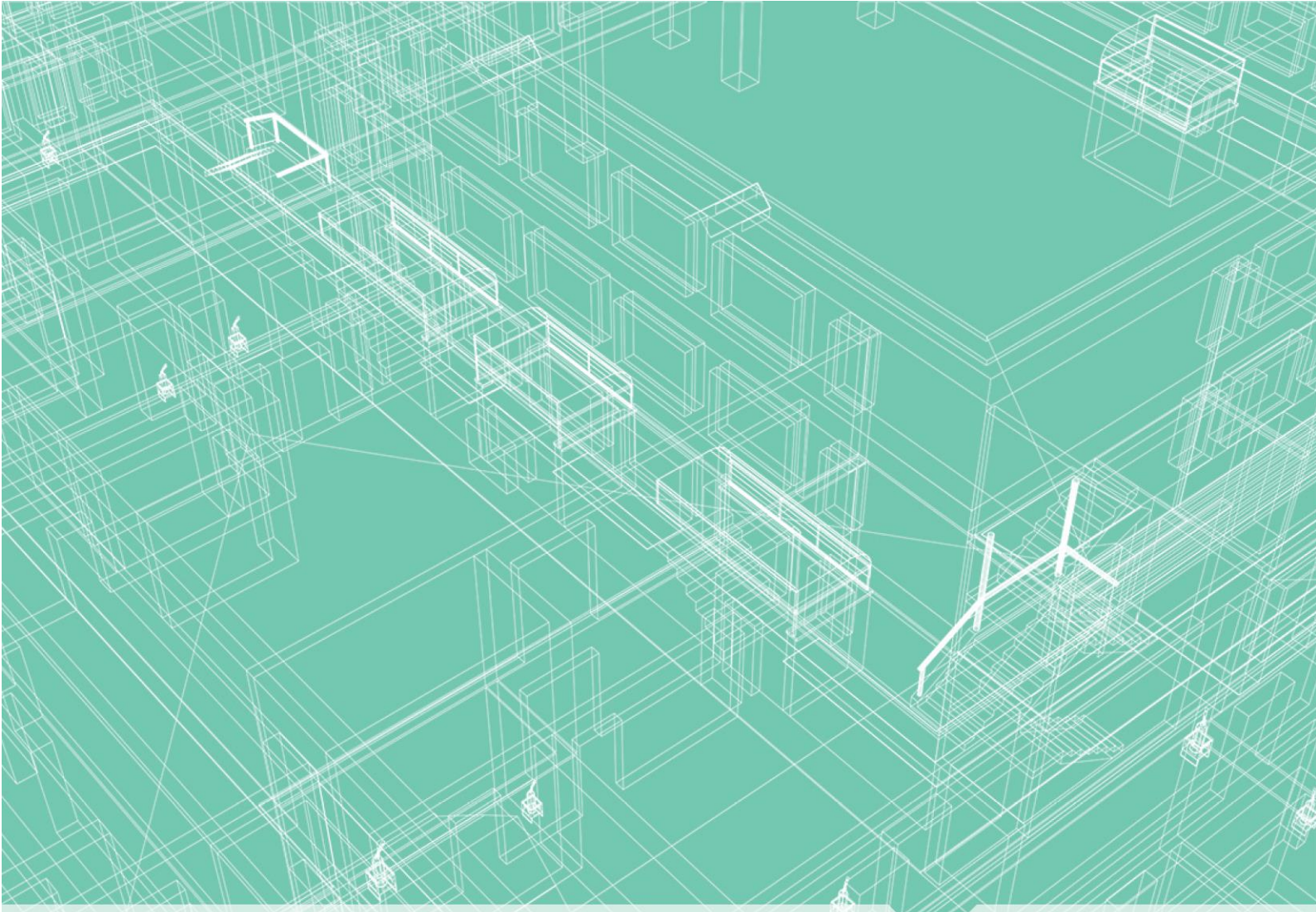

ESD SEARS REPORT

MULTI-TRADES AND DIGITAL TECHNOLOGY HUB

ESD SERVICES

JHA

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EXECUTIVE SUMMARY

This report has been prepared by JHA to identify and summarise the Ecologically Sustainable Design (ESD) initiatives which have been considered in the design of the proposed new Multi-Trades and Digital Technology Hub for TAFE NSW Meadowbank.

The report demonstrates compliance with the Secretary's Environmental Assessment Requirements (SEARs) which apply to the project and has been prepared to accompany a State Significant Development Application (SSDA) to the NSW Department of Planning and Environment. This report should be read in conjunction with the Architectural design drawings and other consultant design reports submitted as part of the application.

The aim of the ESD objectives is to encourage a balanced approach to designing new facilities for the TAFE NSW project; to be resource efficient, cost-effective in construction and operation; and to deliver enhanced sustainability benefits with respect to impacts on the environment and on the health and well-being of students, staff and visitors whilst providing the best possible facilities for a constructive student learning experience.

Some of the proposed key ESD initiatives to be committed for the proposed development are listed below:

- Sufficient exposure to daylight
- Well-designed openings to promote natural ventilation
- Appropriate construction and glazing selection
- Energy efficient air-conditioning systems with control strategy
- LED luminaires with control strategy
- Solar PV System options
- Rainwater storage tank
- Efficient water fixtures
- Waste management plan

The report also identifies how the principles of Ecologically Sustainable Design (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated in the design and on-going operation phases of the development.

1. INTRODUCTION

1.1 PROJECT DESCRIPTION

TAFE Meadowbank is one of the largest TAFE facilities in Sydney, which offers an extensive range of educational services. TAFE Meadowbank is located at See St, Meadowbank NSW 2114 adjacent to Meadowbank Train Station, in the local government area of City of Ryde Council.

The project consists of a new Multi-Trades and Digital Technology Hub Building – part of the SSDA scope.

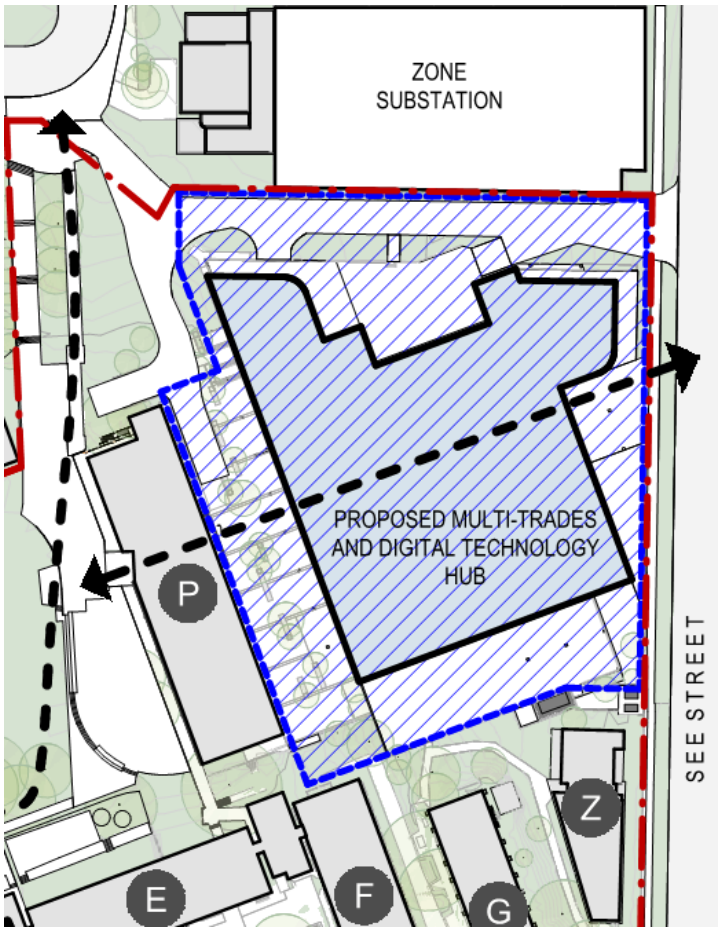


Figure 1 - Proposed New Multi-Trades and Digital Technology Hub Building

1.2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS (SEARS)

This report acknowledges the SEARs prepared by the Secretary which notes the followings in Section 8 of the document:

8. Ecologically Sustainable Development (ESD)

- Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Regulation) will be incorporated in the design and ongoing operation phases of the development.
- Include a framework for how the future development will be designed to consider and reflect national best practice sustainable building principles to improve environmental performance and reduce ecological impact. This should be based on a materiality assessment and include waste reduction design measures, future proofing, use of sustainable and low-carbon materials, energy and water efficient design (including water sensitive urban design) and technology and use of renewable energy.
- Include preliminary consideration of building performance and mitigation of climate change, including consideration of Green Star Performance.
- Include an assessment against an accredited ESD rating system or an equivalent program of ESD performance. This should include a minimum rating scheme target level.
- Provide a statement regarding how the design of the future development is responsive to the CSIRO projected impacts of climate change, specifically:
    - hotter days and more frequent heatwave events;
    - extended drought periods;
    - more extreme rainfall events;
    - gustier wind conditions; and
    - how these will inform landscape design, material selection and social equity aspects (respite/shelter areas).

The items listed above of the SEARS requirements are addressed in sections 3, 4 and 5 of this report.

2. GENERAL

In accordance with the above requirements, the development will implement a holistic and integrated approach to Ecologically Sustainable Design (ESD), maximising passive opportunities with the selective application of modern technology where appropriate. Initiatives will be chosen with due regard to innovation vs. cost effective benefits to TAFE NSW.

The ESD initiatives and targets outlined within this document have been compiled based on the following:

- Best practice design principles;
- Green Star Design and As-Built Submission Guidelines v1.2; and
- National Construction Code (NCC) 2019 Section J – Energy Efficiency.

3. PRINCIPLES OF ECOLOGICALLY SUSTAINABLE DEVELOPMENT

The principles of Ecologically Sustainable Development as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 have been incorporated into the design and on-going operation phases of the development as follows:

3.1 THE PRECAUTIONARY PRINCIPLE

Namely, that 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. In the application of the precautionary principle, public and private decisions should be guided by:

(i) Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and;
(ii) An assessment of the risk-weighted consequences of various options.

PROJECT RESPONSE:

This development is being designed in accordance with a wide range of ESD goals that pertain to the design, construction and operational stages. The development team will ensure that the building minimises the impact on the environment in the areas of energy, water and materials. A strong focus on electrical and mechanical strategies, including the use of renewable energy contributes to significant strides toward minimising climate change impacts.

3.2 INTER-GENERATIONAL EQUITY

Namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

PROJECT RESPONSE:

This development will not cause any significant impact on the health, diversity and productivity of the environment and will provide a community benefit in the form of increased student capacity, upgraded teaching and learning facilities. The project will contribute to a lively community environment and add architectural interest to the surrounding area.

3.3 CONSERVATION OF BIOLOGICAL DIVERSITY AND ECOLOGICAL INTEGRITY

Namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.

PROJECT RESPONSE:

This development is proposed on a previously developed area of land adjacent to a train station, surrounded in an urban residential environment in a north-western suburb of Sydney.

3.4 IMPROVED VALUATION, PRICING AND INCENTIVE MECHANISMS

Namely, that environmental factors should be included in the valuation of assets and services, such as:

(i) polluter pays, that is, 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.

PROJECT RESPONSE:

The design of this development has considered not just capital upfront but operational and maintenance costs to determine the optimum strategy with regards to not only meeting Green Star but also develop an innovative building for the future.

4. SUSTAINABLE DESIGN INITIATIVES

4.1 SUSTAINABILITY BENCHMARKING

The new Multi-Trades and Digital Technology Hub is targeting a 4 star Green Star Design & As Built certification.

This will result in a development built to Australian best practice standards.

4.2 ENVELOPE

Intelligent design and material selection ensure that thermal comfort is not entirely achieved by a mechanical means. Passive design initiatives such as performance glazing, shading and use of insulation will reduce demand on the mechanical air conditioning systems resulting in a reduction of energy consumption and greenhouse gas emissions.

4.2.1 Building Envelope Performance

The building fabric will be designed to meet or exceed the NCC 2019 requirements for building envelope. Thermal breaks will be incorporated into walls, floors and roofs where appropriate to ensure a continuous thermal barrier on the building envelope, reducing the flow of thermal energy between conductive materials.

4.2.1.1 Building Fabric

The minimum performance requirements for the building form and construction at the proposed development location (Climate Zone 5) as per the NCC 2019 Section J – Energy Efficiency are:

Building Elements	NCC 2019 Requirements
Roof & Ceiling	Total R-Value 3.7 (Solar absorptance of the upper surface of a roof must be not more than 0.45)
External Walls	Wall components must achieve a *Minimum Total R-value of R1.0* where the wall is less than 80% of the area of the wall-glazing construction; or Wall components must achieve a *Minimum Total R-value of R1.4* where the wall is 80% or more of the wall-glazing construction
Internal Walls	
Floor	Total R-Value 2.0

This will necessitate the use of insulation in the walls, floor and roof. Insulation reduces heat flow and consequent heat loss in winter and heat gain in summer. This minimises the heating and cooling load demand on the air conditioning systems. Light coloured roof material with a high solar reflective index (SRI) is recommended to be used to reflect more sunlight and reduce summer heat gain.

4.2.1.2 Glazing

Glazing is a major source of unwanted heat gain in the summer and can cause significant heat loss in the winter due to its low insulation performance. It is thus recommended that windows will be high performance glazing systems. Performance glazing substantially reduces heat transmission. This particularly reduces heat loss in winter; therefore, internal heat gain from equipment, lighting and people are better contained. Also, performance glazing absorbs the infrared portion of sunlight and reduces the amount of heat transferred into the conditioned space. This will correspond in a reduction of both heating and cooling loads.

The building will comply with NCC 2019 Section J Energy Efficiency by means of Deemed-To-Satisfy Solution or Performance Solution as appropriate.

The table below details a high performance glazing system that is currently being targeted. As design progresses, these numbers will be fine-tuned but this provides an indication of the preference to balance aesthetics with reducing energy consumption.

Building	Proposed Glazing Values		
	Total System U-Value	Total System SHGC	Description
Combined Multi-Trades and Digital Technology Hub	3.0	0.35	Double glazed low e tint

4.3 SHADING AND DAYLIGHTING

Solar access can enhance indoor environmental quality through access to daylighting and reduce lighting energy consumption. However, excessive solar access and hence, direct solar radiation heat can increase HVAC energy demand and can also cause thermal discomfort.

The proposed combined Multi-Trades and Digital Technology Hub has been designed to maximise daylighting and views with shading provided by the large roof. Furthermore, light shelves will be considered in the design to increase available light. Situated internally or externally, light shelves reflect daylight up to the ceiling where it is then reflected back into the space, allowing for deeper penetration.

Additional daylighting reduces the reliance on artificial light and benefits alertness, mood and productivity. External views provide a connection to nature and also help to create an environment encouraging constructive learning.

4.4 NATURAL VENTILATION

Adequate natural air movement makes an important contribution in creating a comfortable indoor environment and reducing the need for mechanical ventilation by carrying accumulated heat out and replacing it with cooler external air. This is important during the summer months where heat build-up within spaces can be quickly removed with the availability of suitable breeze at the site.

The atrium and workshops are proposed to be naturally ventilated. A combined cooling strategy of spill air from adjacent conditioned spaces, smoke exhaust and possibly operable louvres will ensure the edge is taken off of hot days.

An initial comfort study has shown that an 18 – 26°C range is maintained in the atrium for 75% of the year when this cooling strategy is implemented.

Large ceiling fans and/or pedestal fans will help the perception of feeling cool in summer whereas de-stratification fans will circulate the air to create a more even temperature which particularly helps in winter.

4.5 ENERGY EFFICIENCY

Each climate zone under the Building Code has different design and conditioning requirements to minimise energy use for heating and cooling. Good balance of heating and cooling reduction techniques are required to create an energy efficient development.

4.5.1 HEATING, COOLING AND VENTILATION SYSTEMS

The air-conditioning and ventilation systems shall be designed to comply or exceed the minimum requirements of NCC 2019 Section J5.

The air conditioning system to conditioned spaces is proposed to be water cooled VRV/VRF (variable refrigerant volume/flow) Heat Recovery System due to the high COP, which can provide simultaneous operation of cooling and heating to each individual space. The control of air conditioning system shall be designed to minimise energy consumption.

4.5.2 LIGHTING

Lighting will be designed to comply or exceed the minimum requirements of NCC 2019 Section J6.

Fittings incorporating the latest lamp technologies will be installed to minimise energy use and provide efficient artificial lighting systems.

The proposed development shall be illuminated using LED fittings and be controlled via manual and automatic control system.

Lighting shall be provided with a daylight sensor to reduce light output or turn off lights when sufficient daylight is provided within the space. For large spaces, perimeter lightings shall be designated on a separate zone to make maximum use of the daylight.

4.5.3 CONTROLS

All lighting and HVAC installed will be controlled by BMS. Predictive Energy Optimisation software is proposed to interface into the BMS. Analysing weather data, energy prices, occupancy and demand, the software can adjust the BMS to utilise the most effective operating strategy.

Commissioning activities will take place on the building services systems installed and as part of Green Star certification; a commitment will be made to a tuning process to ensure the building is performing as designed.

Real time building performance data will be displayed to occupants. Research has shown that when aware of this, occupants reduce their consumption by 5 – 15%.

4.5.4 ELECTRICITY METERING

Electricity metering and sub-metering shall be specified in accordance with the Green Star requirements to monitor and manage electricity consumption in the building.

4.5.5 RENEWABLE ENERGY

Installing renewable energy generation has been chosen as a key ESD strategy for the project, with an aspirational goal of reducing site energy consumption and educating students in relevant courses as a means of future proofing the skilled workforce. There is a possibility of eligibility for ARENA funding.

With a large roof space available on the combined Multi-Trades and Digital Technology Hub, there is a prime opportunity for a large solar PV system consisting of various technologies to showcase the options available in the industry. Some of these technologies are:

- Traditional monocrystalline and polycrystalline solar panels
- Thin film solar panels
- Concentrator PV
- Solar tracking
- Building integrated photovoltaics (BIPV)

Wind generation is also available to further develop the educational tools available. There is space on the roof for the installation of different technologies such as:

- Vertical axis wind turbine
- Horizontal axis wind turbine
- Eco Whisper Turbine which advertises virtually silent operation

The latest battery technology will also be considered in detail design stage to provide storage and potentially reduce peak electricity demand.

4.5.6 VERTICAL TRANSPORT

The use of lifts within the development will be discouraged and use of stairs promoted throughout.

4.6 INDOOR AIR QUALITY (IAQ)

The quality of indoor air has a significant impact on our health and environment. Poor indoor air quality resulting in adverse health effect such as allergy, asthma, etc. The outdoor air ventilation rates shall be in accordance with AS 1668.2 for mechanically ventilated spaces. Mechanical ventilation systems shall be linked to CO_2 sensors and designed to not exceed 1,500ppm for more than 20 consecutive minutes in each day. Ventilation system shall be designed to minimise the entry of outdoor pollutants.

4.7 WATER CONSERVATION

The following initiatives are proposed to ensure that significant water saving be achieved.

4.7.1 FIXTURES

Reducing potable water consumption will be at the forefront of this project as a Green Star certification is targeted. This will include selecting high efficiency fixtures.

4.7.2 ALTERNATIVE WATER NETWORK

Rainwater is proposed to be captured to irrigate landscaping and potentially provide for toilet flushing. Stormwater will also be captured to supplement this. Considering the rainfall intensity and demand, there is also the opportunity to use recycled water for heat rejection. Drip irrigation with moisture sensor override installed will allow further reduce water consumption. Hydraulics and civil will confirm this at a later stage.

4.7.3 METERING

Sub-metering shall be specified in accordance with the Green Star requirements.

4.8 SUSTAINABLE MATERIALS

4.8.1 LOW VOC / LOW FORMALDEHYDE MATERIALS

Adhesives, sealants, flooring and paint products will be ideally selected to contain low or no Volatile Organic Compounds (VOCs) and all engineered timber products used in exposed or concealed applications are specified to contain low or no formaldehyde to avoid harmful emissions that can cause illness and discomfort for occupants.

The project will aim to remove all PVC otherwise meet GBCA best practice guidelines.

4.8.2 RECYCLED CONTENT

Products shall be selected based on their recycled content, end-of-life recyclability and product stewardship agreements. By selecting loose furnishings which comply with independent environmental certification, the project will confidently reduce environmental impacts and waste from furnishings over the life of the building. As per Green Star requirements:

- Portland cement to be reduced, mix water to contain reclaimed water and alternative materials to be used as aggregate
- 5% reduction in mass of reinforcing steel or steel framing when compared to standard practice
- For steel frame buildings at least 60% of the fabricated structural steelwork shall be supplied by a steel fabricator/ contractor accredited to the Environmental Sustainability Charter of the Australian Steel institute (ASI).
- For concrete framed buildings at least 60% (by mass) of all reinforcing bar and mesh is produced using energy-reducing processed in its manufacture.

In addition, geopolymer concrete and mineral carbonation will be considered. Geopolymer concrete does not require excavation of virgin materials but rather uses waste or by-products materials such as fly-ash, slag, etc. Mineral carbonation involves injecting CO_2 into the mix which then forms a mineral that is permanently embedded in the concrete.

No Rainforest timbers, or timbers from high conservation forests, are to be used unless plantation grown. Sustainable timber shall be specified for at least 95% (by cost) of all timber products used on the project. This can be achieved by using products certified by a forest certification scheme and from a reused source.

Considerations will be given to reuse the sandstone from excavation.

4.9 ECOLOGICAL CONSERVATION

The development is proposed on a previously developed area of land adjacent to a train station, surrounded in an urban residential environment in a north-western suburb of Sydney. No additional impact will be made to the existing site.

The design aims to bring nature into the building by optimising the use of outdoor workshops and incorporate elements of biophilia.

4.10 WASTE

Waste collection and disposal plays an important role in the protection of the environment and the health of the population in the modern world.

A waste management plan will be prepared in accordance with Green Star requirements to assess and monitor the waste management process during construction and demolition, as well as waste produced during occupation within the development.

The waste management plan shall incorporate how to minimise the amount of waste generated, maximise the reuse, recycling and reprocessing construction waste materials and minimise the volume to materials disposed to landfill.

4.11 WATER SENSITIVE URBAN DESIGN

External area design will implement best practices of water sensitive urban design, including permeable paving and indigenous low water usage plants to increase storm water retention, decrease total suspended solids and mitigate the urban heat island effect. The carbon sequestration of the plants will also combat climate change contributions.

5. IMPACTS OF CLIMATE CHANGE

5.1 NEEDS ANALYSIS

Considering climate risk during the needs analysis stage of the project can help with the early identification of the challenges and opportunities that are likely to have an impact on the project across the lifecycle of the asset.

Both the Climate Change in Australia and AdaptNSW websites present climate change projections for the coastal strip of NSW. Although the specific numbers differ, the key messages to be taken from the data are clear.

- Average and maximum temperatures will continue to increase all year round. The number of hot days will increase while the number of cold nights will decrease.
- This will contribute to more severe fire weather. The site is not identified as bush fire prone however could still be affected by a bush fire (NSW RFS Bushfire Prone Land, 2019).
- Natural variability remains the major driver of rainfall changes in the future.
- The intensity of extreme rainfall events is projected to increase with high confidence.
- Time spent in drought is projected to increase with medium confidence.

Studies have shown that learning performance can be impacted by higher temperatures. Warm spaces may decrease interest and alertness, distracting students. With increasing temperatures, headaches and heat exhaustion symptoms may develop that can hinder academic performance.

5.2 CLIMATE VARIABLES OF INTEREST

Based on the above, the climate variables of interest for this site are maximum daily temperature and rainfall.

5.3 IDENTIFIED TIME SERIES

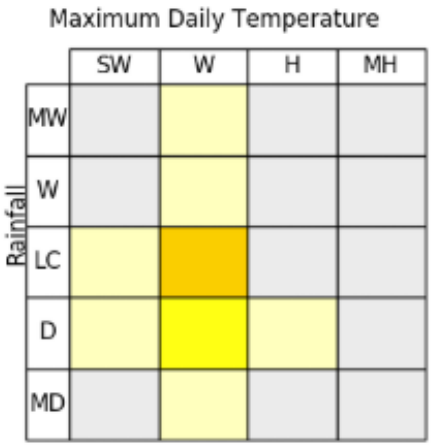
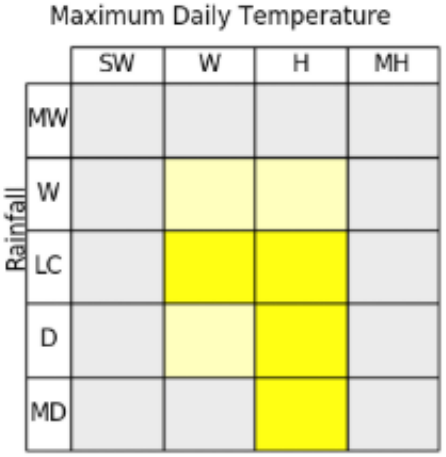
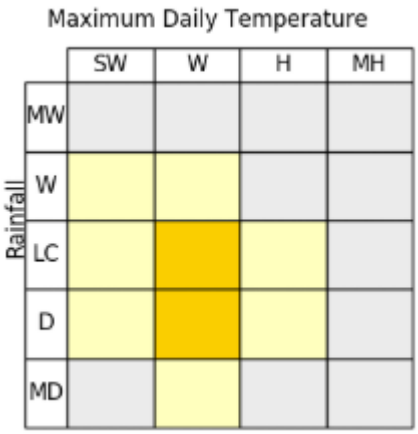
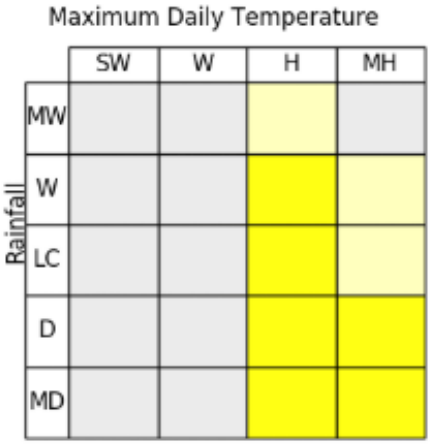
The lifespan of the project components were considered to determine time series. Based on components design life, the time series that is selected to understand the future climate impacts across the project's life are 2030 and 2070.

5.4 IDENTIFIED GREENHOUSE GAS SCENARIOS

In order to source relevant climate projection, a representative concentration pathway (RCPs) based on the latest IPCC report (AR5) is chosen. The RCPs provide plausible climate futures that may eventuate over the coming years. RCP 8.5 scenario has been selected as one future climate projection for this assessment as it's the most conservative pathway and because current emissions are tracking close to RCP 8.5. RCP 8.5 reflects a future with less curbing of emissions, coal fired power generation, increased carbon dioxide concentration reaching 940 ppm by 2100. The RCP 4.5 is chosen to represent a stabilisation pathway in which lower emissions is achieved by application of some mitigation strategies and technologies. RCP 4.5 reflects a future where emissions peak around 2040, and the CO2 concentration reaches 540 ppm by 2100.

5.5 CLIMATE FUTURE PROJECTIONS

The series of climate futures matrices representing the combination of time periods and greenhouse gas scenarios and classified by the combined changes of the climate variables identified above are provided in the table below:

<table>
<tr><td colspan="2">East Coast Climate Futures</td><td colspan="2">Year</td></tr>
<tr><td colspan="2"></td><td>2030</td><td>2070</td></tr>
<tr><td rowspan="2">Emissions Scenarios</td><td>RCP 4.5</td><td> 
</td><td> 
</td></tr>
<tr><td>RCP 8.5</td><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">Keys</td><td colspan="2">Maximum Daily Temperature
SW Slightly Warmer < 0.50
W Warmer 0.50 to 1.50
H Hotter 1.50 to 3.00
MH Much Hotter > 3.00

Rainfall
MW Much Wetter > 15.00
W Wetter 5.00 to 15.00
LC Little Change -5.00 to 5.00
D Drier -15.00 to -5.00
MD Much Drier < -15.00

Consensus / Proportion of models
Not projected — No models
Very Low — < 10%
Low — 10% - 33%
Moderate — 33% - 66%
High — 66% - 90%
Very High — > 90%</td></tr>
</table>

Source: CSIRO and Bureau of Meteorology, Climate Change in Australia website (http://www.climatechangeinaustralia.gov.au/), cited 22/08/2019.

5.6 KEY CASES

For thermal comfort:

"Best Case": Climate Future with the least increase in maximum daily temperature and the least change in rainfall (shorthand: "least hot and wettest")

"Worst Case": Climate Future with the greatest increase in maximum daily temperature and the greatest decrease in rainfall (shorthand: "hottest and driest")

5.7 RESULTS

For thermal comfort:

Case	2030 Climate Future		2070 Climate Future	
	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
"Best"	Slightly warmer and little change (Consensus: Very low)	Slightly warmer and little change (Consensus: Very low)	Warmer and little change (Consensus: Low)	Hotter and little change (Consensus: Low)
"Worst"	Warmer and much drier or Hotter and drier (Consensus: Very low)	Warmer and much drier or Hotter and drier (Consensus: Very low)	Hotter and much drier (Consensus: Low)	Much hotter and much drier (Consensus: Low)
"Maximum consensus"	Warmer and little change (Consensus: Moderate)	Warmer and little change (Consensus: Moderate)	Hotter to warmer and little change (Consensus: Low)	Hotter and little change to drier (Consensus: Low)

5.8 DISCUSSIONS

In the "best case" scenarios, the maximum daily temperature is projected to be slightly warmer by 2030 and warmer to hotter by 2070. Therefore, this project should be designed with warmer temperature being taken into considerations.

High level of passive thermal features should be considered, especially features that will assist in reducing solar heat gains in summer. Overreliance on air-conditioning should be avoided, especially during extreme temperature and heatwave events; air-conditioning should be accompanied by appropriate occupant behaviours and responses to ensure fitting and efficient use of the system. As the climate becomes warmer, energy consumption associated with cooling will increase. This additional electricity demand and associated greenhouse gas emission could be offset with additional photovoltaics panels to provide renewable electricity.

Dedicated "cool outdoor areas" where students and teachers can take shelter during extreme hot days when the power fails and there is no air conditioning proposed shall be explored in more detail at a later stage. This cool area will utilise tap water to provide a cooling 'boost'. Access to water will also be provided via water feature walkways, bottle fill, bubblers and water misters.

Rainwater should be collected, stored and reused to prepare for the drier conditions projected. Although there is uncertainty surrounding the change to rainfall in the future, it is good practice to implement a recycled water network. This will also complement the proposed dedicated cool outdoor areas.

More extreme rainfall events and gustier wind conditions may damage the building and its systems. Deliberation should be made regarding maintenance in the event of damage sustained due to weather conditions but also when selecting materials for construction. The potential increase in site discharge will need to be factored into the civil design. The concern of creating wind tunnels will be considered.