and impacts on the project using at least two time scales, relevant to the project's anticipated lifespan. This must include a summary of potential direct and indirect (environmental, social and economic) climate change impacts on the project;
- Identification of the potential risks (likelihood and consequence) for the project and the potential risks to people. This risk assessment is to be based on a recognised standard;
- A list of actions and responsibilities for all high and extreme risks identified; and
- Stakeholder consultation undertaken during plan preparation and how these issues have been.

5.3.4 Building Information

5.3.4.1 Building Information

Develop and ensure provision of building information that facilitate understanding of a building's systems, operation and maintenance requirements, and environmental targets to enable optimised performance.

5.3.5 Commitment to Performance

5.3.5.1 Environmental Building Performance

Practices that encourage building owners, building occupants and facilities management teams to set targets and monitor environmental performance in a collaborative way. The project will set Energy and Potable Water performance targets

5.3.5.2 End of Life Waste Performance

At least 80% of the project's GFA, excluding car parking areas, will have a formal commitment in place to reduce demolition waste at the end of life.

5.3.6 Responsible Construction Practices

5.3.6.1 Environmental Management Plan

Environmental impacts will be managed during construction by implementing a best practice environmental management plan.

5.3.6.2 Environmental Management System

During construction, the head contractor will have a formalised approach to planning, implementing and auditing in place to ensure conformance with the EMP

5.3.6.3 High Quality Staff Support

High-quality staff support practices will be implemented to promote the mental and physical health of site workers through on-site programs and initiatives. These practices will also improve workers' knowledge of sustainable practices via on-site, off-site, or online education programs.

5.3.7 Operational Waste

5.3.7.1 Performance Pathway: Specialist Plan

A waste professional will develop and implement an Operational Waste Management Plan (OWMP) for the project in line with best practice approaches, ensuring the recommended strategies are integrated into the building's design.

5.4 Indoor Environment Quality

5.4.1 Indoor Air Quality

5.4.1.1 Ventilation System Attributes

The mechanical system will be designed to minimise outdoor pollutants, ensure ease of maintenance and cleaning, and will be cleaned before occupation.

5.4.1.2 Provision of Outdoor Air

At least 95% of the occupied area will receive adequate outdoor air to keep indoor air pollutant levels within acceptable limits.

5.4.1.3 Exhaust or Elimination of Pollutants

The project Team will ensure pollutants from printing, photocopying, cooking equipment, and vehicle exhaust are minimised in the nominated area by either eliminating the sources or venting them directly outside.

5.4.2 Acoustic Comfort

5.4.2.1 Internal Noise Levels

Internal ambient noise levels in the nominated area will be appropriate for the room's activity type, accounting for building system sounds and external noise ingress.

5.4.2.2 Reverberation

The nominated area will be constructed to ensure sound persistence is appropriate for the activities within the space.

5.4.2.3 Acoustic Separation

The nominated enclosed spaces will be designed to minimise sound crosstalk between rooms and between rooms and open areas.

5.4.3 Lighting Comfort

5.4.3.1 Minimum Lighting Comfort

The project lighting design will ensure that all lights in teaching spaces are flicker free and accurately address the perception of colour in the space.

Flicker-free lighting refers to luminaires that have either:

- A minimum Class A1 & A2 ballast;
- High frequency ballasts for all fluorescent lamps; or
- Electronic ballasts in High Intensity Discharge (HID) lighting.

5.4.3.2 General Illuminance and Glare Reduction

The project team will also ensure that, in the nominated area, lighting levels comply with best practice guidelines and that glare is eliminated through the use of baffles, louvers, translucent diffusers, ceiling design, or other means that obscures the direct light source from all viewing angles of occupants.

5.4.4 Visual Comfort

5.4.4.1 Glare Reduction

Glare from sunlight in the nominated area will be reduced using blinds that block at least 90% of visible light on all viewing façades and skylights.

5.4.4.2 Daylight

At least 40% of the nominated area will receive high levels of daylight. High levels of daylight are achieved with at least 160 lux during 80% of the nominated hours.

5.4.4.3 Views

At least 60% of the nominated area will have a clear line of sight to a high quality internal or external view.

5.4.5 Indoor Pollutants

5.4.5.1 Paints, Adhesives, Sealants and Carpets

In addition to the indoor pollutants elements of the EFSG at least 95% of all internally applied paints, adhesives, sealants and carpets will meet the below stipulated 'Total VOC Limits' (TVOC).

Maximum TVOC limits for paints, adhesives and sealants are detailed in the table below.

Table 3 Maximum TVOC Limits for Paints, Adhesives and Sealants

Product Category	Max TVOC content in grams per litre (g/L) of ready to use product
General purpose adhesives and sealants	50
Interior wall and ceiling paint, all sheen levels	16
Trim, varnishes and wood stains	75
Primers, sealers and prep coats	65
One and two pack performance coatings for floors	140
Acoustic sealants, architectural sealant, waterproofing membranes and sealant, fire retardant sealants and adhesives	250
Structural glazing adhesive, wood flooring and laminate adhesives and sealants	100

To demonstrate compliance for the use of carpets all products will be certified under a recognised Product Certification Scheme or other recognised standards. With the certification current at the time of specification.

5.4.5.2 Engineered Wood Products

At least 95% of all engineered wood products including: particleboard, plywood, Medium Density Fibreboard (MDF), Laminated Veneer Lumber (LVL), High-Pressure Laminate (HPL), Compact Laminate and decorative overlaid wood panels meet stipulated formaldehyde limits or no new engineered wood products are used in the building.

All engineered wood products used in the building will meet the relevant limits specified in the table below as per the specified test protocol or have product specific evidence that it contains no formaldehyde.

Table 4 Formaldehyde Emission Limit Values for Engineered Wood Products

Test Protocol	Emission Limit/Unit of Measurement
AS/NZS 2269:2004, testing procedure AS/NZS 2098.11:2005 method 10 for Plywood	≤1mg/ L
AS/NZS 1859.1:2004 - Particle Board, with use of testing procedure AS/NZS 4266.16:2004 method 16	≤1.5 mg/L
AS/NZS 1859.2:2004 - MDF, with use of testing procedure AS/NZS 4266.16:2004 method 16	≤1mg/ L
AS/NZS 4357.4 - Laminated Veneer Lumber (LVL)	≤1mg/ L
Japanese Agricultural Standard MAFF Notification No.701 Appendix Clause 3 (11) - LVL	≤1mg/ L
JIS A 5908:2003- Particle Board and Plywood, with use of testing procedure JIS A 1460	≤1mg/ L
JIS A 5905:2003 - MDF, with use of testing procedure JIS A 1460	≤1mg/ L
JIS A1901 (not applicable to Plywood, applicable to high pressure laminates and compact laminates)	≤0.1 mg/m^2hr*
ASTM D5116 (applicable to high pressure laminates and compact laminates)	≤0.1 mg/m^2hr
ISO 16000 part 9, 10 and 11 (also known as EN 13419), applicable to high pressure laminates and compact laminates	≤0.1 mg/m^2hr (at 3 days)
ASTM D6007	≤0.12mg/m^3**
ASTM E1333	≤0.12mg/m^3***
EN 717-1 (also known as DIN EN 717-1)	≤0.12mg/m^3
EN 717-2 (also known as DIN EN 717-2)	≤3.5mg/m^2hr

*mg/m^2hr may also be represented as $mg/m^2/hr$.

**The test report must confirm that the conditions of Table 3 comply for the particular wood product type, the final results must be presented in EN 717-1 equivalent (as presented in the table) using the correlation ratio of 0.98.

***The final results must be presented in EN 717-1 equivalent (as presented in the table), using the correlation ratio of 0.98.

5.4.6 Thermal Comfort

5.4.6.1 Thermal Comfort

A high level of thermal comfort will be provided to occupants, ensuring satisfaction for at least 80% of users. This will be demonstrated by maintaining Predicted Mean Vote (PMV) levels between -1 and +1.

5.5 Energy

The 'Energy' category aims to facilitate reductions in greenhouse gas emissions by facilitating efficient energy usage and encouraging the utilisation of energy generated by low-emission sources.

5.5.1 Greenhouse Gas Emissions – Comparison to a Reference Building Pathway

The current project design is targeting a 60% reduction in the predicted energy consumption and GHG emissions compared to a minimum code compliant building exceeding the requirements of the GREP.

Prediction of the building performance against this benchmark is to be confirmed using building performance modelling that assesses potential energy use for building services systems including:

- Mechanical Services
- Electrical Services
- Communications, AV and security systems
- Hydraulic Services
- Vertical Transportation Systems

5.5.2 Peak Electricity Demand Reduction – Reference Building

Through the use of efficient systems and on-site generation sources the project is targeting a reduction in peak electricity demand by at least 30%. Peak electricity demand is the predicted annual peak calculated as the sum of all distribution boards (to include all miscellaneous loads) relevant to the building as shown in the as-installed electrical schematics.

5.6 Sustainable Transport

Sustainable transport credit aims to provide design and operational measures that reduce the carbon emissions arising from occupant travel to and from the project, when compared to a benchmark building. In addition, it also promotes the health and fitness of commuters, and the increased accessibility of the location.

5.6.1 Performance Pathway

The project will incorporate design and operational measures to minimise carbon emissions from occupant travel to and from the site, including bicycle parking and end-of-trip facilities for staff. In addition, to help reduce private car use, RAC will implement a Travel Access Guide to inform students about the bus routes servicing the area, as recommended in the School Transport Plan developed for the project.

5.7 Water

The aim of the credit is to encourage building design that minimises potable water consumption in operations.

The project is looking to further improve fixture water efficiency to achieve WELS ratings within one star or those stated in the table below.

Table 5 Sanitary Fixture Efficiencies

Fixture / Equipment Type	WELS Rating
Taps	6 Star
Urinals	4 Star
Toilet	5 Star
Showers	3 Star (> 4.5 but <= 6.0)
Clothes Washing Machines	5 Star
Dishwashers	6 Star

5.7.1 Heat Rejection Water

A waterless heat rejection system is utilised on site minimizing water use for air-conditioning.

Native plants with low water demand will be selected for the landscaped areas to minimise irrigation requirements. Rainwater supported drip irrigation with moisture sensor override is to be installed to minimise potable water used for the landscape irrigation.

5.8 Materials

The aim of the materials credits is to reward projects that include building materials that are responsibly sourced or have a sustainable supply chain. Should these be targeted the project would need to consider

5.8.1 Life Cycle Impacts

5.8.1.1 Portland Cement Reduction

The Portland cement content in all concrete will be reduced by replacing it with supplementary cementitious materials.

5.8.1.2 Water Reduction

The mix water for all concrete used in the project will contain at least 50% captured or reclaimed water

5.8.1.3 Aggregates Reduction

The project will use at least 40% crushed slag aggregate or alternative materials for coarse aggregate, or at least 25% manufactured sand or alternative materials for fine aggregate in the concrete, provided Portland cement use does not increase by more than 5 kilograms per cubic metre.

5.8.1.4 Reduced Use of Steel Reinforcement

The project will achieve a reduction in the mass of steel reinforcement compared to standard practice by using Post-Tensioned slabs.

5.8.2 Responsible Materials

5.8.2.1 Permanent Formwork, Pipes, Flooring, Blinds and Cables

90% (by cost) of all cables, pipes, flooring and blinds in the project will either:

- Do not contain PVC and have an Environmental Product Declaration (EPD); or

- Meet Best Practice Guidelines for PVC.

5.8.3 Sustainable Products

5.8.3.1 Product Transparency and Sustainability

At least 6% of the materials used in the project will meet transparency and sustainability standards through initiatives such as reused or recycled products, environmental product declarations, third-party certifications, or stewardship programs.

5.8.4 Construction and Demolition Waste – Percentage Benchmark

This project will target 90% of the waste generated during construction and demolition being diverted from landfill. Compliance verification summaries should also be provided for the waste contractor and waste processing facilities.

5.9 Land Use and Ecology

The 'Land Use & Ecology' category aims to reduce the negative impacts on sites' ecological value as a result of urban development and reward projects that minimise harm and enhance the quality of local ecology.

As highlighted in the Flora and Fauna Assessment included in the REF submission, the proposed development has been strategically sited within an area predominantly characterised by exotic grassland, thereby largely avoiding areas of native vegetation.

5.9.1 Endangered, Threatened or Vulnerable Species

At the date of site purchase or date of option contract, the project site did not include old growth forest or wetland of ‘High National Importance’, or did not impact on ‘Matters of National Significance’.

5.9.2 Heat Island Effect Reduction

At least 75% of the whole site area (when assessed in plan view) comprises of one or a combination of the following:

- Vegetation;
- Roofing materials, including shading structures, having the following:
    - For roof pitched <15°– a three year SRI >64
- Only where the three year Solar Reflectance Index (SRI) for products is not available, use the following:
    - For roof pitched <15° – an initial SRI > 82
- Unshaded hard-scaping elements with a three year SRI > 34 or an initial SRI > 39;
- Hard-scaping elements shaded by overhanging vegetation or roof structures, including solar hot water panels and photovoltaic panels;
- Areas directly to the south of vertical building elements, and areas shaded by these elements at the summer solstice.

5.10 Emissions

The 'Emissions' category aims to assess the environmental impacts of 'point source' pollution generated by projects. Negative impacts commonly associated with buildings include damage to the environment through refrigerant leaks or disturbances to native animals and their migratory patterns as a result of light pollution.

5.10.1 Light Pollution

5.10.1.1 Light Pollution to Neighbouring Bodies

The project design ensures that all outdoor lighting on the project complies with AS 4282:1997 at all inhabited boundaries, apart from boundaries with roads.

5.10.1.2 Light Pollution to Night Sky

Outdoor lighting has been designed to achieve control of upward light output ratio (ULOR) by demonstrating that no external luminaire on the project has a ULOR that exceeds 5%, relative to its actual mounted orientation.

5.10.2 Microbial Control

The project achieves will be no water-based heat rejection systems preventing the buildup of microbes in these systems.

5.11 Innovation

The 'Innovation' category aims to recognise the implementation of innovative practices, processes and strategies that promote sustainability in the built environment.

5.11.1 Financial Transparency

This Innovation Challenge aims to encourage owners, developers, and operators to disclose the costs of sustainable building practices, and to agree to participate in a yearly report developed by GBCA that will inform the building industry on the true costs of sustainability.

5.11.2 Ultra-Low VOC Paints

The development will ensure that over 50% of all internal paints applied on site have a total VOC content of no more than 5g/L, further supporting a healthy indoor environment for students and staff.

6. Government Architect NSW Design Guide

The Government Architect NSW (GANSW) provides strategic design leadership in architecture, urban design and landscape architecture. In order to improve school design and incorporate the seven objectives for the design of the built environment set out in Better Placed: An integrated design policy for the built environment of NSW, the GANSW has produced the Environmental Design in Schools guide. This document considers the following objectives;

- Better Fit – A project that is contextual, local and of its place
- Better Performance – A project that is sustainable adaptable and durable.
- Better for the community - A project that is inclusive connected and diverse.
- Better for people - A project that is safe, comfortable and liveable.
- Better working - A project that is functional, efficient and fit for purpose.
- Better Value - A project that creates and adds value.
- Better look and feel - A project that is engaging, inviting and attractive

The guide sets out a process for assessment which includes three basic steps these are as follows with general strategies to address the goals of the design guide outlined in the following sections;

- Understand the project surroundings;
- Understand how our surroundings effect people.
- Adopt strategies that will benefit people.

In order to demonstrate environmental design has been achieved in accordance with this guide the project team provide the following discussion outlining how the project has included a strong focus on passive, biophilic and environmental design.

6.1 Ventilation Strategy (Air)

Good air quality in schools can improve student and staff wellbeing and performance, the project aims to incorporate mixed mode systems and natural ventilation where viable increasing the outdoor air provided to lower CO2 build-up and pollutant levels.

Additionally, through the use of variable refrigerant flow systems the humidity within learning spaces will be passively controlled minimizing the mould growth within systems and remove this source of pollutants.

6.1.1 Natural Ventilation Opportunities

Increasing the natural ventilation of the space is a method used to passively cool and ventilate the space and minimise the use of mechanical air conditioning systems and thus an effective way to minimise energy consumption in the building. Ensuring that windows are openable and designed to capture prevailing winds into classroom spaces will help to ensure that the natural ventilation can be maximized.

By specifically providing openings on multiple sides of the buildings or at low and high levels the window design will promote the flow of air though the spaces bringing in fresh air and passive heating and cooling.

Where feasible the project will look to also provide window coverings, which can be used to block out unwanted summer sun (east-facing windows in the morning, and west-facing windows in the afternoon). In winter, these can also be closed window coverings at the end of the day to help rooms stay warmer overnight.

6.1.2 Site conditions

For the site location in Richmond, the average yearly temperature expected is around 17.2 °C, while the hottest yearly temperature observed is: 40.0 °C and coldest yearly temperature observed is: -0.6°C. Predominant winds are from the southwest however are relatively balanced from all directions. This will be considered within the ventilation strategies. Natural ventilation and therefore passive cooling opportunities will be optimised using multidirectional building elements including spacing out of the building to funnelling breezes through the vegetated areas of the site and into the built spaces. This omnidirectionality of the wind present at the site will also assist the project to minimise wind tunnelling effects.

6.2 Comfort Strategy (Comfort)

Good learnings spaces need to be comfortable across the year for staff, students and visitors. To ensure that the proposed buildings achieve this the project considered a mixed mode ventilation strategy that can provide conditioning when required and natural, or mechanically assisted, ventilation when external conditions are favourable. Additional to this the design of the buildings will focus on good passive design elements including the following.

6.2.1 Passive Solar Design & External Shading

The project design will incorporate a strong focus on the use of optimised glazing and window shading to exploit the suns relative position in the sky. This allows solar heat gains through winter while blocking most of the heat entering the building throughout the summer period.

The incorporation of the proposed indoor-outdoor spaces on within the external circulation areas also provides shaded external spaces to support both reduction in heat islanding across the school and shaded areas for outdoor learning.

6.2.2 Thermal Mass

Thermal mass is the ability of a material to absorb and store heat energy for use during cooler times. The project will consider the use of a concrete structure to capture energy throughout the day and release this at night minimizing the internal temperature variation across the day.

6.2.3 Glazing Selection

The types of glass used within the project windows can lead to unwanted heat gain in summer and heat loss in winter or help retain heat in winter and limit unwanted heat gain in summer. The project is aiming to use double glazing throughout with a low-e spectrally selective coating to help to maximise daylight penetration into the spaces while effectively managing heat gains and losses across the year.

To add to this passive control of heat entry, blinds should also be provided to external windows.

6.2.4 Natural Shading devices

The external landscaping incorporates the use of vegetation to help reduce the temperature of prevailing breezes and provided shaded areas to support the use of external areas across the year.

6.2.5 Incorporation of Fans

Where possible the project will consider the use of ceiling fans to help control the room comfort conditions by moving air around. In summer, with the windows open, ceiling fans can help to push hot air outside. In winter, with the windows shut, if you have high ceilings and mechanical heating, ceiling fans can help to make a room feel warmer by gently pushing warm air down from the ceiling level.

6.3 Lighting Strategy (Light)

Daylight and natural light can minimise electricity usage, however direct sunlight can also bring unwanted heat gain should be balanced across the year.

6.3.1 Daylight Access

The proposed design of the site will aim to maximize daylight penetration into both internal and external spaces. This access to daylight throughout the building will both minimise energy used for lighting and will improve occupant connection to their external environment.

In educational environments research also indicates that students in classrooms with access to natural light perform better in all academic fields, have longer attention spans and achieve better health outcomes than those without ready access to daylight.

6.3.2 Highly efficient lighting system

The installation of LED lighting throughout the facility will assist in the minimisation of lighting energy use with a target a lighting power density of less than 5W/m2.

Improved lighting energy also reduces the heat loads within the spaces and therefore lowers the energy used to condition the classroom areas.

6.3.3 Melanotic Lux Consideration

The project lighting design will consider the impacts that lighting has on melatonin production in the brain and will look to create a lighting layout to promote good provision of light matching solar lux levels. This has been shown to improve sleep patterns and educational outcomes.

6.3.4 Motion, photoelectric (PE) and timer controls for circulation space lighting;

The project will consider the installation of motion and PE controls on lighting throughout the circulation and recreation spaces. This will ensure that lighting is not used when spaces are unoccupied. Lighting systems will also be linked to the period bells for the school and timers to ensure that lighting does not remain on after hours and is active when students are entering circulation spaces.

6.4 Acoustics Strategy (Noise)

Noise can have an impact on student performance and will be considered in the layout of the buildings to create quiet and noisy spaces for a variety of leaning styles.

Within learning spaces the acoustic environment should also be managed through the use of soft furnishings or surfaces, like wall treatments or floor rugs. These will be considered in alongside passive strategies, for example, opening windows.

6.4.1 Interior noise level control (sound masking + treatment)

Acoustic considerations will be included into the design of the building layout and systems design with interior nose levels to be maintained below the acceptable limit of 45dB (this is in line with industry accepted practice).

6.4.2 Reverberation through the building

Reverberation of noise throughout the building will be considered throughout the detailed design phases of the project with isolation measures to prevent the transition of noise through the building structure.

6.4.3 Acoustic separation

Acoustically sensitive spaces such as counselling rooms and quiet spaces will incorporate measures to separate these areas from noise transmission, this will include actions like.

- Taking walls to the underside of slabs;
- Incorporating brushes on windows and doors; and
- Inclusion of soft furnishings and acoustic panels in these areas.

6.5 Water

Taking responsibility for water usage is key to its preservation and the project will incorporate quality management of water throughout the construction and operation of the building. Details of the water efficiency measures proposed can be found in Section 2.3. Some additional elements are included below around water sensitive urban design and rainwater capture and storage.

6.5.1 Small rainwater tanks for education and minor irrigation purposes

A rainwater capture, and storage system will be considered for installation to provide educational support around water efficiency and to provide for the sites irrigation needs.

6.5.2 Water Sensitive Urban Design

The project will incorporate a strong focus on water-sensitive urban design with the external landscape and pavement design facilitating surface water recharge, minimisation of irrigation and promotion water water-sensitive plant and materials selection.

6.6 Energy

Simple strategies like turning off lights and adjusting air-conditioning set points over the year will assist with operational energy use. Details of the energy efficiency measures being considered in the design can be found in Section 2.1. Further measures are detailed below:

6.6.1 Improved building fabric and glazing performance.

The building envelope comprises a number of different façade types, with the proposed scheme using a combination of glass, screens and shading devices to achieve low solar heat gains while providing views and daylighting into learning and circulation spaces.

The use of high-performance glazing and building materials will also assist to maximise the projects energy efficiency while managing acoustic and thermal comfort considerations.

6.6.2 Energy efficient domestic hot water

The use of solar thermal, gas boost or heat pump hot water systems will be explored throughout the detailed design process with an efficient solution incorporated into the final design.

6.6.3 Photovoltaic (PV) Energy Systems

The project will incorporate a PV array system. The system will provide onside renewable energy and will reduce the site's electricity consumption from the grid.

6.7 Landscape

Through planting native vegetation and promoting improved interaction with the natural environment, the project will improve the site’s ecology and minimise the ongoing environmental impact of the project. The project will consider the implementation of the following:

- Extensive native vegetation endemic to the local area;
- Shading provided to outdoor spaces and to the building.
- Minimisation of light spill from the facility which impacts on migratory animals and insects;
- Reduced dissolved pollutants in stormwater discharged from the site.

Additionally, landscaping plays an important part in the education of students around local biodiversity and natural systems.

6.8 Materials

The construction and upgrading of buildings consume a large amount of resources, and measures will be taken within the design to maximize the expected lifespan of the installed fixtures and finishes. This will assist in project longevity and help to minimise waste going to landfill.

Additional to this, the buildings should be designed to be highly adaptable with spaces easily altered and structural elements kept to the external elements of the building. This will enable the building to be easily altered to meet changing needs over time and minimise the potential need to demolish and rebuild in the future.

6.9 Education

Given the educational focus of the project, the following initiatives will help to promote an understanding of sustainability and building operation within the school population.

6.9.1 Integrated Garden Landscaping

The inclusion of engaging gardens promotes an understanding of food production and heathy eating decisions. This understanding will help to reinforce other initiatives throughout the school curriculum. This space will also help to build school identity and create a welcoming space for students to study and relax.

6.9.2 The provision of Wi-Fi Connectivity across the site

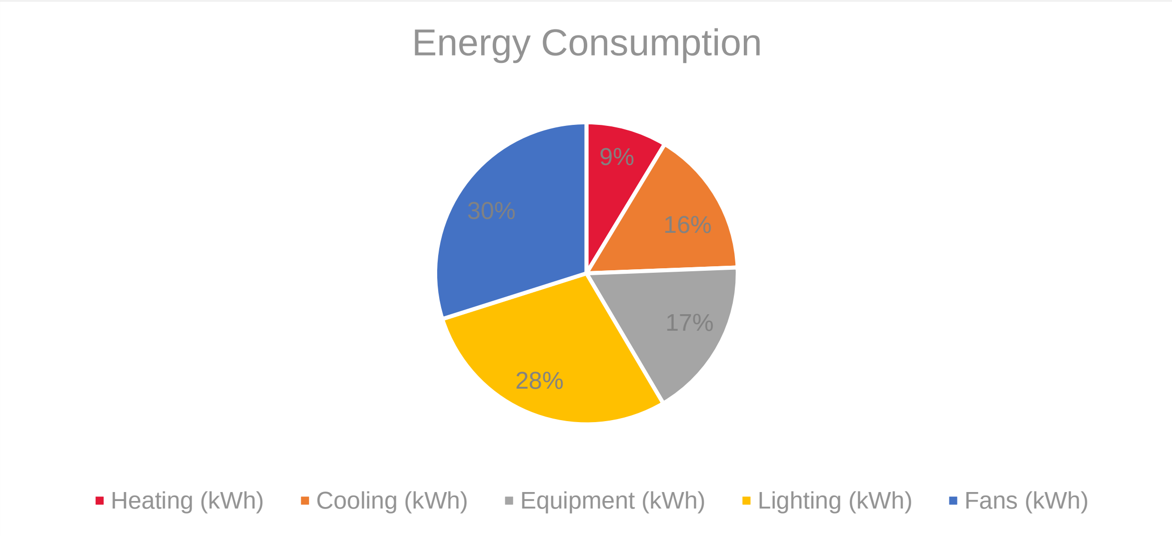
High speed Wi-Fi will be installed throughout the entire site to provide support for next generation educational tools including tablets and laptop learning.

7. Demand Forecast

High level simulation has been completed to assess the likely breakdown of energy and water consumption across the site with key energy and water consumption broken down between end uses as per the following section.

7.1 Energy

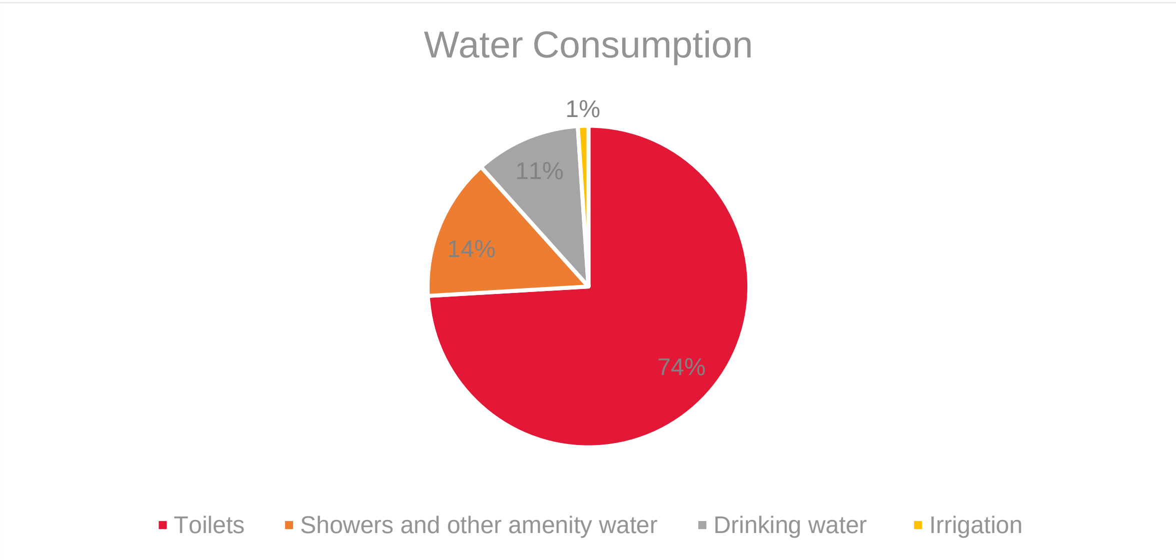
Based on the National Construction code modelling guidelines, energy simulation shows that the school is likely to have an energy breakdown by end use as per the below.



The solar power system will reduce the overall energy use for the site offsetting energy use overall, furthermore the efficient use of heating and cooling systems will reduce overall consumption of these end uses.

7.2 Water

Water use across the school will be predominantly focused on ablution facilities with irrigation and drinking water consuming the remainder of the sites water consumption. High level simulations show the following breakdown.



8. Climate Adaptation

As identified in the previous section, the design team will go through a full climate adaptation planning process, which will look at longer-term risks and adaptation opportunities on a recurring basis over the building's lifetime. This assessment of the site's initial design has included a risk assessment, and the following provides an overview of how the design of the development is responsive to the CSIRO projected impacts of climate change.

8.1 Climate Region

The site lies within Climate Zone 6 as identified by the Building Code of Australia (BCA), Australian Building Codes Board (ABCB) as seen in Figure 8 below. Climate Zone 6 relates to mild temperate conditions, characterised by mid to cool winters with low humidity and hot to very hot summers with moderate humidity. Four distinct seasons are present, where summer and winter have the potential to exceed human comfort range and spring and autumn are ideal for human comfort.

Figure 8 - ABCB Climate Zone Map

8.2 Current Climate Hazards

The project initially assessed the current climate hazards relevant to the site, based on the site conditions and building characteristics for the proposed development. The exposure and vulnerability to floods, hail, bushfire, and extreme winds (or cyclones) were identified with the assistance of the Insurance Council of Australia's Building Resilience tool. Exposure relates to the building location relevant to the site characteristics. The outcome of the assessment can be seen in Table 6.

Table 6 – Identified Climate Hazards

Climate Hazards	Exposure	Vulnerability Risk	Comments
Extreme Heat	Medium - High	Medium	Development is located in Climate Zone 6 – mild temperate conditions. Subject to hot summers.
Floods	High	High	The site is prone to flooding. During the development of the Concept Design, the team carefully assessed the proposed design and building levels to mitigate flood risks. These adjustments are based on the historical 1 in 200 AEP plus a 500mm freeboard.
Bushfire	Medium - High	Medium - High	The site is in proximity of a bushfire zone, no occupied buildings will be located within the APZ (Asset Protection Zone). A 42m APZ will be stablished to the south of the proposed buildings and managed as an Inner Protection Area (IPA) as per Bushfire report. In addition, the proposed development is to be constructed in accordance with BAL-19 requirements.
Severe Thunderstorms/Hail	Medium - High	Medium	More than 19 severe storms occur here annually, a 5% probability. During the 100yr storm event over 275mm of rainfall is predicted to fall in 24hrs.
Extreme Winds	Low	Medium	The structural design takes into consideration the impact of extreme winds. Also the landscape design selected plants that are able to withstand extreme winds.
Cyclones	Low	Low	The site is not located in a cyclone prone region

8.3 Climate Change Effects

The following list provides a summary of the primary climate effects, and the risks associated due to secondary climate effects applicable to the development. The climate change projection data relevant to the climate and site conditions of the project identified within the CSIRO projected impacts of climate change were utilised to establish the below scenarios for the development and how they have been addressed within the design of the project.

8.3.1 Changing Surface Temperature

- An increase in the average surface temperature could lead to reduced thermal comfort for the building occupants over time – reflective and vegetated surfaces will be included throughout the site to minimise urban heat island effects; the building should be designed to capture multidirectional breezes and promote movement of air across the site; mixed mode ventilation and conditioning strategy allows the building to ramp up space conditioning to accommodate the thermal comfort needs of occupants when required.
- An increase in extreme heat could lead to an increase in energy and water demand and associated utility and maintenance costs – the incorporation of native low water use vegetation and not water-based heat rejection systems will minimise water demand for key systems; the use of a flexible mixed mode system supported by onsite solar power generation will work to balance increased energy costs for space conditioning.
- An increase in extreme heat could place additional stress on building services including air conditioning equipment – an increased average outside design temperature will be used to size the air conditioning systems to ensure that they are sufficiently sized for the potential increases in temperature; adaptability of these systems will also be considered with the potential to add additional cooling capacity if required in the future.

8.3.2 Changing Precipitation

- An increase in rainfall intensity could increase local flood events limiting access to the building for vehicles, building occupants and pedestrians – the finished floor levels (FFLs) of the main classrooms are located above the Probable Maximum Flood (PMF) level and are therefore not expected to be vulnerable to the impacts of climate change. In addition, the landscape design incorporates vegetation to assist in the management of stormwater runoff.
- Increased severe thunderstorms and intensity could result in blockages in roof drainage systems from build-up of hail and debris, causing stormwater to overflow and damage the building asset, goods and equipment owned by the school – the projects hydraulic design will consider this risk and increase the capacity of roof drainage to accommodate.
- Power outages during major storm events could lead to a potential disturbance to building systems including security, lighting etc, posing a safety issue to occupants on site – the flexible mixed mode ventilation systems and project focus on good daylight penetration will enable the building to continue operation across most of the year in the occasion of power outages; emergency lighting and safety systems will have redundancy to minimise safety risks posed to building occupants.

8.3.3 Changing Wind Speed

- An increase to wind speed intensity could lead to damaged building assets including windows and roof elements – this will be considered within the structural and landscaping design of the site.
- Increased wind speed intensity could result in damaged vegetation, creating a disturbance to the local ecosystems and increased maintenance costs for the property – this risk will be considered within the landscaping design with the use of endemic native species well suited to the site and these future risks

- An increase in wind speed intensity could potentially damage power lines, resulting in a power outage for the building – the flexible mixed-mode ventilation systems and project focus on good daylight penetration will enable the building to continue operation across most of the year in the event of power outages

8.3.4 Changing Humidity

- Decrease in humidity could relate to higher risks of fires – the inclusion of a rainwater supplied drip irrigation system for landscaping should reduce this risk.
- Decrease in humidity could lead to changes in the micro-climate, impacting the local ecology (flora and fauna) of the site – the use of endemic native vegetation will act as a buffer to this impact as will the provision of the rainwater supplied irrigation systems.

9. Conclusion

Through the initiatives outlined in this report, the project demonstrates how the Richmond Agricultural Centre project meets both the objectives outlined by the Department of Education and those required by Green Star. These are as follows:

- Compliance against the Educational Facilities Standards and Guidelines (EFSG) by the Department of Education (DoE).
- Compliance with the requirements of Section J of the National Construction Code.
- Demonstration of how ESD principles will be incorporated into the design and ongoing operation of the development.
- Detail proposed measures to minimise consumption of resources, water (including water sensitive urban design) and energy.
- Detail how the future development would be designed to consider and reflect national best practice sustainable building principles and improve environmental performance, and reduce ecological impact; and
- Detail how environmental design will be achieved in accordance with the GANSW Environmental Design in Schools Manual (GANSW 2018) and Green Star Design & As-Built v1.3 requirements.

The EFSG and Green Star Design & As-Built v1.3 provide a project-specific design guide benchmarked to Australian Best Practice ESD, and work to ensure that the project is designed to address future climate related events. Therefore, the use of these standards demonstrates the achievement of SINSW objectives. Further sustainability outcomes have also been drawn from the general sustainability sections of this report and demonstrate SINSW strong focus on delivering social, environmental, and economic sustainability from this project.

9.2 Mitigation Measures

The table below (Table 7) outlines the key mitigation measures to be implemented in alignment with the ESD targets identified throughout this report, in accordance with the EFSG and Green Star – Design & As-Built certification requirements. To support clarity and ease of reference, the measures have been summarised in a simplified format.

Table 7 – Mitigation Measures

Project Stage	Mitigation Measure	Relevant Section of Report
Design	All design disciplines are to maintain alignment with the requirements of the EFSG, National Construction Code (NCC), and Green Star, as outlined in this report, throughout the design process and within their respective documentation. This is essential to ensure the development minimises its environmental impact and supports the broader sustainability objectives established for the project.	Sections 3 to 6
Construction	The head contractor and all subcontractors are to ensure adherence to the requirements outlined in this report throughout the entire construction period. This is critical to minimising the environmental impact of the construction process and to supporting the project's overall sustainability objectives.	Sections 3 to 6
Operation	The Head Contractor, subcontractors, and design team are to provide As-Built drawings, reports, and all necessary supporting evidence to facilitate the Green Star submission process. This is required to demonstrate compliance with the project's sustainability commitments and to support the targeted 5 Star Green Star – Design & As-Built certification.	Section 5