IGS INTEGRATED GROUP SERVICES

Ecologically Sustainable Design (ESD) Report

10 Missenden Rd, Camperdown NSW

15th August 2025

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CONTENTS

1. Executive Summary

IGS has been commissioned to prepare this Ecologically Sustainable Design (ESD) assessment report in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs) and in support of the preparation of an Environmental Impact Statement (EIS) and State Significant Development Application for the proposed ancillary health and research facilities, retail tenancies, commercial office space, and associated car parking to the Department of Planning, Housing and Infrastructure (DPHI). The proposed development's address is 10 Missenden Rd, Camperdown NSW.

This report has been prepared with reference to architectural plans prepared by Architectus and dated 04th June 2025.

The principles of ecologically sustainable design will be an integral consideration throughout this development. This report summarises the ESD provisions for the development which demonstrate commitment to environmental sustainability.

The sustainability targets for the development will be achieved in an integrated and staged approach through minimising the need for energy consumption (via passive measures) and then consumption optimisation (energy efficiency) and use of renewable resources where required.

The initiatives presented in this report demonstrate a wide range of measures which will result in high levels of environmental performance and also improvement of occupants' health, productivity, comfort, and satisfaction.

Aiming at leading practice in energy and environmental targets, the project architect and building services design team will maximise energy efficiency in an integrated and staged approach as described in Table 1 below.

Table 1. Sustainability Approach

Load Reduction (Minimising the need for resource consumption e.g., energy, water, and material)	Passive Design
	Building fabric improvements
	Maximise use of natural lighting
	Maximise use of Natural ventilation
	Maximise use of native plants and species
Optimising resources consumption (energy, water & materials)	High efficiency Heating, Ventilation and Air Conditioning
	High efficiency lighting
	High efficiency hot water systems
	High efficiency appliances
	Commissioning and tuning of building services post completion
	High efficiency building control, automation and BMS
Indoor Environmental Quality	Thermal Comfort
	Acoustic comfort
	Effective Daylighting / Natural Lighting
	Natural Ventilation
	Volatile Organic Compounds (VOC) & Formaldehyde Minimisation
Material	Maximise separation and recycling of demolition and construction materials.
	Minimise use of Ozone Depleting materials
	Avoid specifying materials with environmentally sensitive

	content
	Participation in waste minimisation training for contractors and sub-contractors.
	Waste minimisation plan to reduce site waste to landfill.
Transport Efficiency	Sustainable transport measures & bicycle racks
Use of renewable resources (renewable energy and rainwater harvesting)	Application of Solar Energy & Heat Pump technology
	Rainwater harvesting
Land use and Ecology	Maintaining and improving the ecological value of the land
Emissions	Insulation products with low Ozone Depletion Potential
	Refrigerants with Ozone Depletion Potential of zero
	Stormwater Management
	Light Pollution: Minimise light beams directed upwards or outside the buildings.

Benchmarking and compliance requirements:

The development will meet and outperform the following regulatory sustainability requirements:

- Standard Secretary's Environmental Assessment Requirements (SEARs) – ESD requirements.
- NCC Section J – Energy Efficiency

Sustainability benchmarks beyond the minimum requirements

The development will target a 5 Star Green Star rating. The design team will consider the sustainable design principles based on the following sustainability tool.

- Green Star Buildings Tool – Green Building Council of Australia.

This will be developed further prior to the Stage 2 SSDA lodgement.

2. Introduction

The Concept SSDA seeks development consent for a Concept Proposal for:

- Development of a private hospital, including the provision of ancillary health and research uses, ancillary retail and commercial office space and carparking;
- A building envelope which includes:
    - Three (3) basement levels to a maximum depth of RL 13;
    - Five (5) storey terraced podium with a maximum height of RL 56.4;
    - A 10-storey tower, plus roof plant level, with a maximum height of RL 85.5;

  The concept proposal *anticipates* the private hospital development will provide:

- Vehicular access from Missenden Road;
- 33,253m2 gross floor area;
- A maximum of 264 basement car parking spaces and three (3) ground floor, hospital drop-off parking spaces;
- Associated tree removal and tree transplanting, site landscaping, public art and public domain upgrades within and adjacent to the Concept Development Area.
- Accommodation of approximately 90 ward beds, 26 ICU/CCU beds and 8 Theatre rooms. Additionally, spaces for ancillary uses, such as:
    - Radiology
    - Pathology
    - Clinical suites
    - Research / technology
    - Education
    - Retail food and beverage
    - Pharmacy

This Concept SSDA is being sought pursuant to Division 4.4 of the EP&A Act. No physical works are proposed as part of this Concept SSDA. The Concept SSDA seeks development consent for the proposed concept envelope and private hospital land use only, further detailed design in the submission of staged DAs will determine the exact use and operation of these spaces.

All physical works will be the subject of detailed proposals as part of a future required detailed DA. An indicative reference scheme has been prepared by Architectus which provides a proof of concept that the proposed built form outcome is able to sensitively respond and integrate within the existing heritage fabric of the surrounding sites while accommodating the intended land use operations.

The proposal will provide a private hospital that is co-located to the RPA and supports the broader Camperdown Health, Education and Research Precinct ecosystem by providing for contributory health and life science land uses.

This report has been prepared in response to the requirements contained within the Secretary’s Environmental Assessment Requirements (SEARs) dated 5 March 2025 and issued for the SSDA (SSD-79888213). Specifically, this report has been prepared to respond to the SEARs requirement issued below.

2.1 Response to SEARs

The ESD SEAR's report is required by the Secretary's Environmental Assessment Requirements (SEARs). identifies the SEARs and relevant reference within this report.

SEARs Items	Project Response
Identify how ESD principles (as defined in clause 7(4) of Schedule 2 of the EP&A Regulation) are incorporated in the design and ongoing operation of the development.	The sustainability targets for the development will be achieved in an integrated and staged approach through first minimising the need for energy consumption (via passive measures) and then consumption optimisation (energy efficiency) and use of renewable resources where required. The outcome of this staged approach is to ensure the development aligns with the ecological sustainable development principles of Clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000. Refer to section 7 for the proposed ESD initiatives.
Demonstrate how the concept development will meet or exceed the relevant industry recognised building sustainability and environmental performance standards.	The proposed development will outperform the minimum regulatory requirements of NCC Section J and will target a 5 Star Green Star and the design team will incorporate sustainable design principles where feasible, guided by established sustainability frameworks. Refer to Section 7 for the targeted sustainability measures, including strategies for energy and water conservation.
Demonstrate how the concept development minimises greenhouse gas emissions (reflecting the Government's goal of net zero emissions by 2050) and consumption of energy, water (including water sensitive urban design) and material resources.	Mitigation of the operational GHG emissions of the development has been considered in the design of the hospital. The building's upfront carbon emissions (A1-5) will aim to be at least 10% less than those of a reference building. This will be further investigated prior to the lodgement of the Stage 2 SSDA. Section 7 provide building performance measures considered to reduce resource consumption and carbon emissions.

If Chapter 3 of SEPP (Sustainable Buildings) 2022 applies:
• demonstrate how the development has been designed to address the provisions set out in Chapter 3.2(1).
• provide a NABERS Embodied Emissions Material Form to disclose the number of embodied emissions attributable to the development in accordance with section 35BA of the EP&A Regulation.
• provide a net zero statement (as defined in section 35C of the EP&A Regulation) that includes:
  ○ evidence of how the development will either be fossil fuel-free after the occupation of the development commences or transition to be fossil fuel-free by 1 January 2035.
  ○ details of any renewable energy generation and storage infrastructure implemented and any passive and technical design features that minimise energy consumption.
  ○ estimations of annual energy consumption for the building and number of emissions relating to
	Furthermore, a NABERS Embodied Emissions Material Form has been provided in Appendix D of this report.
	○ the development will aim to be fully electric post occupancy; this will be investigated further by Stage 2 SSDA lodgement and investigation of the hospital requirements.
	○ The development will be supplied with renewable energy generation and storage infrastructure (minimum 20 kW Solar PV).
	○ The design team will provide estimations of annual energy consumption for the building and the volume of emissions relating to energy use in the building.
	Please refer to Sections 7.6 & 7.7.
	A climate adaptation study has been undertaken to identify the climate risks in response to the projected impacts. Actions and design strategies have been identified to lower the impacts and the associated risk levels. The climate change adaption plan is provided in Section 6 of this report. The plan is based on NSW and ACT Government Regional Climate Modelling (NARCliM) climate change projections.

energy use in the building (if information is available).	

2.2 The Site

The site is located at 10 Missenden Road, Camperdown, within the Sydney Local Government Area (LGA), outlined in red in Figure 1 and Figure 2. The site is legally described below:

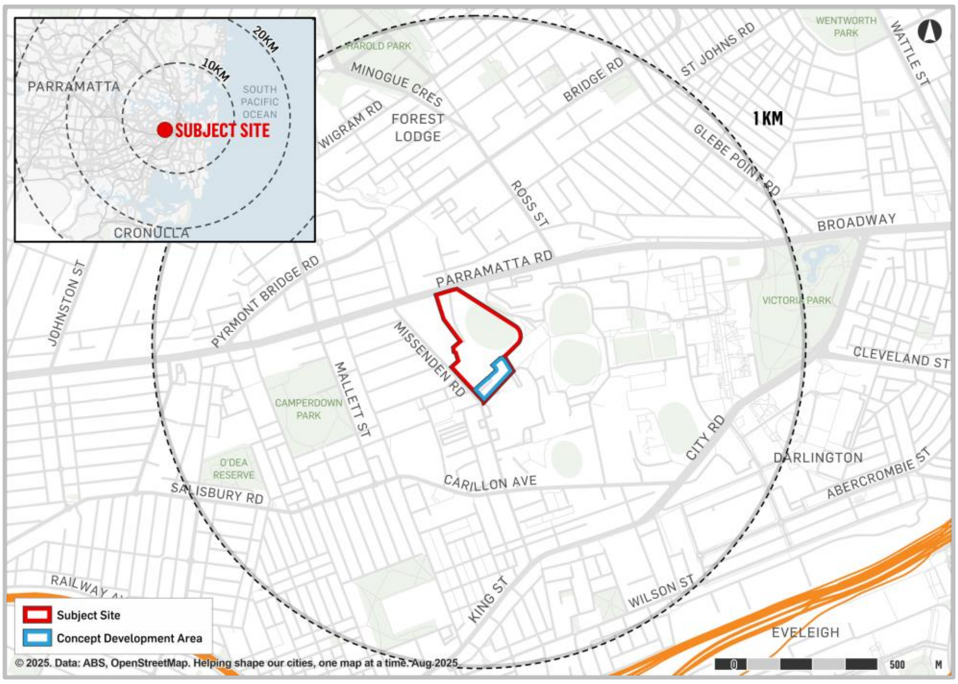
Lot	Address	Site Area
Lot 2 in DP 1124852	10 Missenden Road, Camperdown	4.79ha

The area of the concept envelope (herein referred to as the Concept Development Area) sits within the southern part of the overall grounds of St Johns College site as outlined in blue in Figure 1 and Figure 2. The Concept Development Area comprises 7,329m2. The bulk of the Concept Development Area is currently comprised of at-grade, outdoor carparking (public paid car park) with scattered tree plantings and a driveway/access point from Missenden Road. At the south-west corner, fronting Missenden Road, is a sing-storey retail building, known as the Benning Building, which current accommodates three retail tenancies, a post-office, a “7/11” convenience store and an office.

The Concept Development Area has a prevailing topography characterised by a moderate slope from Missenden Road to the east of the Concept Development Area located along John Hopkins Drive.
The site is located within the Camperdown Health, Education and Research Precinct (CHERP), which contains a mixture of healthcare services, medical research and education institutions. Surrounding land uses include the Royal Prince Alfred Hospital (RPAH), University of Sydney and ancillary student accommodation, and mixed-use buildings comprising commercial and residential activity.

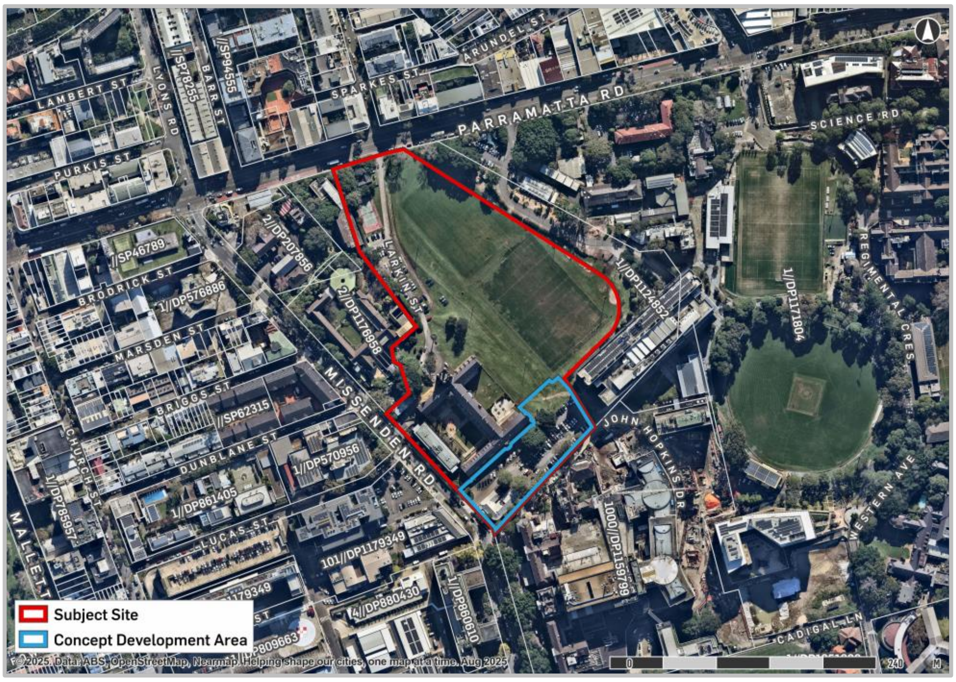
St Johns College is identified under the Sydney Local Environmental Plan 2012 (SLEP 2012) as a local heritage item (no. 67). The Concept Development Area has been assessed as having medium to low archaeological significance, with a potential for Aboriginal archaeological materials to be present in the area. However, it is noted by the St Johns College Conservation Management Plan 2020 that based on the level of continued site disturbance, it is highly unlikely that any deposits or materials would be in situ or undisturbed. The Concept Development Area is also situated within the C5 “University of Sydney” State Heritage Conservation Area. Further, the Concept Development Area is located in proximity to the “Admission Block” and “Victoria & Albert Pavilions” of the RPAH to the south of the area, which are listed on the state heritage register (listing numbers 00830 and 00829, respectively).

Figure 1 Site Location Plan



Source: Urbis Spatial, 2025

Figure 2 Aerial Photograph.



Source: Urbis Spatial, 2025

2.3 Sustainable Design Vision and Initiatives

Figure 3. Location – 10 Missenden Rd, Camperdown NSW Source: Google Map.

The design team recognise the importance of sustainable developments in terms of environmental preservation, occupants' health, safety, and wellbeing, as well as in terms of greenhouse gases emissions reduction.

The project architect, consultants and contractors will strive to design and construct the building based on the Environmentally Sustainable Design (ESD) principles which meet the minimum regulatory NCC Section J requirements.

The facade and floor plans are designed with the vision to give occupants the very best in terms of passive heating and passive cooling. This, when combined with other energy efficiency strategies (listed later in the report) will lead to low energy demands for the tenancies and base building and therefore lower greenhouse gas emissions during the life of this development.

IGS has been commissioned to prepare this Ecologically Sustainable Design (ESD) assessment report in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs) and in support of the preparation of an Environmental Impact Statement (EIS) and State Significant Development Application for the proposed ancillary health and research facilities, retail tenancies, commercial office space, and associated car parking to the Department of Planning, Housing and Infrastructure (DPHI). This report has been prepared with reference to architectural plans prepared by Architectus and dated 04th June 2025.

Natural lighting and natural ventilation will be utilised very effectively throughout the development. In addition to thermal comfort, energy and water efficiency, the proposed building design will provide sustainable and efficient operation to the occupants.

The proposed sustainable design initiatives will not only improve the building services life but are low-cost, low maintenance and reliable, especially when compared to often prohibitively complex and expensive retrofits. Furthermore, the passive design principles will facilitate a low-energy and cost-effective operation for the occupants.

The following are some of the design initiatives which will improve the environmental performance of the development and deliver long term energy efficiency during the life of the building.

- Optimising the size of the mechanical plant to ensure the plant is working at its peak efficiency and minimise the capital cost of the plant.
- Having high efficiency lighting and air conditioning equipment will reduce the energy consumption of the buildings.
- Variable Speed Drives (VSD) controls the speed of pumps, fans, and other mechanical plant to ensure that they are only using as much power as it is needed.
- Commissioning of all services equipment to ensure their correct operation.
- A high-performance façade will limit the heat entering the buildings, reducing air conditioning system sizes and the energy use over the year.
- Emission reductions and material optimisation.
- Maximise use of non-toxic building materials.
- Maximise use of materials that are recyclable.
- Minimise Waste in Construction.
- Minimise Waste in Operation.
- Renewable Energy generation – Solar PV & Heat Pump technology.

3. Methodology

This Ecologically Sustainable Design (ESD) assessment has been prepared by IGS with reference to the architectural plans developed by Architectus (dated 04th June 2025) and in alignment with the Secretary's Environmental Assessment Requirements (SEARs) for the State Significant Development Application (SSD-79888213). The objective of the methodology is to ensure that ESD principles are integrated throughout the lifecycle of the proposed hospital facility, from design to construction and operational phases.
The following steps were undertaken to complete this assessment:

3.1 Review of Project Design and Planning Context

Comprehensive review of the hospital's design layout, vertical stacking, orientation, façade articulation, and services strategy as shown in the latest architectural sections and plans.
Identification of building uses across levels, including ward areas, ICU/CCU, flexible tenancies, theatres, food services, parking, and retail components.
Assessment of applicable planning instruments, including the National Construction Code (NCC) Section J, State Environmental Planning Policies (SEPP), and relevant local council requirements.

3.2 Identification of ESD Opportunities

Analysis of passive design opportunities, including solar access, daylighting, natural ventilation, and building envelope performance.
Evaluation of building orientation and façade treatment to minimise cooling and heating loads.
Consideration of building form and materials in relation to energy demand and thermal performance.

3.3 Quantitative and Qualitative Performance Analysis

Preliminary energy modelling and simulations (where applicable) to inform likely energy consumption and greenhouse gas emissions based on proposed HVAC, lighting, and facade strategies.
Assessment of operational water use reduction strategies, including low-flow fittings, rainwater harvesting potential, and water reuse systems.
Review of waste management practices for both construction and operational phases.

3.4 Stakeholder Engagement and Design Team Coordination

Engagement with the architectural, mechanical, electrical, hydraulic, and structural consultants to integrate sustainable initiatives into the base building and tenancy areas.
Collaborative design reviews to ensure proposed systems (e.g., high-performance glazing, VSD-controlled mechanical systems, rooftop solar PV) are technically and financially feasible.

3.5 Development of ESD Initiatives

Compilation of recommended ESD measures across categories such as:

- Energy Efficiency
- Water Efficiency
- Indoor Environmental Quality
- Materials and Waste
- Transport and Mobility
- Emissions Reduction and Renewable Energy

3.6 Benchmarking and Compliance Review

Evaluation of performance against NCC Section J and identification of measures compliance as a commitment to sustainable development.

3.7 Reporting and Recommendations

Documentation of findings in this report to support the Environmental Impact Statement (EIS) for SSD application submission.

Provision of a clear summary of achievable ESD initiatives, their environmental benefits, and their contribution to long-term operational cost savings and reduced carbon footprint.

4. Assessment and Findings

This section outlines the outcomes of the Ecologically Sustainable Design (ESD) technical assessment undertaken for the proposed hospital facility as part of the State Significant Development (SSD-79888213). The assessment was carried out in accordance with the requirements of the Secretary's Environmental Assessment Requirements (SEARs), relevant environmental legislation, and best-practice sustainability standards for health infrastructure.
In addition, this report acknowledges Schedule 193 of Division 5 of Part 8 of the Environmental Planning and Assessment Regulation 2021, and it is confirmed that a future detailed development application will be designed in accordance with the principles set out in these regulations.

4.1 Compliance with NCC and Section J Requirements

- The proposed development complies with the National Construction Code (NCC) Section J requirements applicable to healthcare and commercial spaces.
- The building envelope, including wall, glazing, and roof elements, exceeds minimum thermal performance benchmarks through the use of high-performance façade systems.
- Air conditioning and mechanical systems are designed for energy efficiency and include Variable Speed Drives (VSDs), optimally sized plant, and high Coefficient of Performance (COP) chillers, reducing operational energy use.

4.2 Energy Efficiency Performance

- Passive design principles, including appropriate orientation, natural ventilation, and shading, significantly reduce reliance on mechanical systems.
- Integration of solar PV and heat pump technology will contribute to renewable energy generation on-site, improving the hospital's energy profile.
- Preliminary modelling suggests an estimated energy demand reduction of 25–35% compared to a standard-compliant hospital facility, contributing to long-term greenhouse gas emission reductions.

4.3 Water Efficiency

- Water-sensitive design strategies have been incorporated, including low-flow water fittings and potential for rainwater harvesting for non-potable uses such as irrigation and toilet flushing.
- Water-efficient fixtures are estimated to reduce potable water demand by up to 40% in comparison to standard baselines.

4.4 Indoor Environmental Quality (IEQ)

- The design prioritises access to natural daylight and ventilation in non-critical areas to enhance occupant comfort and reduce energy loads.
- Indoor air quality will be improved through selection of low-VOC materials and provision of mechanical systems with appropriate filtration and ventilation rates as per healthcare standards.

4.5 Materials and Waste

- Sustainable materials have been specified where possible, with an emphasis on low-toxicity, high-recyclability, and local sourcing to reduce embodied energy.
- A comprehensive construction waste management plan will be implemented to target at least 80% diversion of construction waste from landfill.
- Operational waste strategies, including space for clinical, recyclable, and general waste streams, have been integrated into the design.

4.6 Climate Resilience and Emissions Reduction

- The hospital will be designed to be climate-resilient, with robust mechanical systems and passive features that mitigate risks associated with extreme heat and power outages.
- Lifecycle greenhouse gas emissions are expected to be significantly reduced through the integration of passive design, energy-efficient systems, and renewable energy technologies.

4.7 Environmental and Ecological Considerations

- No potentially serious or irreversible impacts to threatened species, populations or ecological communities have been identified as part of this development.
- Landscaping will include native and drought-resistant species, contributing to local biodiversity and reducing irrigation demand.

4.8 Economic and Regional Benefits

- The development is expected to generate significant economic benefits for the region through job creation during both construction and operation phases.
- By reducing operational costs through sustainable design, the hospital will be more economically efficient over its lifecycle, allowing more funding to be directed toward patient care and services.

In accordance with Schedule 193 of Division 5 of Part 8 of the Environmental Planning and Assessment Regulation 2021, the proposed development acknowledges and aligns with the prescribed sustainability principles for health infrastructure. A future detailed Development Application will be prepared and designed in full compliance with these principles, ensuring that the final design and associated documentation reflect the regulatory requirements and best practice standards outlined in the Regulations 2021.

5. Benchmarking

Benchmarking and compliance requirements:

The development will meet and outperform the following regulatory sustainability requirements:

- Standard Secretary's Environmental Assessment Requirements (SEARs) – ESD requirements
- NCC Section J – Energy Efficiency

Sustainability benchmarks beyond the minimum requirements

The development will target a 5 Star Green Star rating. The design team will consider the sustainable design principles based on the following sustainability tool.

- Green Star Buildings Tool – Green Building Council of Australia.

This will be developed further prior to the Stage 2 SSDA lodgement.

5.1 National Construction Code (NCC) Section J

Section J of the NCC sets regulations for energy efficiencies for all types of buildings with respect to the building's construction, design, and activity.

The objective of the NCC Section J is to reduce the greenhouse gas emissions. Section J requires that a building, including its services, must have features to the degree necessary that facilitate the efficient use of energy.

The NCC offers two compliance methods that differ in complexity and flexibility. The two compliance methods are:

- Deemed-to-Satisfy (DTS) Compliance.
- J1V3 – Verification using a referenced building.

The Deemed-to-Satisfy Provisions in Section J of the NCC 2022 include the following 8 components.

- Part J1 - Energy efficiency performance requirements.
- Part J2 - Energy efficiency.
- Part J3 - Elemental provisions for a sole-occupancy unit of a Class 2 building or a Class 4 part of a building.
- Part J4 - Building Fabric relates to the building fabric and minimum thermal performance for constructions according to climate zone for roofs, ceilings, roof lights, walls, glazing and floors.
- Part J5 – Building Sealing – Provisions to reduce the loss of conditioned air and restrict unwanted infiltration to a building.
- Part J6 - Air-Conditioning and Ventilation – Requirements to ensure these services are used and use energy in an efficient manner.
- Part J7 - Artificial Lighting and Power – Requirements for lighting and power to ensure energy is used efficiently within a building.
- Part J8 - Heated water supply and swimming pool and spa pool plant – Restrictions for hot water supply design except for solar systems within climate zones 1, 2 and 3.
- Part J9 - Energy monitoring and on-site distributed energy resources.

The development will meet and outperform the NCC energy efficiency requirements of Part J4 report will be prepared once the design is further progressed.

5.2 Green Star

Green Star is an environmental rating tool developed by the Green Building Council of Australia (GBCA) that has a holistic approach over a wide range of issues that covers a range of sustainability impact areas. There are various Green Star tools developed to suit a range of different building types including:

- Green Star Buildings.
- Design and As-Built.
- Office Interiors.
- Performance.
- Communities.

Green Star rating tools use Stars to rate performance:

- Legal compliance: The building is compliant with legislation (National Construction Code 2019 or later)
- Good Practice: The building meets the Minimum Expectations of good practice energy and water efficient, good indoor environment quality and built to operate well.
- 4 Star reflects a Best Practice environmental performer. It builds on the Minimum Expectations to deliver a building that is
- either climate positive or a higher performer in energy, water, and health related issues (15 out of 100 points)
- 5 Star demonstrates Australian Excellence by being a high environmental performer that addresses social issues relevant to the building owner (35 out of 100 points)
- 6 Star showcases World Leadership. It has been built to be a highly efficient building fully powered by renewables that addresses a significant number of environmental and social issues, and contributes to the community (70 out of 100 points).

The diagram in Figure 4 below details the ratings awarded by Green Star Buildings.

Figure 4. The ratings awarded by Green Star Buildings.

Green Star rating tools include eight separate environmental impact categories, as shown Figure 5 and Figure 6 follows.

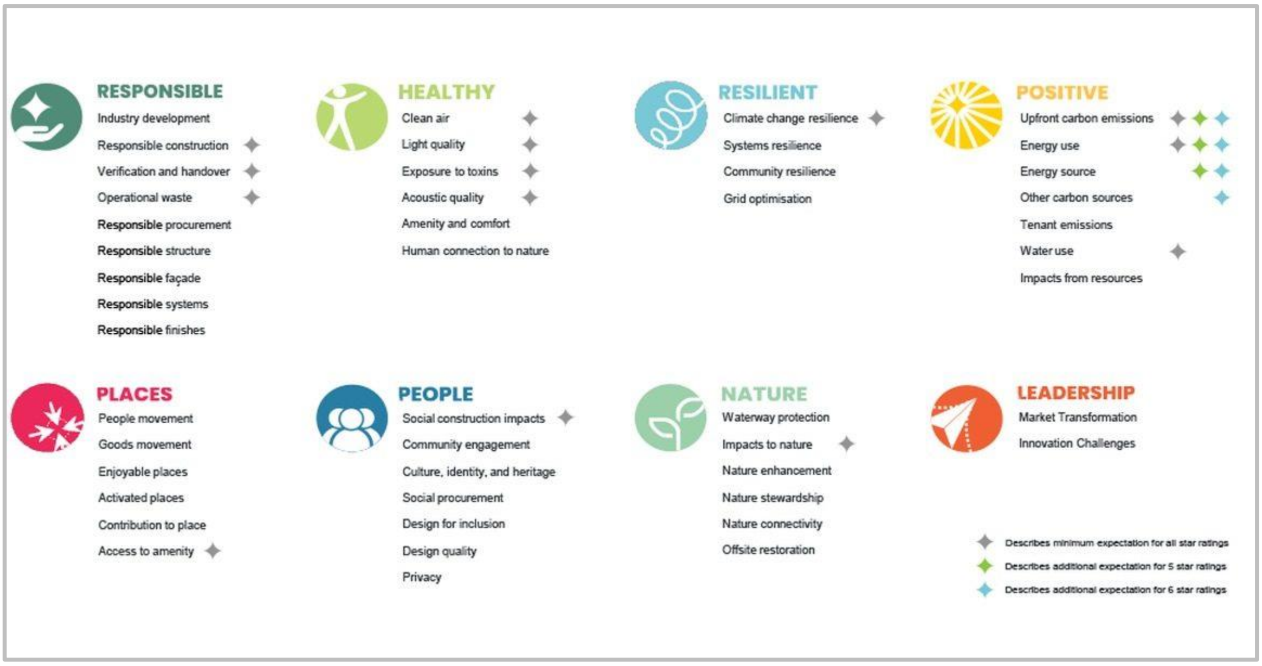


Figure 5. Environmental impact categories list used in Green Star rating tools.

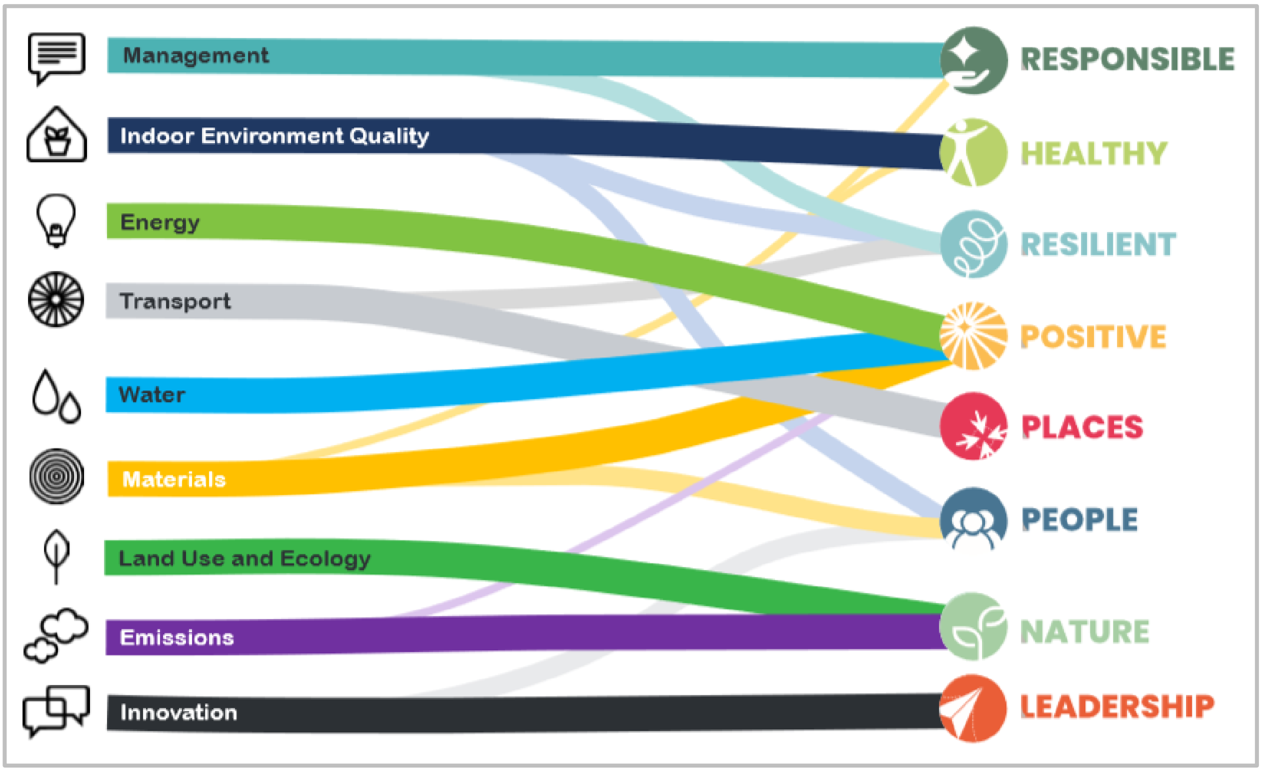


Figure 6. Eight separate environmental impact categories chart used in Green Star rating tools.

The development will target a 5 Star Green Star rating. This will be developed further prior to the Stage 2 SSDA lodgement.

6. Development Location

The development will be located in Camperdown NSW which is within the NCC climate zone 5 (Warm temperate). The climate zone map of the development is depicted in Figure 7.

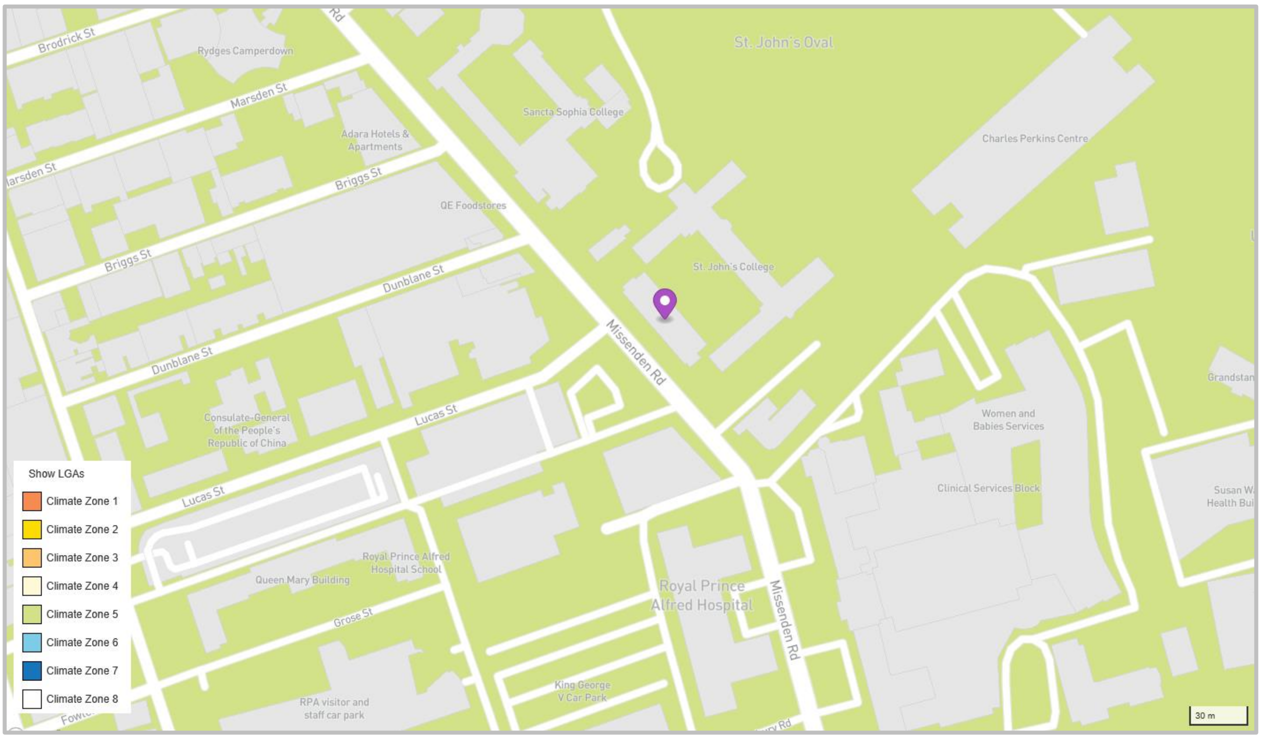


Figure 7. Climate zone map.

6.1 Information Used in Review

Our review is based on the following preliminary architectural drawings by Architectus Architects (Table 2).

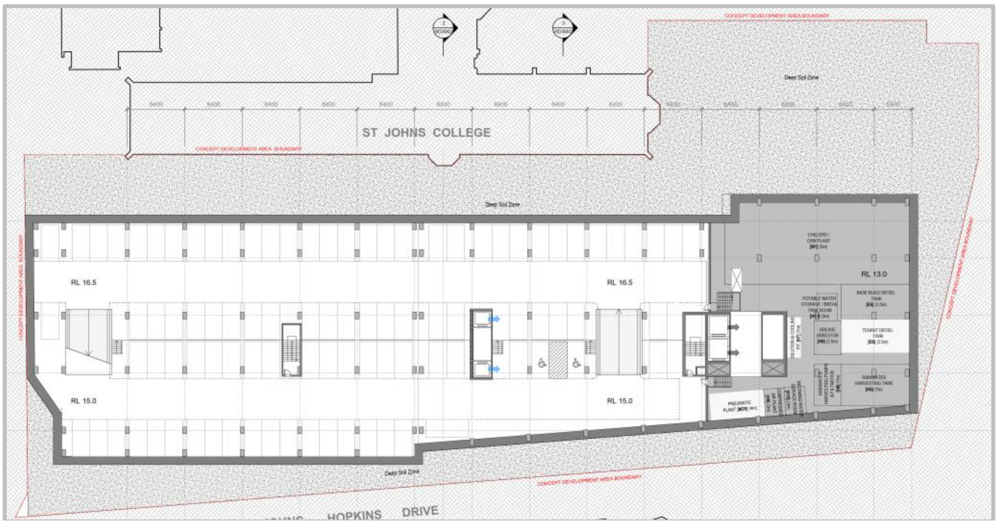
Table 2. Architectural drawing list.

Drawing title	Drawing number
Cover	RD0001
Site Plan	RD0010
Basement 3	RD2003
Basement 2	RD2004
Basement 1	RD2005
Lower Ground	RD2006
Mid Ground	RD2007
Upper Ground	RD2008
Level 1	RD2009
Level 2	RD2010
Level 3 (Theatres / Recovery)	RD2011
Level 4 (ICU / CCU Rooms)	RD2012
Level 5 - 7 (30 Bed Ward)	RD2013
Level 8	RD2014
Level 9 - 10	RD2015
Level 11	RD2016
Section 1 - East West	RD3001
Section 2 & 3 - North South	RD3002

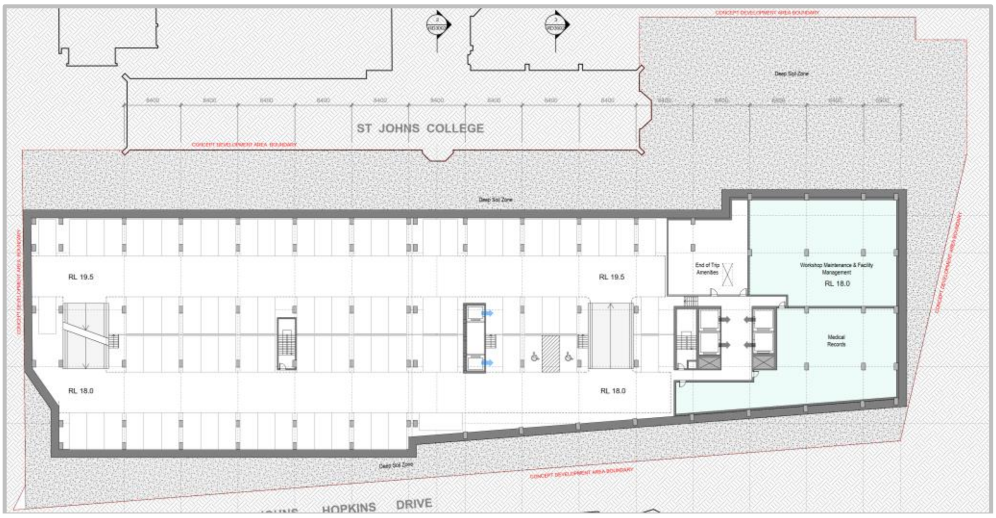
6.2 Architectural Drawings

Selected architectural plans and elevations for the proposed development are provided below.

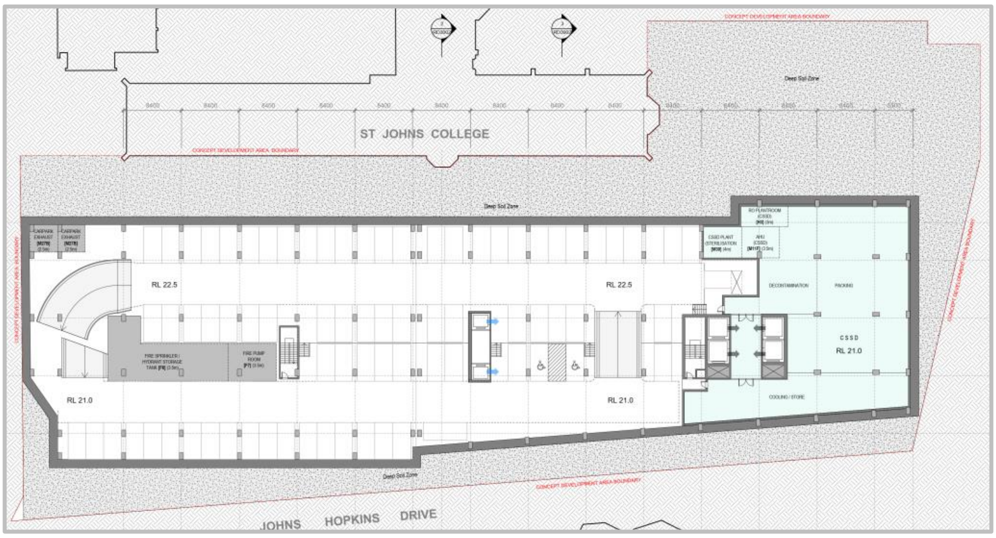
Basement 03 – Floor Plan



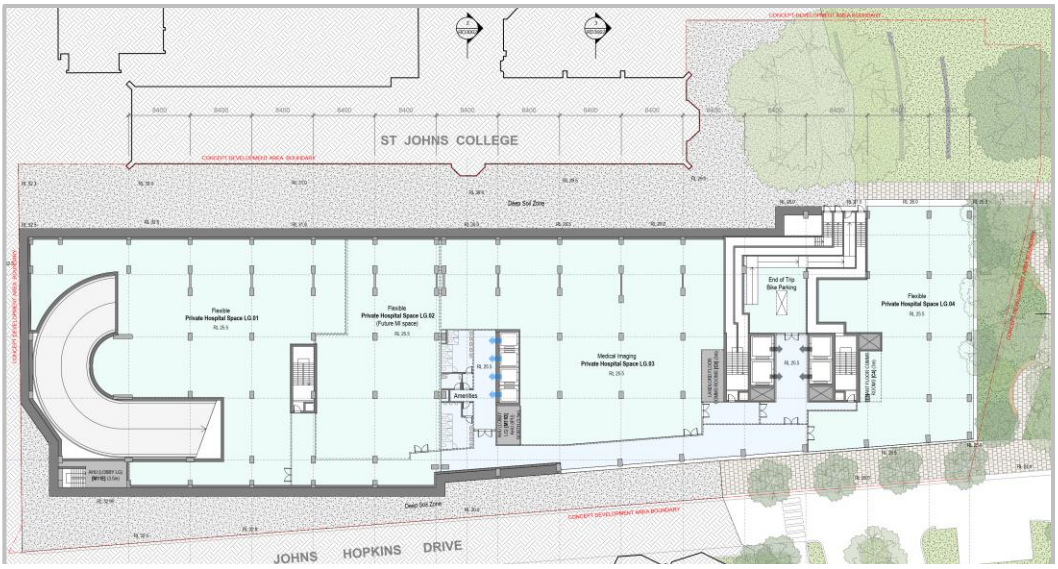
Basement 02 – Floor Plan



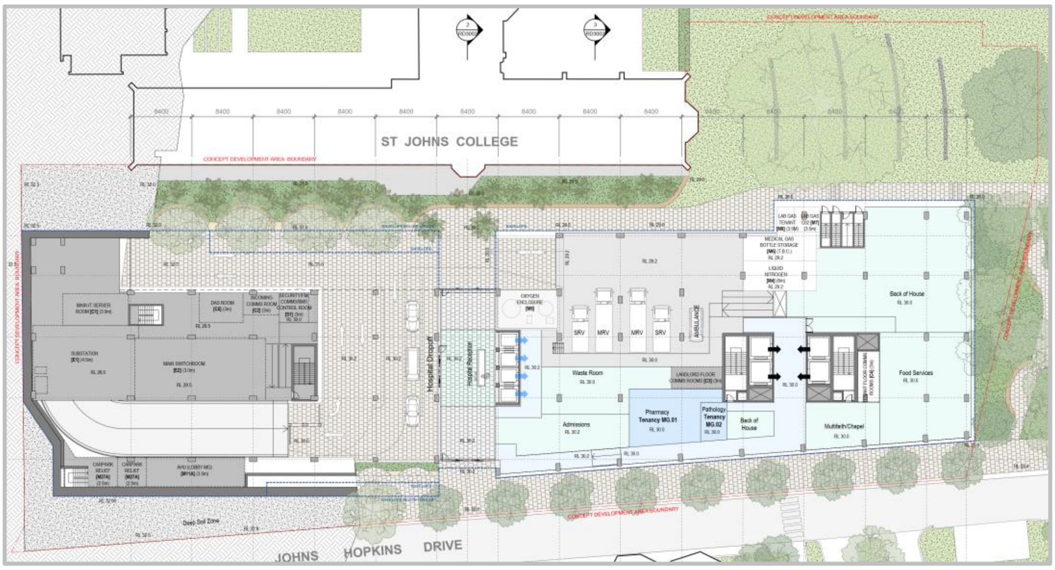
Basement 01 – Floor Plan



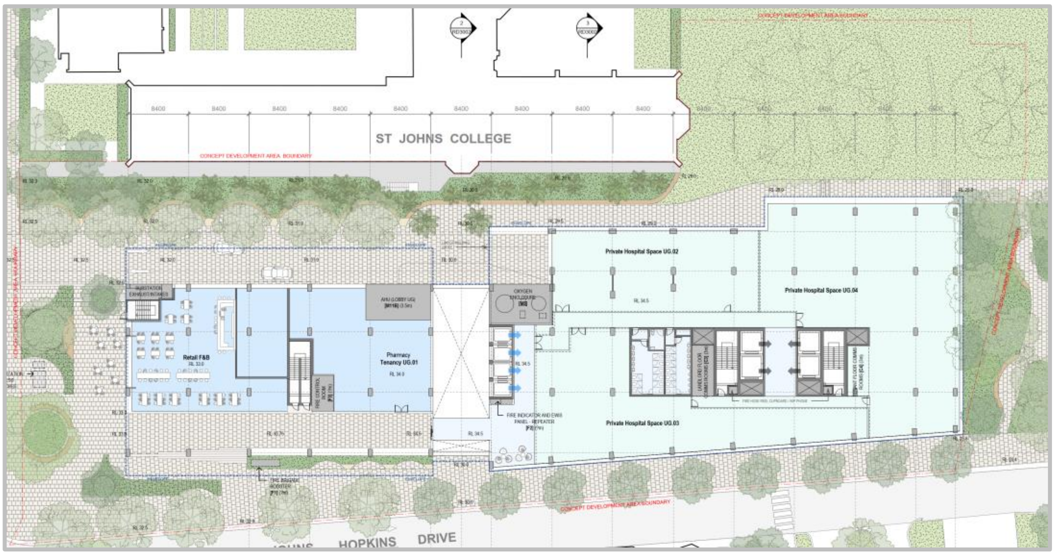
Lower Ground – Floor Plan



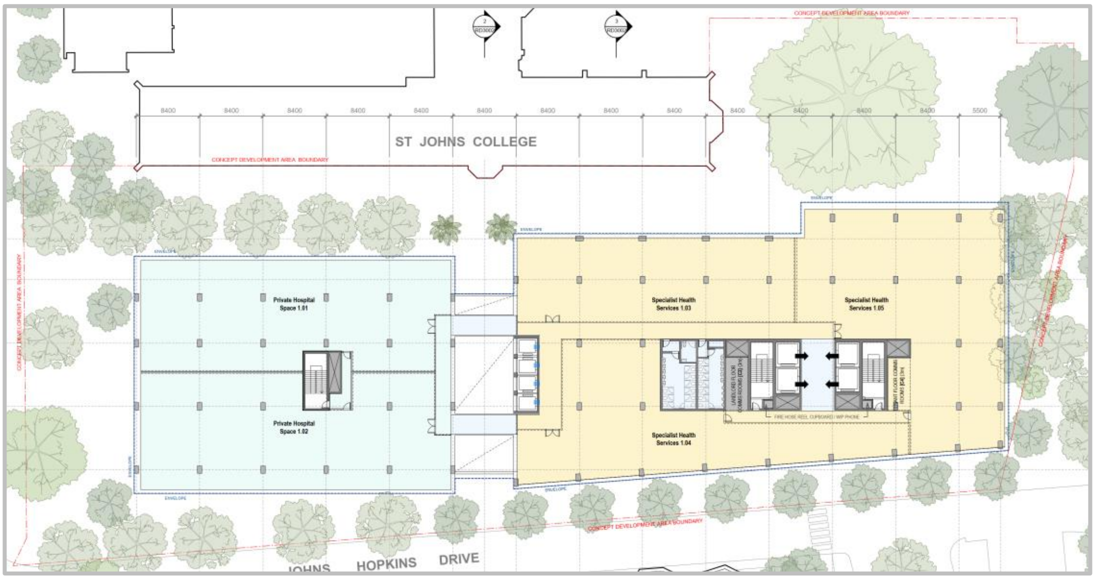
Mid Ground - Floor Plan



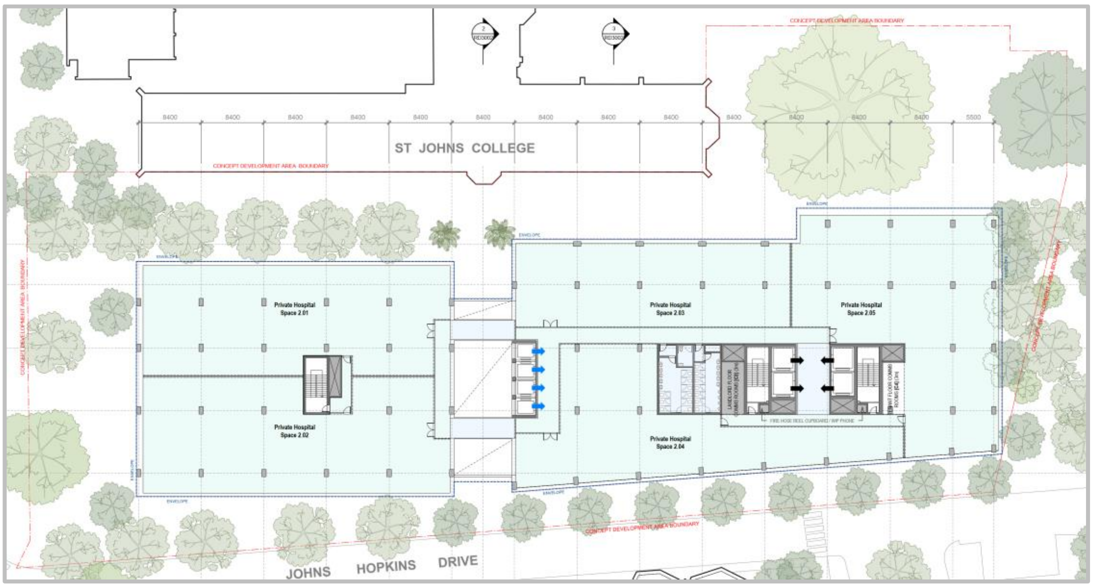
Upper Ground - Floor Plan



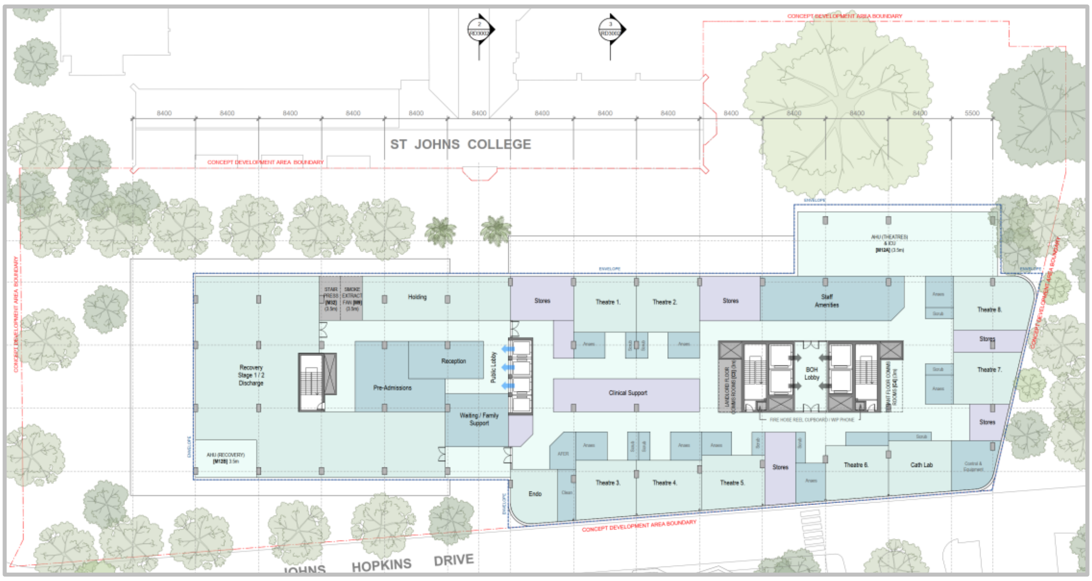
Level 1 - Floor Plan



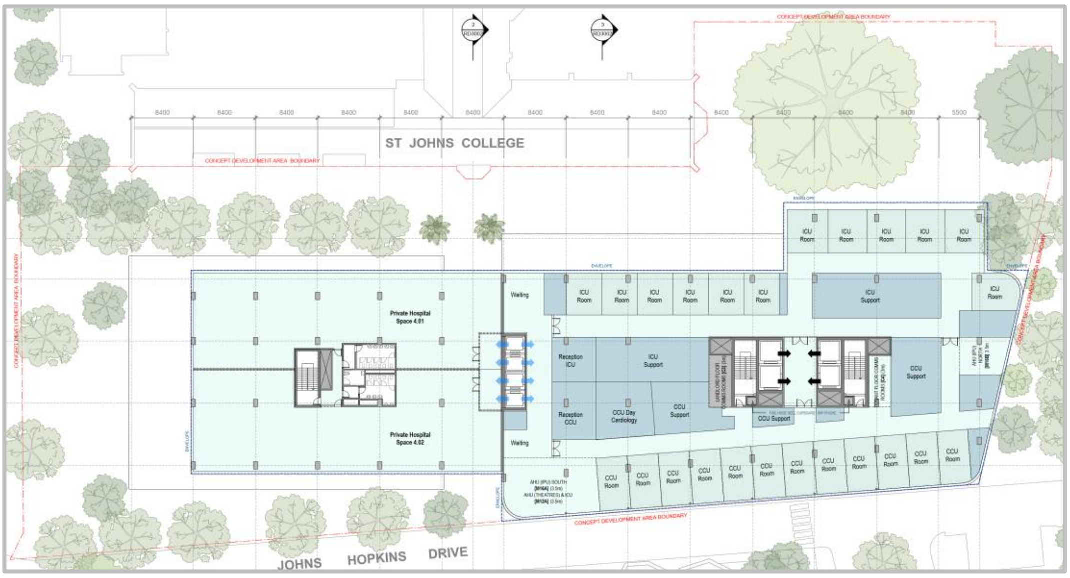
Level 2 - Floor Plan



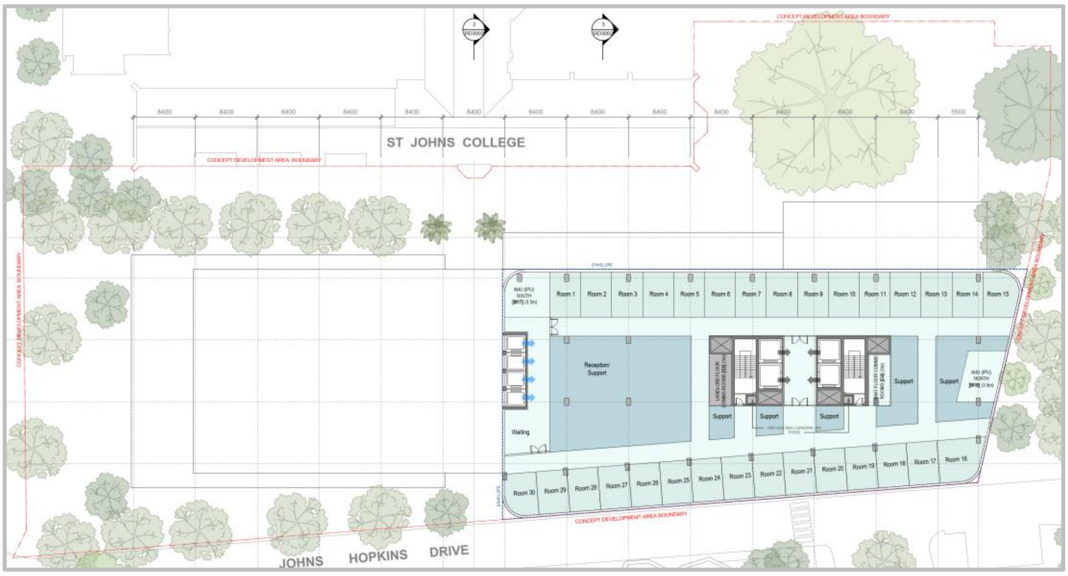
Level 03 - Floor Plan



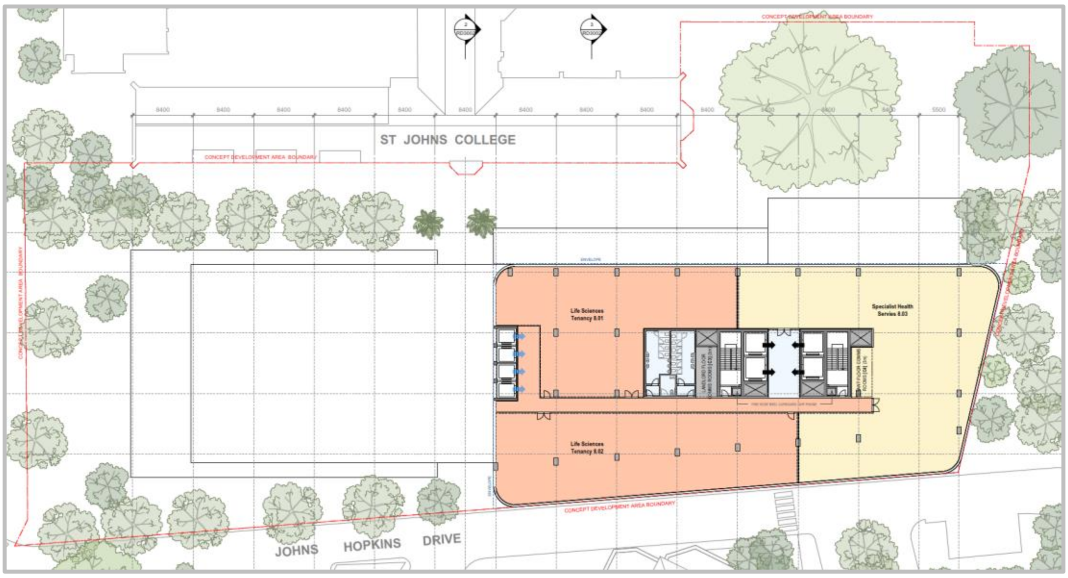
Level 04 - Floor Plan



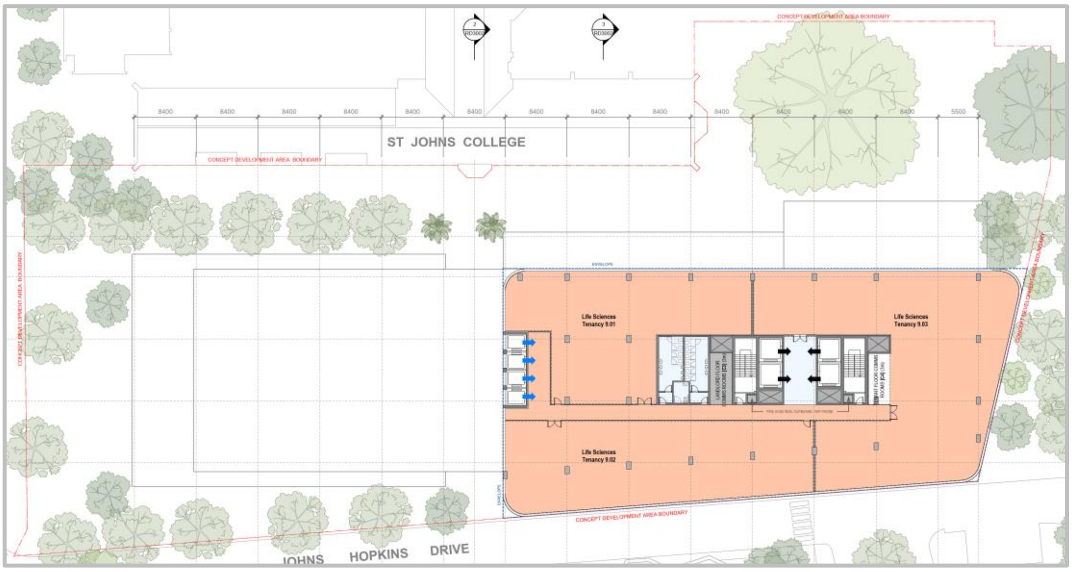
Level 05-07 - Floor Plan



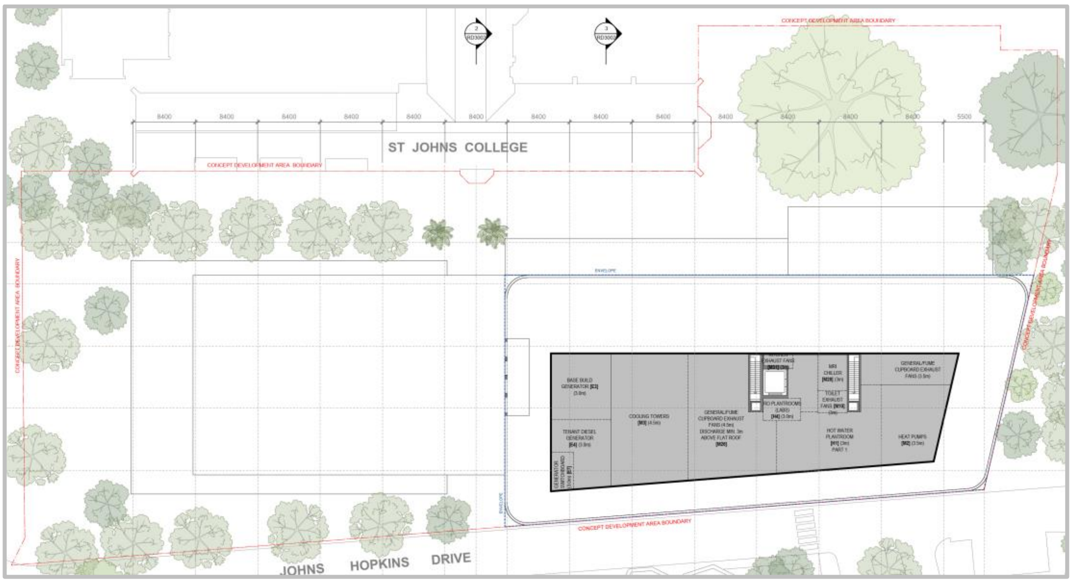
Level 08 - Floor Plan



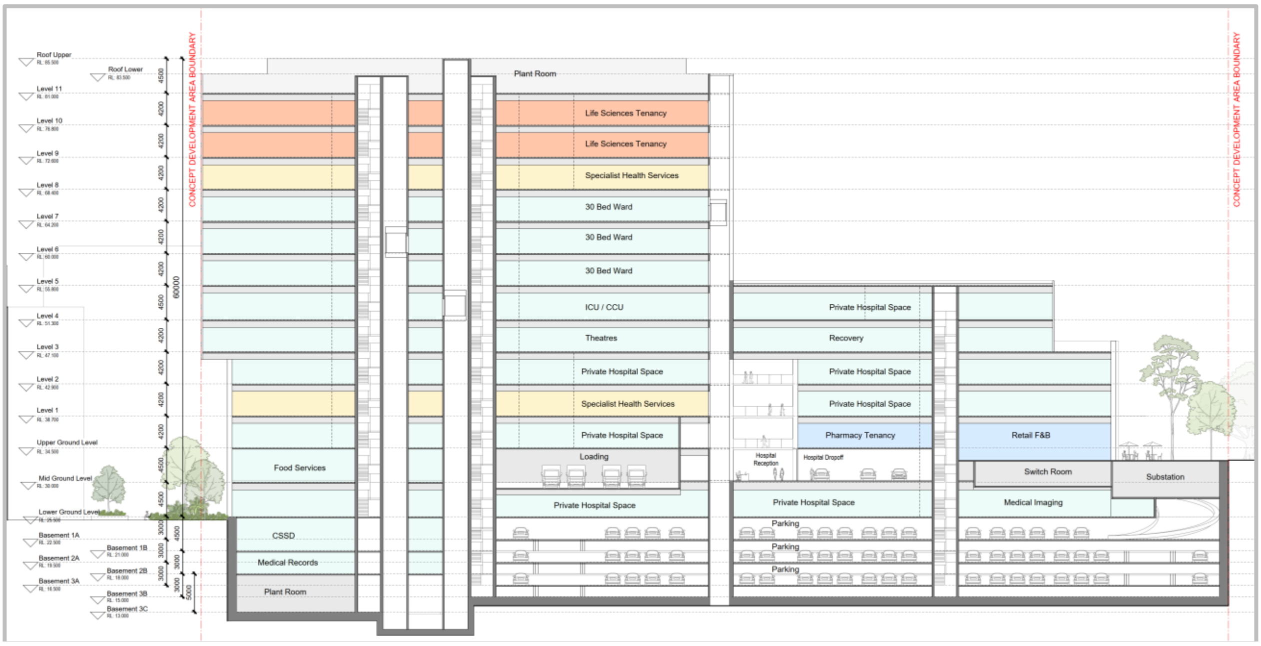
Level 9-10 - Floor Plan



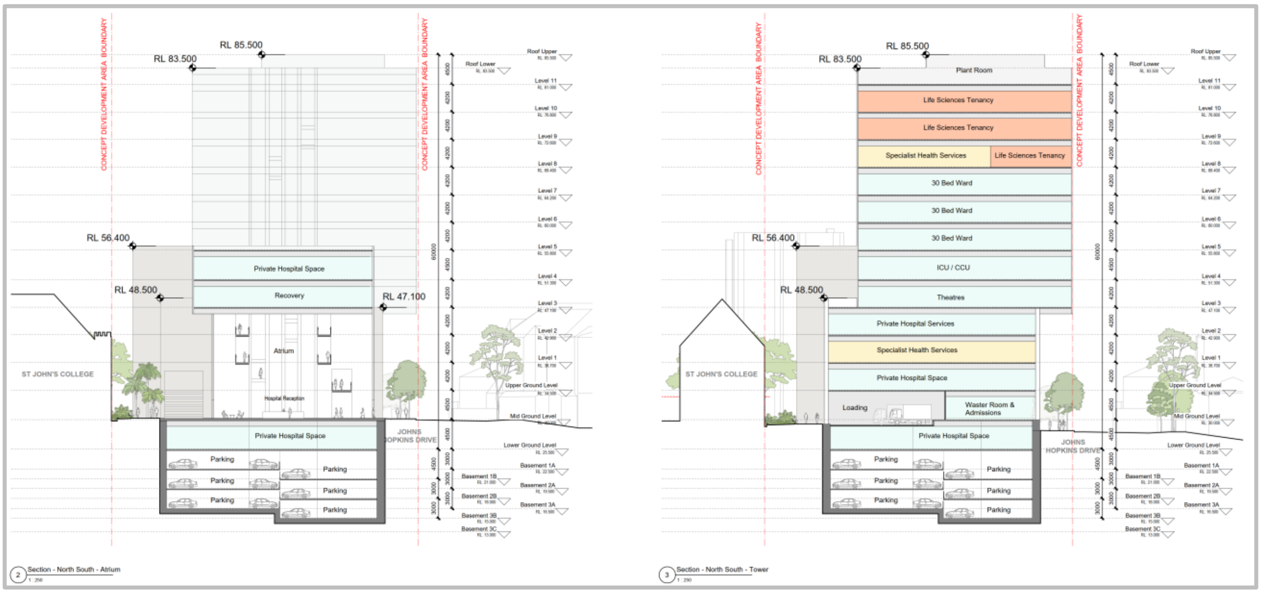
Level 11 - Floor Plan



Section 1 – East West



Section 2 & 3 - North South



7. Ecologically Sustainable Design (ESD) Initiatives

The principles of ecologically sustainable development are an integral consideration in design and construction of proposed development and also in assessing its benefits and impacts.
The design team will focus on a wide range of ESD strategies which will result in high levels of environmental performance and an increment on occupant's health, productivity, comfort and satisfaction.

7.1 Integrated Design Approach

The integrated design process is a process by which all of the design variables that affect one another are considered together and resolved in an optimal fashion. Often referred to as holistic design, this approach considers the development as a whole with the emphasis on integrating the different aspects of building's design.

7.2 Greenhouse gas emission reduction

Greenhouse gas emission reduction is achieved in a staged approach:

- First, reduction in overall energy consumption through demand reduction, passive design and energy efficiency, then;
- Reduction in electricity and gas utility consumption by utilising waste products, rainwater harvesting and renewable energy technologies (where feasible).

The integrated response to energy proposed for this project is summarised below:

1. Load Reduction and Passive Design.
2. System Efficiency.
3. Capture Waste.
4. Renewable Energy (where feasible).

Energy consumption will be reduced through the efficient design of lighting, air-conditioning and ventilation systems, as well as energy efficient water heating and renewable energy technologies (where feasible). The development will consider Greenhouse gas emission reduction in design and operation through utilising energy conservation measures suitable for the development.

The following sections of the report outline the sustainability initiatives that will be considered and further developed by the design team during the detailed design stages.

7.3 Management

The initiatives under the management category promote the adoption of environmental principles from project inception, design, and construction phases to the operation of the building and its systems.

This category aims to highlight the importance of a holistic and integrated approach to constructing a building with good environmental performance. The following measures are some of the initiatives targeted within the management category and are subject to further design development. These initiatives aim to reduce environmental impacts at construction and operational stages as well as to maximise building performance at commissioning.

7.3.1 Environmental Ratings and Involvement of a GSAP

Environmental rating schemes such as Green Star (Australia), LEED (US), Living Building Challenge (US) or BREEAM (UK) are used to create a marketable environmental credential based on achievement of a recognised benchmark. Ratings can be useful for marketing to the occupants and for demonstrating ESD achievement for planning submissions.

Green Star is the most recognised rating scheme in Australia, with hundreds of certified buildings, mostly office buildings. The new Green Star – Design and As-Built chosen as an appropriate benchmark for the project.

Green Star includes a range of categories under which credits are available. Points are scored under each credit, and the total score is used to determine a final rating; 45-59 points for 4 Star, indicating Best Practice, 60-74 points for 5 Star, indicating Australian Excellence; and 75 or more points for 6 Star, indicating World Leadership. The categories are as follows:

- Management.
- Indoor environment quality.
- Energy.
- Water.
- Transport.
- Materials.
- Land use and ecology.
- Emissions.
- Innovation.

A Green Star Accredited Professional (GSAP) is involved as part of the design and construction to prepare the necessary ESD guidelines.

7.3.2 Commissioning Clauses

Commissioning of building systems to a high standard, with independent oversight, will ensure that a quality process is followed and provide an outside review of the practicalities of the design. An extended building tuning period should be undertaken following defects liability period to ensure that systems are performing as intended, taking into account different seasonal variables, and that any need for recommissioning is identified and carried out.

To adopt commissioning and handover initiatives that ensure that all building services can operate to optimal design potential, such as:

- Where possible, comprehensive pre-commissioning, commissioning, and quality monitoring to be contractually required to be performed for all building services (BMS, mechanical, electrical and hydraulic).

7.3.3 Building Tuning

After handover, the building owner is expected to implement tuning of all building systems and undertake full re-commissioning 12 months after practical completion.

7.3.4 Building User's Guide

To produce a Building User's / Occupant's Guide, information management that enables building users / occupants to optimise the building's environmental performance during its operation.

7.3.5 Environmental Management Plan

The contractor is expected to adhere to a comprehensive Environmental Management Plan (EMP) for the works. Contractors are recommended to be ISO 14001:2004 certified. Environmental management plans and systems should be implemented to ensure that demolition and construction activities appropriately manage and mitigate environmental impacts.

7.3.6 Waste Management System

To encourage and facilitate effective waste management once the development is in operation, sufficient spatial provision will be made to allow for the effective separation of waste from recycling. Dedicated waste recycling rooms allow space for the separation and storage of recyclable waste during the building's operation, allowing for the following waste streams to be separated:

- Glass.

- Cardboard.
- Paper.
- Organics.
- Plastics.
- Metals.

Waste management solutions are varied and dependant on the extent of commitment of the end user. Recycling, reuse, and composting are examples of waste management options.

7.3.7 Environmental Management and Maintenance

Effective environmental and waste management will be implemented throughout the demolition, construction, and operational stages of this development.

The EMP shall include a Waste Management Plan, specifying recycling targets for demolition and construction waste. It is recommended that construction and demolition contracts stipulate a minimum 90% target for diversion of waste from landfill. This may be achieved through recycling or reuse.

- Identification of appropriate waste sub-contractors for recycling, costs of collection and timing of collection service.
- Participation in waste minimisation training for contractors and sub-contractors.
- Published waste minimisation plan to reduce site waste to landfill.

Provision of separate waste skips for cardboard, timber, metal, soft plastic, polystyrene, insulation, concrete, glass, and bricks.

7.4 Indoor Environmental Quality (IEQ) Initiatives

Indoor Environmental Quality initiatives consider the wellbeing of occupants, addressing factors such as heating, ventilating and air conditioning (HVAC), lighting, indoor air quality and building attributes, all of which contribute to good indoor environmental quality.

The following measures are some of the initiatives targeted within the IEQ category for further consideration and development during detailed design.

- Improvement of outside air rate by providing at a rate greater than AS1668.2 requirements. Air-conditioning system will be installed with carbon dioxide monitoring and control to ensure sufficient outside is delivered to occupants.
- Optimisation of the air quality by improving air change effectiveness
- Maximisation of natural lighting level to the building occupants
- Minimisation of the contribution and levels of Volatile Organic Compounds (VOCs) via the use of low VOC paints, adhesives and sealants, carpets, and flooring.
- All engineered wood products to be used in the development will have low formaldehyde emission.
- High efficiency lighting system with suitable luminance levels to avoid causing discomfort and strain for the occupants. All fluorescent luminaries are to be installed with high frequency ballasts to avoid discomfort caused by low frequency flicker.
- External Views: The design allows unobstructed external views for the majority of occupied spaces.
- Internal noise level at an appropriate level to ensure the occupants' satisfaction and wellbeing.

7.4.1 Thermal Comfort

Thermal comfort can be provided by passive and mechanical means. Passive design initiatives will be considered before the design of the mechanical systems to reduce operational energy costs, with potential reductions in the air conditioning size and ongoing maintenance.

Thermal comfort is a function of the following factors:

- Radiant temperature (45% of net comfort effect).
- Air temperature and humidity (35% of net comfort effect).
- Air movement, clothing, and activity (20% of net comfort effect).

Passive heating and cooling design strategies which will improve occupant thermal comfort include:

- Roof insulation not only reduces heat gain and loss, but will also moderate radiant temperatures from the walls, floor, and ceiling.
- Building facades with high performance glazing and window frames will have a combination of external shading and high-performance glass to reduce heat transfer and radiant temperatures in proximity to the windows.

Indoor areas will be designed to be protected from excessive summer solar radiation, reducing radiant heat loads on the space, but still providing enough daylight during appropriate times of the year to improve comfort levels.

The approximate annual Dry-bulb temperature and comfort range for the Concept Development Area is shown in Figure 8:

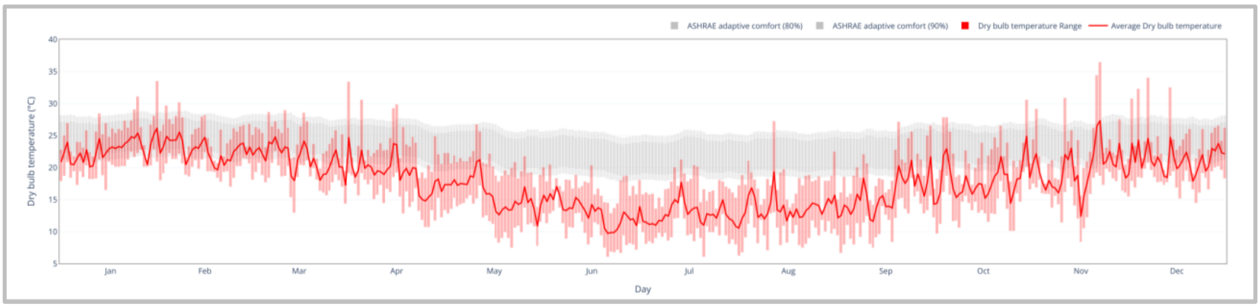


Figure 8. Annual Dry-bulb temperature and comfort range

7.4.2 Effective Daylighting / Natural Lighting

Daylighting is the architectural and services design to allow maximum daylight penetration into a building whilst minimizing heat gain and thereby reducing indoor lighting loads.

The level of natural light in the building is primarily determined by the extent and type of glazing, and the depth of the building floor plate. Extent of glazing must be optimised to allow maximum daylight, views, and winter sun, while minimising uncomfortable glare and excessive solar heat gains in summer. Glazing should be selected with a high Visual Light Transmission to maximise daylight penetration.

Daylighting strategies will be considered to allow effective control of indoor lighting levels whilst minimising power consumption for the building. High level of architectural input regarding design, orientation and external shading will be considered to effectively maximise natural lighting for the building.

Daylighting strategies combined with dimmable lighting systems will allow high control of indoor lighting levels whilst minimising power consumption for the building.

7.4.3 Volatile Organic Compounds (VOC) & Formaldehyde Minimisation

To ensure long term comfort of occupants, all due care will be taken to minimise VOC and formaldehydes used within the building. Maintaining VOC limits below the recommended levels will assist in reducing any potential detrimental impacts on occupant health arising from products which may emit volatile pollutants.

VOCs are commonly found in carpets, paints, adhesives, and sealants uses in construction and extensive exposure to VOC's can cause Sick Building Syndrome effects (eye, nose and skin irritation, headaches lethargy etc.).

Formaldehydes are found within composite wood products and extensive exposure can cause irritation to eyes, nose, and throat, lead to skin ailments and respiratory system ailments such as asthma.

Where possible, contamination of indoor air by common indoor pollutants will be minimised in this development by careful material selection, including:

- Use of low-VOC and water-based paints rather than oil-based paints, stains, or sealants, reducing indoor air contamination and consequent side-effects including sick-building syndrome and respiratory problems.
- Selection of low-VOC carpets and adhesives.
- Selection of low formaldehyde composite wood products, avoiding the carcinogenic effects of formaldehyde off-gassing.

7.5 Energy Conservation Initiatives

It is essential to ensure the building is designed and built to minimise energy consumption and reduce or eliminate greenhouse gas emission to the atmosphere. Energy performance is considered by the design team as a crucial issue.

The energy conservation initiatives aim to reduce the overall energy consumption for the project directly contributing to greenhouse gas emissions and energy production capacity.

Greenhouse reductions are achieved in a staged approach:

- Reduction in overall energy consumption through demand reduction and energy efficiency.
- Reduction in electricity and gas utility consumption by utilising waste products and renewable energy technologies.

Several strategies will be assessed and put in place to minimise energy consumption.

The integrated energy strategies being considered for the development include items which are listed in Table 3 below:

Table 3. The integrated energy strategies.

Load Reduction (Minimising the need for energy consumption)	Passive Design
	Building fabric improvements
	Maximise use of natural lighting
	Maximise use of natural ventilation
Optimising energy consumption	High efficiency Heating, Ventilation and Air Conditioning
	High efficiency LED lighting with occupancy controls
	High efficiency hot water systems
	High efficiency appliances
	Commissioning and tuning of building services post completion
	High efficiency building control, automation and BMS
Use of renewable resources (renewable energy and rainwater harvesting)	Application of Solar Energy & Heat Pump technology

7.5.1 Passive Design

The development will utilise passive design to minimise the amount of air-conditioning required and therefore significantly reduce the building's energy consumption and greenhouse performance. A building's form, fabric and orientation will have the biggest influence on its thermal comfort and environmental performance. The following factors will be considered in the detailed stages of the design:

- Orientation.

- Shading.
- Structure.
- Insulation.
- Glazing.

Climate data for the Concept Development Area

The following indicative site information data can be used to inform the design team (Figure 9).

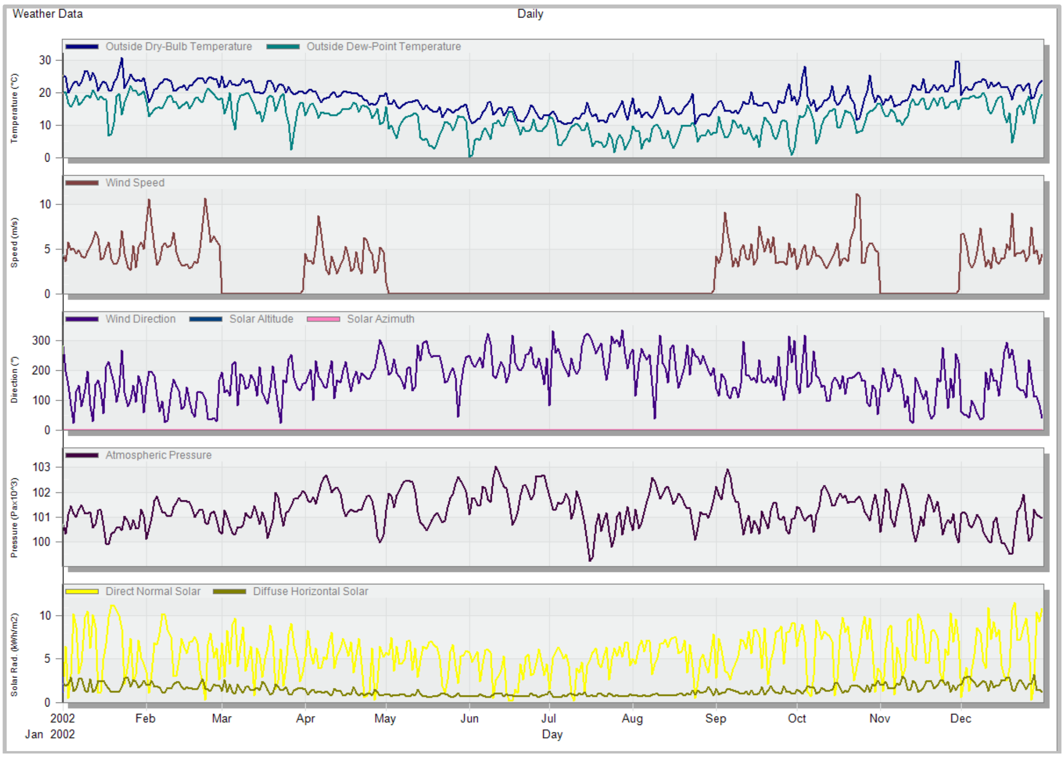


Figure 9. Climate data for the Concept Development Area.

Wind data based on the nearest weather station

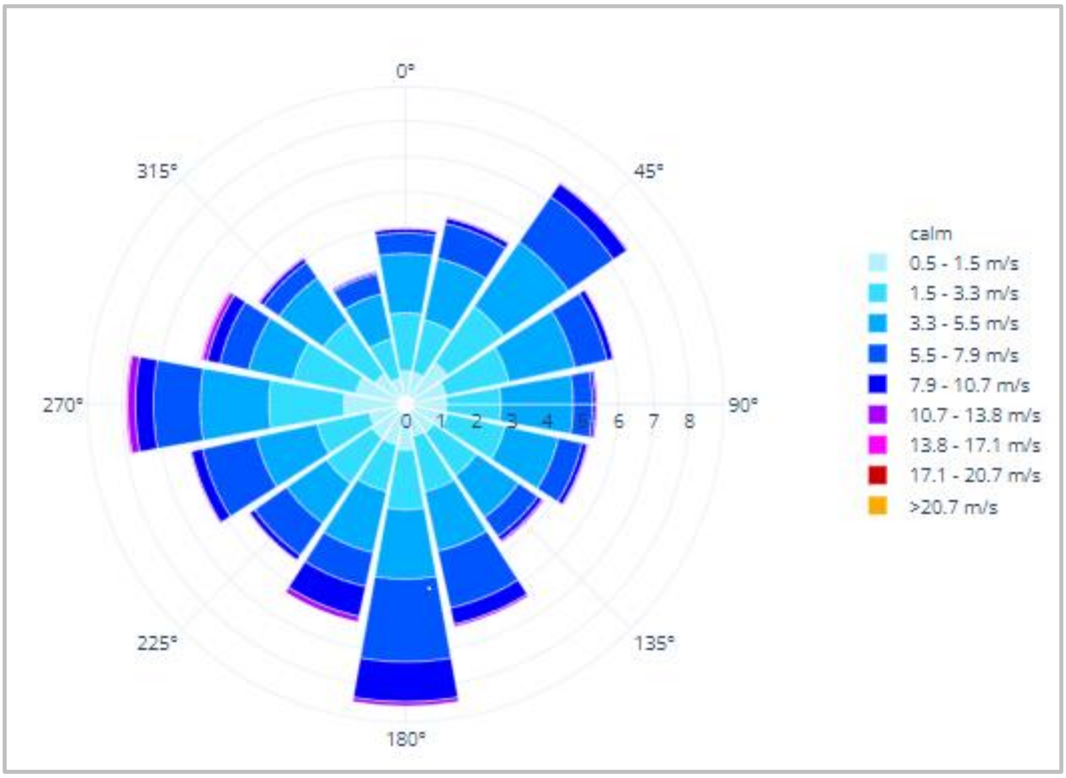


Figure 10. Wind data based on the nearest weather station

Sun path and temperature chart for the Concept Development Area

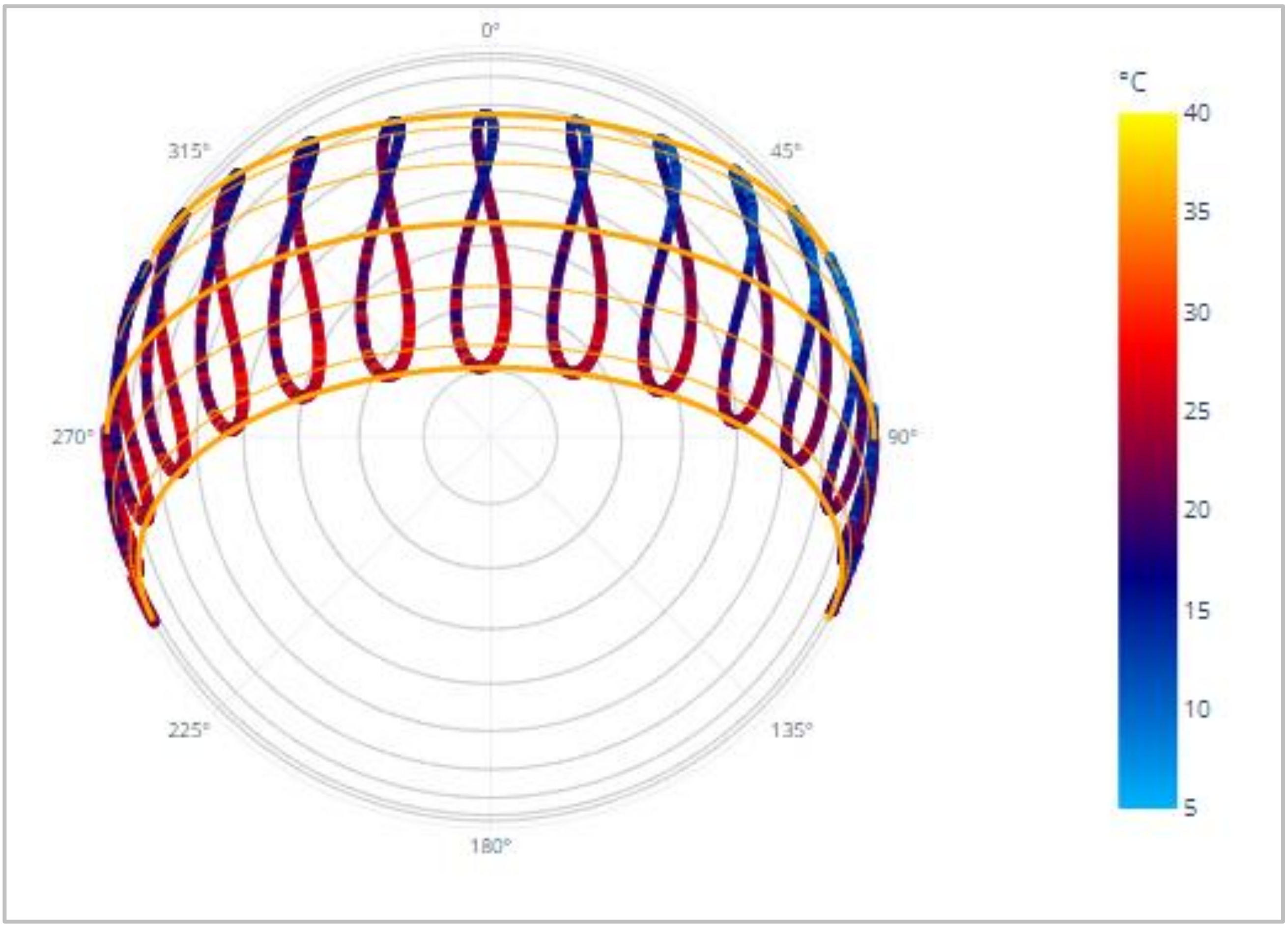


Figure 11. Sun path and temperature chart for the site.

7.5.2 Building Envelope

The building envelope will be designed to reduce heating and cooling requirements through passive design principles. The role of the building envelope is to block solar gains from penetrating the building fabric in summer while optimising daylight and minimising glare. The glazing performance and shading configuration for each orientation will be optimised to ensure that thermal comfort is achieved, and solar gains are adequate for the efficient operation of the mechanical system.

7.5.2.1 Insulation

The building envelope will be treated with the required levels of thermal insulation to reduce heat gains in hot days and to minimise heat losses in cold days through conduction. This will have significant impact on reducing energy consumption.

Insulation reduces the heat transfer between the internal and external conditions. Adequate insulation will be allowed for the ceilings, floors, and walls to reduce the heating and cooling load of the building and to reduce the ongoing operational costs. This has a twofold saving through a smaller mechanical system capacity along with operating energy consumption reduction.

All insulations installed are required to meet NCC and AS/NZ 4859.1 and the builder is required to ensure compliance, during construction.

7.5.2.2 Glazing and Window Framing

Adequate performance glass will be provided to reduce excessive heat gains in hot conditions, reducing the frequency of air conditioning use.

The following glazing parameters will be considered:

- U-Value: a measure of how much heat is passed through the glass.
- Solar Heat Gain Coefficient (SHGC)
- Visible Light Transmission (VLT): the percentage of visible light transmitted by the glass.

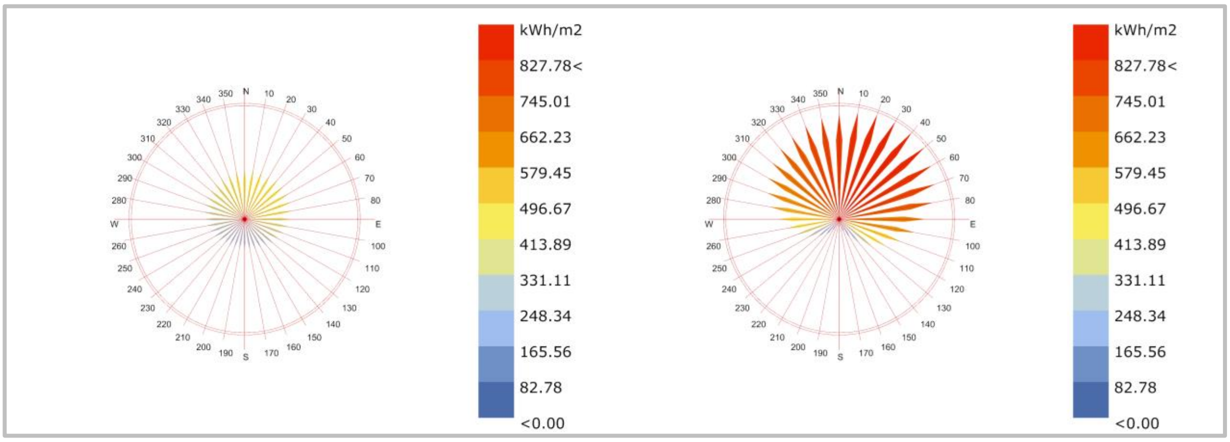
Where possible, the glazing will have a low SHGC to avoid heat gains in the summer, and a low U-value to reduce losses in the winter through the glass. The performance of the proposed glazing systems (glass and frame) is required to comply with NFRC100-2001 conditions and using the tested AFRC values.

Consideration will be given to incorporating effective shading features into the design to avoid the necessity for low shading coefficients in the glass, which usually also decrease the visible light transmission (VLT) of the glass. To maximise the natural daylight within the building, VLT should be as high as possible.

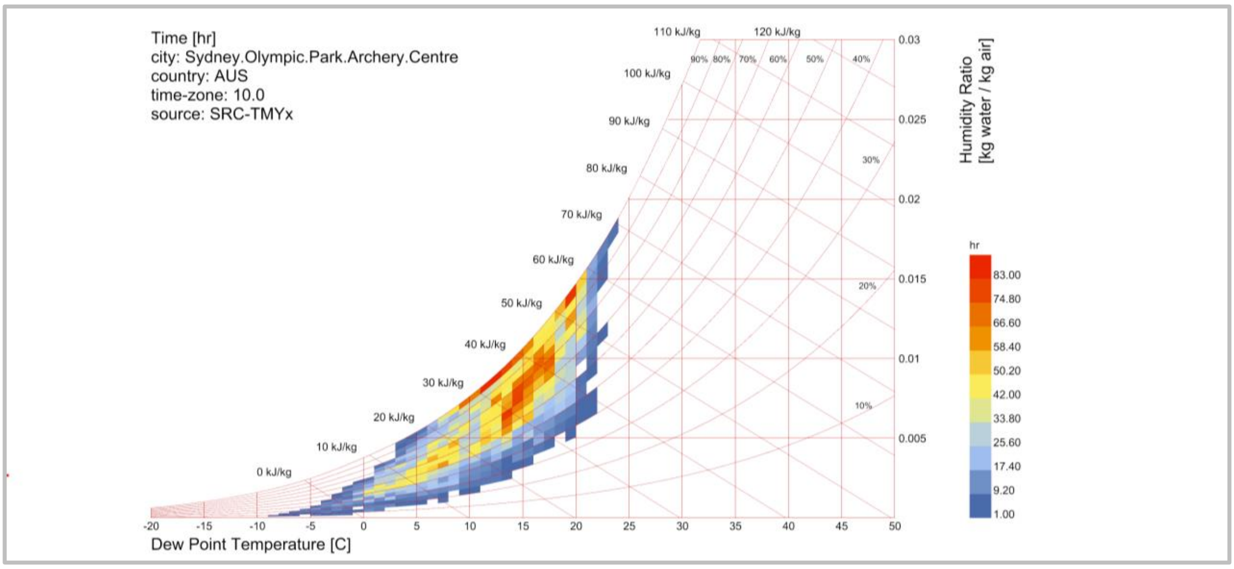
Glazing properties will be specified in conjunction with the shading arrangement on each orientation to control solar loads imposed on the mechanical systems, ensuring thermal comfort, optimising daylight penetration, and preventing glare. This strategy will effectively minimise direct solar loads whilst maximising daylight penetration and access to views.

To reduce heat losses in cold days, especially at night, the use of blinds will limit the contact between the internal air and the glass, therefore reducing heat losses by conduction.

Solar Radiation Rose



Psychrometric Chart



7.5.3 Energy Efficient Systems and Services

The mechanical and electrical design for the buildings will be developed to minimise the need for plant equipment and will be designed to be responsive to the immediate climatic conditions. Energy consumption will be reduced through the efficient design of lighting, air-conditioning, hot water, and ventilation systems. The following energy efficiency initiatives will be further investigated and where feasible incorporated in the building services design.

7.5.3.1. Efficient Artificial Lighting

Lighting efficiency is important in maintaining low energy consumption for reuse projects. Lighting consumption for a facility such as this could account between 15-25% of the estimated energy use of the facility.

High efficiency lighting and effective control initiatives such as daylight and movement sensors will be considered to reduce artificial lighting energy consumption and allow maximum advantage to be taken of natural lighting.

Lighting power density is required to meet AS1680 and NCC requirements. Energy efficiency for the internal lighting throughout the building is required to be in accordance with NCC energy efficiency requirements and the following.

- High quality LED lighting.
- Lighting control system based on smart zoning, occupancy profiles and operational hours, dimming controls and timers.

Photoelectric (PE) / Photodiode sensors or similar controls to detect when external lighting should switch on and off to reduce the energy consumption associated with external lighting where possible.

No external lighting is to be installed such that any direct light beam results into the night sky either generated from within the concept development area. The path of any direct light's angle of incidence that is directed to the sky must be obstructed by a non-transparent surface and the lighting design and is to comply with AS4282 'Control of the Obtrusive Effects of Outdoor Lighting.

7.5.3.2. Efficient Heating, Ventilation & Air-Conditioning (HVAC)

Heating and cooling of the building accounts for a large portion of the building's energy use throughout the year. Selection of highly efficient HVAC equipment with high performance levels not only minimises energy consumption, but also reduces operational energy costs.

The design of the mechanical services will be to industry Best Practise Standards. An emphasis will be placed on providing low energy Heating Ventilation Air Conditioning (HVAC) systems and strategies. To ensure the energy efficient performance of HVAC systems specified and installed mechanical plant will be of high quality and supplied by leading industry manufacturers.

The energy efficiency of HVAC system is required to meet the minimum requirements of the National Construction Code (NCC), Green Star provisions where feasible and relevant Australian Standards including but not limited to AS1668.1, AS1668.2, AS 1682 and AS3666.

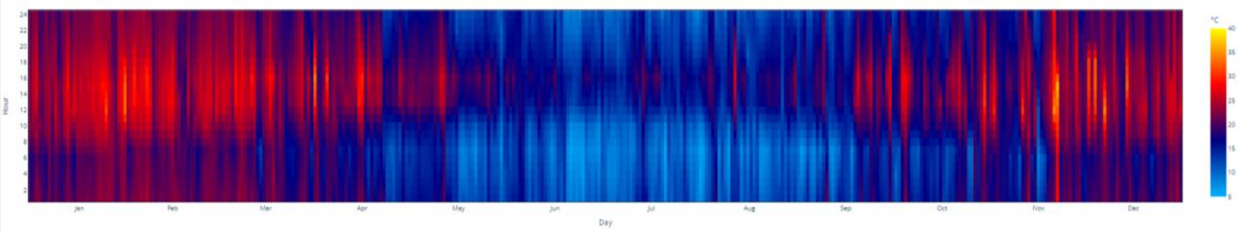
The following energy initiatives will be further considered in the detailed design phase:

- The air conditioning strategy is optimized to reduce energy consumption and maximize efficiency. For example, by moderating the amount of fresh air relative to the number of people in the space, through the use of CO2 detectors. The system will be zoned to increase the flexibility in the use of different spaces and reduce overall consumption.
- Variable speed drives will be provided to fans and pumps where feasible.
- Full outside air cycle will be provided to all air handling systems.
- Building commissioning and building tuning to be undertaken to ensure that the building systems function as required to achieve energy efficiency design targets.
- All refrigerant plant will be specified such that the refrigerant type has Zero Ozone Depletion Potential (ODP).

Common area ventilation systems are to include variable speed modes where appropriate and are to be linked to light switches where feasible to limit the extent of operation and improve energy efficiency of these areas.

The Mechanical services will be designed to satisfy the minimum Green Star and NABERS requirements.

Heatmap Chart based on the data from the nearest weather station is depicted in Figure 12 below:

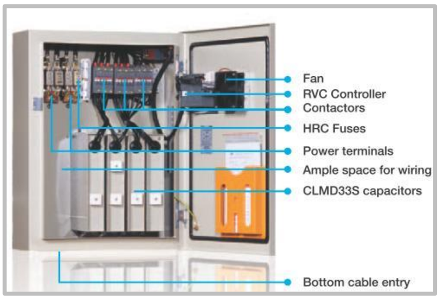


Descriptive statistics

month	mean (°C)	std (°C)	min (°C)	1% (°C)	25% (°C)	50% (°C)	75% (°C)	99% (°C)	max (°C)
Jan	22.78	2.55	16.4	18.03	21	22.6	24.4	30.16	33.5
Feb	22.67	2.48	16.9	18.04	20.78	22.4	24.32	29	30.2
Mar	21.45	2.86	12.9	15.2	19.6	21.2	23.3	28.11	29
Apr	19.16	3.66	10.7	11.7	16.8	19.3	21.2	29.7	33.4
May	15.86	3.64	7.4	8.4	13.2	15.6	18.6	24.51	26.7
Jun	13.14	3.07	6	6.72	11	13.3	15.6	19.38	20.5
Jul	12.8	2.82	6	7.67	10.5	12.5	14.9	20.06	21.3
Aug	13.71	3.28	6.2	6.9	11.7	13.4	15.9	22.67	27.3
Sep	15.83	3.84	6.6	8	13.4	15.4	18.3	25.68	27.2
Oct	17.9	3.69	9.7	10.6	15.3	17.55	20.2	27.76	30.6
Nov	19.8	4.06	8.3	10.58	17.4	19.6	22	31.48	36.5
Dec	21.26	3.04	14.4	15.6	19.1	20.8	22.8	31.66	34
Year	18	4.83	6	7.9	14.3	18.3	21.5	28.64	36.5

Figure 12. Heatmap Chart.

7.5.3.3. Power Factor Correction



To reduce maximum kVA demand on the electricity grid and lower the demand charges, power factor correction units will be provided at the main switch board(s) in accordance with the NSW Installation and Service Rules.

The power factor correction units proposed will improve the power to a factor of 0.98 or higher.

7.5.3.4. Monitoring & reporting

To enable effective monitoring and tracking of energy and water consumption, sub-metering will be considered for systems with major energy use, to help identify areas of inefficiency with potential for improvement.

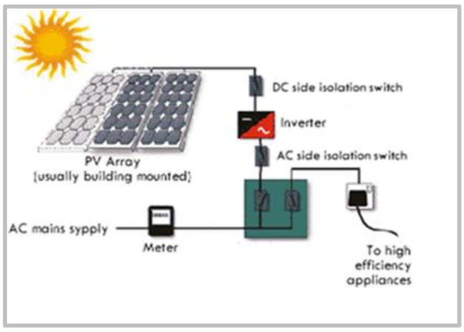
Metering is to be provided throughout the building and central services for all major building plant and equipment. An effective monitoring system is to be provided to monitor energy and water consumption throughout the building as required.

Ongoing reporting may allow the manager of the facility to set goals for energy consumption reductions and attributed energy costs to particular uses. By monitoring energy, losses and wastage can be identified, therefore improving the overall performance of the building in operation. This initiative is subject to further design development and review.

7.5.3.5. Hot Water Systems

High efficiency heat pump hot water systems will be used to provide the Hot Water demands for the buildings.

7.5.4 Renewable Energy – Solar Photovoltaic (PV) System



Photovoltaic (solar PV) is a common and widely accepted technology to generate electricity onsite. The generated electricity can be harnessed and used to power any number of devices. It is proposed that the PV panels are mounted on the roof where they will be out of sight and produce the optimum energy output.
PV modules have a very long lifetime with many manufacturers guaranteeing an output of at least 80% of manufactured capacity for 20 years. Another benefit of PV is that it can be installed in various system sizes and the modular design of the systems allows retrofitting of additional panels if required in the future.

There are generally three types of solar panels available: mono-crystalline (proposed for this development), poly-crystalline and amorphous. Each of these have their advantages and disadvantages and efficiencies range from 8% for amorphous to 22% for mono-crystalline

A 20 kW Solar PV system has been nominated for the development. The expected renewable energy generation by the overall 20 kW system is approx. 24.1 MWh per annum.

7.5.4.1 Solar PV - System Components

The Photovoltaic (PV) system may consist of the following main components or of equal capacity (Table 4).

Total nominal power: **20 kW**

Approx. roof space requirements: **125 m^2**

Table 4. Solar PV components information.

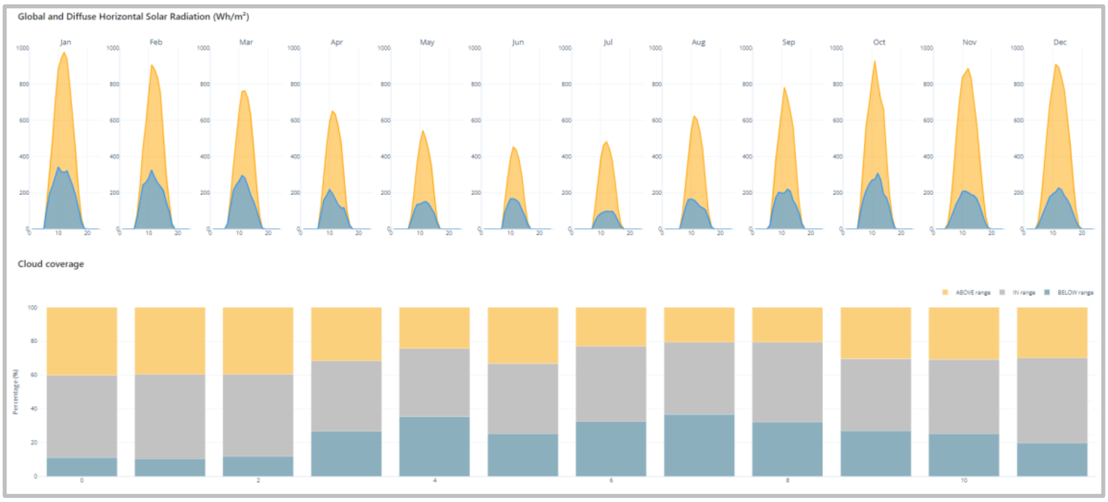
Components	**Brand, Model & Quantity**
Sample PV Inverter	Sungrow 20kW – SG20KTL - Quantity: 1
Sample PV Panels	Trina Vertex 600 W - TSM-DEG20C.20 Quantity: 34
Sample Battery storage (if required)	Tesla Powerpack or other similar systems
PV mounting frame and system balance	Quantity: depending on the requirements and final design

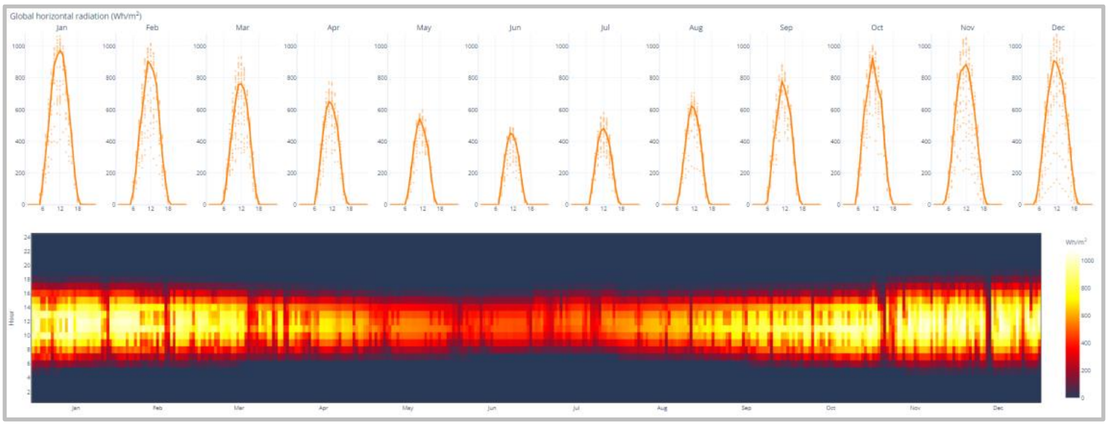
Table below summarises the estimated annual Renewable Energy generation for the proposed Solar PV (20 kW).

Annual energy generation based on full 7 days per week (With battery)	**24,121 kWh**
Annual energy generation based on 5 days per week.	**17,229 kWh**

The exact sizing, configuration and final design will be completed during the design stage. Please refer to Appendices A, B, C, D & E for technical data sheets of the proposed PV panels (Trina) and grid-connected inverter (Sungrow).

7.5.4.2 Solar Ration and Cloud Coverage for the site





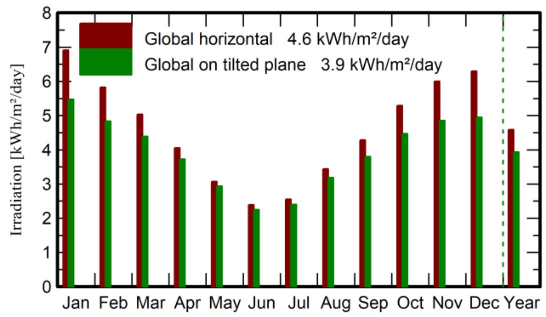
7.5.4.3 Solar PV - Projected energy generation based on 20 kW system

Grid system presizing

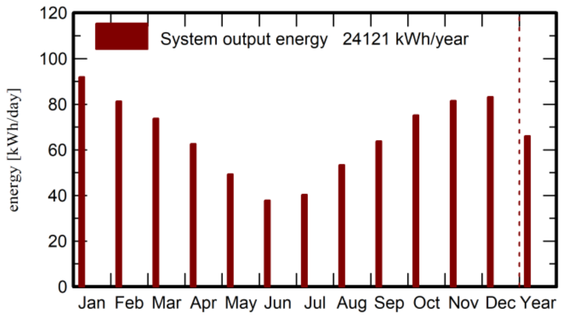
System summary

Nominal power	20.0 kWp	Total area	125 m²
Module type	Standard	Supports for modules	Flat roof
Technology	Monocrystalline cells	Ventilation property	Free air circulation
Annual yield	24.1 MWh		
Specific prod.	1206 kWh/kWp		

Meteo and incident energy



System output



	Horizontal global kWh/m²/day	Coll. plane kWh/m²/day	System output kWh/day	System output kWh
Jan.	6.91	5.47	91.95	2850
Feb.	5.83	4.84	81.27	2276
Mar.	5.03	4.38	73.69	2284
Apr.	4.05	3.72	62.57	1877
May	3.07	2.93	49.28	1528
June	2.39	2.25	37.76	1133
July	2.55	2.40	40.32	1250
Aug.	3.44	3.18	53.42	1656
Sep.	4.28	3.79	63.78	1913
Oct.	5.29	4.47	75.12	2329
Nov.	6.00	4.85	81.55	2446
Dec.	6.30	4.95	83.18	2579
Year	4.59	3.93	66.09	24121

7.6 Net Zero Statement

Achieving Net Zero emissions in healthcare facilities is critical to meeting the NSW government's ambitious targets of reducing greenhouse gas emissions by 70% by 2035 and achieving net zero by 2050. According to the Sustainable Buildings SEPP (SB SEPP) and Section 35C of the Environmental Planning and Assessment Act Regulation, large developments such as hospitals must submit a Net Zero Statement demonstrating how the building will either be fossil fuel-free upon occupation or transition to fossil fuel-free operation by 1 January 2035.

7.6.1 Limitations Due to Current Project Stage

At this early stage of the project, a full detailed energy assessment is not feasible. A comprehensive energy assessment requires detailed information on mechanical design, equipment specifications, building systems, and operational schedules. Without these critical data points, any full simulation or precise estimation would be premature and potentially misleading.

Therefore, this report presents a preliminary Net Zero pre-assessment based on typical energy consumption profiles for similar healthcare buildings, informed by industry benchmarks and best practice assumptions.

7.6.2 Net Zero Approach

Net Zero initiatives adopted for this development aim to minimise operational energy emissions through the elimination of fossil fuel use, enhancement of energy efficiency, and integration of renewable energy generation and storage systems. The key design strategies proposed for this development include:

- High-performance building envelope with enhanced insulation, shading, airtightness, and glazing.
- Electrification of heating, cooling, and hot water systems, prioritising heat pumps and electric technologies.
- Optimised HVAC and lighting systems with smart controls and sensors.
- Integration of onsite renewable energy generation such as rooftop photovoltaics (PV).
- Provision for future transition infrastructure to enable fossil fuel systems to be fully replaced by electric alternatives by 2035.

7.6.3 Preliminary Energy Consumption Breakdown

Based on reference data for hospital buildings, the estimated energy consumption breakdown (expressed as a percentage of total energy use) is shown in Figure 11 below.

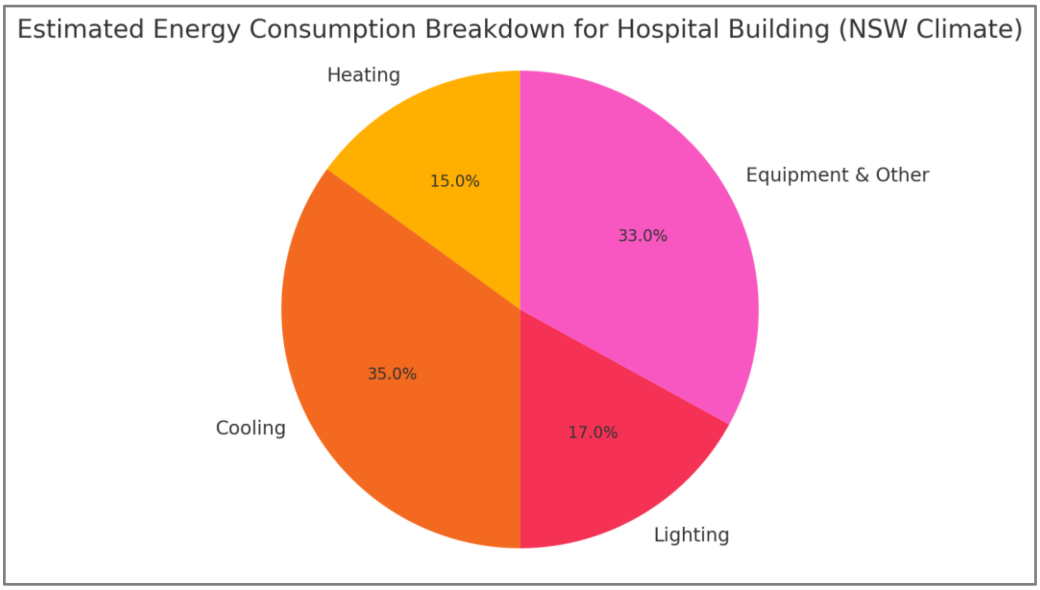


Figure 13. Estimated Energy Breakdown for Hospital Building.

7.6.4 Emission Considerations and Compliance

While precise emissions estimates require detailed energy modelling, this preliminary assessment confirms that the project will be designed to meet the fossil fuel-free or transition requirements mandated by NSW regulations. Infrastructure and space allowances for electrification will be integrated into the design to ensure compliance with the Net Zero Statement requirements.

The completed NABERS Embodied Emissions Materials Form is included as Appendix D of this report for reference and submission with the development application.

7.7 NABERS Embodied Emissions

Embodied emissions refer to the greenhouse gas emissions generated throughout the lifecycle of building materials—from extraction, manufacturing, transportation, construction, through to end-of-life disposal. These emissions represent a significant portion of a building's total environmental impact and must be addressed alongside operational emissions to achieve true sustainability.

In compliance with Section 35BA of the Environmental Planning and Assessment Act Regulation, the project is required to provide a NABERS Embodied Emissions Materials Form.

This form discloses the number of embodied emissions attributable to the development and supports transparency and accountability in reducing the building's carbon footprint.

7.7.1 Methodology and Data

The embodied emissions assessment is based on detailed quantification of materials used across the building's structure, envelope, internal walls, services, and external works. Quantities are reported primarily in metric units (such as cubic metres, kilograms, and square metres), supported by cost data where applicable, and exclude labour and equipment.

Due to the early project stage, some quantities have been estimated based on previous projects and best available data. The form captures at least 80% of the total material costs for the main contractor scope, consistent with NSW Government guidelines.

7.7.2 Integration with Project Sustainability

This embodied emissions disclosure complements the operational Net Zero commitments of the project by addressing the lifecycle emissions associated with building materials. The project team is committed to reducing embodied carbon through material selection, use of recycled content, and exploring low-carbon alternatives wherever feasible.

7.8 Transport sustainability measures

The use of transport (both private and commercial) is a major contributor to environmental pollution and the excessive consumption of natural resources. The following sustainable transport principles are recommended.

- Improve amenity for active transport users (pedestrians and cyclists), with attention paid to the needs of specific user groups likely to have a greater reliance on active transport such as youths, office employees, and nearby community groups.
- Promote nearby cyclist facilities to enhance the uptake of cyclists to the Concept Development Area.
- Integrate transport initiatives into community engagement and communication strategies.

Given the location of the Concept Development Area, the occupants will be able to take advantage of local public transport networks and available facilities around the Concept Development Area such as retail shops.

The following measures are some of the initiatives recommended to reduce dependence on motorised vehicles, encouraging walking, cycling and the use of mass public transport.

- **Cyclist facilities:** provision of bicycle racks; where possible adequately sized and fully equipped secure cyclist facilities with change room and showers are to be provided to promote the use of cycling to work.
- **Public Transport:** The building is close to public transport with a number of bus routes served; building occupants are encouraged to use mass transport to travel to work.
- **Trip Reduction:** The development is located adjacent to several local amenities, reducing the need for trips.
- **Fuel efficient vehicles:** encouraging the use of more fuel-efficient vehicles by providing adequate parking spaces at prime parking spot solely dedicated for use by small cars, car-pool participants or other alternative fuel vehicles and EV charging points.

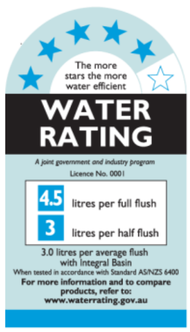
7.9 Water Conservation and Management Initiatives

The water conservation category aims to reduce the overall water potable consumption and provide effective mechanisms for recycling of water uses on site.

The approach to water efficiency for the development will focus on reducing water demand through conservation measures and water reuse systems. Water conservation strategies proposed for this project include:

- Reducing the potable water consumed within the development through demand management.
- Substituting mains water required to meet this demand by utilising alternative sources such as rainwater.

7.9.1 Demand Management



Strategies to minimise consumption include water-efficient fittings and fixtures, water-efficient appliances and low-water use air-conditioning and irrigation systems. In order to reduce the overall water consumption for this development, the following initiatives will be considered.

All water fixtures to be installed to the building are to be water efficient and where possible outperform the minimum requirements. The following criteria are provided as a guide and subject to further design development (Table 5).

Table 5. Surplus design criteria.

Water Fixtures	Hand wash basins – 5 Star WELS;
	Kitchen taps (where provided) – 5 Star WELS
	Showerheads (where provided) – 4 Star WELS or higher
	Toilets – 4 Star WELS or higher
Appliances	Dishwashers (where provided) – 5 Star WELS or higher
Air Conditioning	Minimise use of water-cooled systems
Landscape Irrigation (where applicable)	Native and water efficient species
	Sub-surface irrigation
	Rainwater usage for landscape

7.9.2 Landscape Selection

The use of native, drought-resistant planting will be considered to reduce water consumption used in irrigation. Sub-soil irrigation systems should be considered where non-native species are selected.

The landscape design shall enhance Biodiversity in terms of Landscape Area and Diversity of Species

7.9.3 Rainwater collection and recycling

In order to reduce the impacts of stormwater runoff from the site, the following stormwater management strategies will be considered:

- Rainwater captures from rooftops for reuse in building reducing stormwater runoff as well as mains potable water use.
- The use of permeable surfaces to be considered where suitable, allowing stormwater to seep directly into the earth and reducing stormwater flows off-site.

Collecting rainwater from roof runoff is a common way to recycle water. In addition to saving potable water, it allows preparation for times of low rainfall, so landscapes will be maintained throughout the year. It also reduces loads on storm water systems because roof runoff is not flushed into the drains. Rainwater will be collected from roof runoff and piped to storage tanks and will be used on site.

Ultra-violet (UV) treatment is the disinfection process of passing water by a special light source. Immersed in the water in a protective transparent sleeve, the special light source emits UV waves that can inactivate harmful microorganisms. This method of treatment is growing in popularity because it does not require the addition of chemicals.
Harvested water will be considered to supplement non-potable water uses such as common area landscape irrigation.

This strategy will assist to significantly reduce the potable water consumption for the facility.

7.9.4 Water consumption monitoring and reporting

Where practical, it is recommended that all major water uses within the building to be provided with water meters. This includes central services, rainwater tanks, irrigation systems, potable water, non-potable water sources.

Water monitoring will assist to identify abnormal usage patterns usually associated with leaks, helping to reduce the considerable water lost in this way. In addition, it would also allow to measure and verify the impact of any water efficiency measures implemented in the facilities.

7.10 Materials

This category aims to reduce the consumption of natural resources and encourage the reuse of materials. The various environmental and human health impacts arising from building materials are reduced when special attention is given to the selection of ecologically preferable materials.
To minimise the environmental impact of the development, preference will be given to environmentally responsible materials during the selection process, according to the following principles:

- Avoidance of ecologically sensitive products (such as scarce minerals and old-growth forest).
- Selection of materials with a low embodied energy and high recycled content.
- Low toxicity material selection.
- Low impact on the indoor environment.
- Durability, flexibility, and recyclability.
- Emissions in manufacture and composition, including greenhouse gases and ozone depleting substances.
- Waste reduction.
- Provisions for appropriate recycling storage space that facilitates recycling.

The targeted initiatives will reduce embodied energy and environmental impacts caused by the whole life cycle of building materials.

7.10.1 Reuse and Conservation of materials

Where possible reuse the building material to conserve embodied energy and water. By conserving the building fabric or structure the waste volumes are significantly reduced for the development.

7.10.2 New Materials

Material specifications for the project will consider elements of sustainability that relate to the following factors of durability, embodied energies, renewable sources content, ease of manufacturing, ability to be recycled / reused / reconditioned, maintenance, local availability, VOC content, emission production, affordability, and toxicity.
Where feasible the materials specified for this project are to consider the above environmental measures through a comparison between different product types and manufacturers where possible. The design team is to adopt this approach in assessing suppliers and products for the development.

Interiors finishes will consider the concentration of Volatile Organic Compounds with products for adhesives, paints, carpets, and floor sealants. The design team will work with suppliers and contractors to identify opportunities to reduce the level of VOC’s within products and finishes.

7.10.3 Materials with Ozone Depletion Potential

Selection of insulation will be targeted to minimise Ozone Depletion Potential (ODP).

7.10.4 Operational Waste Minimisation

To encourage and facilitate effective waste management once the facility is in operation, sufficient spatial provision will be made to allow for the effective separation of waste from recycling. Dedicated waste recycling rooms allow space for the separation and storage of recyclable waste during the building’s operation, allowing for the following waste streams to be separated:

- Glass.
- Cardboard.
- Paper.
- Organics.
- Plastics.
- Metals.

Waste management solutions are varied and dependant on the extent of commitment of the end user. Recycling, reuse, and composting are examples of waste management options.
The following waste streams have currently been identified:

- Office waste.
- Paper and cardboard.
- Plastics.
- PET bottles and containers, cans, and glass.
- Compostable material.
- Grease and fats.
- Cigarette butts.
- Light tubes.
- Toxic or hazardous materials.
- Foam.
- Cleaning products and other substances going down drains.
- Composting of organic waste from the restaurant, for re-use within the Greenhouse.

7.10.5 Timber

Where possible, timber will be supplied from sustainable sources including Forestry Stewardship Council (FCS) certified plantation timbers and recycled products. No timber (either solid or veneer form) will be sourced from rainforests or old-growth forests.

7.10.6 PVC Minimisation

PVC is being phased out in the European Union, as there is widespread evidence to its harmful environmental impact, particularly during disposal or fire. PVC is used in almost all electrical and data cabling and for drainage pipework. Alternatives to PVC products will be used where feasible:

- HDPE and polypropylene pipe work instead of PVC pipe for water supply and drainage systems.
- Linoleum and other natural products instead of vinyl floor coverings.
- Composite materials for electrical cabling.

7.11 Land Use and Ecology

This initiative refers to improvements through Reuse of Land or Change of Ecological Value. The Concept Development Area has been previously built on, and is not a Greenfield. The new development will aim to enhance permeable area and vegetation improving the ecological value of the site.

7.12 Emissions

In addition to the reduction in greenhouse emissions as a result of lower on-site energy usage, emissions to land, air and water will be minimised. The following measures are some of the initiatives targeted within the emissions category:

- Where available, thermal insulation products should be selected which have a low Ozone Depletion Potential in their manufacture and composition, reducing the impacts of insulation on the atmosphere.
- Where feasible, refrigerants will have an Ozone Depletion Potential of zero; and integrated refrigerant leak detection will ensure early identification of leaks.
- Estimated wastewater discharge to sewer will be significantly reduced relative to a standard building through the implementation of water efficiency measures.
- Watercourse Pollution: Design that minimises stormwater run-off to and the pollution of the natural watercourses.

- Light Pollution: No light beam will be directed upwards or outside the building. External lighting will be in accordance with AS 4282-1997. This will assist to minimise interference and disturbance to neighbouring properties and wildlife.

8. Climate Change Adaptation

8.1 NARCliM Climate Change Projections

The information provided in this section of the report follows the climate change projections based on the NSW and ACT Regional Climate Modelling (NARCliM) project. NARCliM is a multi-agency research partnership between the NSW and ACT governments and the Climate Change Research Centre at the University of NSW. NSW Government funding comes from the Office of Environment and Heritage (OEH), Sydney Catchment Authority, Sydney Water, Hunter Water, NSW Office of Water, Transport for NSW, and the Department of Primary Industries.

Climate change projections are presented for the near future (2030) and far future (2070), compared to the baseline climate (1990–2009). The projections are based on simulations from a suite of twelve climate models run to provide detailed future climate information for NSW and the ACT.

The climate change projections are made for the following 5 parameters:

1. Temperature extremes.
2. Hot days.
3. Cold nights.
4. Rainfall.
5. Fire weather.

Reference: https://climatechange.environment.nsw.gov.au/
NSW Office of Environment and Heritage (OEH)

8.1.1 Temperature

Camperdown NSW is expected to experience an increase in all temperature variables (average, maximum and minimum) for the near future and the far future

- Maximum temperatures are projected to increase by 0.7°C in the near future and up to 1.9°C in the far future. Spring will experience the greatest change in maximum temperatures, increasing by up to 2.2°C in the far future. Increased maximum temperatures are known to impact human health through heat stress and increasing the number of heatwave events.
- Minimum temperatures are projected to increase by 0.6°C in the near future up to 2°C in the far future. Increased overnight temperatures (minimum temperatures) can have a considerable effect on human health.

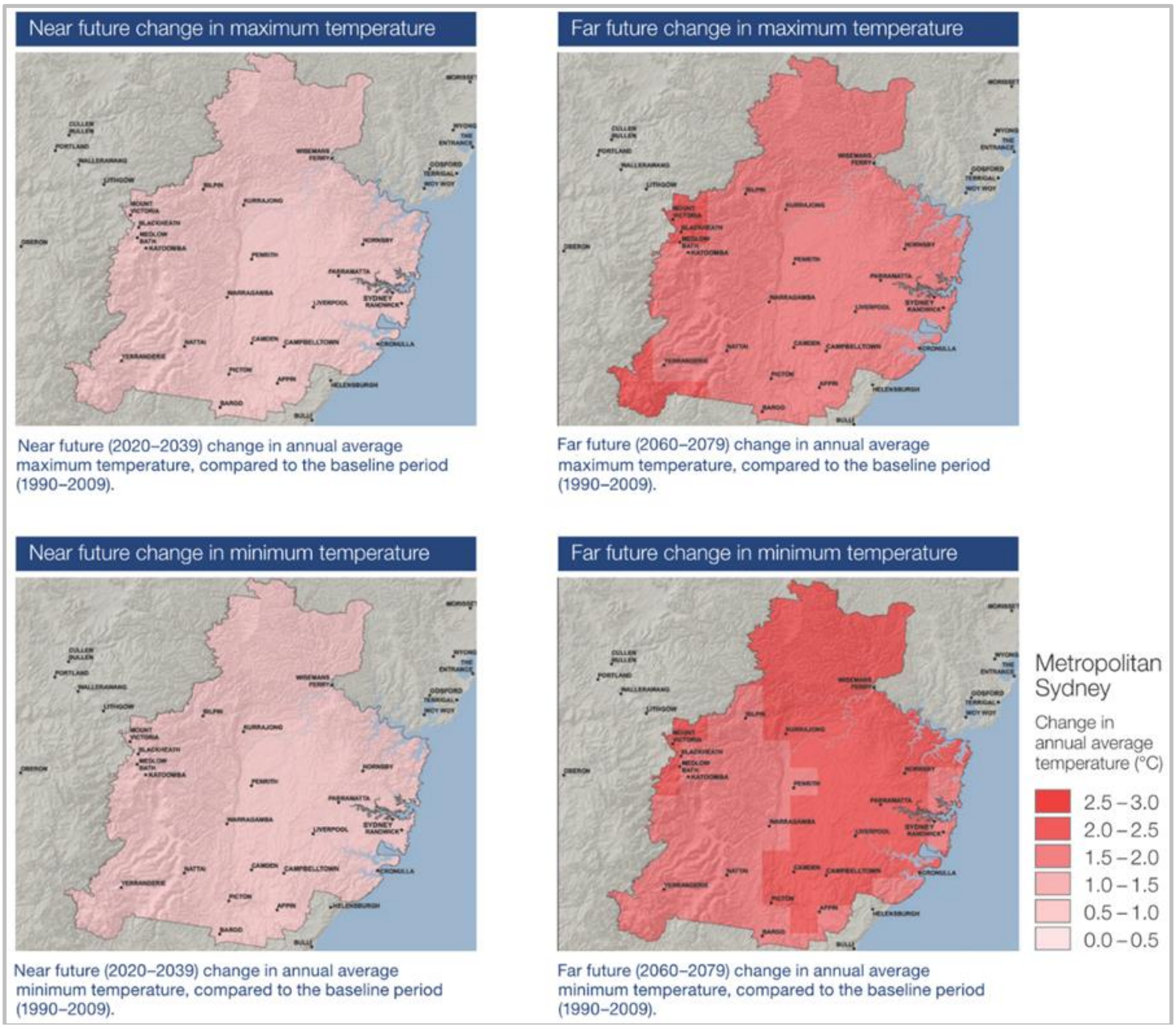


Figure 14. Annual average temperature – Sydney variation map.

8.1.2 Hot days (days per year above 35°C)

Currently Camperdown NSW experiences fewer than 10 days above 35°C each year due to its proximity to the coast. Seasonal changes are likely to have considerable impacts on bushfire danger, infrastructure development and native species diversity.

- The facility is expected to experience more hot days in the near future and in the far future.
- These increases in hot days are projected to occur mainly in spring and summer although in the far future hot days are also extending into autumn.

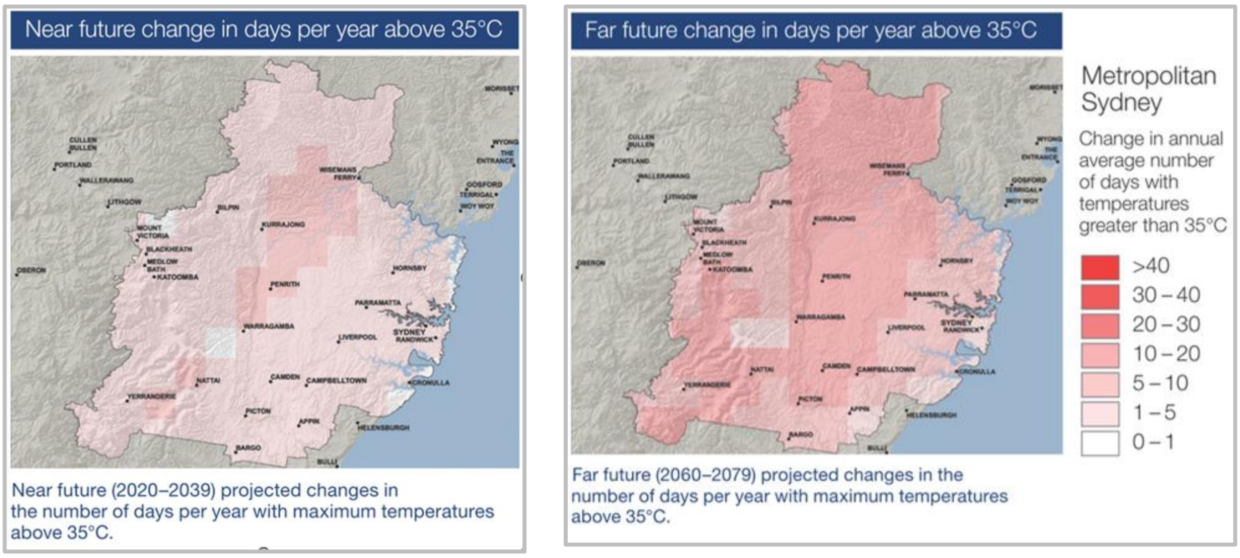


Figure 15. Change in annual average number of days with temperatures greater than 35°C – Sydney variation map.

8.1.3 Cold nights (days per year below 2°C)

Most of the emphasis on changes in temperatures from climate change has been on hot days and maximum temperatures, but changes in cold nights are equally important in the maintenance of our natural ecosystems and agricultural/horticultural industries. For example, some common temperate fruit species require sufficiently cold winters to produce flower buds.

- The greatest decreases are projected to occur in the south-west and in the Blue Mountains, with decreases of up to 20 nights by 2030 and more than 40 fewer cold nights by 2070.
- NARCliM projections suggest that Camperdown NSW will not see a considerable decrease in cold nights (see the white areas in the map).

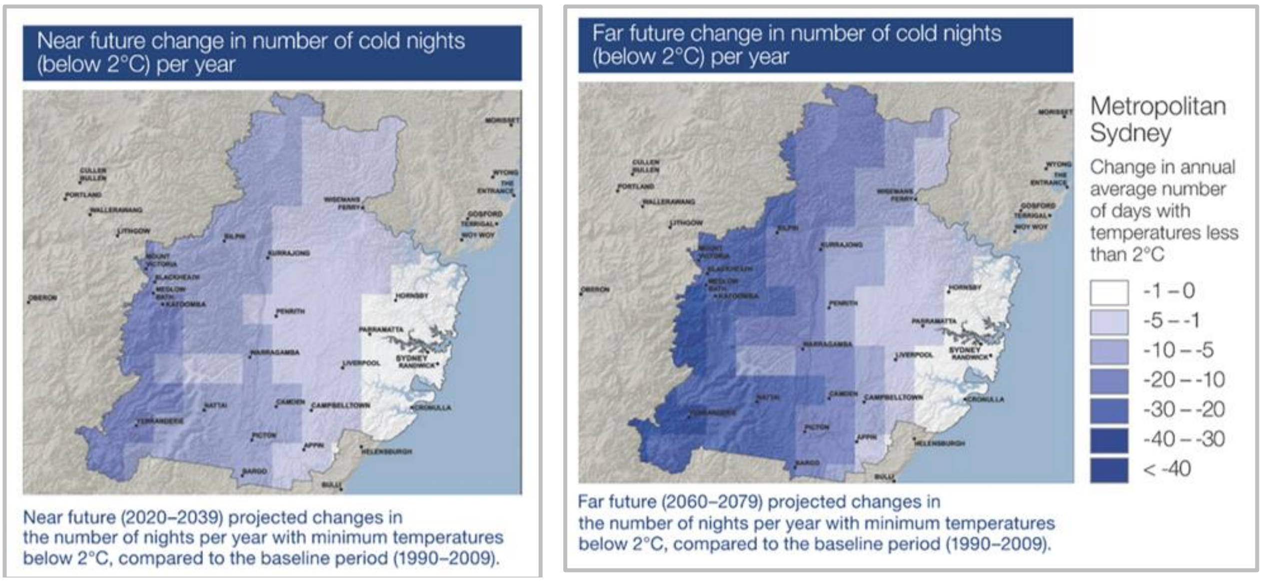
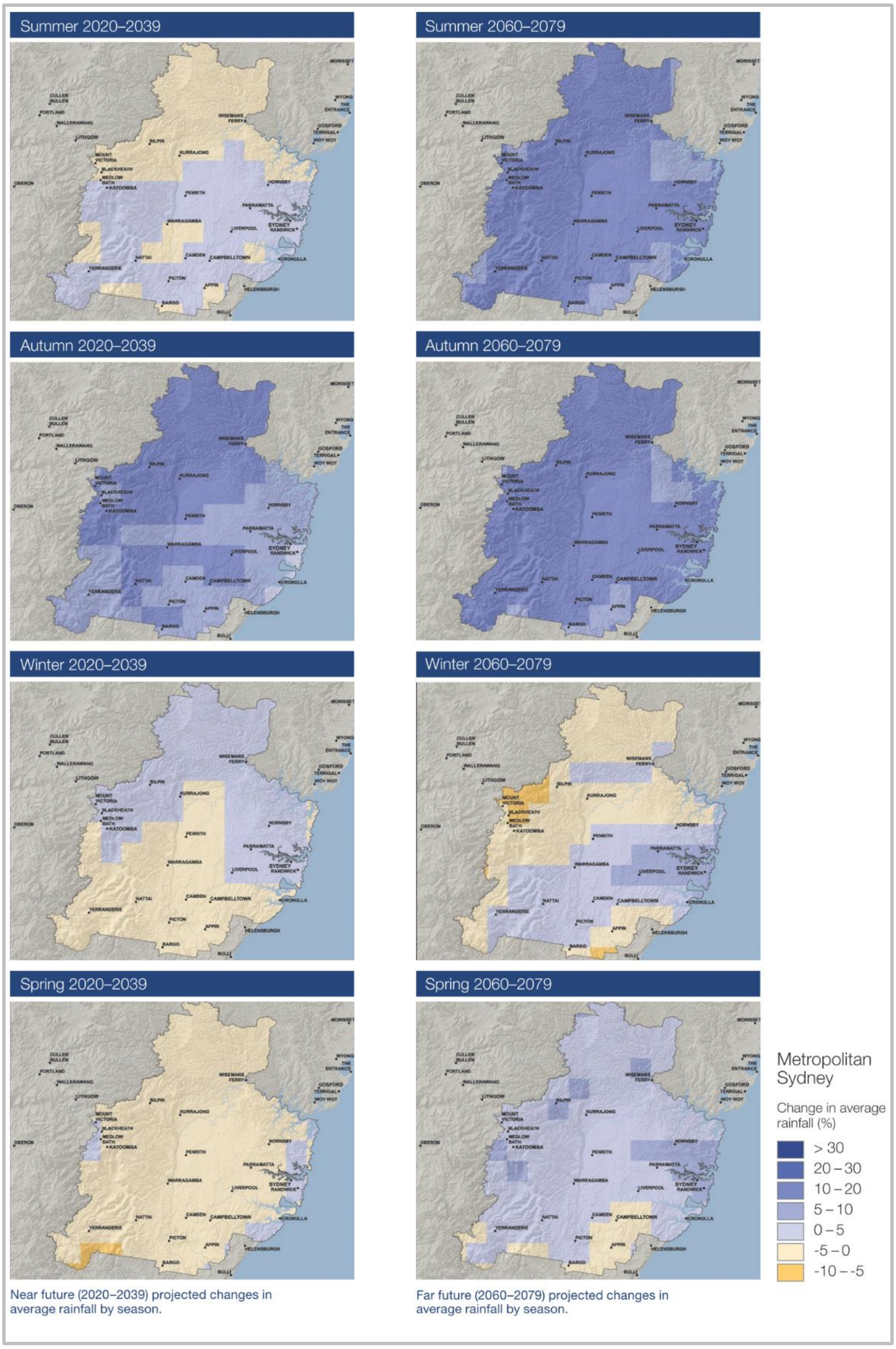


Figure 16. Change in annual average number of days with temperature less than 2°C – Sydney variation map.

8.1.4 Rainfall

Changes in rainfall patterns have the potential for widespread impacts. Seasonal shifts can often impact native species' reproductive cycles as well as impacting agricultural productivity, for example crops that are reliant on winter rains for peak growth. The majority of models (8 out of 12) agree that autumn rainfall will increase in the near future and the far future (7 out of 12). Rainfall is projected to increase in autumn.



Near future (2020–2039) projected changes in average rainfall by season.

Far future (2060–2079) projected changes in average rainfall by season.

Figure 17. Change in average rainfall (%) – Sydney variation map.

8.1.5 Fire weather

The Bureau of Meteorology issues Fire Weather Warnings when the FFDI (Forest Fire Danger Index) is forecast to be over 50. High FFDI values are also considered by the Rural Fire Service when declaring a Total Fire Ban.

Projected regional climate changes

- Metropolitan Sydney is expected to experience an increase in average and severe fire weather in the near future and the far future.
- The increases are projected mainly in summer and spring in the far future. These changes are projected in prescribed burning periods (spring) and the peak fire risk season (summer).
- The majority of models (7 out of 12) project an increase of severe fire weather in spring in the near future, with a greater confidence in the increase in the far future.

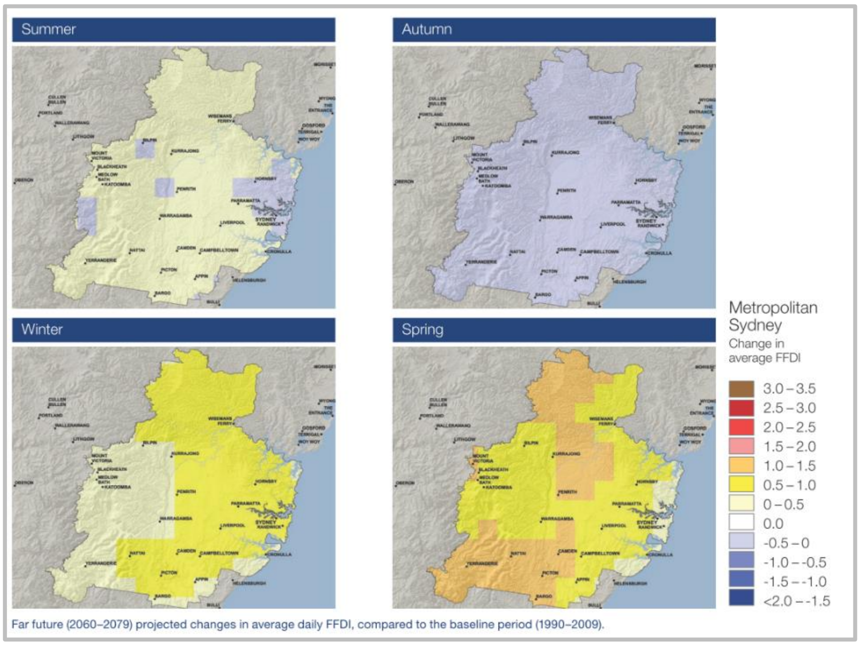


Figure 18. Change in average FFDI – Sydney variation map.

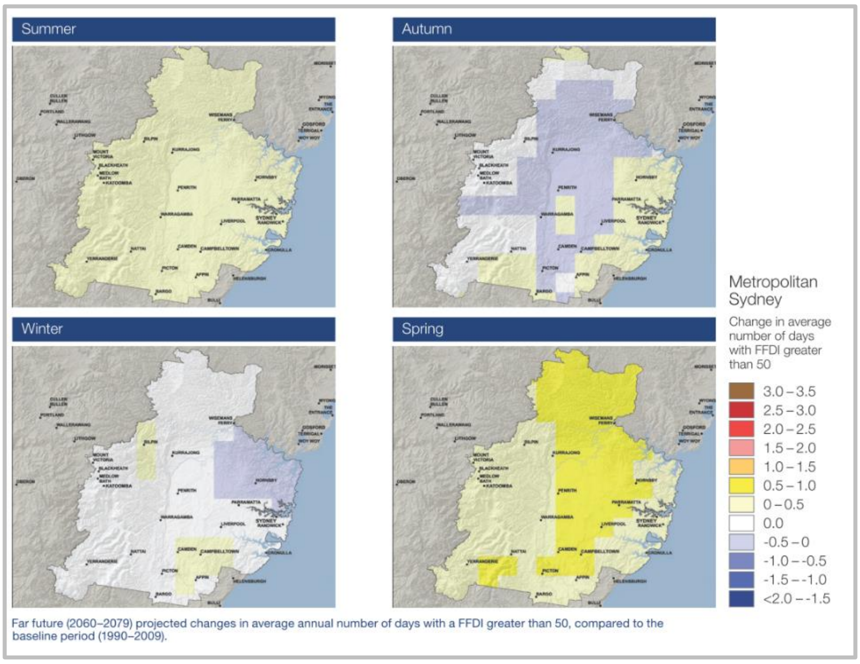


Figure 19. Change in average number of days with FFDI greater than 50 – Sydney variation map.

8.2 Climate Change Adaptation Plan

The climate change adaptation plan (CCAP) follows the ISO31000 Risk Management Process.

The plan involves three key steps to develop risks and mitigation strategies collaboratively with key project stakeholders.

1. Review of the development and context.

2. Risk analysis.
3. Mitigation Strategies.

8.2.1 Risk Assessment Framework

To assess risks systematically, a likelihood scale was used to determine how likely a risk was to occur, followed by consequence assessment. The first stage of the assessment is to define the likelihood of a given risk. The likelihood level can be described as the frequency or probability for a risk to occur.

Table 6. Risk likelihood matrix.

Likelihood	**Almost Certain** expected in most circumstances.
	Likely will probably occur in most circumstances.
	Possible might occur at some time.
	Unlikely could occur at some time.
	Rare may occur, only in exceptional circumstances.

Table 7. Example Consequence Scale and Success Criteria (AGO 2007).

	Public Safety	**Local Economy and Growth**	**Community and Lifestyle**	**Environment and Sustainability**	**Financial /Time Program/Budgets**
Catastrophic	Large numbers of serious injuries or loss of life	Precinct decline leading to widespread business failure	The area is considered very unattractive, moribund, and unable to support its community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Loss or increased cost of 50% or greater of annual budget.
Major	Isolated instances of serious injuries or loss of lives	Precinct stagnation such that businesses are unable to thrive	Severe and widespread decline in services and quality of life within the community	Severe loss of environmental amenity and a danger of continuing environmental damage	Loss or increased cost of 25%-50% of annual budget.
Moderate	Small numbers of injuries	Significant general reduction in precinct economic performanc e	General applicable decline in services	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Loss or increased cost of 10%-25% of annual budget
Minor	Serious near misses or minor injuries	Isolated areas in precinct decline	Isolated but noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Loss or increased cost of 5% to 10% of annual budget
Insignificant	Appearanc e of a threat but no actual harm	Minor shortfall to forecast growth	There would be minor areas in which the region was unable to maintain its current services	No environmental damage	Loss or increased cost of less than 5% of annual budget

Risk likelihood and consequence were then combined using the risk assessment matrix in Table below, leading to the systematic development of a risk rating used to prioritise risk management strategies.

Table 8. Example Risk matrix:

Show	**Matrix Score**				
Risk Rating Number + Name	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium	High	High	Critical	Critical
Likely	Medium	Medium	High	Critical	Critical
Possible	Low	Medium	Medium	High	Critical
Unlikely	Low	Low	Medium	Medium	High
Rare	Low	Low	Low	Medium	High

Risk management strategies listed in Table 9 aim to reduce risk levels by reducing either likelihood or consequence of the risk, or both. The objective is to develop cost-effective options for treating/controlling each identified risk and minimise its impact to the project.

Table 9.. Risk management.

Show	**Matrix Score**				
Risk Rating Number + Name	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium	High	High	Critical	Critical
Likely	Medium	Medium	High	Critical	Critical
Possible	Low	Medium	Medium	High	Critical
Unlikely	Low	Low	Medium	Medium	High
Rare	Low	Low	Low	Medium	High

8.2.2 Risk Assessment outcomes

Climate variable	Risk Statement	Likelihood	Consequence	Level of Risk	Adaptation actions	Residual Likelihood	Residual Consequence	Residual level of Risk
Increase in hot days	Accelerated structural material fatigue and degradation of facades leading to increased maintenance and repair costs	Rare	Catastrophic	High	Select materials which have a higher temperature tolerance if required. Review material datasheets for in-service temperature range and allow for increase in peak temperatures.	Rare	Moderate	Low
Increase in hot days	Brownouts/ Blackouts leading to failure of critical electrical equipment	Possible	Major	High	Ensure that existing plans to add to backup generation based on demand is followed through. Consider use of Solar Energy with Battery Energy Storage Systems (BESS).	Possible	Minor	Medium
Increased rainfall variability	Parapet roof retains water due to blockage in syphonic drainage system leading to structural failure.	Possible	Major	High	Check the design includes overflow outlets in parapet. Add to design if required.	Rare	Major	Medium
Increased rainfall variability	Parapet roof retains water due to insufficient capacity in the syphonic drainage system leading to structural failure.	Possible	Major	High	Overflow systems in place in the form of overflow slots. The capacity of these can be increased if required to allow for increased rainfall intensity.	Rare	Major	Medium

Climate variable	Risk Statement	Likelihood	Consequence	Level of Risk	Adaptation actions	Residual Likelihood	Residual Consequence	Residual level of Risk
Increased rainfall variability	Onsite Water Detention Tank (OSD) cannot deal with increased flows leading to overflow and flooding of adjacent areas.	Possible	Major	High	If necessary, overflow system to be provided. Hydraulic engineers to check if systems can manage the increased flows and implement further measures if required.	Rare	Major	Medium
Increased rainfall variability	Overland flow of water leads to pooling around the electrical infrastructure, causing electrical failure and power outage.	Possible	Catastrophic	Critical	Primary storm water drainage system to be designed to cater for a minimum of a 100-year storm. System to also have full backup of either piped overflow or overland flow designed to a higher storm intensity.	Rare	Major	Medium
Increased intensity of storm events	Mechanical plant on the roof (if any) are damaged by extreme hail event leading to failure of ventilation system.	Possible	Major	High	Consider options for protecting the mechanical plant in design. Implement if required.	Rare	Major	Medium

Climate variable	Risk Statement	Likelihood	Consequence	Level of Risk	Adaptation actions	Residual Likelihood	Residual Consequence	Residual level of Risk
Increased intensity of storm events	Severe hail blocking roof drains causing increased water ingress into building envelope and potential structural impacts, leading to increased maintenance costs	Possible	Major	High	Screen outlets with hail guards. Planned overflow slots should allow rain to overflow for all but the most severe hail events.	Rare	Major	Medium
Increased intensity of storm events	Airborne debris causing damage to exterior building elements and increased maintenance costs.	Possible	Major	High	Check wind load thresholds in engineering for façade and glazing. If required, adopt heat treated glazing for greater impact strength.	Rare	Major	Medium
Increased intensity of storm events	Wind driven rain penetrates the building, creating slip hazards for public circulation spaces	Likely	Moderate	High	Consider in design and highlight risk for building managers. Include wet weather management plan in facilities management contract.	Rare	Moderate	Low
Increased fire weather	Smoke ingress into facility via HVAC system causing increased health risks for the occupants.	Almost certain	Major	Critical	Evacuation plan to be developed by FM company, including use of link to nearby hospitals for particularly vulnerable occupants. Consider use of non-latching outside air smoke detectors to shut down outside air systems in the event of a bushfire situation.	Almost certain	Insignificant	Medium

8.2.3 Recommendations

Many of the potential risks to the building are already addressed by existing design features of the building or are being explored as an immediate consequence of this process. All those identified through the workshop and subsequent discussions as requiring additional action are set out in table below, along with responsibility for those actions.

This information should be added to the overall project risk register, with actions implemented and recorded, and subsequently reported in the Green Star documentation.

Summary of adaptation actions required to achieve revised risk rating is presented in Table 10:

Table 10. Adaptation Actions Required to Achieve Revised Risk Rating.

Risk Statement	Initial Risk	Residual Risk	Action requiring implementation	Design / Operations	Proposed Responsibility
Brownouts/Blackouts leading to failure of critical electrical equipment.	High	Medium	Where possible, Solar PV with Battery Energy Storage System (BESS).	Design and operations	Electrical Engineer
Accelerated structural material fatigue and degradation of façades, leading to increased maintenance and repair costs	High	Low	Review material datasheets for in-service temperature range and allow for a nominal tolerance on peak temperatures based on today's values. Select materials which have a higher temperature tolerance if required.	Design	Façades Engineer, Structural Engineer
Water restrictions during prolonged droughts leading to inability to deliver core services.	High	Low	Develop a Drought Management Plan. Water restrictions would likely be signposted well in advance. Consider alternative water supply.	Operations	Facilities Manager
Parapet roof retains water due to blockage in symphonic drainage system leading to structural failure.	High	Medium	Check the design includes overflow outlets in parapet. Add to design if required.	Design	Hydraulic Engineer
Parapet roof retains water due to insufficient capacity in the symphonic drainage	High	Medium	Check whether capacity of overflow slots and drainage system is sufficient to allow for increased rainfall intensity. Increase either/both if required.	Design	Hydraulic Engineer, Architect

system leading to structural failure.					
Onsite Water Detention Tank (OSD) cannot deal with increased flows leading to overflow and flooding.	High	Medium	Ensure secondary overflow system provided and check if systems can manage increased flows. Implement further measures if required.	Design	Civil Engineer
Overland flow of water leads to pooling around electrical infrastructure, causing electrical failure and power outage.	Critical	Medium	Primary storm water drainage system to be designed to cater for a minimum of a 100- year storm. System to also have full backup of either piped overflow or overland flow designed to a higher storm intensity. Consider other feasible mitigation measures as required.	Design	Hydraulic Engineer, Architect, Electrical Engineer
Mechanical plant on the roof (if any) are damaged by extreme hail event leading to failure of ventilation system.	High	Medium	Consider options for protecting the mechanical plant in design. Implement if required.	Design	Mechanical Engineer
Severe hail blocking roof drains causing increased water ingress into building envelope and potential structural impacts, leading to increased maintenance costs	High	Medium	Screen outlets with hail guards.	Design	Hydraulic Engineer
Airborne debris causing damage to exterior building elements and increased maintenance costs -	High	Medium	Check wind load thresholds in engineering for façade and glazing. Adopt heat treated glazing for greater impact strength if required.	Design	Façades Engineer, Structural Engineer

particularly discussed potential increase in wind loadings due to CC.					
Wind driven rain penetrates the building, creating slip hazards for public circulation spaces	High	Low	Consider in design and highlight risk for building managers. Include wet weather management plan in facilities management contract.	Design and operations	Architects and Facilities Manager
Smoke ingress into facility via HVAC system causing increased employee health risks	Critical	Medium	Evacuation plan to be developed by FM company, including use of link to nearby hospitals for particularly vulnerable occupants. Consider use of non-latching outside air smoke detectors to shut down outside air systems in the event of a bushfire situation.	Design and operations	Mechanical Engineer, Facilities Manager, Owner

9. Cumulative Impacts

This section assesses the potential cumulative impacts of the proposed hospital development (SSD-79888213) in the context of other existing and planned developments within the Camperdown Health, Education and Research Precinct, as per the NSW Government's *Cumulative Impact Assessment Guidelines*. While this ESD report is primarily concerned with the environmental performance and sustainability credentials of the hospital, ESD-related impacts may intersect with broader environmental, urban, and social considerations. Where relevant, this assessment considers the cumulative contribution of the proposal to impacts on solar access, wind, services infrastructure, traffic and transport, and environmental amenity.

9.1 Urban Context and Planned Precinct Growth

The Crows Nest precinct is undergoing a significant transformation under the NSW Government's broader strategic planning objectives, including the Crows Nest Metro Station, mixed-use development sites, and the St Leonards-Crows Nest 2036 Plan. The proposed hospital development is an integral part of this growth, contributing to essential health infrastructure and employment.

Increased density and mixed land uses may introduce cumulative environmental pressures. However, the proposed development's ESD strategy has been specifically designed to mitigate such pressures through resource efficiency, passive design, and reduced operational impact.

9.2 Cumulative Energy and Infrastructure Demand

While increased demand on precinct-level electricity and water infrastructure is anticipated due to multiple major developments, the proposed hospital's low-energy design, rooftop solar generation, and water-saving measures (e.g., rainwater harvesting, water-efficient fixtures) will help mitigate these demands.

The design includes:

- Reduced peak energy demand through passive heating/cooling.
- Optimisation of plant sizes to avoid overspecification.
- On-site renewable energy systems to partially offset grid reliance.

These measures will reduce cumulative load on local utilities when considered alongside other precinct-scale developments.

9.3 Cumulative Shadow and Wind Impacts

While shadow and wind studies are typically covered in specialist reports, the hospital's stepped massing and articulated facade design contribute to the mitigation of overshadowing impacts on adjacent open spaces and developments. The use of ESD-informed façade strategies, such as solar control devices and window placement, ensures daylight access for internal occupants while minimising adverse shadow impacts on the public realm.

Where cumulative overshadowing from multiple precinct developments is a concern, the hospital design has:

- Located high-rise wards and ICU functions away from lower-scale residential interfaces.
- Maintained building separations to limit continuous shadowing.
- Considered prevailing winds in the orientation and articulation of the building to avoid intensified wind tunnel effects.

9.4 Cumulative Transport and Access Impacts

The hospital development forms part of a transit-oriented development model, located adjacent to the Crows Nest Metro Station, minimising reliance on private vehicle use. The cumulative traffic impact of multiple SSDA developments in the area is acknowledged; however:

The hospital includes basement-level car parking and dedicated hospital drop-off and loading areas to manage on-site circulation.

The development promotes active transport through bike parking and pedestrian connectivity.

ESD initiatives include the potential for electric vehicle charging infrastructure, supporting long-term sustainable mobility in the precinct.

9.5 Cumulative Environmental and Amenity Outcomes

From an environmental sustainability perspective, the hospital will:

- Contribute positively to precinct-wide energy and water conservation outcomes.
- Avoid critical impacts on biodiversity or ecological corridors.
- Be constructed and operated with minimal environmental nuisance through noise and dust controls, in line with best-practice construction environmental management plans (CEMPs).

The cumulative benefit is a healthcare facility that enhances the precinct's environmental performance, provides critical services to the growing community, and operates with a lower environmental footprint relative to typical hospitals.

10. Mitigation Measures

The following mitigation measures have been identified to manage environmental impacts associated with the proposed hospital development. These measures have been developed in accordance with ESD best practice principles and will either be incorporated into the current design or implemented during the detailed design and construction phases.

Mitigation Measure	Status
High-performance façade system to reduce thermal loads and energy demand	Incorporated into design
Installation of solar PV and heat pump systems to reduce operational emissions	Incorporated into design
Use of low-flow water fixtures and potential for rainwater harvesting to reduce potable water use	Incorporated into design
Provision of secure bicycle parking and end-of-trip facilities to encourage sustainable transport	Incorporated into design
Selection of low-VOC, non-toxic, and recyclable materials to improve indoor environmental quality and reduce waste	Incorporated into design
Construction and demolition waste management plan targeting 80% landfill diversion	Condition of consent – to be detailed prior to construction
Commissioning of building services and ongoing performance monitoring to ensure energy and water systems operate efficiently	Condition of consent – detailed design phase
Landscaping using native, drought-tolerant species to reduce irrigation needs and support biodiversity	Incorporated into design

These measures will collectively support the project's sustainability objectives, manage environmental risks, and ensure long-term operational efficiency and resilience.

11. Conclusion

The proposed hospital development incorporates a comprehensive suite of Ecologically Sustainable Design (ESD) initiatives that address energy efficiency, water conservation, indoor environmental quality, material selection, and emissions reduction. Where potential environmental impacts have been identified, appropriate mitigation measures have either been integrated into the design or can be effectively implemented during the detailed design and construction phases.

With these measures in place, the residual environmental impacts are considered to be minimal, well-managed, and appropriate for the context of the Crows Nest precinct. The development will deliver long-term sustainability benefits and align with relevant planning and environmental objectives.

12. Disclaimer

This report is prepared using the information described above and inputs from other consultants. Whilst IGS has endeavoured to ensure the information used is accurate, 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 IGS for detailed advice which will take into account that party's particular requirements.

Computer performance assessment provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on simulation results alone. IGS and its employees and agents shall not be liable for any loss arising because of, any person using or relying on the Report and whether caused by reason or error, negligent act or omission in the report. The draft assessment has been prepared indicatively and using the limited architectural and building services design with the view to conduct a detailed assessment once the design is further developed.

Performance of the completed building may be significantly affected by the quality of construction; the quality of commissioning, ongoing management of the building, and the way the building is operated, monitored, and maintained.

APPENDIX A - TECHNICAL DATASHEETS FOR SAMPLE PV PANELS (600 W)

Vertex

BIFACIAL DUAL GLASS MONOCRYSTALLINE MODULE

PRODUCT: TSM-DEG20C.20

PRODUCT RANGE: 580-600W

600W	0~+5W	21.2%
MAXIMUM POWER OUTPUT	POSITIVE POWER TOLERANCE	MAXIMUM EFFICIENCY

High customer value

- Lower LCOE (Levelized Cost of Energy), reduced BOS (Balance of System) cost, shorter payback time
- Lowest guaranteed first year and annual degradation;
- Designed for compatibility with existing mainstream system components
- Higher return on Investment

High power up to 600W

- Up to 21.2% module efficiency with high density interconnect technology
- Multi-busbar technology for better light trapping effect, lower series resistance and improved current collection

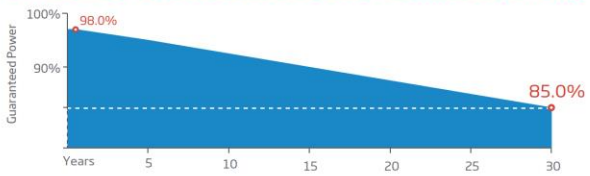
High reliability

- Minimized micro-cracks with innovative non-destructive cutting technology
- Ensured PID resistance through cell process and module material control
- Resistant to harsh environments such as salt, ammonia, sand, high temperature and high humidity areas
- Mechanical performance up to 5400 Pa positive load and 2400 Pa negative load

High energy yield

- Excellent IAM (Incident Angle Modifier) and low irradiation performance, validated by 3rd party certifications
- The unique design provides optimized energy production under inter-row shading conditions
- Lower temperature coefficient (-0.34%) and operating temperature
- Up to 25% additional power gain from back side depending on albedo

Trina Solar's Vertex Bifacial Dual Glass Performance Warranty



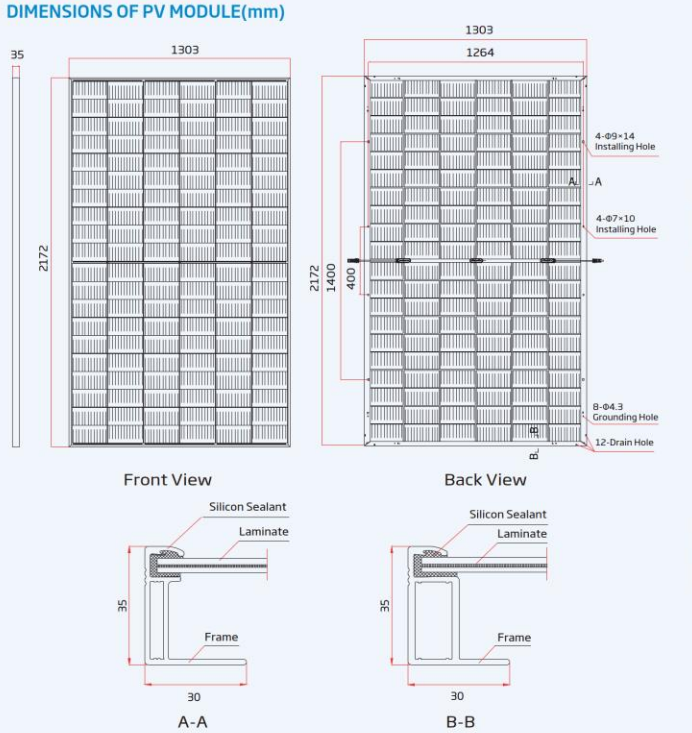
Comprehensive Products and System Certificates

IEC61215/IEC61730/IEC61701/IEC62716/UL61730
ISO 9001: Quality Management System
ISO 14001: Environmental Management System
ISO14064: Greenhouse Gases Emissions Verification
ISO45001: Occupational Health and Safety Management System

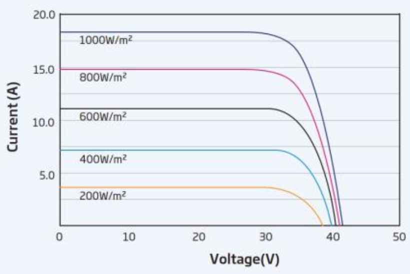
Trinasolar

Vertex BIFACIAL DUAL GLASS MONOCRYSTALLINE MODULE

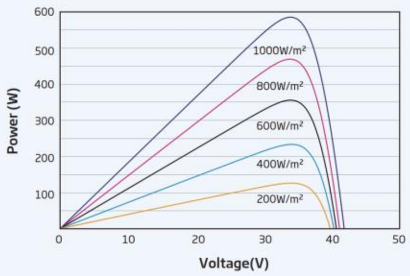
DIMENSIONS OF PV MODULE(mm)



I-V CURVES OF PV MODULE(590 W)



P-V CURVES OF PV MODULE(590 W)



ELECTRICAL DATA (STC)

Peak Power Watts-PMAX (Wp)*	580	585	590	595	600
Power Tolerance-PMAX (W)			0 ~ +5		
Maximum Power Voltage-VMPP (V)	33.8	34.0	34.2	34.4	34.6
Maximum Power Current-IMPP (A)	17.16	17.21	17.25	17.30	17.34
Open Circuit Voltage-Voc (V)	40.9	41.1	41.3	41.5	41.7
Short Circuit Current-Isc (A)	18.21	18.26	18.31	18.36	18.42
Module Efficiency η m (%)	20.5	20.7	20.8	21.0	21.2

STC: Irrdiance 1000W/m2, Cell Temperature 25°C, Air Mass AM1.5. *Measuring tolerance: ±3%.

Electrical characteristics with different power bin (reference to 10% Irradiance ratio)

Total Equivalent power -PMAX (Wp)	621	626	631	637	642
Maximum Power Voltage-VMPP (V)	33.8	34.0	34.2	34.4	34.6
Maximum Power Current-IMPP (A)	18.36	18.41	18.46	18.51	18.55
Open Circuit Voltage-Voc (V)	40.9	41.1	41.3	41.5	41.7
Short Circuit Current-Isc (A)	19.48	19.54	19.59	19.65	19.71
Irradiance ratio (rear/front)			10%		

Power Bifaciality:70±5%.

ELECTRICAL DATA (NOCT)

Maximum Power-PMAX (Wp)	439	443	447	451	454
Maximum Power Voltage-VMPP (V)	31.5	31.7	31.9	32.0	32.2
Maximum Power Current-IMPP (A)	13.93	13.97	14.01	14.06	14.10
Open Circuit Voltage-Voc (V)	38.5	38.7	38.9	39.1	39.3
Short Circuit Current-Isc (A)	14.68	14.72	14.76	14.80	14.84

NOCT: Irradiance at 800W/m², Ambient Temperature 20°C, Wind Speed 1m/s.

MECHANICAL DATA

Solar Cells	Monocrystalline
No. of cells	120 cells
Module Dimensions	2172×1303×35 mm (85.51×51.30×1.38 inches)
Weight	35.3 kg (77.8 lb)
Front Glass	2.0 mm (0.08 inches), High Transmission, AR Coated Heat Strengthened Glass
Encapsulant material	EVA/POE
Back Glass	2.0 mm (0.08 inches), Heat Strengthened Glass (White Grid Glass)
Frame	35mm(1.38 inches) Anodized Aluminium Alloy
J-Box	IP 68 rated
Cables	Photovoltaic Technology Cable 4.0mm² (0.006 inches²), Portrait: 280/280 mm(11.02/11.02 inches) Length can be customized
Connector	MC4 EVO2 / TS4*

*Please refer to regional datasheet for specified connector.

TEMPERATURE RATINGS

NOCT(Nominal Operating Cell Temperature)	43°C (±2°C)
Temperature Coefficient of PMAX	- 0.34%/°C
Temperature Coefficient of Voc	- 0.25%/°C
Temperature Coefficient of Isc	0.04%/°C

MAXIMUMRATINGS

Operational Temperature	-40~+85°C
Maximum System Voltage	1500V DC (IEC) 1500V DC (UL)
Max Series Fuse Rating	35A

WARRANTY

12 year Product Workmanship Warranty
30 year Power Warranty
2% first year degradation
0.45% Annual Power Attenuation

(Please refer to product warranty for details)

PACKAGING CONFIGUREATION

Modules per box: 25/36 pieces
Modules per 40' container: 549 pieces

Trinasolar

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

Version number: TSM_EN_2021_B
www.trinasolar.com

APPENDIX B - TECHNICAL DATASHEETS FOR SAMPLE PV INVERTERS

SUNGROW

SG15KTL-M/SG20KTL-M

String Inverter

High Yield

- Max. efficiency 98.6 %, European efficiency 98.3 %
- 1.1 overload capacity, 10% more yield under high irradiance
- Adapt to complex power grid, extend the grid - connected generation time
- Patented PID recovery function

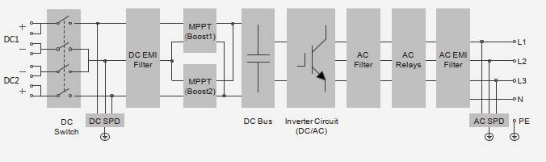
Easy O&M

- 26kg, easy O&M
- Plug and play design, easy installation
- String currrent monitoring function for fast trouble shooting
- Fast commissioning, easy local and on-line monitoring

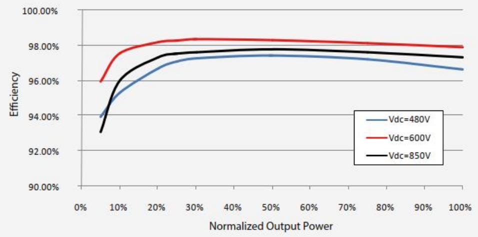
Safe and Reliable

- High power quality, no interference for electrical equipment
- Low radiation, compliance with household equipment standards
- High anti-corrosion with aluminum alloy die casting
- Build-in surge arresters and residual current protection

Circuit Diagram



Efficiency Curve



SUNGROW

SG15KTL-M/SG20KTL-M

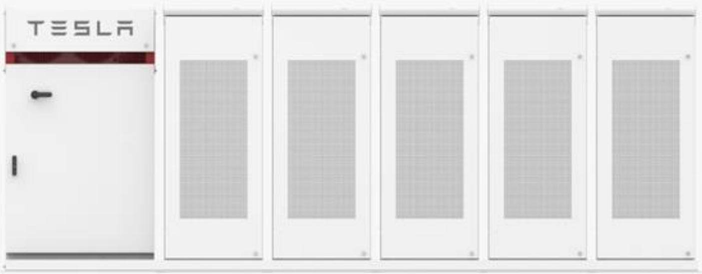
Input (DC)	SG15KTL-M	SG20KTL-M
Max. PV input voltage	1000 V	
Min. PV input voltage / Startup voltage	200 V / 250 V	
Nominal input voltage	600 V	
MPP voltage range	200 V – 1000 V	
MPP voltage range for nominal power	380 V – 850 V	480 V – 850 V
No. of independent MPP inputs	2	
Max. number of PV strings per MPPT	2	
Max. PV input current (at 35 ˚C)	44A (22A / 22A)	
Max. current for input connector	15 A	
Max. PV short-circuit current	60 A (30A / 30A)	
Output (AC)		
Nominal AC power (at 45 ˚C)	15000 W	20000 W
Max. AC output at PF=1 (at 35 ˚C)	16500 W	22000 W
Max. AC apparent power (at 35 ˚C)	16500 VA	22000 VA
Max. AC output current (at 35 ˚C)	24.0 A	31.9 A
Nominal AC voltage	3 / N / PE, 230 / 400 V	
AC voltage range	270 V – 480 V	
Nominal grid frequency	50 Hz, 60 Hz,	
Grid frequency range	45 Hz–55 Hz, 55 Hz–65 Hz	
Total Harmonic Distortion (THD)	< 3 % (of nominal power)	
DC current injection	< 0.5 % In	
Power factor	>0.99 / 0.8 leading - 0.8 lagging	
Feed-in phases / Connection phases	3 / 3	
Efficiency		
Max. efficiency / Euro. efficiency	98.6 % / 98.3 %	
Protection		
Islanding Protection	Yes	
LVRT	No	
DC reverse connection protection	Yes	
AC short-circuit protection	Yes	
Leakage current protection	Yes	
Grid monitoring	Yes	
DC switch / AC switch	Yes / No	
PV string current monitoring	Yes	
PID recovery function	Optional	
Overvoltage protection	DC Type II / AC Type II	
General Data		
Dimensions (W*H*D)	370 * 485 * 220 mm	
Weight	26 kg	
Isolation method	Transformerless	
Degree of protection	IP65	
Night power consumption	< 1 W	
Operating ambient temperature range	-25 to 60 ℃ (> 45 ℃ derating)	
Allowable relative humidity range (non-condensing)	0 – 100 %	
Cooling method	Smart forced air cooling	
Max. operating altitude	4000 m (> 2000 m derating)	
Display / Communication	LED, Bluetooth + APP / RS485, (WiFi, E-Net optional)	
DC connection type	MC4 (Max. 6 mm²)	
AC connection type	Plug and play connector (Max. 16 mm²)	
Compliance	EN62109-1, EN62109-2, IEC 61727, IEC 62116	
Grid support	Active & reactive power control and power ramp rate control	
Type designation	SG15KTL-M-10	SG20KTL-M-10

APPENDIX C - TECHNICAL DATASHEET FOR TESLA POWERPACK (ENERGY STORAGE OPTION)

POWERPACK

Tesla has been building integrated battery systems in cars for over 10 years. The same degree of expertise, quality control and technological innovation has informed our process of developing high-performance energy storage systems.

The Powerpack system scales to the space, power and energy requirements of any site from 210 kWh to 100 MWh+.



Powerpack System Includes an Inverter and DC Battery Packs

FULLY INTEGRATED SYSTEM

A complete energy storage system including DC batteries, bi-directional inverter, and a Powerpack controller with intelligent software. This turnkey system is designed to maximize savings and prolong battery life.

OPTIMIZATION SOFTWARE

Powerpack systems have the most advanced battery technology and dispatch optimization software to quickly learn and predict a facility's energy patterns. Tesla's proprietary storage dispatch software can charge and discharge autonomously to maximize customer value.

ENHANCED SYSTEM SAFETY

Powerpack's battery architecture consists of a low voltage battery with a DC/DC converter for added electrical isolation and safety. It also has an integrated liquid cooling / heating system for thermal safety and enhanced performance and reliability.

APPLICATIONS

PEAK SHAVING
Discharge at times of peak demand to reduce expensive demand charges

EMERGENCY BACKUP
Powers a facility when the grid goes down

CAPACITY FIRMING
Smooth out the intermittency of renewables by storing and dispatching when needed

LOAD SHIFTING
Shift energy consumption from one point in time to another

MICROGRID
Build a localized grid that can disconnect from the main power grid

TRANSMISSION & DISTRIBUTION SUPPORT
Supply power at a distributed location to defer the need to upgrade aging infrastructure

DEMAND RESPONSE
Discharge or charge in response to signals from a demand response administrator

ANCILLARY SERVICES
Provide service to the grid in response to signals sent

TESLA

TESLA.COM/ENERGY

POWERPACK SPECIFICATIONS
4hr System

- 1 Powerpack includes 16 battery pods
- Each pod has an isolated DC/DC inverter and thermal control system
- Sensors to monitor cell-level performance in real-time
- Standard configuration:
  i. 4 hour discharge duration

ELECTRICAL

AC Voltage	380-480VAC 3-phase
Nominal Frequency	50 & 60 Hz
Continuous Discharge Duration	4 hours
AC Energy available per Powerpack[1]	210 kWh
Inverter Sizes	Scalable from 50kW - 653kW
Roundtrip[1] System Efficiency	89%

[1]Net energy delivered at 25°C (77°F) including thermal control.

REGULATORY

Lithium-Ion Cells	NRTL listed to UL 1642
System	NRTL listed to UL 1973, 9540, 1741 IEEE 1547 Compliant to grid codes and safety standards of all major markets. Full list provided upon request.

MECHANICAL AND MOUNTING

Enclosure	IP67 (Pod) NEMA 3R / IP35 (Powerpack) NEMA 4 / IP66 (Inverter)
System Area Requirements	50kW / 210kWh: 95ft² / 8.9m² 100kW / 420kWh: 127ft² / 11.8m² 250kW / 1050kWh: 221ft² / 20.5m² 500kW / 2100kWh: 377ft² / 35m²
Powerpack Unit Dimensions	L: 51.5" (1308mm) W: 32.4" (822mm) H: 86" (2185mm)
Weight	2160 kg / 4765 lbs
Inverter Dimensions	L: 39.9" (1014mm) W: 49.4" (1254mm) H: 86.3" (2192mm)
Weight	Up to 1200 kg / 2645 lbs
Operating Ambient Temperature	-22°F to 122°F / -30°C to 50°C

COMMUNICATIONS

Protocol	Modbus TCP DNP3 Rest API

TESLA

TESLA.COM/ENERGY

Tesla's software for behind the meter Powerpack applications, called Opticaster, is designed to maximize economic benefit for customers. Opticaster now operates in more than 100 commercial and industrial stationary energy storage systems, resulting in tens of thousands of hours of field experience in a vast range of grid-connected and off-grid applications. With each of Tesla's 120,000+ electric vehicles operating its proprietary battery system software, Tesla's experience in this realm is unparalleled.

The robust data set accumulated through Tesla's field experience informs the development and continuous improvement of Tesla's global fleet of vehicles and energy storage systems. Tesla's software logic for behind the meter energy storage applications is a culmination of this vast experience and is the focus of this paper.

Opticaster is an integral component of Powerpack system. At every stage of project maturity, Opticaster is used to optimize Powerpack system size to achieve maximum financial returns for customers. During operation, it forecasts and optimizes the dispatch of stored electricity to reduce electricity bills and perform grid services.

This paper illustrates the applications Tesla's Opticaster performs, and explores three layers of functionality that define its operation: forecasting, optimization, and real-time control.

SYSTEM SIZING

System modeling enables customers to evaluate the benefits of adding a Powerpack system. Based on a simple set of customer data, such as utility rate structures and historical load data, Opticaster leverages its core optimization and forecast abilities to perform detailed simulations, which determine an optimal system size and application set for any customer. Figure 1 illustrates commonly modeled functions and applications:

Figure 1

TESLA POWERPACK | POWERPACK@TESLA.COM | 1

To ensure the greatest probability for customer savings and revenue, Tesla simulates multiple scenarios for each customer. Each scenario provides a probability for economic benefit by testing multiple customer load behaviors against an array of Powerpack sizes and applications.

APPLICATIONS

Commercial electricity bills are usually comprised of demand charges and energy charges. Opticaster automatically optimizes both weighted by their respective costs.

Demand charges typically make up the greatest portion of commercial electricity bills, and can be reduced by discharging an on-site Powerpack system during the customer's period of peak demand. Through peak shaving / demand charge management, Opticaster automatically forecasts customers' site peak and discharges Powerpack batteries to reduce demand charges.

To reduce energy charges, Opticaster charges Powerpacks when the site demand or utility energy prices are low, then dispatches electricity to the customer when prices are high. Figure 2 demonstrates a combination of peak shaving and energy load shifting in an application called **tariff optimization.**

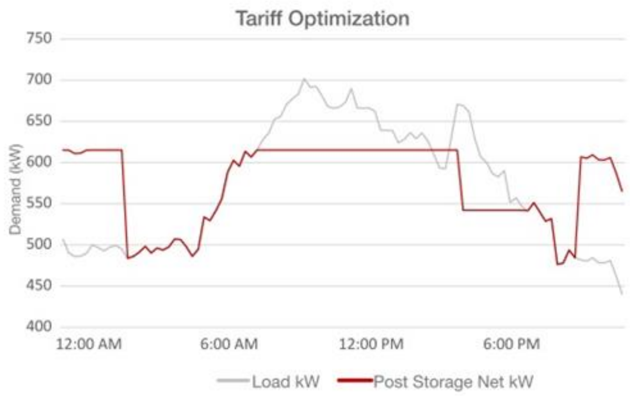


Figure 2

Commercial customers may also use solar panels to offset the electricity their site consumes from the local grid. For these customers, an on-site Powerpack system stores the solar electricity generated during the day for use during peak demand times through an application called **solar self-consumption.**

In solar self-consumption, Opticaster maintains system parameters to ensure optimal performance: maximum solar export power, percentage of battery to charge from solar, maximum and minimum site power level, utility interconnection rules, and other requirements that qualify the customer for government incentives. This flexible approach maximizes economic benefit for customers.

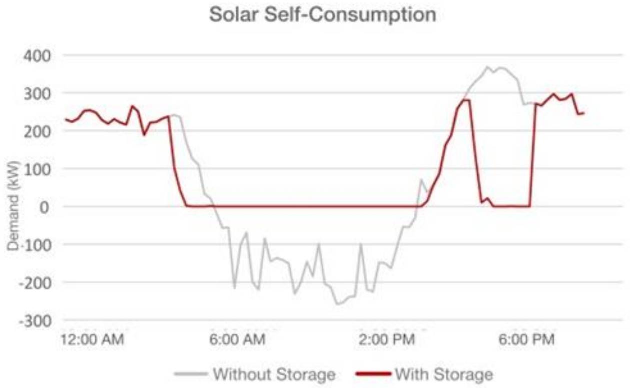


Figure 3

Figure 3 shows an example of Opticaster commanding Powerpacks to charge from solar during the day, then discharge to shave the customer's evening peak.

To secure multiple revenue streams for customers, Opticaster also supports **demand response (DR)** and other special price events such as critical peak pricing in PG&E and TUoS in the U.K.. Figure 4 shows an example of a DR event, during which the algorithm commands the Powerpack system to precisely meet the DR commitment of 50 kW below the baseline.

Figure 4

Through a combination of peak shaving and load shifting applications, customers reduce demand charges and energy charges on-site. By also participating in a DR program, customers add a layer of revenue that increases financial returns. Figure 5 depicts a customer co-optimizating all applications, which includes tariff optimization where Powerpacks charge during the night and discharge to keep the maximum peak below 410 kW at all time, and demand response where Powerpacks discharge to reduce the load well below the demand response baseline.

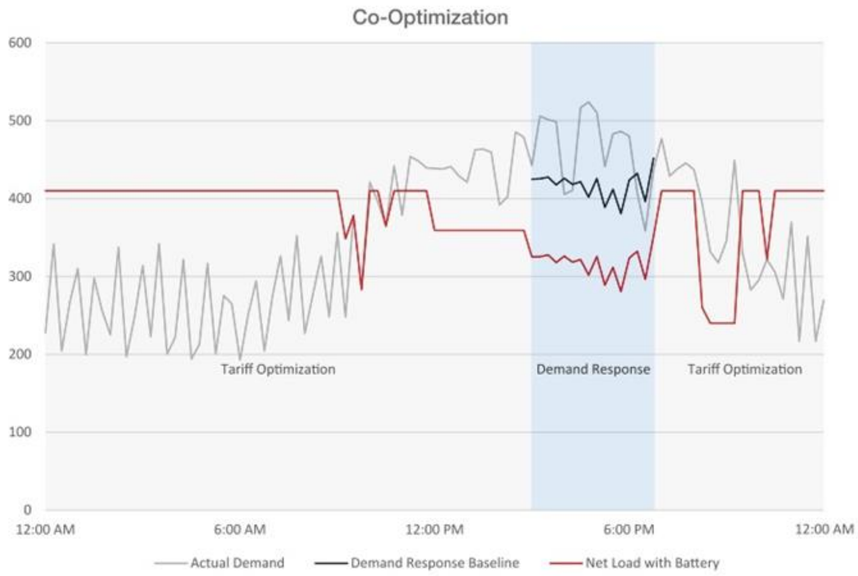


Figure 5

OPERATION

Opticaster's operation takes three major steps: demand forecast, optimization, and real-time operation.

Accurately forecasting customer demand is critical to overall system performance. To produce a customer demand forecast, Opticaster considers a robust set of variables including load profiles, solar profiles, holiday schedules, and temperature data. In addition, on-site electric and solar meters feed data into the system's data set to update the demand forecast continuously.

Continuous updates of demand forecast occur every couple of minutes. As shown in Figure 6, the forecast of the peak load gets increasingly accurate as it moves forward in time. The data retrieved between each new forecast become new input for the optimization model explained next.

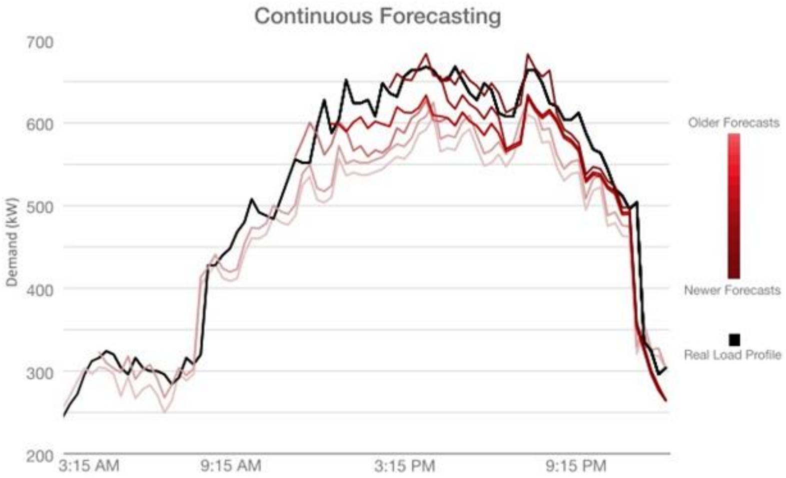


Figure 6

Based on the forecasted demand, utility rate structure, and battery state, Opticaster's optimization module autonomously develops a charge/discharge schedule that maximizes customer savings while satisfying other non-monetary requirements. These schedules are updated with the same frequency as demand forecasts.

Then the real-time operation module translates the charge/discharge schedules to the instantaneous power commands that control Powerpacks. It monitors the real-time demand from the site and ensures that optimal charge/discharge schedules are satisfied.

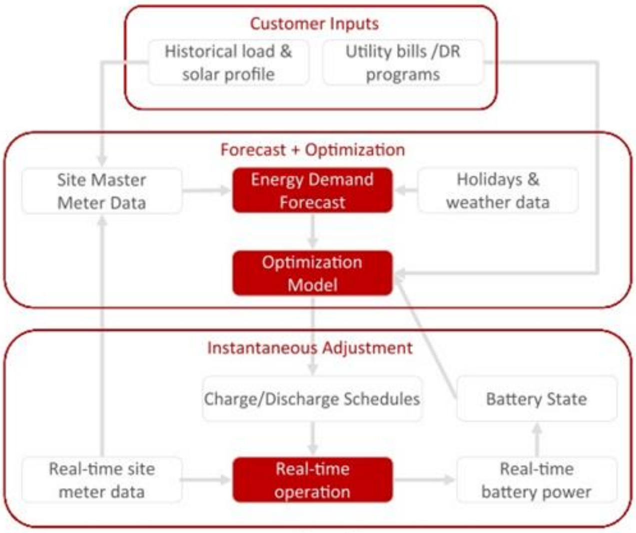


Figure 7

Every new version of Opticaster is benchmarked against Tesla's performance at existing sites to ensure constant improvement. Opticaster's combination of forecasting, optimization, and real-time controls makes it the most capable software solution on the market for managing advanced energy storage applications. Scalable to the power and energy requirements of any site, Powerpack systems provide a complete solution for a breadth of commercial and utility applications. To determine if energy storage is right for your site, please email powerpack@tesla.com.

APPENDIX D – NABERS EMBODIED EMISSIONS FORM

NSW Government
4 Parramatta Square
Parramatta NSW 2150
nabers.gov.au

NABERS Embodied emissions materials form

New non-residential developments must complete this form

From 1 October 2023, all new non-residential developments must report on embodied emissions using this form in NSW, where the NSW government's State Environmental Planning Policy (Sustainable Buildings SEPP) 2022 applies. You must disclose the amounts of key materials at the development application and construction certificate stages.

More on the Sustainable Buildings SEPP

Embodied carbon emissions are generated across the full life cycle of a building from "cradle to grave". Embodied carbon made up 16% of the whole-of-life carbon footprint of Australia's buildings in 2019 [1]. The purpose of this form is to report on material quantities only, to support project team discussions about potential reduction in emissions from key materials. The form does not include embodied emissions factors. This reporting form will be updated to reflect the NABERS Embodied Carbon tool when it's available in 2024.

Step 1: About the building

In the 'About the building' tab, you will add the location, function, and type of building you are planning to construct. You will also need to add information that describes the building, including gross floor area, number of floors, area of carpark, and more. Collecting this information will allow the NSW Government to compare similar buildings.

Step 2: Quantity of materials

In the 'Quantity of materials' tab, you will add the amounts of materials that you will use to construct your building. You only need to complete those fields relevant to your building. Leave fields that aren't relevant to your building blank. We recognise that there will be uncertainty, particularly at DA stage, so please use your best estimates where information is unknown (e.g., based on past projects).

How much do I need to include?
You must include all parts of the building delivered by the main contractor, covering at least 80% of the total materials bill. For example, if you spent $100,000 on materials, you need to include the material amounts of at least $80,000 of those materials in this form.

Wherever possible, consider materials costs only, not labour, plant or equipment. However, where you cannot split out the materials costs, please simply be consistent in the way the costs are reported throughout the spreadsheet.

Enter the **quantity of materials** (excluding labour, plant, equipment, margins and taxes) for:

(1) Structure (substructure and superstructure) within the envelope of the building. Also include any ancillary buildings that are necessary for the main building to function (for example, plant that is in a separate building).

(2) Envelope (cladding, curtain walls, roofing, windows, doors etc.)

(3) Permanent internal walls and doors. At minimum, this should include all structural walls.

(4) External works (hard landscaping, carparks, etc.) outside of the building envelope.

Enter the **cost of materials** (excluding labour, plant, equipment, margins and taxes) for:

(5) Building services (mechanical, electrical, plumbing, vertical transport, etc.) required to run the core of the building. Exclude special equipment required by a particular tenant.

You must enter the amounts of materials in SI units (commonly known as the metric system). These are generally consistent across the various products on the market. However, you might need to convert the units of some materials (for example, convert volume to kg).

Step 3: Certifier details

In the 'Certifier' tab you will add the details of the person who has entered data, and the person who has certified the accuracy of the data. The certifier must be a quantity surveyor, designer, engineer or NABERS assessor.

Step 4: Attach to approval

Attach this Excel spreadsheet to your development application or construction certificate application.

The data collected in this form will be used by the NSW Government to inform future policy development.

Help!

If you have general questions about reporting on the embodied emissions of your building, you should contact your local council or consent authority.

If you have technical questions about this spreadsheet, please contact NABERS:
nabers@environment.nsw.gov.au

[1] Green Building Council of Australia, 2021, https://new.gbca.org.au/news/gbca-news/gbca-and-thinkstep-release-embodied-carbon-report/

Step 1: About the building

Fill out blue cells

Building location and site data	Value	Unit	Note	Comment
Building address	10 Missenden Rd, Camperdown NSW			
Postcode	2050		Required	Postcode of building
Town/city	CAMPERDOWN + 2 other localities		Town/city/suburb/region automated from postcode (may not give exact town name)	Town/city/suburb/region of the building site.
Distance to nearest major city/town	4	km	Enter for rural/regional locations only	Declare the shortest route by road to your site from the centre of your nearest major city (>100,000 people). The route must be traversable by a semitrailer truck.
Project stage	Development Application		Required	Stage of development
New build or major renovation?	New build		Required	
Brownfield or greenfield site?	Brownfield		Required	

Floor area by NCC building classification	Gross (GFA)	Net (NLA/NSA/UFA)	Unit	Note	
Please enter all floor areas relevant to your building. Leave areas blank if not applicable. Please enter Gross Floor Area (GFA) for all building classifications. Please also enter the corresponding net area (Net Lettable Area, Net Sellable Area or Usable Floor Area) where it is commonly used for that building classification.					
Class 1a: Detached residential buildings	0	0	m²	Required for Class 1a: Detached residential houses, townhouses	Gross Floor Area (GFA), as defined by the AIQS Australian Cost Management Manual
Class 1b: Boarding houses and hostels	0	0	m²	Required for Class 1b: Boarding house, guest house, hostel	Net area (Net Lettable Area, Net Sellable Area, Usable Floor Area), as defined by the PCA's Method of Measurement
Class 2: Multi-unit residential buildings	0	0	m²	Required for Class 2: Multi-unit residential, including apartment buildings	
Class 3: Other residential buildings	0	0	m²	Required for Class 3: Other residential buildings	
Class 4: Residential inside non-residential	0	0	m²	Required for Class 4: Residential building inside a non-residential building, e.g., caretaker residence	
Class 5: Office buildings	600	580	m²	Required for Class 5: Office building	
Class 6: Retail buildings	1,700	1,632	m²	Required for Class 6: Retail building, e.g., shop, restaurant, café	
Class 7a: Carparks	9,343	9,190	m²	Required for Class 7a: Carparks	
Class 7b: Warehouse-type buildings	0	0	m²	Required for Class 7b: Warehouses, wholesalers and storage facilities	
Class 8: Industrial buildings	0	0	m²	Required for Class 8: Industrial buildings, e.g., factories and workshops	
Class 9a: Healthcare buildings	9,900	9,650	m²	Required for Class 9a: Healthcare, e.g., hospitals, clinics, day surgeries	
Class 9b: Civic buildings	340	315	m²	Required for Class 9b: Civic buildings, e.g., theatres, civic centres, train stations	
Class 9c: Aged care and personal care buildings	0	0	m²	Required for Class 9c: Aged care and personal care	
Class 10a: Non-habitable buildings	0	0	m²	Required for Class 10a: Non-habitable buildings including sheds, carports and private garages	
Class 10b: Miscellaneous structures	0	0	m²	Required for Class 10b: Miscellaneous structures, including fences, masts, antennas, retaining walls and swimming pools	
Class 10c: Bushfire shelters	0	0	m²	Required for Class 10c: Bushfire shelters not attached to a Class 1a building	
Total	21,883	21,367	m²	Required: Sum of m² inputs must be more than 0.	

Project information	Value	Unit	Note	
Total cost of project	85,000,000	AUD excl. GST	Required	Include labour, materials, transport, plant, equipment and professional fees. Exclude GST, land, finance, escalation and other costs.
Building design life	20	years	Required	If uncertain, enter 50 years
Estimated envelope life	20	years	Optional	
Estimated replacement cycle for mechanical services	30	years	Optional	
Estimated replacement cycle for vertical transportation	30	years	Optional	

Dimensions of the building and the site	Value	Unit	Note	
Site area	5,916	m²	Required	Total area of site to external boundary.
Shared services or infrastructure	No		Required	Indicate if there are shared services that the building utilises, or shared foundations, basement or podium
Building footprint area	4,349	m²	Required	Total floor area of the ground floor measured to the outside edge of the floorplate.
Typical floor area (if different to building footprint area)	17,005	m²	Only needed if different to row above	
Typical floor perimeter	921	m	Required	
Area of external carpark (not included in GFA)	0	m^2	Required. Enter 0 if not applicable.	
Area of external hardstand (not included in GFA)	0	m^2	Required. Enter 0 if not applicable.	
Area of other hard landscaping (not included in GFA)	0	m^2	Required. Enter 0 if not applicable.	Include all other impervious areas. For example, patios, paths and driveways (not already included in carparks and hardstands above).
Number of floors/storeys above ground, including ground floor	13	no.	Required	
Number of floors/storeys below ground	3	no.	Required. Enter 0 if not applicable.	
Number of floors/storeys of car parking	3	no.	Required. Enter 0 if not applicable.	
Total height above ground	61	m	Required	Measured from the average finished grade to the highest point of the building, excluding protrusions (lighting rods, masts, chimneys, etc.)

Structural material choices	Value	Unit	Note	
Foundation type	Slab-on-ground		Required	
Frame type (dominant)	Steel		Required	
Suspended floor type (typical)	Reinforced concrete		Only needed for multi-storey buildings	
Describe low carbon materials specified in your building (e.g. green concrete, low carbon bricks)	Where feasible, the project team will utilise green concrete. The timber used in the development will not be from endangered tree species.		Required	
Describe recycled content specified in your building (e.g. recycled steel)	No recycled steel content.		Required	

Step 2: Quantity of materials

Complete all blue cells that are applicable to the building. <u>Leave items that aren't applicable</u> blank.

Fill out blue cells

Material category	Sub-category 1	Sub-category 2	Sub-category 3	Value	Unit of measure	Comment	AIQS ACMM Code	ICMS3 (Level 3 Codes Construction)
Structure								
The structural parts of the building that are below ground (substructure) and above ground (superstructure). This includes fill below the substructure, foundations, basement levels, suspended floors, wall structure, roof structure, stairs, lift shafts and balconies. It excludes external areas such as hardstands, carparks, patios, etc.								
Coverage of structural material spend	-	-	-	80	%	Required. Coverage of <u>spend</u> for structural elements entered below. Minimum requirement = 80%. Exclude head contractor preliminaries and margins.		
Concrete in-situ	≤10 MPa	-	-		m^3	Please enter reinforcing steel as part of "Reinforcing steel" below	01_SB or 02-11	02 or 03
Concrete in-situ	>10 MPa to ≤20 MPa	-	-		m^3	Please enter reinforcing steel as part of "Reinforcing steel" below	01_SB or 02-11	02 or 03
Concrete in-situ	>20 MPa to ≤32 MPa	-	-		m^3	Please enter reinforcing steel as part of "Reinforcing steel" below	01_SB or 02-11	02 or 03
Concrete in-situ	>32 MPa to ≤40 MPa	-	-		m^3	Please enter reinforcing steel as part of "Reinforcing steel" below	01_SB or 02-11	02 or 03
Concrete in-situ	>40 MPa to ≤50 MPa	-	-	30.0	m^3	Please enter reinforcing steel as part of "Reinforcing steel" below	01_SB or 02-11	02 or 03
Concrete in-situ	>50 MPa to ≤60 MPa	-	-		m^3	Please enter reinforcing steel as part of "Reinforcing steel" below	01_SB or 02-11	02 or 03
Concrete in-situ	>60 MPa to ≤80 MPa	-	-		m^3	Please enter reinforcing steel as part of "Reinforcing steel" below	01_SB or 02-11	02 or 03
Concrete in-situ	>80 MPa to ≤100 MPa	-	-		m^3	Please enter reinforcing steel as part of "Reinforcing steel" below	01_SB or 02-11	02 or 03
Concrete in-situ	>100 MPa	-	-		m^3	Please enter reinforcing steel as part of "Reinforcing steel" below	01_SB or 02-11	02 or 03
Concrete pre-cast panel	-	-	-		m^3	Please enter reinforcing steel in relevant line items below. If not known at DA stage, please make your best estimate. If not known at CC stage, please ask your supplier.	01_SB or 02-11	02 or 03
Concrete block	Hollow core	-	-	65.0	m^3	Enter as <u>cubic metres</u>, calculated as (area in m^2) * (thickness in mm / 1000). Please include all block fill concrete and all reinforcing steel in relevant line items above/below.	01_SB	02 or 03
Concrete block/brick	Solid	-	-	600.0	m^3	Enter as <u>cubic metres</u>, calculated as (area in m^2) * (thickness in mm / 1000)	01_SB	02 or 03
Concrete block/brick	Solid AAC	-	-		m^3	Solid Aerated Autoclaved Concrete (AAC) block. Enter as <u>cubic metres</u>, calculated as (area in m^2) * (thickness in mm / 1000).	01_SB	02 or 03
Mortar	-	-	-		kg		01_SB	02 or 03
Reinforcing steel	Bar & mesh	-	-	100,000	kg	**Include all reinforcing steel bar/mesh in the building's structure in this row.** Usually this is calculated as kg/m^3 per concrete element and then summed. Example: 10 m^3 of 40 MPa concrete @ 100 kg/m^3 + 5 m^3 of 50 MPa concrete @ 150 kg/m^3 = 1,750 kg reinforcing steel.	01_SB or 02-11	02 or 03
Reinforcing steel	Fibre & strand	-	-		kg	**Include all steel fibre reinforcing and steel strand in the building's structure in this row.**	01_SB or 02-11	02 or 03
Structural steel	Hot rolled structural	-	-		t	Examples include universal beams, universal columns and welded beams	01_SB	02 or 03
Structural steel	Cold formed structural	-	-		t	Examples include C purlins, Z purlins and all light gauge steel framing	01_SB	02 or 03
Structural steel	Other welded structural	-	-		t		01_SB	02 or 03
Structural steel	Plate	-	-		t	Include any allowance for connections here	01_SB	02 or 03
Structural steel	Sheet	-	-		t		01_SB	02 or 03
Stainless steel	-	-	-		t	Primarily for engineered timber structure connections	02_11	02 or 03
Reinforced concrete piles	Concrete	-	-		m^3	Please enter reinforcing steel in the line below. If not known at DA stage, please make your best estimate. If not known at CC stage, please ask your supplier.	01_SB	02 or 03
Reinforced concrete piles	Steel reinforcing				kg	If not known at DA stage, please make your best estimate. If not known at CC stage, please ask your supplier.	01_SB	02 or 03
Steel piles	-	-	-		t	Where concrete and reinforcing steel are also used, enter these in the rows above.	01_SB	02 or 03
Timber poles/piles	-	-	-		m^3	Where concrete and reinforcing steel are also used, enter these in the rows above.	01_SB	02 or 03
Timber (solid)	Sawn softwood	-	-	760.0	m^3		02_11	02 or 03
Timber (solid)	Sawn hardwood	-	-		m^3		02_11	02 or 03
Timber (engineered)	CLT	-	-		m^3		02_11	02 or 03
Timber (engineered)	Glulam	-	-		m^3		02_11	02 or 03
Timber (engineered)	LVL	-	-		m^3		02_11	02 or 03
Timber (engineered)	OSB	-	-		m^3	Enter as <u>cubic metres</u>, calculated as (area of wall in m^2) * (thickness in mm / 1000)	02_11	02 or 03
Fs	Heat cured	-	-		m^3	Enter as <u>cubic metres</u>, calculated as (area of wall in m^2) * (thickness in mm / 1000)	02_11	02 or 03
Structural Insulated Panel (SIP)	Steel outer	-	-		m^2		01_SB	02 or 03
Structural Insulated Panel (SIP)	Aluminium outer	-	-		m^2		01_SB	02 or 03
Structural Insulated Panel (SIP)	Engineered timber outer	-	-		m^2		01_SB	02 or 03
Fill	-	-	-		t	Include purchased material only. Exclude site-won material.	01_SB	01
Sand & gravel	-	-	-		t	Include purchased material only. Exclude site-won material and sand/gravel in concrete.	01_SB	01
Waterproofing membrane	Bituminous	-	-		m^2		01_SB	01 or 02 or 03
Waterproofing membrane	Polyethylene	-	-	800	m^2		01_SB	01 or 02 or 03
Other structural (Describe and add unit >>)		-	-			Please enter a description for any structural material that does not fit a predefined classification		
Other structural (Describe and add unit >>)		-	-			Please enter a description for any structural material that does not fit a predefined classification		
Other structural (Describe and add unit >>)		-	-			Please enter a description for any structural material that does not fit a predefined classification		
Envelope								
The skin of the building that separates the internal building from the external environment. This includes the roof cladding, wall cladding, windows, doors and internal/external shading. It also includes insulation and the internal wall lining of envelope walls.								
Coverage of envelope material spend	-	-	-	80	%	Required. Coverage of <u>spend</u> for the envelope items you have entered below. Minimum requirement = 80%. Exclude head contractor preliminaries and margins.		

Roof cladding	Profiled steel	-	-		m²	Enter as m² of roof area. Exclude allowances for overlap in the roofing sheets. This row includes all metal-coated and pre-painted steel sheets where steel is the base metal. Examples include: galvanised steel, zinc-aluminium (zincalume) coated steel and zinc-aluminium-magnesium (ZAM) coated steel, whether painted or unpainted.	05_RF	03 or 04
Roof cladding	Profiled aluminium	-	-		m²	Enter as m² of roof area. Exclude allowances for overlap in the roofing sheets. This row also includes pre-painted aluminium sheets.	05_RF	03 or 04
Roof cladding	Profiled zinc	-	-		m²	Enter as m² of roof area. Exclude allowances for overlap in the roofing sheets. This row also includes pre-painted zinc sheets.	05_RF	03 or 04
Roof cladding	Membrane	-	-		m²	Enter as m² of roof area. Exclude allowances for overlap in the membrane sheets.	05_RF	03 or 04
Roof cladding	Tiles (traditional clay)	-	-		m²	Enter as m² of roof area. Exclude allowances for overlap between the tiles.	05_RF	03 or 04
Roof cladding	Tiles (concrete)	-	-		m²	Enter as m² of roof area. Exclude allowances for overlap between the tiles.	05_RF	03 or 04
Roof cladding	Other (Please describe >>)	Glass	-	320	m²	Please enter a description for any roofing that does not fit a predefined classification	05_RF	03 or 04
Wall cladding	Bricks (heat cured)	-	-		m²	Enter as m² of wall area. Heat-cured bricks use a kiln or furnace to raise the brick temperature above ambient temperature during curing process.	06_EW	03 or 04
Wall cladding	Bricks (air dried)	-	-		m²	Enter as m² of wall area. Air-dried bricks are cured using ambient temperature.	06_EW	03 or 04
Wall cladding	Bricks (under fired)	-	-		m²	Enter as m² of wall area.	06_EW	03 or 04
Wall cladding	Bricks (concrete)	-	-		m²	Enter as m² of wall area	06_EW	03 or 04
Wall cladding	Mortar and render	-	-		kg		06_EW	03 or 04
Wall cladding	Profiled steel	-	-		m²	Enter as m² of wall area. Exclude allowances for overlap in the cladding sheets, offcuts, etc. This row includes all metal-coated and pre-painted steel sheets where steel is the base metal. Examples include: galvanised steel, zinc-aluminium (zincalume) coated steel and zinc-aluminium-magnesium (ZAM) coated steel, whether painted or unpainted.	06_EW	03 or 04
Wall cladding	Profiled aluminium	-	-		m²	Enter as m² of wall area. Exclude allowances for overlap in the cladding sheets, offcuts, etc. This row also includes pre-painted aluminium sheets.	06_EW	03 or 04
Wall cladding	Profiled zinc	-	-		m²	Enter as m² of wall area. Exclude allowances for overlap in the cladding sheets, offcuts, etc. This row also includes pre-painted zinc sheets.	06_EW	03 or 04
Wall cladding	GRC cladding	-	-		m²	Enter as m² of wall area. GRC = Glass Reinforced Concrete.	06_EW	03 or 04
Wall cladding	Timber weatherboards	-	-		m²	Enter as m² of wall area. Exclude allowances for overlap between weatherboards, offcuts, etc.	06_EW	03 or 04
Wall cladding	Fibre cement board	-	-		m²	Enter as m² of wall area. Exclude allowances for offcuts, etc.	06_EW	03 or 04
Wall cladding	Terracotta	-	-		m²	Enter as m² of wall area. Exclude allowances for offcuts, etc.	06_EW	03 or 04
Wall cladding	Brick tiles / veneers	-	-		m²	Enter as m² of wall area. Exclude allowances for offcuts, etc.	06_EW	03 or 04
Wall cladding	Plasterboard	-	-	3,000	m²	Enter as m² of wall area. Exclude allowances for offcuts, etc. Include both external wall linings and internal wall linings for envelope walls.	12_WF or 06_EW	03 or 04
Wall cladding	Plywood	-	-		m²	Enter as m² of wall area. Exclude allowances for offcuts, etc. Include both external wall linings and internal wall linings for envelope walls.	12_WF or 06_EW	03 or 04
Wall cladding	Other (Please describe >>)		-		m²	Please enter a description for any wall cladding that does not fit a predefined classification	06_EW or 12_WF	03 or 04
Windows & doors	Aluminium frame	Single glazed	-	970	m²	Include all single glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	Aluminium frame	Double glazed	-		m²	Include all double glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	Aluminium frame	Triple glazed	-		m²	Include all triple glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	Timber frame	Single glazed	-		m²	Include all single glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	Timber frame	Double glazed	-		m²	Include all double glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	Timber frame	Triple glazed	-		m²	Include all triple glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	uPVC frame	Single glazed	-		m²	Include all single glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	uPVC frame	Double glazed	-		m²	Include all double glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	uPVC frame	Triple glazed	-		m²	Include all triple glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	Frameless	Single glazed			m²	Include all single glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	Frameless	Double glazed			m²	Include all double glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	Frameless	Triple glazed			m²	Include all triple glazing, including standard, toughened, laminated and low-E	07_WW or 08_ED	03 or 04
Windows & doors	Other (Please describe >>)		-		m²	Please enter a description for any windows or doors that do not fit a predefined classification	07_WW or 08_ED	03 or 04
Curtain wall	Single skin façade	Glazed panel	Single glazed		m²	Please declare all single-skin façade area in this section. All double-skin façade area should be entered in the next section. Include all single glazing, including standard, toughened, laminated and low-E	06_EW	03 or 04
Curtain wall	Single skin façade	Glazed panel	Double glazed		m²	Include all double glazing, including standard, toughened, laminated and low-E	06_EW	03 or 04
Curtain wall	Single skin façade	Glazed panel	Triple glazed		m²	Include all triple glazing, including standard, toughened, laminated and low-E	06_EW	03 or 04
Curtain wall	Single skin façade	Opaque panel	Aluminium cladding		m²		06_EW	03 or 04
Curtain wall	Single skin façade	Opaque panel	GRC cladding		m²	GRC = Glass-fibre Reinforced Concrete	06_EW	03 or 04
Curtain wall	Single skin façade	Opaque panel	Insulated shadow box		m²		06_EW	03 or 04
Curtain wall	Single skin façade	Opaque panel	Brick cladding		m²		06_EW	03 or 04
Curtain wall	Single skin façade	Opaque panel	Stone cladding		m²		06_EW	03 or 04
Curtain wall	Double skin façade	Glazed panel	Single glazed		m²	Please declare all double-skin façade area in this section. Please declare as the area of the curtain wall and do not enter the inner and outer skins twice. Include all single glazing, including standard, toughened, laminated and low-E.	06_EW	03 or 04
Curtain wall	Double skin façade	Glazed panel	Double glazed		m²	The type of glazing refers to the building's envelope wall, not including the outer skin	06_EW	03 or 04
Curtain wall	Double skin façade	Glazed panel	Triple glazed		m²	The type of glazing refers to the building's envelope wall, not including the outer skin	06_EW	03 or 04
Curtain wall	Double skin façade	Opaque panel	Aluminium cladding		m²		06_EW	03 or 04
Curtain wall	Double skin façade	Opaque panel	GRC cladding		m²	GRC = Glass-fibre Reinforced Concrete	06_EW	03 or 04
Curtain wall	Double skin façade	Opaque panel	Insulated shadow box		m²		06_EW	03 or 04
Curtain wall	Double skin façade	Opaque panel	Brick cladding		m²		06_EW	03 or 04
Curtain wall	Double skin façade	Opaque panel	Stone cladding		m²		06_EW	03 or 04
Curtain wall	Other (Please describe >>)		-		m²	Please enter a description for any curtain wall that does not fit a predefined classification	06_EW	03 or 04

Stick-framed wall system	Aluminium frame	Glazed section	Single glazed		m^2	Include all single glazing, including standard, toughened, laminated and low-E	06_EW	03 or 04
Stick-framed wall system	Aluminium frame	Glazed section	Double glazed		m^2	Include all double glazing, including standard, toughened, laminated and low-E	06_EW	03 or 04
Stick-framed wall system	Aluminium frame	Glazed section	Triple glazed		m^2	Include all triple glazing, including standard, toughened, laminated and low-E	06_EW	03 or 04
Stick-framed wall system	Aluminium frame	Opaque section	Aluminium cladding		m^2		06_EW	03 or 04
Stick-framed wall system	Aluminium frame	Opaque section	GRC cladding		m^2	GRC = Glass-fibre Reinforced Concrete	06_EW	03 or 04
Stick-framed wall system	Aluminium frame	Opaque section	Insulated shadow box		m^2		06_EW	03 or 04
Stick-framed wall system	Aluminium frame	Opaque section	Brick cladding		m^2		06_EW	03 or 04
Stick-framed wall system	Aluminium frame	Opaque section	Stone cladding		m^2		06_EW	03 or 04
Stick-framed wall system	Steel frame	Glazed section	Single glazed		m^2	Include all single glazing, including standard, toughened, laminated and low-E	06_EW	03 or 04
Stick-framed wall system	Steel frame	Glazed section	Double glazed		m^2	Include all double glazing, including standard, toughened, laminated and low-E	06_EW	03 or 04
Stick-framed wall system	Steel frame	Glazed section	Triple glazed		m^2	Include all triple glazing, including standard, toughened, laminated and low-E	06_EW	03 or 04
Stick-framed wall system	Steel frame	Opaque section	Aluminium cladding	740	m^2		06_EW	03 or 04
Stick-framed wall system	Steel frame	Opaque section	GRC cladding		m^2	GRC = Glass-fibre Reinforced Concrete	06_EW	03 or 04
Stick-framed wall system	Steel frame	Opaque section	Insulated shadow box		m^2		06_EW	03 or 04
Stick-framed wall system	Steel frame	Opaque section	Brick cladding		m^2		06_EW	03 or 04
Stick-framed wall system	Steel frame	Opaque section	Stone cladding		m^2		06_EW	03 or 04
Stick-framed wall system	Other (Please describe >>)		-		m^2	Please enter a description for any wall system that does not fit a predefined classification	06_EW	03 or 04
Wall louvre system	Aluminium	-	-		m^2		06_EW	03 or 04
External shading system	Aluminium frame	Aluminium cladding	-	800	m^2	Please enter as m^2 of shaded area = linear metres * (width in mm / 1000)	06_EW	03 or 04
External shading system	Aluminium frame	GRC cladding	-	290	m^2	Please enter as m^2 of shaded area = linear metres * (width in mm / 1000). GRC = Glass-fibre Reinforced Concrete.	06_EW	03 or 04
External shading system	Aluminium frame	Terracotta cladding	-		m^2	Please enter as m^2 of shaded area = linear metres * (width in mm / 1000)	06_EW	03 or 04
External shading system	Aluminium frame	Stone cladding	-		m^2	Please enter as m^2 of shaded area = linear metres * (width in mm / 1000)	06_EW	03 or 04
External shading system	Aluminium frame	Pre-cast concrete	-		m^2	Please enter as m^2 of shaded area = linear metres * (width in mm / 1000)	06_EW	03 or 04
External shading system	Aluminium frame	Timber	-		m^2	Please enter as m^2 of shaded area = linear metres * (width in mm / 1000)	06_EW	03 or 04
External shading system	Aluminium frame	Glass (opague)	-		m^2	Please enter as m^2 of shaded area = linear metres * (width in mm / 1000)	06_EW	03 or 04
External shading system	Aluminium frame	Steel	-		m^2	Please enter as m^2 of shaded area = linear metres * (width in mm / 1000)	06_EW	03 or 04
External shading system	Other (Please describe >>)		-		m^2	Please enter as m^2 of shaded area = linear metres * (width in mm / 1000)	06_EW	03 or 04
Roller doors	Steel profile	-	-	390	m^2	Please note unit is <u>square metres</u>, not quantity	08_ED	03 or 04
Roller doors	Hardwood over steel	-	-		m^2	Please note unit is <u>square metres</u>, not quantity	08_ED	03 or 04
Roller doors	Softwood over steel	-	-		m^2	Please note unit is <u>square metres</u>, not quantity	08_ED	03 or 04
Revolving doors	Glass/aluminium/steel	-	-		no.		08_ED	03 or 04
Fire-rated doors	Engineered timber	-	-	2	no.	Please enter as single-leaf equivalent. For double-leaf doors, multiply the quantity by 2.	08_ED	03 or 04
Fire-rated doors	Steel	-	-		no.	Please enter as single-leaf equivalent. For double-leaf doors, multiply the quantity by 2.	08_ED	03 or 04
Fire-rated doors	Aluminium/glass	-	-		no.	Please enter as single-leaf equivalent. For double-leaf doors, multiply the quantity by 2.	08_ED	03 or 04
Insulation	Glass wool / fibreglass	-	-	3,112	m^2	Please include both wall and ceiling insulation	05_RF or 06_EW	03 or 04
Insulation	Stone wool	-	-		m^2	Please include both wall and ceiling insulation	05_RF or 06_EW	03 or 04
Insulation	Polyester	-	-		m^2	Please include both wall and ceiling insulation	05_RF or 06_EW	03 or 04
Insulation	Expanded polystyrene	-	-		m^2	Please include both wall and ceiling insulation	05_RF or 06_EW	03 or 04
Insulation	Other (Please describe >>)		-		m^2	Please include both wall and ceiling insulation	05_RF or 06_EW	03 or 04
Other (Please describe and add unit >>)		-	-			Please enter a description for any envelope material that does not fit a predefined classification		
Other (Please describe and add unit >>)		-	-			Please enter a description for any envelope material that does not fit a predefined classification		
Other (Please describe and add unit >>)		-	-			Please enter a description for any envelope material that does not fit a predefined classification		

Permanent internal walls and doors

Walls and doors within the building that are either structural or designed to be permanent.

Coverage of material spend on permanent internal walls and doors					%	Enter the % coverage of <u>spend</u> for the items you have entered below. There is no minimum requirement: enter what you know. This should include all structural walls. Exclude head contractor preliminaries and margins.		
Interior wall (permanent)	Steel (light framing)	-	-	2.50	t		09_NW	03 or 04
Interior wall (permanent)	Timber framing	-	-		m^3		09_NW	03 or 04
Interior wall (permanent)	AAC panel (reinforced)	-	-		m^2	Panels of autoclaved aerated concrete (AAC) with reinforcing steel. E.g., Hebel.	09_NW or 12_WF	03 or 04
Interior wall (permanent)	Concrete-filled steel panel	-	-		m^2	Panels made from a steel sheet outer with an aerated concrete core. E.g., Speedpanel.	09_NW or 12_WF	03 or 04
Interior wall (permanent)	Plasterboard	-	-	5,000	m^2	Enter as single-layer equivalent. If using 2 layers, multiply the area by 2.	09_NW or 12_WF	03 or 04
Interior wall (permanent)	Plywood	-	-		m^2	Enter as single-layer equivalent. If using 2 layers, multiply the area by 2.	09_NW or 12_WF	03 or 04
Interior wall (permanent)	Fibre cement sheet	-	-		m^2	Enter as single-layer equivalent. If using 2 layers, multiply the area by 2.	09_NW or 12_WF	03 or 04
Interior wall (permanent)	Insulation	-	-	900.0	m^2		09_NW or 12_WF	03 or 04
Interior wall (permanent)	Glass	-	-		m^2		09_NW or 12_WF	03 or 04
Interior wall (permanent)	Other (Please describe >>)		-		m^2	Please enter a description for any internal wall that does not fit a predefined classification	09_NW or 12_WF	03 or 04
Internal door (permanent)	Aluminium/glass	-	-		no.	Please enter as single-leaf equivalent. For double-leaf doors, multiply the quantity by 2.	11_ND	03 or 04
Internal door (permanent)	Timber/glass	-	-		no.	Please enter as single-leaf equivalent. For double-leaf doors, multiply the quantity by 2.	11_ND	03 or 04
Internal door (permanent)	Timber solid lightweight	-	-	30	no.	Please enter as single-leaf equivalent. For double-leaf doors, multiply the quantity by 2.	11_ND	03 or 04
Internal door (permanent)	Fire resistant	-	-	20	no.	Please enter as single-leaf equivalent. For double-leaf doors, multiply the quantity by 2.	11_ND	03 or 04
Internal door (permanent)	Steel	-	-		no.	Please enter as single-leaf equivalent. For double-leaf doors, multiply the quantity by 2.	11_ND	03 or 04
Internal door (permanent)	Other (Please describe >>)		-		no.	Please enter a description for any internal door that does not fit a predefined classification	11_ND	03 or 04
Other (Please describe and add unit >>)		-	-			Please enter a description for any material that does not fit a predefined classification		

Other (Please describe and add unit >>)		-	-			Please enter a description for any material that does not fit a predefined classification		
Other (Please describe and add unit >>)		-	-			Please enter a description for any material that does not fit a predefined classification		

Services

Building services included <u>within the main building contract</u>. If the building components that are the subject of the development application or the construction certificate are base building only, then only enter these items. If you cannot split services by type, please enter them all in the "Other services" category at the bottom. Enter all values as material costs in dollars.

					Unit of measure			
Mechanical services	-	-	-	4,840,000	AUD excl. GST	Where possible, enter material costs excluding labour, plant, equipment, margins and taxes	28_SS	05
Vertical transportation	-	-	-	1,936,000	AUD excl. GST	Where possible, enter material costs excluding labour, plant, equipment, margins and taxes	28_SS	05
Electrical services	-	-	-	2,904,000	AUD excl. GST	Electrical services including the main power supply, backup generators, security and communications. Excluding solar installations. Where possible, enter material costs excluding labour, plant, equipment, margins and taxes.	26_LP	05
Solar photovoltaic installations	-	-	-	40,000	AUD excl. GST	Where possible, enter material costs excluding labour, plant, equipment, margins and taxes	26_LP_LPGP	05
Plumbing/hydraulic services	-	-	-	2,323,200	AUD excl. GST	Where possible, enter material costs excluding labour, plant, equipment, margins and taxes	18_PD and 19_WS	05 or 06
Fire services				1,548,800	AUD excl. GST	Where possible, enter material costs excluding labour, plant, equipment, margins and taxes	25_FPSS04 or 39 XWAW_03 or 41_XF	05
Other services (Please describe)		-	-		AUD excl. GST	Please group all other services here, meaning that coverage will always be 100% for services. Enter only the material costs (excluding labour, plant, equipment, margins and taxes).	29_SS or multiple	

External works

The materials associated with hard landscaping and outbuildings on the site but outside the building envelope.
This includes hardstands, carparks, driveways, covered walkways, decks, patios, awnings, fences, gates, etc. Soft landscaping should be excluded.

Coverage of spend on external works	-	-	-	80	%	Required. Coverage of <u>spend</u> for external works (excluding soft landscaping) entered below. Minimum requirement = 80%. Exclude head contractor preliminaries and margins.		
Asphalt	-	-	-		t		33_XR	07
Concrete in-situ	≤10 MPa	-	-		m³	Please enter reinforcing steel as part of "Reinforcing steel" below	33_XR or 34_XN or 35_XB or 36_XL	07
Concrete in-situ	>10 MPa to ≤20 MPa	-	-		m³	Please enter reinforcing steel as part of "Reinforcing steel" below	33_XR or 34_XN or 35_XB or 36_XL	07
Concrete in-situ	>20 MPa to ≤32 MPa	-	-		m³	Please enter reinforcing steel as part of "Reinforcing steel" below	33_XR or 34_XN or 35_XB or 36_XL	07
Concrete in-situ	>32 MPa to ≤40 MPa	-	-		m³	Please enter reinforcing steel as part of "Reinforcing steel" below	33_XR or 34_XN or 35_XB or 36_XL	07
Concrete in-situ	>40 MPa to ≤50 MPa	-	-		m³	Please enter reinforcing steel as part of "Reinforcing steel" below	33_XR or 34_XN or 35_XB or 36_XL	07
Concrete in-situ	>50 MPa	-	-		m³	Please enter reinforcing steel as part of "Reinforcing steel" below	33_XR or 34_XN or 35_XB or 36_XL	07
Pavers, bricks and blocks	Concrete	-	-	610	m²		33_XR	07
Pavers, bricks and blocks	Clay	-	-		m²		33_XR	07
Reinforcing steel	Bar & mesh	-	-		kg	**Include all reinforcing steel bar/mesh in the external works in this row.** Usually this is calculated as kg/m³ per concrete element and then summed. Example: 10 m³ of 40 MPa concrete @ 100 kg/m³ + 5 m³ of 50 MPa concrete @ 150 kg/m³ = 1,750 kg reinforcing steel.	33_XR or 34_XN or 35_XB or 36_XL	07
Reinforcing steel	Fibre & strand	-	-		kg	**Include all steel fibre reinforcing and steel strand in the external works in this row.**	33_XR or 34_XN or 35_XB or 36_XL	07
Structural steel	-	-	-		t		02_11	07
Structural aluminium	-	-	-		t	Includes structures, louvre systems, etc.	35_XB	07
External roof/wall cladding	Polycarbonate	-	-		m²	Enter as profiled polycarbonate sheet that would ordered, including allowance for overlap	35_XB	07
External roof/wall cladding	PVC	-	-		m²	Enter as profiled PVC sheet that would ordered, including allowance for overlap	35_XB	07
External roof/wall cladding	Bitumen sheet	-	-		m²	Enter as bituminous sheet that would ordered, including allowance for overlap	35_XB	07
External roof/wall cladding	Steel profile	-	-		m²	Enter as profiled steel sheet that would ordered, including allowance for overlap	35_XB	07
Fill	-	-	-		t	Include purchased material only. Exclude site-won material.	33_XR or 34_XN or 35_XB or 36_XL	07
Sand & gravel	-	-	-		t	Include purchased material only. Exclude site-won material and sand/gravel in concrete.	33_XR or 34_XN or 35_XB or 36_XL	07
Timber (solid)	Sawn softwood	-	-		m³		33_XR or 34_XN or 35_XB or 36_XL	07
Timber (solid)	Sawn hardwood	-	-		m³		33_XR or 34_XN or 35_XB or 36_XL	07
Timber (engineered)	CLT	-	-		m³		33_XR or 34_XN or 35_XB or 36_XL	07
Timber (engineered)	Glulam	-	-		m³		33_XR or 34_XN or 35_XB or 36_XL	07
Timber (engineered)	LVL	-	-		m³		33_XR or 34_XN or 35_XB or 36_XL	07
Timber (engineered)	OSB	-	-		m³		33_XR or 34_XN or 35_XB or 36_XL	07
Fabric (awning/sunshade)					m²		35_XB or 36_XL	07
Other (Please describe and add unit >>)		-	-			Please enter a description for any external works that does not fit a predefined classification		
Other (Please describe and add unit >>)		-	-			Please enter a description for any external works that does not fit a predefined classification		
Other (Please describe and add unit >>)		-	-			Please enter a description for any external works that does not fit a predefined classification		

Step 3: Certifier details

Fill out blue cells

The material quantities must be determined through an itemised list of building materials (such as a bill of quantities) and certified by a quantity surveyor, designer, engineer or NABERS Assessor.

Person that completed this form	Value	Note
Name	Benhrooz Shojaei	Required
Company	IGS - Integrated Group Services	Required
ABN	68163019029	
Profession	Senior ESD Engineer	Required
Qualification or registration	Professional Engineer - Inst. Engineers Australia Senior ESD Engineer - 20 years of experience NABERS, Green Star Accredited Engineer.	Required

Person that certified the details in this form	Value	Note
Name	Benhrooz Shojaei	Required
Company	IGS - Integrated Group Services	Required
ABN	68163019029	
Profession	Senior ESD Engineer	Required
Qualification or registration	Professional Engineer - Inst. Engineers Australia Senior ESD Engineer - 20 years of experience NABERS, Green Star Accredited Engineer.	Required

Confirmation of certification	Value	Note
Are 80% of material costs captured for the building's structure, envelope and external works?	Yes	Required
If no - why not?	-	

Additional comments from data provider

Additional comments of certifier

Attach this Excel spreadsheet to your development application or construction certificate application.