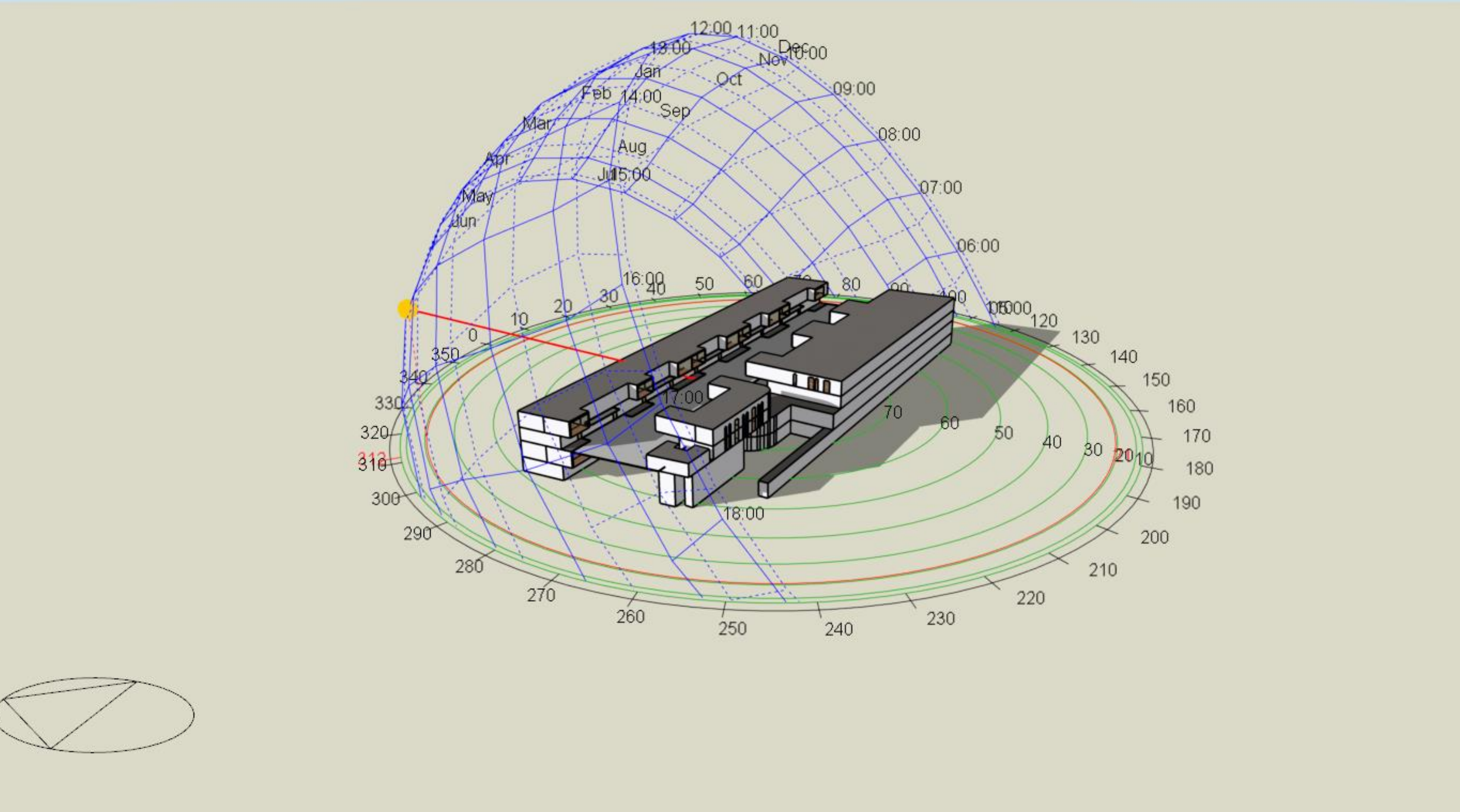


101 - 105 Old Pittwater Rd, Brookvale NSW

Sustainability Assessment Report

VALUE | INNOVATION | TRUST

Suite 1.11, 75 Mary Street,
St Peters NSW 2044
Phone: +61 2 8488 4600
Fax: +61 2 9475 4588
Email: admin@igs.com.au
Web: www.igs.com.au
linkedin.com/company/3213174
ABN: 68 163 019 029

Document Control

Revision	Date	Author	
1.0	13 April 2022	B.Shojaei	BS
1.1	14 April 2022	B.Shojaei	BS

CONTENTS

1 EXECUTIVE SUMMARY

IGS has been engaged by to undertake the required Ecologically Sustainable Design (ESD) assessments and provide a sustainability report for the proposed development 101-105 Old Pittwater Rd, Brookvale NSW.

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:

Load Reduction (minimising the need for resource consumption e.g. energy, water and material)	Passive Design
	Building fabric improvements
	Natural lighting
Optimising energy and water consumption	High efficiency Heating, Ventilation and Air Conditioning
	High efficiency lighting
	High efficiency hot water systems
	High efficiency appliances
Use of renewable resources (renewable energy and rainwater harvesting)	Application of Solar Energy where practical
	Rainwater harvesting

Benchmarking and compliance requirements:

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

- D22 of the Warringah Control Plan
- NCC 2019 Section J (Energy Efficiency – outlined as part of the NCC Section J JV3 Report)

Sustainability targets beyond the minimum requirements

Although not seeking formal rating certification, where feasible, the design team will also consider the sustainable design principles based on the following sustainability tool.

- Green Star Design & As Built Tool – Green Building Council of Australian.

2 INTRODUCTION

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.

Location – 101-105 Old Pittwater Rd, Brookvale NSW – Source: Google Map

The project architect, consultants and contractors will strive to design and construct the building based on the Environmentally Sustainable Design (ESD) principles which exceed the minimum 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.

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
- Emission reductions and material optimisation
- Maximise use of non-toxic building material
- Maximise use of materials that are recyclable
- Minimise Waste in Construction
- Minimise Waste in Operation.

3 Benchmarking

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

- D22 of the Warringah Control Plan
- NCC 2019 Section J (Energy Efficiency – outlined as part of the NCC Section J JV3 Report)

Sustainability targets beyond the minimum requirements:

Although not seeking formal rating certification, where feasible, the design team will also consider the sustainable design principles based on the following sustainability tool.

- Green Star Design & As Built Tool – Developed by Green Building Council of Australian

3.1 D22 Conservation of Energy and Water

In this section we provide a descriptive response to the requirements of D22 of the Warringah Control Plan, further the Client confirmed that a restriction as to user and positive covenant will be prepared in response to conditions of DA consent and implemented prior to occupation of the development.

Requirements	Design Response
The orientation, layout and landscaping of sites is to make the best use of natural ventilation, daylight and solar energy.	The proposed design appropriately responds to the intended function and use of the development. It is noted that the nature of a large warehouse building with limited amount of glazing and openings on the façade does not present many opportunities to implement passive solar design principles typical of other building classes.
Site layout and structures are to allow for reasonable solar access for the purposes of water heating and electricity generation and maintain reasonable solar access to adjoining properties.	The development does not negatively impact solar access to adjoining properties.
Buildings are to be designed to minimise energy and water consumption	The proposed building has the design potential to outperform the minimum energy efficiency performance requirements of the NCC2019 (refer to Appendix A). Further, all water fittings and appliances shall have the following WELS ratings: Taps – 6 Stars Toilets – 4 Stars Urinals – 4 Stars Showers – 3 Stars (>4.5 but <=6.0)
Landscape design is to assist in the conservation of energy and water.	The proposed landscaping shall use drought-tolerant species that do not require irrigation after the initial establishment period. Where vegetation requiring ongoing irrigation is selected, a sub-soil irrigation system shall be installed.
Reuse of stormwater for on-site irrigation and domestic use is to be encouraged, subject to consideration of public health risks.	Rainwater from the clean roof area shall be temporarily stored in rainwater tanks and re-used for landscape irrigation (refer to Section 4.7.3).
All development must comply with Council's Water Management Policy.	The development shall comply with relevant water management policies and regulations. The appointed civil and hydraulic engineers / contractors shall provide the necessary supporting documentation as required by the relevant authority.

3.2 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
- JV3 – Verification using a referenced building.

The Deemed-to-Satisfy Provisions in Section J of the NCC 2019 include the following 8 components.

- Part J1 - Building Fabric – Minimum thermal performance constructions for roofs, ceilings, roof lights, walls, glazing and floors in the relevant climate zone.
- Part J2 - Blank in NCC 2019
- Part J5 - Air-Conditioning and – Provisions to reduce the loss of conditioned air and restrict unwanted infiltration to a building.
- Part J4 – Blank in NCC 2019
- Part J5 - Air-Conditioning and Ventilation Systems – Requirements to ensure these services are used and use energy in an efficient manner.
- Part J6 - Artificial Lighting and Power – Requirements for lighting and power to ensure energy is used efficiently within a building.
- Part J7 - Hot Water Supply – Restrictions for hot water supply design except for solar systems within climate zones 1, 2 and 3.
- Part J8 - Facilities for Energy Monitoring

The development will meet and outperform the NCC energy efficiency requirements of Part J.

3.3 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:

- Design and As-Built
- Office Interiors
- Performance
- Communities

Green Star rating tools use Stars to rate performance:

- 4 Star Green Star Certified Rating (score 45-59) signifies 'Best Practice'
- 5 Star Green Star Certified Rating (score 60-74) signifies 'Australian Excellence'
- 6 Star Green Star Certified Rating (score 75-100) signifies 'World Leadership'

Green Star rating tools include nine separate environmental impact categories as follows.

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

The development is not seeking a formal Green Star certification, however, where feasible, the design team will consider the sustainable design initiatives associated with Green Star.

3.4 Development Location

The development is located in Brookvale NSW which is within the NCC climate zone 5 (warm temperate).

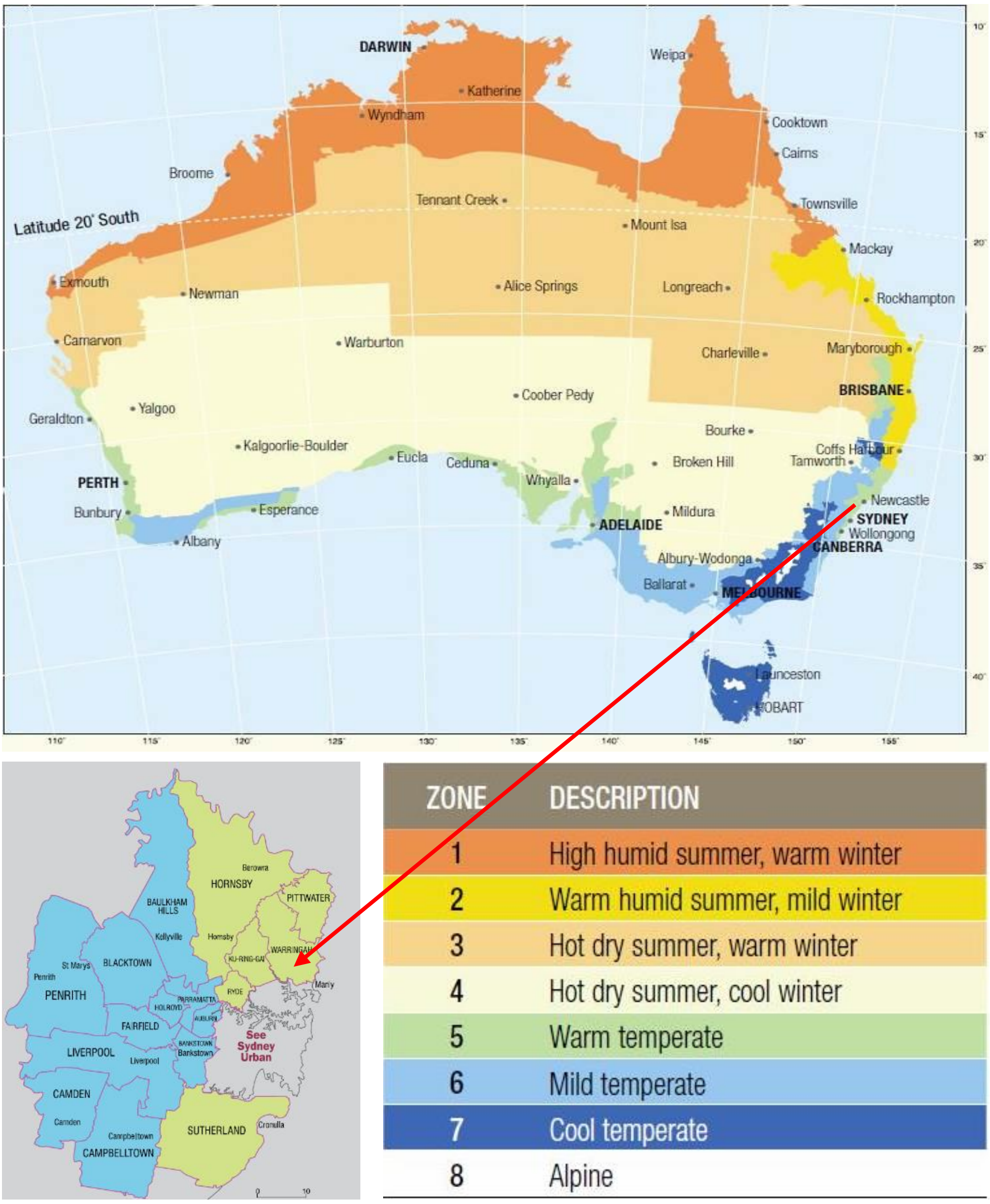


Figure 1. Climate Zone Map.

3.5 Information Used in Review

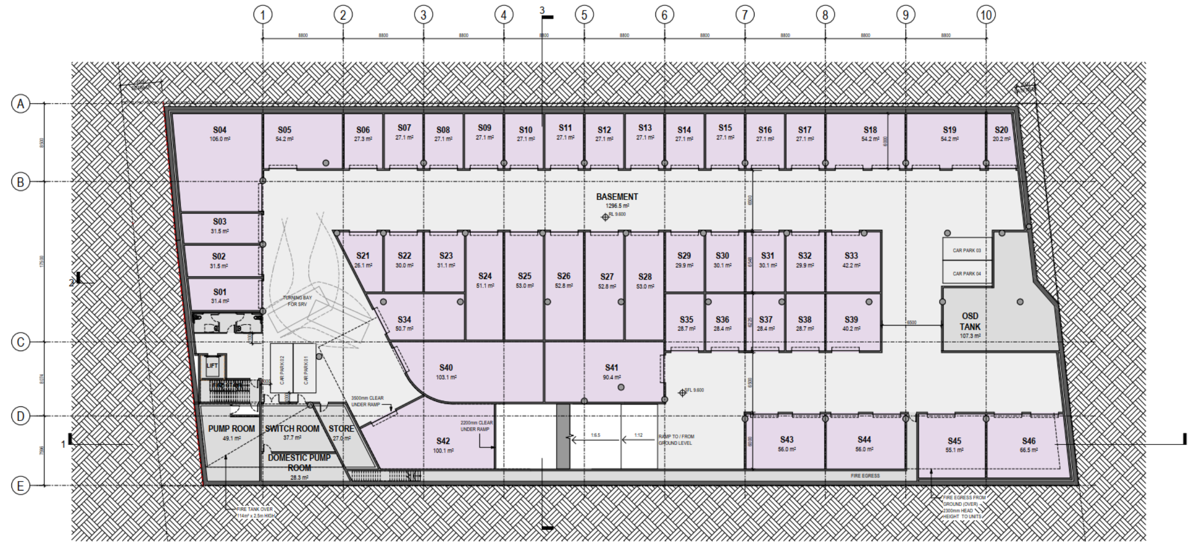
Our review is based on the following preliminary architectural drawings provided by Rothelowman Architecture.

Drawing Title	Drawing Number	Date of Issue
Floor Plans – Basement to Level 1 Mezzanine	SK01.01 to SK01.05	6.04.2022
Elevations	SK02.02	7.04.2022
Sections	SK03.01	1.04.2022

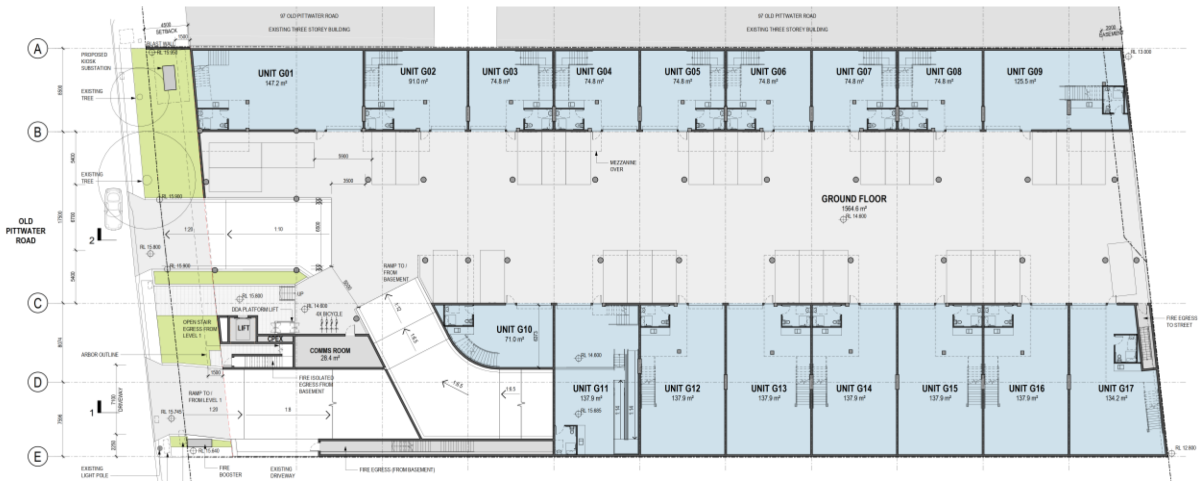
3.6 Architectural Drawings

Selected architectural drawings for the proposed development are provided below.

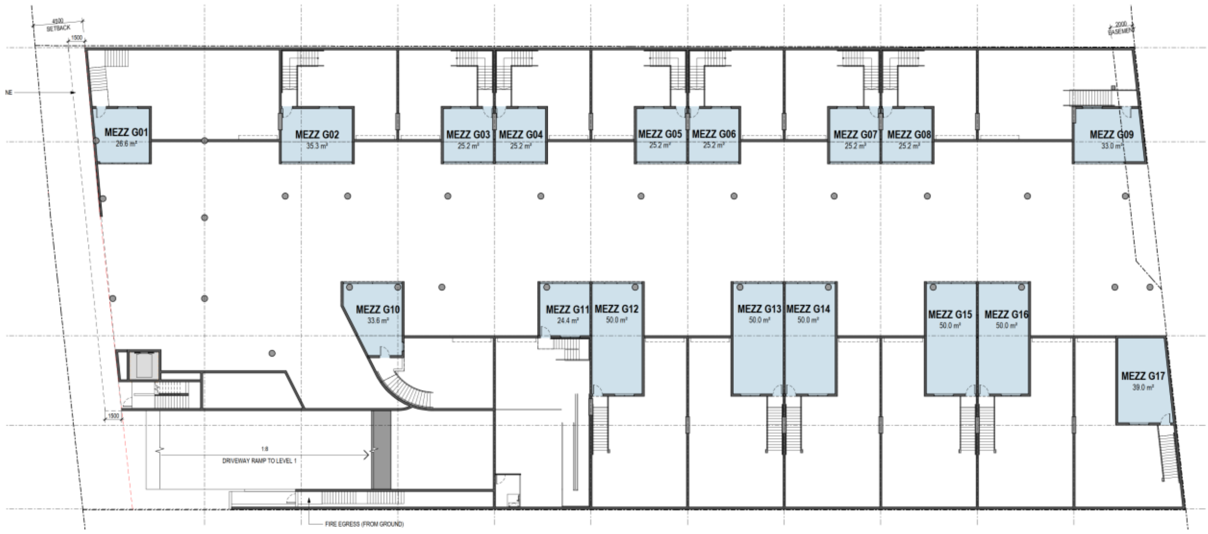
Basement – Floor Plan



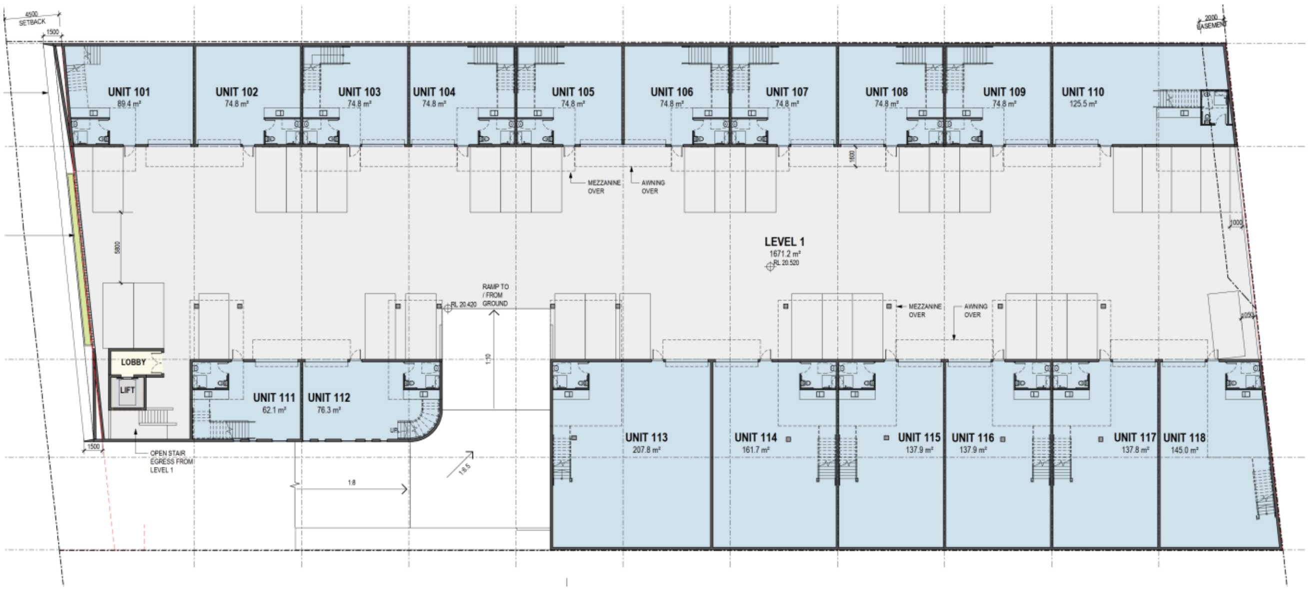
Ground – Floor Plan



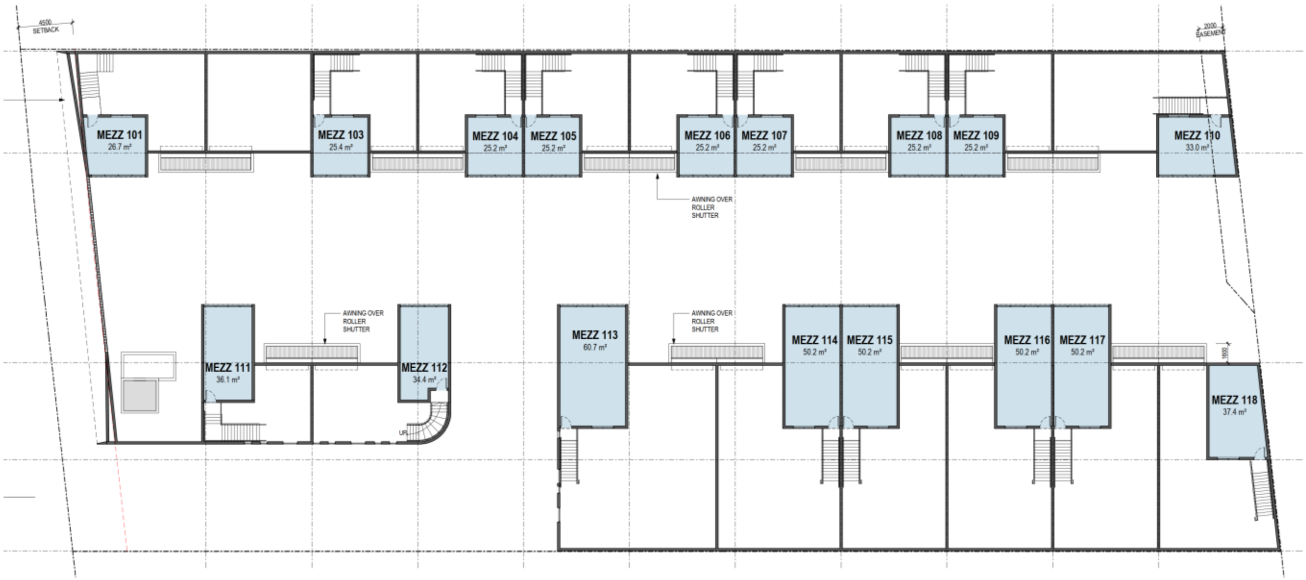
Ground Mezzanine – Floor Plan



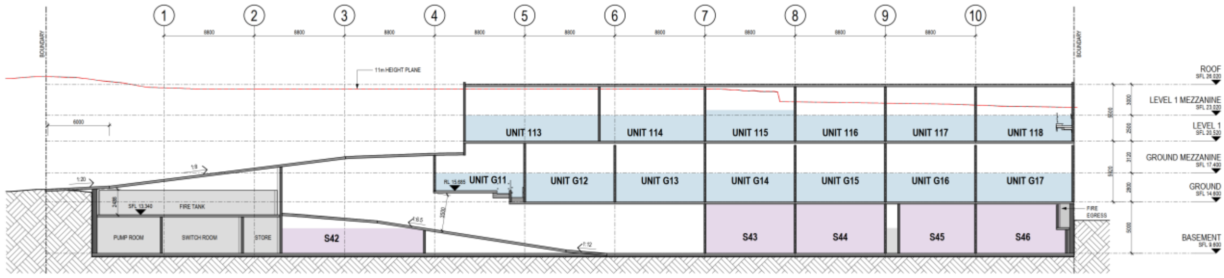
Level 1 – Floor Plan



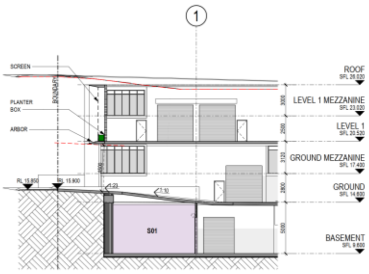
Level 1 Mezzanine – Floor Plan



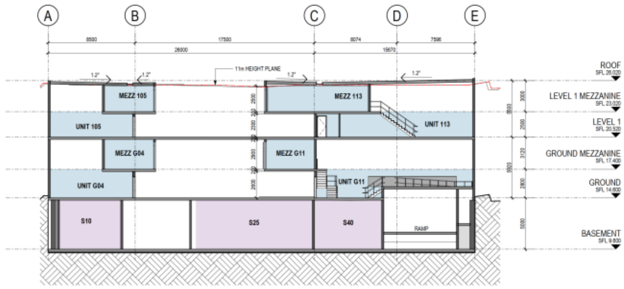
Sections



SECTION 1

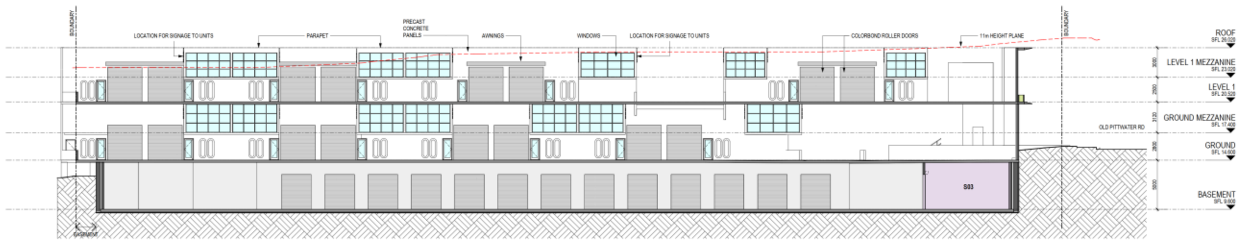


SECTION 2



SECTION 3

Elevations



ELEVATION 5
SCALE 1 : 200

ELEVATION 6
SCALE 1 : 200

4 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.

4.1 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.

4.2 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.

4.3 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.

4.3.1 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 occupants and for demonstrating ESD achievement.

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

It is recommended to involve a Green Star Accredited Professional (GSAP) as part of the design to prepare the necessary ESD guidelines. The ESD consultant from IGS (author of this report) is a Green Star Accredited Professional.

4.3.2 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).

4.3.3 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.

4.3.4 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.

4.3.5 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.

4.4 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
- 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.

4.4.1 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 development is required to meet the minimum performance levels for the thermal comfort of the conditioned spaces in compliance with NCC Part J.

4.4.2 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.

4.5 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:

Load reduction	Passive Design
	Maximise use of natural lighting
	Energy efficient equipment
	Water efficiency in hot water systems
Building Services System Efficiency	High Efficiency in Heating, ventilation and Air Conditioning
	High efficiency LED
	High efficiency hydraulic services
	High efficiency appliances
Renewable Energy	Solar PV (if deemed feasible by the design team)

4.5.1 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

4.5.2 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.

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.

The thermal insulation requirements will be compliant with the minimum NCC Section J requirements.

Glazing and Window Framing

Adequate performance glass will be provided to reduce excessive heat gains in hot conditions, and therefore 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) are 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.

The glazing performance requirements shall comply with the minimum requirements outlined under the Energy Performance Report (see Appendix A)

4.5.3 Energy Efficient Systems and Services

The mechanical and electrical systems for the building 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.

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 where applicable;
- 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 site. 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.

<u>Efficient Heating, Ventilation & Air-Conditioning (HVAC)</u>

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 minimal 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.

<u>Monitoring & reporting</u>

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.

<u>Hot Water Systems</u>

High efficiency instantaneous hot water systems will be used to provide the Domestic Hot Water demands for the facility.

4.6 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.
- Promote nearby cyclist facilities to enhance the uptake of cyclists to the site.
- Integrate transport initiatives into community engagement and communication strategies.

Given the site location of the development, the occupants will be able to take advantage of local public transport networks and available facilities around the site 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.

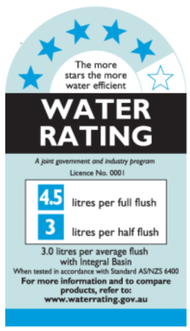
- **Cyclist facilities:** provision of bicycle racks to promote the use of cycling to work.
- **Public Transport:** The building is close to public transport with a number of bus routes served; building occupants are encouraged to use mass transport to travel to work.
- **Trip Reduction:** The development is located adjacent to a number of 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.

4.7 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.



4.7.1 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 exceed the BASIX requirements. The following criteria are provided as a guide and subject to further design development.

Water Fixtures	Hand wash basins – 6 Star WELS;
	Kitchen taps (where provided) – 6 Star WELS;
	Showerheads (where provided) – 3 Star WELS or higher;
	Toilets – 4 Star WELS or higher;
Appliances	Dishwashers (where provided) – 4 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

4.7.2 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.

4.7.3 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.

4.7.4 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.

4.8 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.

4.8.1 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.

4.8.2 Materials with Ozone Depletion Potential

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

4.8.3 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.

4.8.4 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.

4.8.5 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.

4.9 Land Use and Ecology

This initiative refers to improvements through Reuse of Land or Change of Ecological Value. The site 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.

4.10 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 a low Ozone Depletion Potential; 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.

5 Disclaimer

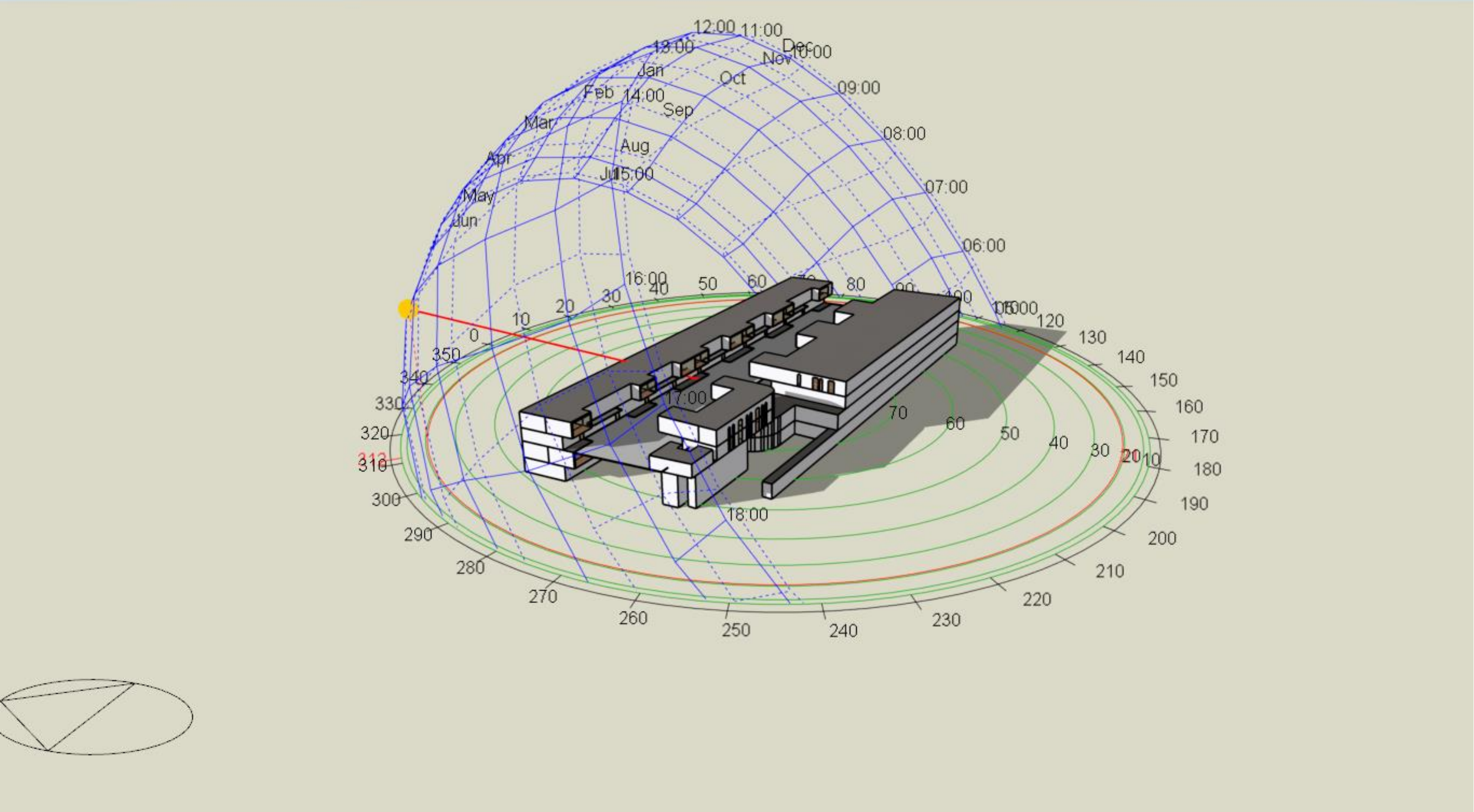
This report is prepared using the information described above and inputs from other consultants. Whilst IGS has endeavoured to ensure the information used is accurate, no responsibility or liability to any third party is accepted for any loss or damage arising out of the use of this report by any third 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 BASIX 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 – Energy Performance Report

IGS INTEGRATED GROUP SERVICES



101 - 105 Old Pittwater Rd, Brookvale NSW

Energy Performance Report

NCC Section J (Energy Efficiency) – JV3 Assessment

14 April 2022

Suite 1.11, 75 Mary Street,
St Peters NSW 2044
Phon: +61 2 8488 4600
Fax: +61 2 9475 4588
Email: admin@igs.com.au
Web: www.igs.com.au
linkedin.com/company/3213174
ABN: 68 163 019 029

Document Control

Revision	Date	Author	
1.0	13 April 2022	B.Shojaei	BS
1.1	14 April 2022	B.Shojaei	BS

CONTENTS

1 Executive Summary

IGS has been engaged to review the energy performance of the proposed development at 101 - 105 Old Pittwater Road Brookvale NSW against the requirements for the National Construction Code 2019 provisions for energy efficiency under Section J (NCC 2019 Amendment 1 Volume 1, Part J).

This report details the outcome of a National Construction Code (NCC) 2019 Section J assessment (JV3) to determine compliance requirements for the proposed building. Energy simulations were undertaken to provide an alternative method of verification (JV3) in relation to NCC Section J in order to allow for glazing and insulation variations within the development.

JV3 requires the comparison of a reference building (Case 1) to two proposed building models, one having the reference building (Case 2) and one having the same services as the proposed services (Case 3). The comparison is based on the forecasted annual greenhouse gas emissions. Furthermore, in the proposed building (case 3), a thermal comfort level of between a Predicted Mean Vote of -1 to +1 is required across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building.

Table 1 details the computer simulation results for the simulation cases undertaken in compliance with the JV3 Verification Method. The simulation process is detailed as part of this report.

Table 1. Result Summary.

	Case 1 Reference Building [DTS Fabric and DTS Services]	Case 2 Proposed Building [Proposed Fabric and DTS Services] *	Case 3 Proposed Building [Proposed Fabric and Proposed Services] *	Compliance Achieved
Annual greenhouse gas emissions	200,426 kg p.a.	200,280 kg p.a.	200,280 kg p.a.	YES

** The "proposed services" under the modelling case 3 have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same (200,280 kg/annum).*

The results show that the total annual Greenhouse Gas emission of the Proposed Building models is less than the annual Greenhouse Gas of the Reference Building. The glazing and insulation systems utilised within the proposed building are therefore compliant with the performance requirement of JP1 under JV3 method of verification.

Building Fabric Compliance Options

Table 2 outlines the glazing and thermal insulation levels utilised in the Proposed Building simulations. Based on this assessment, systems with performance level of equal or better will achieve NCC Part J compliance under the JV3 method of verification.

Table 2. Minimum Building Fabric Requirements.

Envelope (separating conditioned and un-conditioned zones)	Minimum Insulation & Glazing Requirements
Roof / Ceiling	Minimum total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.
Walls	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.
Glazing	All Glazing Components: • Total system U-Value $\leq$ 4.9 • Total system SHGC $\leq$ 0.49
Floors	Suspended Floors (where any): minimum total R2.0 thermal insulation. Concrete Slab on Ground: no added insulation required.

Other	• Building services: minimum DTS performance or better. • Thermal comfort level of between a Predicted Mean Vote of -1 to +1 across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building.

A summary of the NCC Section J requirements is provided in section 7 of this report.

Subject to satisfaction of the provisions outlined in this report, this development will comply with the requirements of Section J of NCC 2019 Amendment 1. The location of the development is shown in Figure 1.

Figure 1. Location of the development - 101 - 105 Old Pittwater Road Brookvale NSW– Source: Google Map.

2 Introduction

IGS has been engaged to review the energy performance of the proposed development at 101 - 105 Old Pittwater Road Brookvale NSW against the requirements for the National Construction Code 2019 provisions for energy efficiency under Section J.

The minimum required deemed- to-satisfy (DTS) provisions for Section-J, has been established as per Volume One of NCC 2019. Energy simulation was undertaken to provide an alternative method of verification (JV3) in relation to NCC Section J in order to allow for glazing and thermal insulation variations within the development.

The assessment process under JV3 requires a comparison of simulated annual energy consumption of a reference building to the proposed building utilising the required assumptions and inputs for JV3. The reference building is based on the proposed building with the performance of all features set to the minimum performance in order to achieve DTS compliance with the provisions of Part J1 to J7.

The proposed building in this assessment also utilises DTS compliance performance of the provisions of Part J1 to J8 excluding those of Part J1 in relation to the glazing and insulation system performance as outlined in section 7 of this report.

On this basis, the outcome of this JV3 assessment demonstrates achievement of compliance for the proposed glazing and thermal insulation variations for the building (outlined in section 7). Compliance with the DTS provisions for all the other parts is therefore required by all the applicable design trades of the development.

A summary of the NCC Section J requirements for the development is provided in section 7 of this report.

Compliance with JP1 has been verified in accordance with JV3 requirements and utilising Design Builder energy modelling software package that is ABCB protocol compliant and strictly in accordance with the following guideline:

- NCC Section J Part JV3 Verification Using a Reference Building

3 National Construction Code - Section J

The National Construction Code (NCC) 2019 includes mandatory minimum energy performance requirements for buildings (Class 3, Class 5 to 9) in Section J. The objective is to reduce building greenhouse gas emissions by efficiently using operational energy. Section J is focused on establishing minimum acceptable practice in the building industry.

To meet the performance requirements JP1 of Section J of the NCC, compliance of the design and function of the building can be demonstrated with the Deemed-To-Satisfy (DTS) provisions of Section J Parts J1 to J8. Alternatively, achievement of the performance requirements can be demonstrated through Verification Method JV3.

- Part J1 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 J3 Building Sealing details requirements in order to restrict unwanted infiltration into a building.
- Part J5 Air-Conditioning and Ventilation Systems details requirements to ensure these services are used and use energy in an efficient manner.
- Part J6 Artificial Lighting and Power details requirements for lighting and power to ensure energy is used efficiently by these systems.
- Part J7 Heated Water Supply and Swimming Pool & Spa Pool Plant details requirements for hot water supply design.
- Part J8 Facilities for Energy Monitoring.

3.1 NCC JV3 - Verification using a reference building

Compliance with JP1 is verified when:

a. it is determined that the annual greenhouse gas emissions of the proposed building are not more than the annual greenhouse gas emissions of a reference building when—

- the proposed building is modelled with the proposed services; and
- the proposed building is modelled with the same services as the reference building; and

b. in the proposed building, a thermal comfort level of between a Predicted Mean Vote of -1 to +1 is achieved across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building; and

c. the building complies with the additional requirements in Specification JVa.

i. renewable energy generated and used on site; and

ii. another process such as reclaimed energy, used on site. The annual greenhouse gas emissions of the proposed building may be offset by—

The calculation method used for (A) and (B) must comply with—

i. ANSI/ASHRAE Standard 140; and

ii. Specification JVb.

The following section summarises the process of performing the NCC Section J Performance Solution JV3 used in this study:

Modelling Case 1 (Reference Building): Calculated the theoretical annual greenhouse gas emissions by modelling a reference building. This was the DTS complying building based on the JV3 criteria provided in the following pages.

Modelling Case 2: Calculated the theoretical annual greenhouse gas emissions of the proposed Alternative Solution with the services modelled as if they were the same as those of the reference building.

Modelling Case 3: Calculated the theoretical annual greenhouse gas emissions of the proposed Alternative Solution (building and services).

The theoretical greenhouse gas emissions calculated in cases 2 and 3 were then compared to the annual greenhouse gas emissions calculated in case 1 to ensure that in both cases, the annual emissions of the reference building in case 1 is not exceeded by that in cases 2 and 3.

The following tables outline the NCC requirements for the JV3 method of verification which were considered in all the modelling runs for the Reference Building.

(a) The reference building must— (i) comply with Deemed-to-Satisfy Provisions in Parts J1 to J7; and (ii) have the minimum amount of mechanical ventilation required by Part F4.
(b) The external walls must have a solar absorptance of 0.6.
(c) The air-conditioning must— (i) for 98% of the annual hours of operation, achieve temperatures between— (A) 18°CDB to 25°CDB for conditioned spaces with transitory occupancy; and (B) subject to (ii), 21°CDB to 24°CDB in all other conditioned spaces; and (ii) if the proposed building has no mechanically provided cooling or has mixed mode cooling, have the same method of control and control set points for non-mechanical cooling as the proposed building.
(d) The infiltration rate in each zone must be— (i) 0.7 air changes per hour throughout all zones when there is no mechanically supplied outdoor air; and (ii) 0.35 air changes per hour at all other times.
(e) The artificial lighting must achieve the required maximum Illumination power density in Part J6 without applying the control device adjustment factors.
(f) Minimum Energy Performance Standards must be applied to services not covered by Parts J5 to J7.

4 Building Description

4.1 NCC Climate Zone & Building Classification

The climate zone is defined by the NCC as ‘an area for specific locations, having energy efficiency provisions based upon a range of similar climatic characteristics.

The proposed development will be located in Brookvale NSW which is within the NCC climate zone 5 (Warm temperate). The climate zone map of the development is depicted in Figure 2.

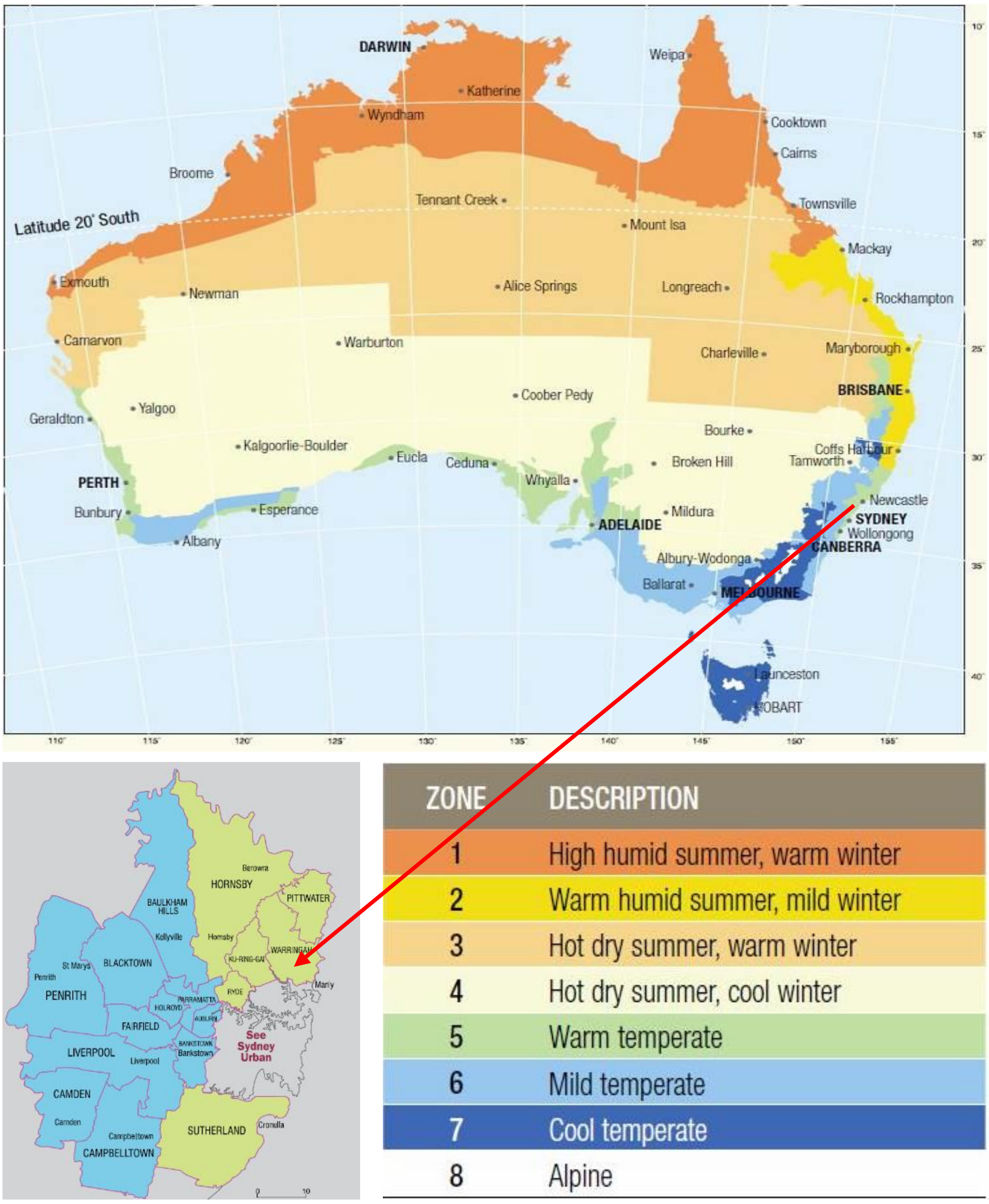
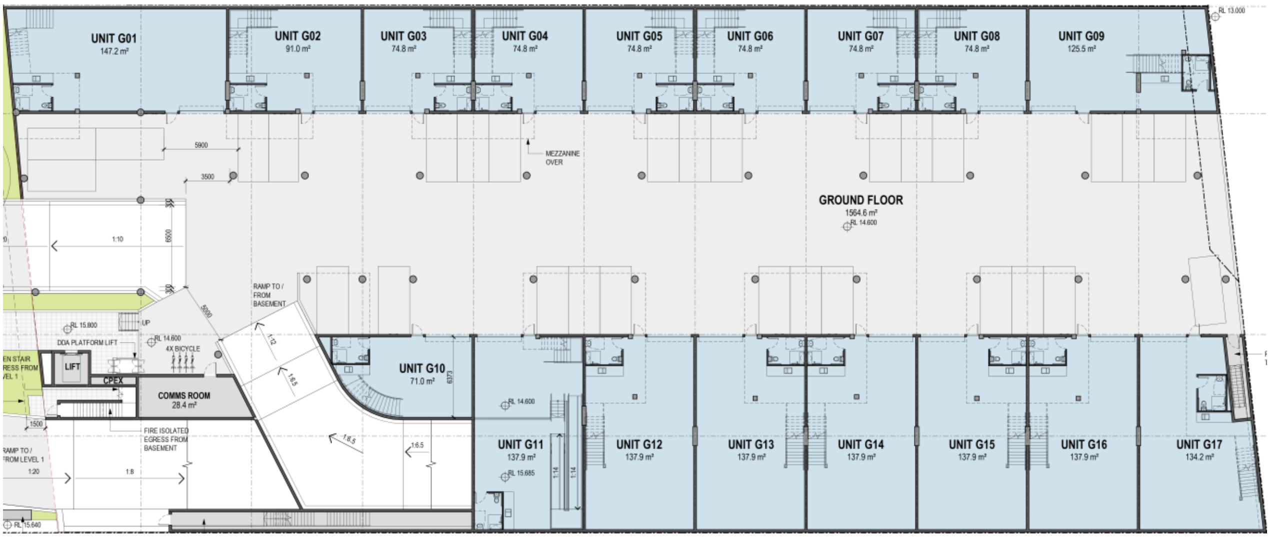


Figure 2. Climate Zone Map.

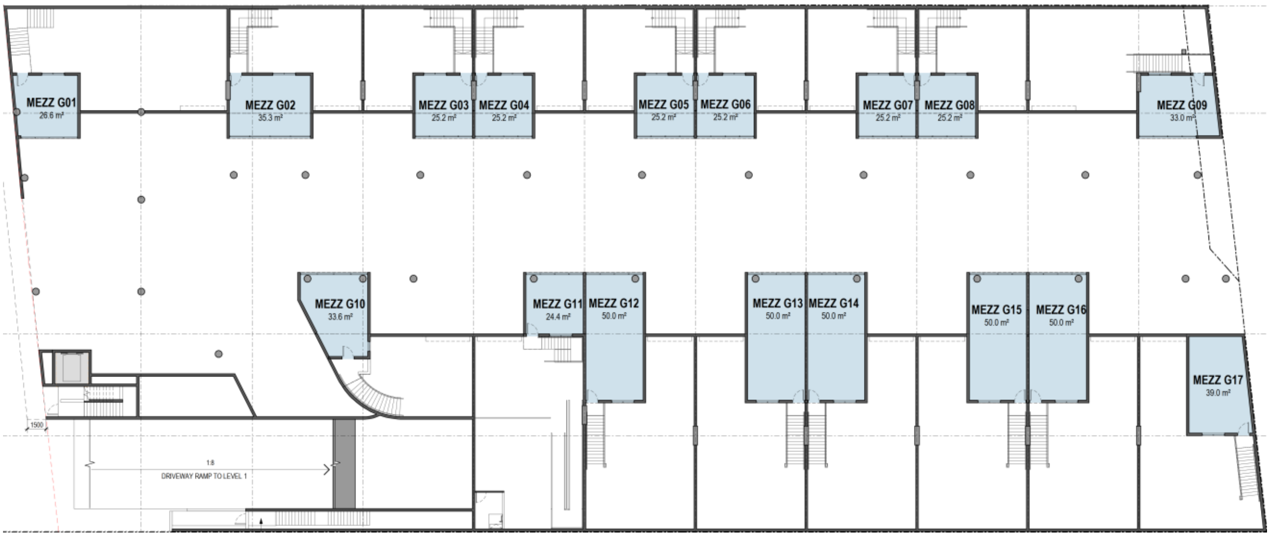
4.2 Architectural Drawings

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

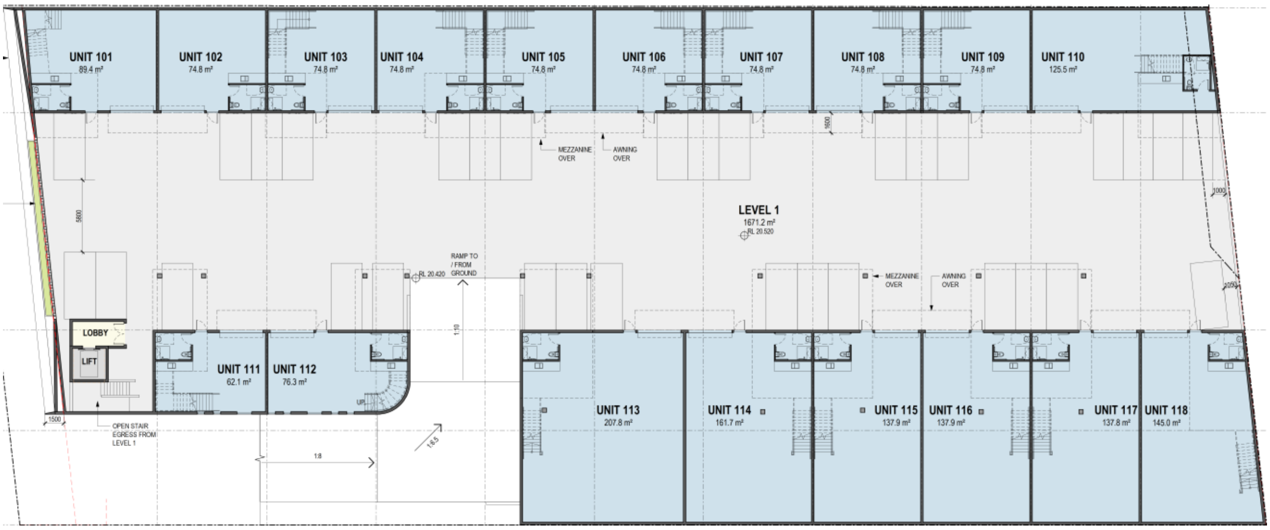
Floor plan - Ground Floor



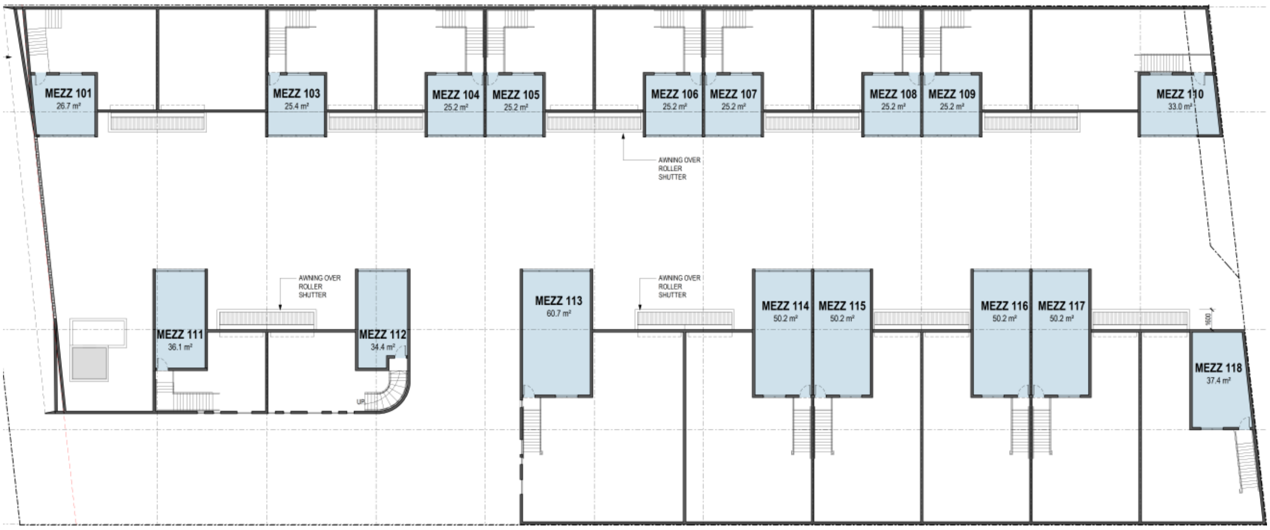
Floor plan – Ground Mezzanine



Floor plan – Level 1



Floor plan - Level 1 Mezzanine



Northern Elevation

Southern Elevation

4.3 Scope of Analysis

The scope of this report is based on;

1. Review & interpretation of the architectural drawings to determine the Section J envelope and orientation of the building for assessment.
2. Parts J1 compliance (see sections 5 and 7 of the report)
    - Review and interpretation of façade and glazing dimensions based on the architectural drawings.
    - Establish glazed areas of building envelope to conduct Part J1 DTS analysis (wall-glazing).
    - Input parameters (façade area, external shading devices and glazing dimensions) into the NCC 2019 Amendment 1 - J1 Calculator (Facade) which is currently available in Beta version only.
3. JV3 compliance (see Section 6)
    - Conduct energy modelling for a reference building using the DTS results of the Parts J1 assessment and inputs reflecting achievement of minimum performance under the DTS provisions of Parts J3-J8. The energy modelling conducted is based on geometry development from the architectural and facade documentation.
    - Conduct energy modelling runs for the proposed building using glazing system thermal performances to reflect products in alignment with the architectural design intent.
    - Comparison of the annual energy consumption to determine JV3 compliance for the building with proposed level of glazing and wall insulation performance.

4.4 Information Used

The assessment within the report presents the requirements of Section J Part JV3 with respect to the documented design of the development. The assessment format generally follows the layout of Clauses within NCC Section J, to demonstrate the compliance requirements for Part J1. The assessment is based on the following architectural drawings prepared by Rothelowman Architects (Table 3).

Table 3. Drawing List.

Drawing Title	Drawing Number	Date of Issue
Floor Plans – Basement to Level 1 Mezzanine	SK01.01 to SK01.05	6.04.2022
Elevations	SK02.02	7.04.2022
Sections	SK03.01	1.04.2022

4.5 General Modelling Parameters

The parameters presented in were applied for both the Reference and the Proposed building models developed for this project.

Table 4. General modelling parameters.

Items	Reference project	Proposed Project
Climate zone	NCC climate zone 5	Same as Reference Building
Weather data (location and data format)	Terrey Hills NSW (TMY)	Same as Reference Building
Building Orientation	As per Architectural Drawings	Same as Reference Building
Heating fuel(s)	Electricity	Same as Reference Building
Cooling fuel(s)	Electricity	Same as Reference Building
Infiltration	• 0.7 air changes per hour throughout all zones when there is no mechanically supplied outdoor air; • 0.35 air changes per hour at all other times.	Same as Reference Building

4.6 Space Summary

Modelling parameters for each of the space types included in the building simulation models are described in Table 5.

Table 5. Space summary.

SPACE TYPE	Class 5 Areas
Occupancy Profiles	Class 5 profile
Temperature Control Range	21°C to 24°C
Occupant Density m^2/person	10
SPACE TYPE	**Class 7b Areas**
Temperature Control Range	21°C to 24°C
SPACE TYPE	**Conditioned Common Areas**
Temperature Control Range	21°C to 24°C
SPACE TYPE	**Unconditioned Common Areas**
Temperature Control Range	-
Occupant Density m^2/person	-

4.7 General Assumptions for Glazing and JV3 Analysis

- Glazing areas defined as glazing in the building envelope (as per Section J) include the area of any associated framing.
- The glazing thermal performance properties are inclusive of frame effects (Total system: Glass + Frame).
- Relevant shading must comply with the requirements of the NCC 2019 Amendment 1.
- With the exception of Part J1 (outlined in section 7.1 of this report), all other elements of the building design are required to achieve the DTS compliance provisions of NCC 2019 Amendment 1 under Section J

4.8 Building Geometry

The building was modelled as per architectural plans and elevations. The following figures provide a representation of various elevations as constructed in the energy simulation model.

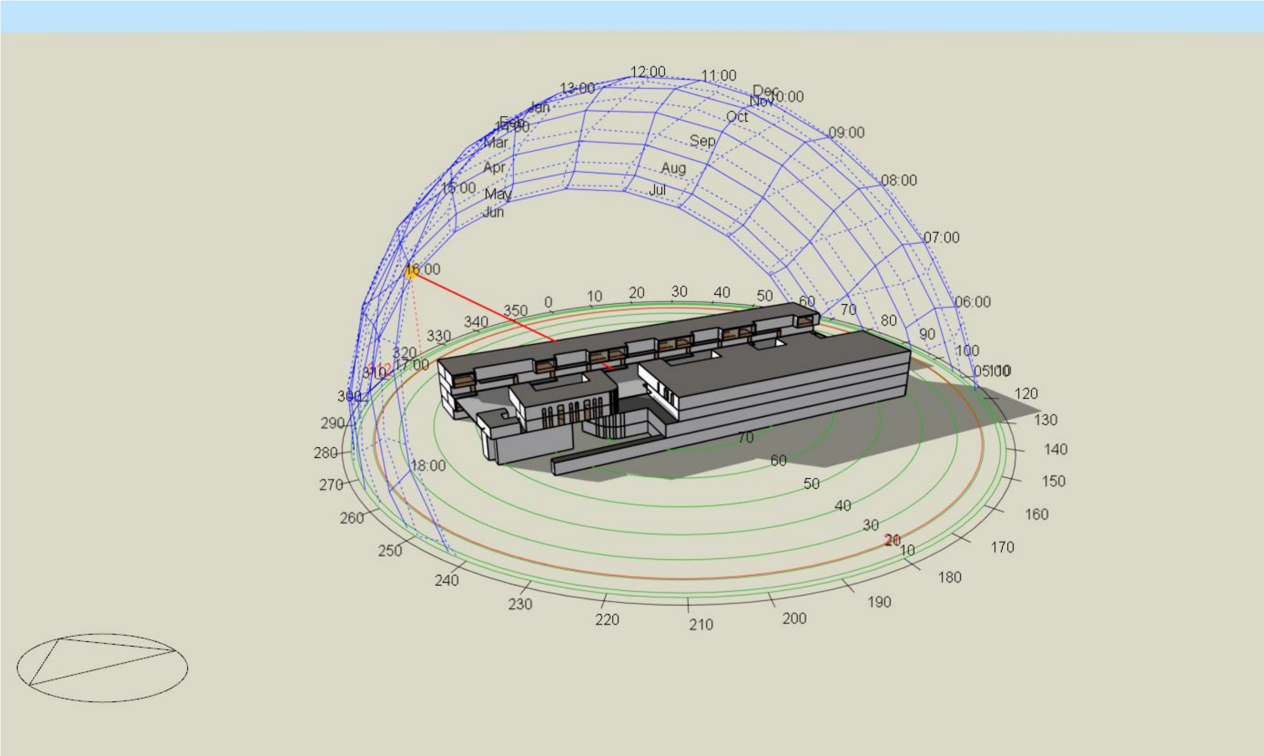


Figure 3. Design Builder Model Geometry – Overall View.

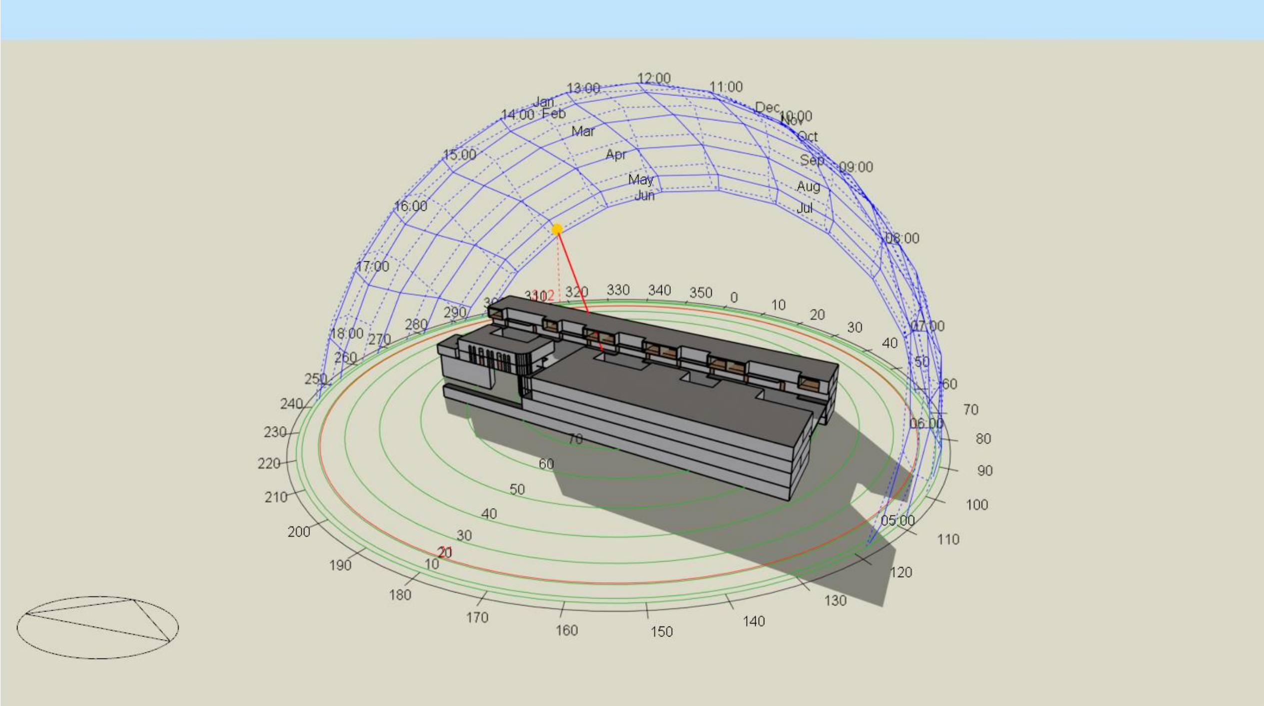


Figure 4. Design Builder Model Geometry – South View.

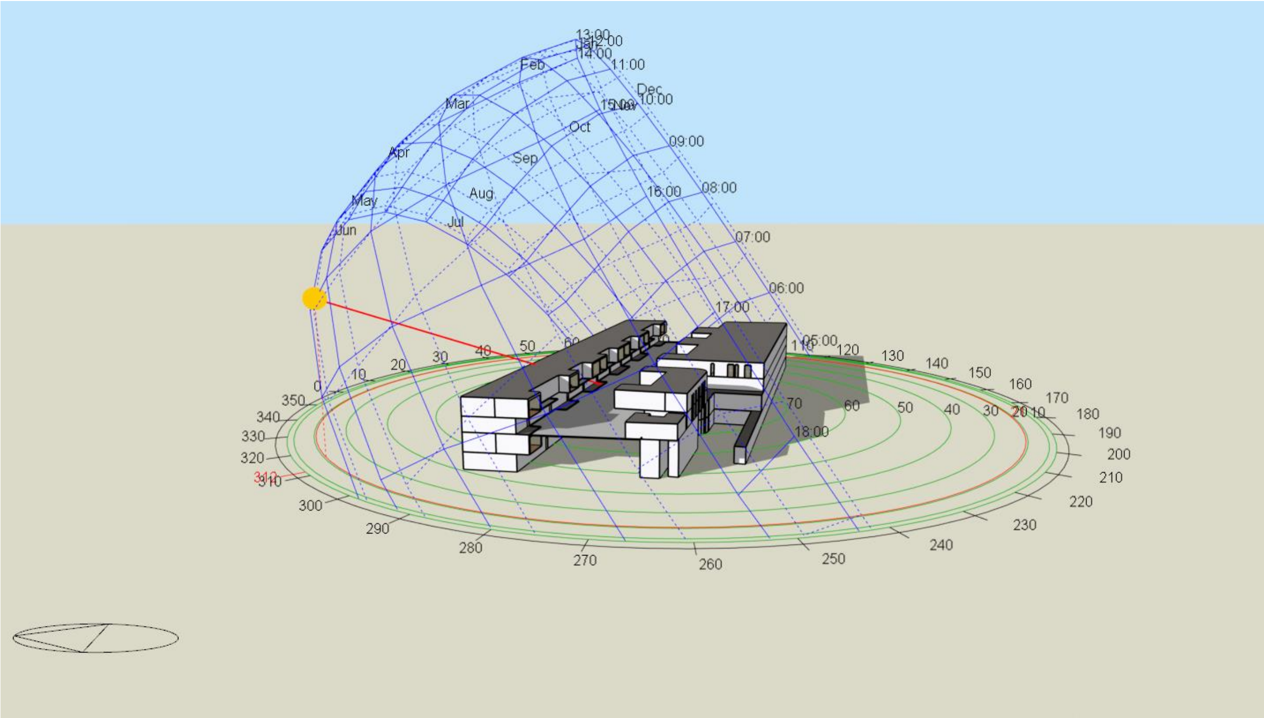


Figure 5. Design Builder Model Geometry – West View.

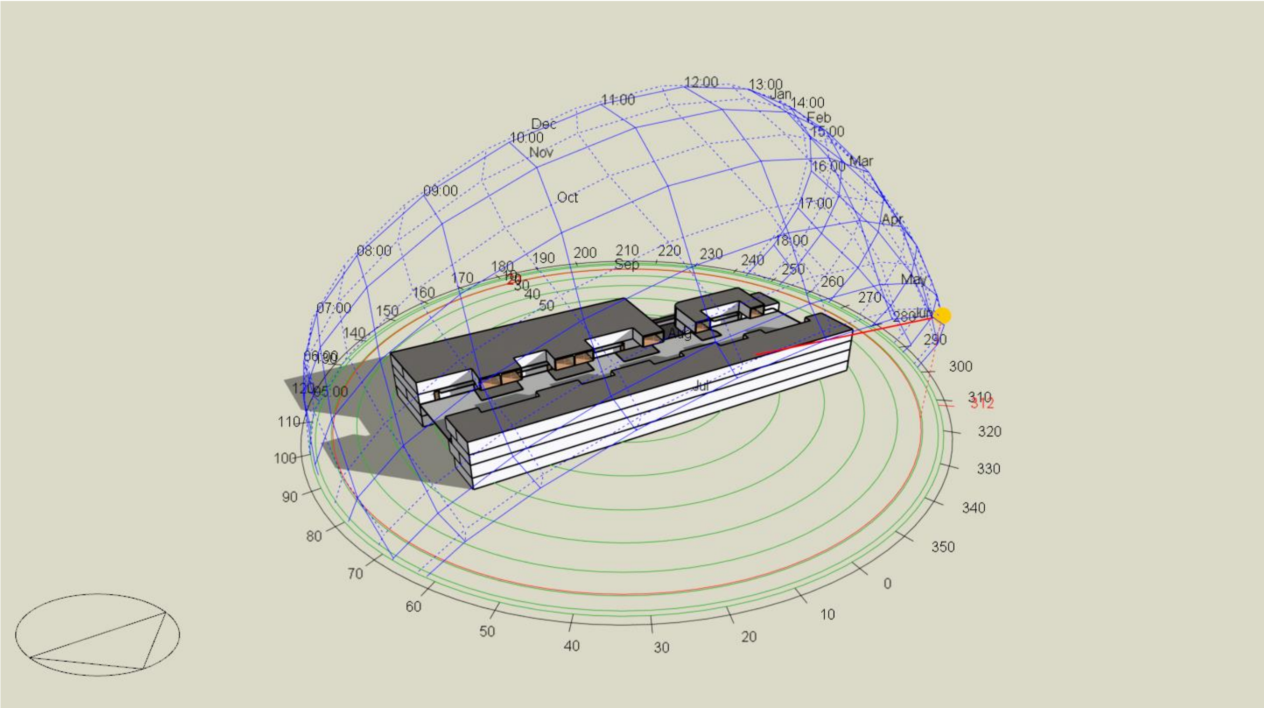


Figure 6. Design Builder Model Geometry – North View.

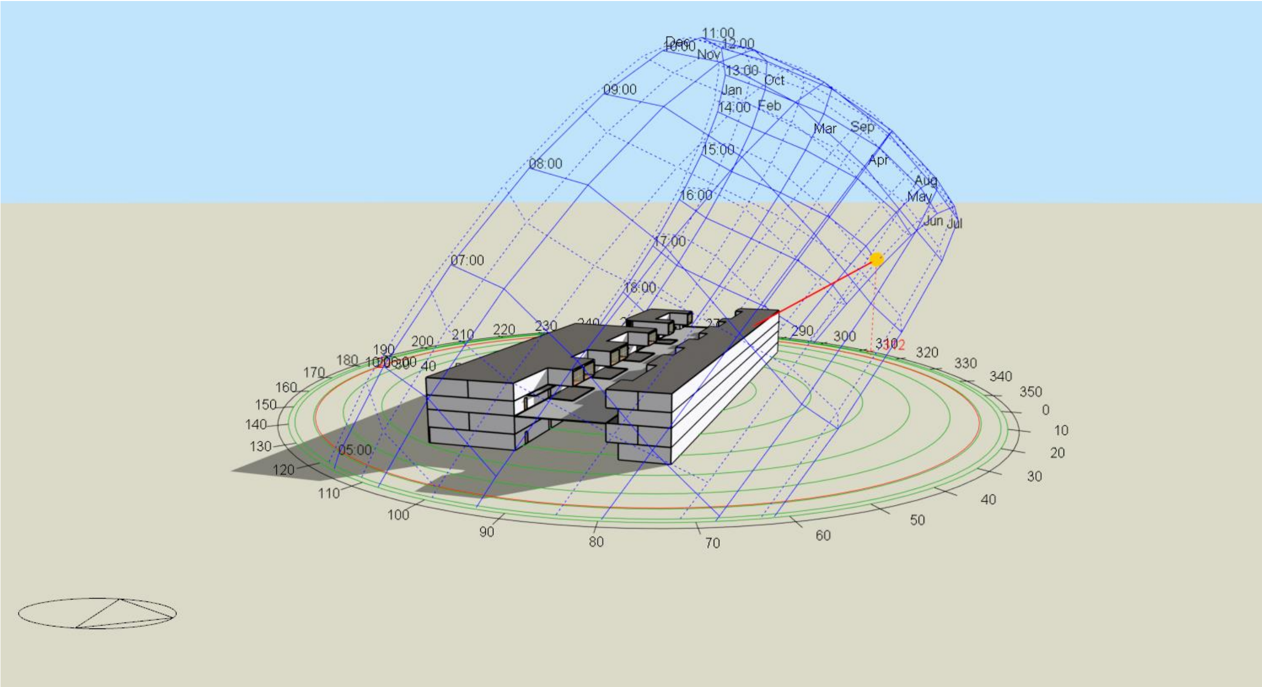


Figure 7. Design Builder Model Geometry – East View.

5 Energy Modelling

5.1 Process

A Reference Building energy model was generated using the NCC compliant energy simulation software (Design Builder). This model was based on the deemed to satisfy provisions (J1-8) and solar absorbance of 0.6 for external walls. This reference model provided the annual greenhouse gas emissions target for JP1 verification. This target was measured in kg/annum.
The following two modelling cases were generated and compared with the reference building:

- The proposed building as modelled with the proposed design services.
- The proposed building as modelled with the same services used in modelling of the Reference Building.

The above process has been detailed in the following sections of the report.

5.2 Computer Simulation

Computer modelling was performed using the Design Builder software to predict the annual mechanical energy consumption requirements for the building. This program uses a dynamic simulation to assess the building envelope response as well as space and surface temperatures, internal loads and energy consumption.

To ensure appropriate results are derived from the software package, ABCB requires that the software conform to appropriate BESTEST validation test or be certified in accordance with ANSI/ASHRAE Standard 140-2001: “Standard Method of Test for Evaluation of Building Energy Analysis Computer Programs”. Design Builder satisfies this requirement

The Design Builder program models the heat exchange between the air-conditioned space and the external environment to the space, hot or cold bodies in the space including people, lighting, and machines, and the air-conditioning system. The external environment includes the external ambient conditions and adjacent spaces.

The heat exchange analysis includes convection to and from surfaces, radiation exchange to and from the external environment, radiation exchange between the space internal surfaces, conduction through surfaces, and changes in humidity.
The software addressed all the main aspects of thermal modelling such as:

- Energy flow through the building’s envelope, including at adiabatic surfaces and also including thermal storage effects;
- Accurately modelling the performance of the air-conditioning and ventilation systems, including plant and equipment using their energy input ratios, coefficients of performance, or efficiency at full and part load;
- Control strategies, sequencing of plant and equipment, controlled settings and types of controls;
- Relative humidity range; and
- Use of different energy types.

The energy consumption outputs from the program were used as inputs to this assessment.

This Energy Simulation analysis has been carried out using the Energy Plus energy simulation developed by the USDOE. Energy Plus development is continually tested using industry standard methods as major builds are completed. Three major types of tests are currently conducted:

a. Analytical tests:
   - HVAC tests, based on ASHRAE Research Project 865
   - Building fabric tests, based on ASHRAE Research Project 1052

b. Comparative tests:
   - ANSI/ASHRAE Standard 140-2011

- International Energy Agency Solar Heating and Cooling Programme (IEA SHC) BESTEST (Building Energy Simulation Test) methods not yet in Standard 140
- Energy Plus HVAC Component Comparative tests
- Energy Plus Global Heat Balance tests

c. Release and executable tests

The BESTEST suites compare the results of multiple simulation programs for a series of load-related attributes.

Therefore, the Design Builder simulation suite complies with the ABCB software protocol. The Design Builder graphic user interface (GUI) has been used to develop the complex building geometry with external shading and to access the power of Energy Plus. The energy simulation analysis software description is summarized in Table 6.

Table 6. Energy simulation analysis software description.

Software name and version	Design Builder v7.0.0.082
Software developer	Design Builder Software Ltd / USDOE
Software validation standard	BESTEST

5.3 Modelling Input Data

In accordance with Verification Method JV3, the following input data were used to calculate the annual energy consumption for the reference and proposed buildings.

5.3.1 Weather Data

Historical hourly local weather data, in the form of twelve months' data, was used to represent the building external ambient data at the building location and to accurately model the dynamic nature of building thermal response. The weather data contains hourly records of radiation, temperature, humidity, sunshine duration and wind speed and direction for a typical meteorological year.

Based on the location of the development, the weather data from the closest weather station was used for the simulation of all models (Terrey Hills NSW, approx. 10km from the site). The weather station distance from site is illustrated in Figure 8. Table 7 outlines details of the simulation weather file. The Typical Meteorological Year (TMY) weather file represents a year without unusual extremes in temperature or typical average conditions, suitable for energy simulation modelling.

Table 7. Simulation weather file details.

Weather File Property	Value
Location	Terrey Hills NSW
Weather File Type	A Typical Meteorological Year (TMY)

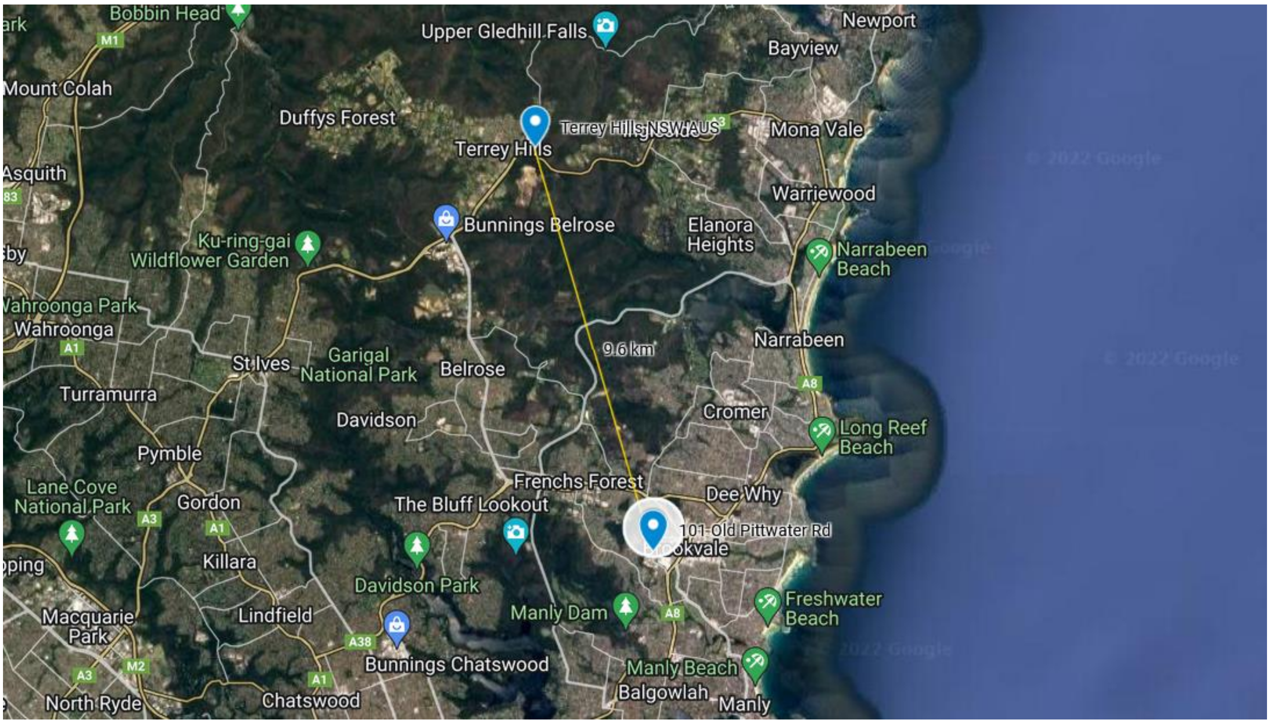


Figure 8. Weather Station distance from site.

5.3.2 NCC Default Values

In compliance with NCC Section J requirements, there are parameters that must be the same in all modelling runs (i.e., the reference building as well as the proposed building). This is to avoid using energy efficiency criteria or calculations that could result in a more generous allowance using the reference building and then criteria or calculations that result in lower annual energy consumption values for the proposed building.

In compliance with NCC Section J, the following parameters remained unchanged in all the simulation runs:
(a) General— (i) annual greenhouse gas emissions calculation method; and (ii) greenhouse gas emissions factors (based on Table 3a); or (iii) location, being either— (A) the location where the building is to be constructed if appropriate climatic data is available; or (B) the nearest location with similar climatic conditions, for which climatic data is available; and (iv) adjacent structures and features; and (v) orientation; and (vi) building form, including— (A) the roof geometry; and (B) the floor plan; and (C) the number of storeys; and (D) the ground to lowest floor arrangements; and (E) the size and location of glazing; and (F) external doors; and (vii) testing standards including for insulation, glazing, water heater and unitary air-conditioning equipment; and
(b) Fabric and glazing— (i) quality of insulation installation; and (ii) thermal resistance of air films including any adjustment factors, moisture content of materials and the like; and

(iii) dimensions of external, internal and separating walls; and (iv) internal shading devices, their colour and their criteria for operation; and
(c) Services— (i) range and type of services and energy sources, other than renewable energy generated on site; and (ii) assumptions and means of calculating the temperature difference across air-conditioning zone boundaries; and (iii) floor coverings and furniture and fittings density; and (iv) internal artificial lighting illumination levels; and (v) internal heat gains including people, lighting, appliances, meals and other electric power loads; and (vi) air-conditioning system configuration and zones; and (vii) profiles for occupancy, air-conditioning, lighting and internal heat gains from people, hot meals, appliances, equipment and heated water supply systems based on— (A) Specification JVc; or (B) NABERS Energy for Offices simulation requirements; or (C) Green Star simulation requirements; or (D) the actual building if— (aa) the operating hours per year are not less than 2,500; or (bb) the daily operating profiles are not listed in Specification JVc; and (viii) supply heated water temperature and rate of use; and (ix) infiltration values, unless the following have been specified— (A) additional sealing provisions to those required by Part J3; and (B) an intended building leakage of less than 10 m3 /hr.m2 at 50Pa; and (C) pressure testing to verify achievement of the intended building leakage, in which case the intended building leakage at 50Pa may be converted into a whole building infiltration value for the proposed building infiltration using Tables 4.16 to 4.24 of CIBSE Guide A; and (x) sequencing for water heaters, refrigeration chillers and heat rejection equipment such as cooling towers; and (xi) representation of clothing and metabolic rate of the occupants; and (xii) control of air-conditioning except— (A) the reference building must have variable temperature control for chilled and heated water that modulates the chilled water and heated water temperatures as required to maximise the efficiency of the chiller or boiler operation during periods of low load; and (B) if the controls for the proposed building are not adequately specified or cannot be simulated, the sample control specifications in Appendix B of AIRAH-DA28 must be used; and (xiii) environmental conditions such as ground reflectivity, sky and ground form factors, temperature of external bounding surfaces, air velocities across external surfaces and the like; and (xiv) number, sizes, floors and traffic served by lifts and escalators.
For the modelling of services for the purposes of calculating annual greenhouse gas emissions, for both proposed and reference building:
(a) system demand and response for all items of plant must be calculated on a not less frequent than hourly basis; and (b) energy usage of all items of plant must be calculated with allowances for— (i) part load performance; and (ii) staging to meet system demand; and (c) energy usage of cooling plant must be calculated with allowances for— (i) the impact of chilled water temperature on chiller efficiency; and (ii) the impact of condenser water temperature on water-cooled plant efficiency; and

(iii) the impact of ambient temperature on air-cooled plant efficiency; and
(iv) the energy use of primary pumps serving individual chillers; and
(v) the energy use of auxiliary equipment, including controls and oil heating for chillers; and
(vi) thermal losses in the chilled water system; and
(vii) the impact of chilled water temperature on thermal losses in the chilled water system; and

(d) energy usage of water heating systems for space heating must be calculated with allowances for—
(i) the impact of water temperature on water heater efficiency; and
(ii) the energy use of primary or feedwater pumps serving individual water heaters; and
(iii) thermal losses in water heating systems; and
(iv) the thermal mass of water heating systems, accounting for thermal losses during periods when the system is not operating; and

(e) energy usage of fan and pump systems must be calculated with allowances for—
(i) the method of capacity regulation; and
(ii) the use of either fixed or variable pressure control; and

(f) energy usage of pump systems must be calculated with allowances for the system fixed static pressure head; and

(g) energy usage of auxiliary equipment associated with co-generation and tri-generation systems, including pumps, cooling towers and jacket heaters, must be calculated; and

(h) where the energy usage of the heated water supply for food preparation and sanitary purposes or the energy usage of lifts and escalators is the same in the proposed building and the reference building, they may be omitted from the calculation of both the proposed building and the reference building; and

(i) energy use of a lift in a building with more than one classification may be apportioned according to the number of storeys of the part for which the annual greenhouse gas emissions and thermal comfort level are being calculated.

5.3.3 Internal heat loads and occupancy density

The internal heat loads applied to both the “reference” and “proposed” models are provided in the Table 8. The occupancy, lighting and equipment loads have been uniformly distributed throughout the building.

Table 8. Load Details.

Item	Details
People Load	75 W sensible heat gain and 55 W latent heat gain. An average adjusted metabolic rate from Table 45 of AIRAH-DA09. A heat emission rate from Table 6.3 of CIBSE Guide A.
Hourly Profile	The schedule is provided in section 5.3.10 – based on NCC Specification Table 2c and 2d.
Internal heat gains for appliances and equipment	Based on NCC Specification Table 2I.

5.3.4 Infiltration Rates

The infiltration rates have been included in both the “reference” and proposed” models in compliance with Section JVb of the NCC.

5.3.5 Shading

All external shading has been incorporated in the model based on the provided architectural drawings.

5.3.6 Internal Lighting System

The Reference and proposed buildings have been modelled with appropriate Illumination power density in accordance to Table J6.2a of NCC 2019 and listed in Table 9.

Table 9. Internal lighting system.

	Lighting Power Density (W/m^2)	
	Reference Building	**Proposed Building**
NCC Class 5 Office	4.5	Same as Reference Building
Car Park	2.0	Same as Reference Building
Lobby	5.0	Same as Reference Building
Control Room	4.5	Same as Reference Building
Plant Room	4.0	Same as Reference Building
Storage	1.5	Same as Reference Building
stairways	2.0	Same as Reference Building
toilet	5.0	Same as Reference Building

5.3.7 Ancillary Mechanical Ventilation Fans

The Ancillary Mechanical Ventilation Fans for both Reference and proposed Building models were simulated with the input parameters in accordance with the DTS Requirements of NCC Part J5 and MEPS standard. The annual energy consumption of ancillary mechanical ventilation fans is summarized in Table 10.

Table 10. Ancillary mechanical ventilation fans.

	Annual energy consumption (kWh)	
	Reference Building	**Proposed Building**
Outdoor Air & Exhaust Fans	17,175	17,175

5.3.8 Schedules of Usage

The internal load schedules used in the model are as per the Specification JVc Modelling profiles provided in NCC Section J. Details of the schedules used are contained in the following tables.

(a) The air-conditioning, must be modelled on the basis of—

(i) the daily occupancy and operation profiles in Tables 2a to 2k (see the schedules provided in the following table); and

(ii) the internal heat gains in a building—

(A) from occupants and hot meals, in accordance with one of the options in Table 2n; and

(B) from appliances and equipment, in accordance with Table 2l; and

(C) from artificial lighting, determined in accordance with (b).

(b) The artificial lighting must be modelled on the basis of the proposed level of artificial lighting in the building with the daily profile in Tables 2a to 2k.

(c) The heated water supply, must be modelled on the basis of the consumption rates of Table 2m.

Occupancy and operation profiles

The following table provides the occupancy and operation profiles used for modelling runs in accordance with NCC Section J - Table 2c: Weekday occupancy and operation profiles of NCC Class 5.

Time period	Occupancy	Artificial lighting	Appliances and equipment	Air-conditioning
	(Monday to Friday)	(Monday to Friday)	(Monday to Friday)	(Monday to Friday)
12:00am to 1:00am	0%	15%	25%	Off
1:00am to 2:00am	0%	15%	25%	Off
2:00am to 3:00am	0%	15%	25%	Off
3:00am to 4:00am	0%	15%	25%	Off
4:00am to 5:00am	0%	15%	25%	Off
5:00am to 6:00am	0%	15%	25%	Off
6:00am to 7:00am	0%	15%	25%	Off
7:00am to 8:00am	10%	40%	65%	On
8:00am to 9:00am	20%	90%	80%	On
9:00am to 10:00am	70%	100%	100%	On
10:00am to 11:00am	70%	100%	100%	On
11:00am to 12:00pm	70%	100%	100%	On
12:00pm to 1:00pm	70%	100%	100%	On
1:00pm to 2:00pm	70%	100%	100%	On
2:00pm to 3:00pm	70%	100%	100%	On
3:00pm to 4:00pm	70%	100%	100%	On
4:00pm to 5:00pm	70%	100%	100%	On
5:00pm to 6:00pm	35%	80%	80%	On
6:00pm to 7:00pm	10%	60%	65%	Off
7:00pm to 8:00pm	5%	60%	55%	Off
8:00pm to 9:00pm	5%	50%	25%	Off
9:00pm to 10:00pm	0%	15%	25%	Off
10:00pm to 11:00pm	0%	15%	25%	Off
11:00pm to 12:00am	0%	15%	25%	Off

Note:

The occupancy profile is expressed as a percentage of the maximum number of people that can be accommodated in the building. The artificial lighting profile is expressed as a percentage of the maximum illumination power density permitted under NCC Part J6. The appliances and equipment profile are expressed as a percentage of the maximum internal heat gain in NCC Section - Table 2I. The air-conditioning profile is expressed as the plant status.

The following table provides the occupancy and operation profiles used for modelling runs in accordance with NCC Section J - Table 2d: Weekend occupancy and operation profiles of NCC Class 5.

Time period	Occupancy	Artificial lighting	Appliances and equipment	Air-conditioning
	(Saturday, Sunday and holidays)	(Saturday, Sunday and holidays)	(Saturday, Sunday and holidays)	(Saturday, Sunday and holidays)
12:00am to 1:00am	0%	15%	25%	Off
1:00am to 2:00am	0%	15%	25%	Off
2:00am to 3:00am	0%	15%	25%	Off
3:00am to 4:00am	0%	15%	25%	Off
4:00am to 5:00am	0%	15%	25%	Off
5:00am to 6:00am	0%	15%	25%	Off
6:00am to 7:00am	0%	15%	25%	Off
7:00am to 8:00am	0%	15%	25%	Off
8:00am to 9:00am	5%	25%	25%	Off
9:00am to 10:00am	5%	25%	25%	Off
10:00am to 11:00am	5%	25%	25%	Off
11:00am to 12:00pm	5%	25%	25%	Off
12:00pm to 1:00pm	5%	25%	25%	Off
1:00pm to 2:00pm	5%	25%	25%	Off
2:00pm to 3:00pm	5%	25%	25%	Off
3:00pm to 4:00pm	5%	25%	25%	Off
4:00pm to 5:00pm	5%	25%	25%	Off
5:00pm to 6:00pm	0%	15%	25%	Off
6:00pm to 7:00pm	0%	15%	25%	Off
7:00pm to 8:00pm	0%	15%	25%	Off
8:00pm to 9:00pm	0%	15%	25%	Off
9:00pm to 10:00pm	0%	15%	25%	Off
10:00pm to 11:00pm	0%	15%	25%	Off
11:00pm to 12:00am	0%	15%	25%	Off

Note:
The occupancy profile is expressed as a percentage of the maximum number of people that can be accommodated in the building. The artificial lighting profile is expressed as a percentage of the maximum illumination power density permitted under Part J6. The appliances and equipment profile are expressed as a percentage of the maximum internal heat gain in Table 2l. The air-conditioning profile is expressed as the plant status.

5.4 Air Conditioning Simulation

The HVAC systems for both the Proposed Building and Reference Building models were simulated in Design Builder software package. In compliance with NCC JV3, the following temperature bands were adopted for 98% of the plant operation time.

- 18°CDB to 25°CDB for conditioned spaces with transitory occupancy; and
- 21°CDB to 24°CDB in all other conditioned spaces

The mechanical systems for both the Proposed Building and Reference Building models were simulated with the input parameters in accordance with the DTS Requirements of NCC Part J5. The design heating and cooling COPs is set at 2.9 for Proposed Building HVAC system. Figure 9 and Figure 10 demonstrate the HVAC detail applied to the models.

The HVAC systems were simulated based on a selected set of monthly design day temperatures and coincident wet bulb temperatures. The part load performance curves adjust the efficiency of the system based on the capacity, as well as the supply air and environmental conditions.

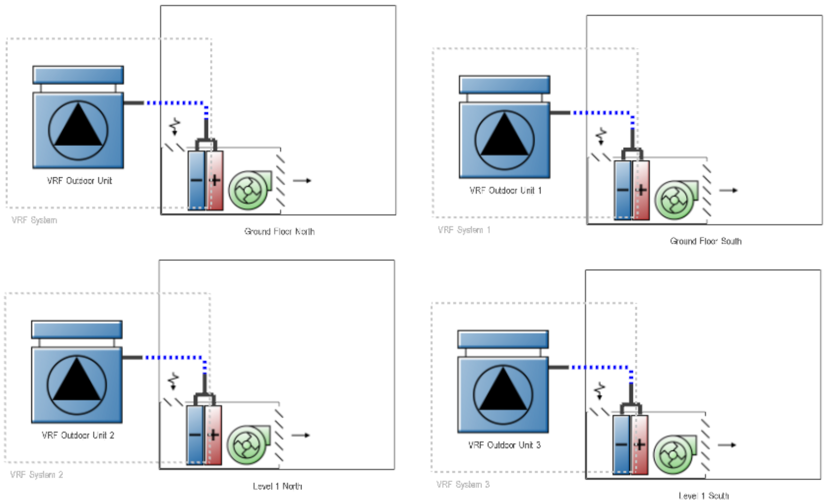


Figure 9. Detailed HVAC system modelled.

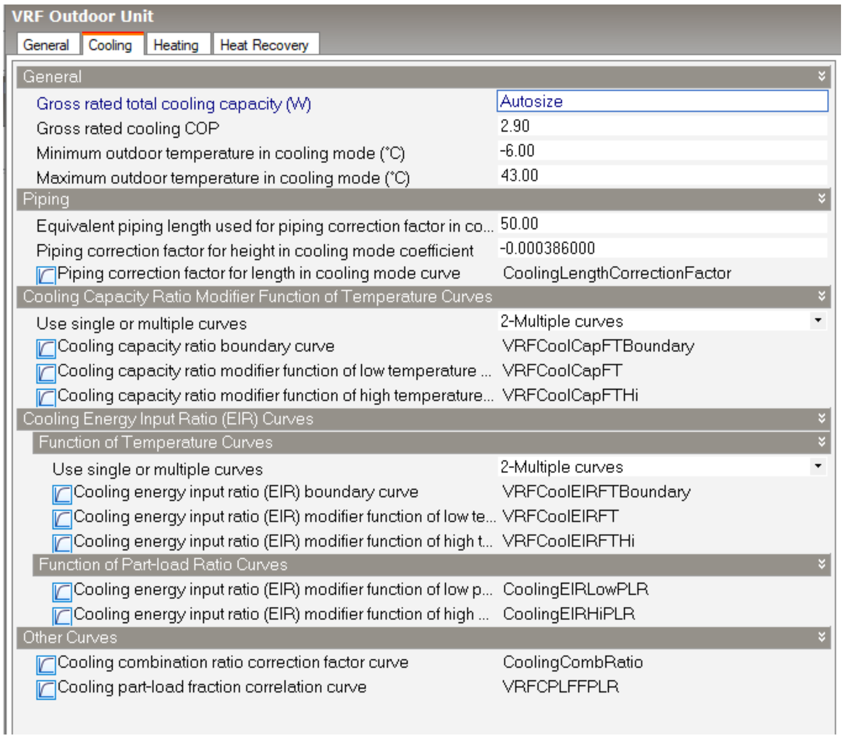


Figure 10. Sample of input data for detailed HVAC modelling – outdoor units - Sample.

5.5 Greenhouse gas emissions factors

The annual greenhouse gas emissions for the proposed building and the reference building have been calculated using the greenhouse gas emissions factors (kg CO_2-e/GJ) listed in Table 11.

Table 11. Greenhouse gas emissions factors.

Energy Source	GHG emissions factors (kgCO_2-e/GJ)
Electricity	256

5.6 Onsite Energy Generation

JV3 allows the renewable energy generated on-site or the “free” energy derived from another process (e.g. heat from cogeneration) to be deducted from the annual energy consumption of the proposed building. This means that the “annual energy consumption” is the sum of the energy drawn annually from the electrical grid, the gas network or fuel brought in by road transport and not the total of the energy consumed by the services that use energy.

5.7 Modelling for Compliance

5.7.1 Compliance Modelling Case 1 – Reference Building with DTS Services

5.7.1.1 Inputs

Building Fabric: The building fabric was modelled based on the minimum Deemed to Satisfy (DTS) provisions outlined in the NCC Part J1 for building fabric (summarised in the following table).

Building Services: Based on the minimum NCC part J Deemed to Satisfy provisions.

Table 12 further outlines the DTS building fabric thermal performance and services used within the simulation model 1 (reference case).

Table 12. Modelling Case 1 - Reference Building with DTS Services.

Items (Where separating conditioned and non-conditioned zones)		**Reference Building Case (Model 1)**
J1 (DTS)	**Roof / Ceiling**	Total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.
	Walls &Glazing	• Total System U-Value of wall-glazing construction $\leq$ U2.0; • Total System R-Value of wall components of the wall-glazing construction >R1.4. • Maximum wall-glazing construction solar admittance 0.13 **Process:** As expected, the “Proposed” glazing and insulation did not meet the NCC part J1 ‘deemed to satisfy’ calculators. Specification of the DTS external glazing and insulation were refined to be as close as possible to 100% to ensure the highest possible energy consumption figure was achieved for the reference building.
	Floors	Suspended Floors (where any): minimum total R2.0 thermal insulation. Concrete Slab on Ground: no added insulation required.
J3-8 (DTS)	**Building Services**	Set at the minimum NCC 2019 Amendment 1 DTS requirements.
Other	**Solar Absorptance:**	Solar absorptance of 0.6 for external walls, in accordance with JV3.

5.7.1.2 Results

The GHG emissions outcome for the Reference Building with DTS services was 200,426 kg p.a.

5.7.2 Compliance Modelling Case 2 – Proposed Building with DTS Services

5.7.2.1 Inputs

Building Fabric: The building was modelled based on the proposed fabric which is the same as the NCC part J deemed to satisfy provisions with the following exceptions:

- J1 – Building Fabric: modelling is based on the proposed glazing and insulation performance specification (provided in the following table and summarised in section 7.1 of the report);

Building Services: Based on the minimum NCC part J Deemed to Satisfy provisions.

Table 13 outlines the performance inputs applied to the simulation model 2 (proposed building with DTS services).

Table 13. Modelling Case 2 - Proposed Building with DTS Services.

Items (Where separating conditioned and non-conditioned zones)		Proposed Building Case (Model 2)
J1 (Proposed)	Roof / Ceiling	Total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.
	Walls (Addressed through JV3 assessment)	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.
	Glazing (Addressed through JV3 assessment)	All Glazing Components: • Total system U-Value ≤ 4.9; • Total system SHGC ≤ 0.49.
	Floors	Suspended Floors (where any): minimum total R2.0 thermal insulation. Concrete Slab on Ground: no added insulation required.
J3-8 (DTS)	Building Services	As required by NCC JV3 method: Set at the minimum of NCC 2019 Amendment 1 DTS requirements (Similar to Case 1- Reference Building)
Other requirements		• Building services: minimum DTS performance or better • Thermal comfort level of between a Predicted Mean Vote of -1 to +1 across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building.

5.7.2.2 Results

The GHG emissions outcome for the Proposed Building with DTS services was 200,280 kg p.a.

5.7.3 Compliance Modelling Case 3 – Proposed Building with Proposed Services

5.7.3.1 Inputs

Building Fabric: The building was modelled based on the proposed fabric which is the same as the NCC part J deemed to satisfy provisions with the following exceptions:

- J1 – Building Fabric: modelling is based on the proposed glazing and insulation performance specification (provided in the following table and summarised in section 7.1 of the report);

Building Services: The "proposed services" under the modelling case 3 have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore identical.

Table 14 outlines the performance inputs applied to the simulation model 3 (proposed building with proposed services).

Table 14. Modelling Case 3 - Proposed Building with Proposed Services.

Items (Where separating conditioned and non-conditioned zones)		**Proposed Building Case (Model 3)**
J1 (Proposed)	**Roof / Ceiling**	Total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.
	Walls (Addressed through JV3 assessment)	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.
	Glazing (Addressed through JV3 assessment)	All Glazing Components: • Total system U-Value $\leq$ 4.9; • Total system SHGC $\leq$ 0.49.
	Floors	Suspended Floors (where any): minimum total R2.0 thermal insulation. Concrete Slab on Ground: no added insulation required.
J3-8 (DTS)	**Building Services**	The "proposed services" under the modelling case 3 have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same.
Other requirements		• Building services: minimum DTS performance or better • Thermal comfort level of between a Predicted Mean Vote of -1 to +1 across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building.

5.7.3.2 Results

The GHG emissions outcome for the Proposed Building with Proposed services was 200,280 kg p.a.

Note: The "proposed services" under the modelling case 3 have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same (200,280 kg/annum).

6 Summary of the Simulation Results and Conclusion

Table 15 summarises the total annual energy consumption for the simulation cases of the development.

Table 15. Result Summary.

	Case 1 Reference Building [DTS Fabric and DTS Services]	Case 2 Proposed Building [Proposed Fabric and DTS Services] *	Case 3 Proposed Building [Proposed Fabric and Proposed Services] *	Compliance Achieved
Annual greenhouse gas emissions	200,426 kg p.a.	200,280 kg p.a.	200,280 kg p.a.	YES

The "proposed services" under the modelling case 3 have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same (200,280 kg/annum).

A reference building was modelled having minimum DTS envelope characteristics as well as minimum DTS services. The annual energy consumption of the reference building and services was estimated to be 200,426 kg/annum.

The annual energy consumption of the proposed building with the DTS services (modelling case 2) is calculated at 200,280 kg/annum. The services under the 3rd modelling case have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same (200,280 kg/annum).

The Proposed Building therefore meets the criteria of JV3 (a) (i) & (ii), for Verification Method JV3 as 200,280 kg/annum is less than the 200,426 kg/annum estimated for the Reference Case.

The proposed insulation and glazing system for compliance are therefore compliant with the performance requirement of NCC 2019 Amendment 1 Section J.

7 Summary of the Section J Requirements

7.1 Part J 1 – Building Fabric Requirements

7.1.1 Overview

Section J part J1 outlines the minimum requirements of building envelope. The envelope is defined by the NCC as parts of a building's fabric that separate a conditioned space or habitable room from the exterior of the building or a non-conditioned space.

The required thermal insulation requirements are as provided in Table 16.

Table 16. The required thermal insulation requirements.

Envelope (separating conditioned and un-conditioned zones)	Minimum Insulation & Glazing Requirements
Roof / Ceiling	Total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.
Walls	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.
Glazing	All Glazing Components: • Total system U-Value $\leq$ 4.9; • Total system SHGC $\leq$ 0.49.
Floors	Suspended Floors (where any): minimum total R2.0 thermal insulation. Concrete Slab on Ground: no added insulation required.

7.1.2 Part J1.1 – Application

The Deemed-to-Satisfy Provisions of this Part apply to building elements forming the envelope of a Class 2 to 9 building other than J1.2(e), J1.3, J1.4, J1.5 and J1.6(a) which do not apply to a Class 2 sole-occupancy unit or a Class 4 part of a building. Part J1 is therefore applicable to the upgrade works.

7.1.3 J1.2 Thermal Construction General

1. Where required, insulation must comply with AS/NZS 4859.1 and be installed so that it—

i. abuts or overlaps adjoining insulation other than at supporting members such as studs, noggings, joists, furring

channels and the like where the insulation must be against the member; and

ii. forms a continuous barrier with ceilings, walls, bulkheads, floors or the like that inherently contribute to the

thermal barrier; and

iii. does not affect the safe or effective operation of a service or fitting.

2. Where required, reflective insulation must be installed with—

i. the necessary airspace to achieve the required R-Value between a reflective side of the reflective insulation

and a building lining or cladding; and

ii. the reflective insulation closely fitted against any penetration, door or window opening; and

iii. the reflective insulation adequately supported by framing members; and

iv. each adjoining sheet of roll membrane being—

(A) overlapped not less than 50 mm; or

(B) taped together.

3. Where required, bulk insulation must be installed so that—
   i. it maintains its position and thickness, other than where it is compressed between cladding and supporting members, water pipes, electrical cabling or the like; and
   ii. in a ceiling, where there is no bulk insulation or reflective insulation in the wall beneath, it overlaps the wall by not less than 50 mm.
4. Roof, ceiling, wall and floor materials, and associated surfaces are deemed to have the thermal properties listed in Specification J1.2.
5. The required Total R-Value and Total System U-Value, including allowance for thermal bridging, must be:
   i. calculated in accordance with AS/NZS 4859.2 for a roof or floor; or
   ii. determined in accordance with Specification J1.5a for wall-glazing construction; or
   iii. determined in accordance with Specification J1.6 or Section 3.5 of CIBSE Guide A for soil or sub-floor spaces.

Note:

The thermal insulation performance requirements outlined in this report nominate the Section J compliance requirements only. The specified performance values therefore do not consider requirements for any other disciplines such as Acoustics, Fire or Safety compliance. Where required, the development shall comply with any additional requirements related to other disciplines in addition to the Section J compliance requirements detailed in this report. All works need to comply with the minimum Section J1 requirements, Thermal bridging must be accounted for in accordance with J1.2 (e) and is the responsibility of the builder or the architect to obtain a construction build-up calculation from their insulation supplier.

7.1.4 J1.3 Roof and Ceiling Construction

For roof and ceiling constructions that form part of the building envelope of the conditioned space, NCC Section J Compliance shall be achieved with minimum total R3.7 thermal insulation.

The solar absorptance of the upper surface of a roof must be not more than 0.45.

7.1.5 J1.4 Roof Lights

Based on the information provided roof lights are proposed for the development, Part J1.4 is therefore applicable to this development.

The roof light must meet the following criteria (Table J1.4 Roof Lights – Thermal Performance of transparent and translucent elements).

Roof light shaft index	Total area of roof lights up to 3.5% of the floor area of the room or space	Total area of roof lights more than 3.5% and up to 5% of the floor area of the room or space
< 1.0	≤ 0.45	≤ 0.29
≥ 1.0 to < 2.5	≤ 0.51	≤ 0.33
≥ 2.5	≤ 0.76	≤ 0.49

Notes:

1. The total area of a roof light serving the space as a percentage of the floor area of the space must not exceed 5%.
2. Roof lights must have—
   a. a total area of not more than 5% of the floor area of the room or space served; and
   b. transparent and translucent elements, including any imperforate ceiling diffuser, with a combined performance of—
      i. for Total system SHGC, in accordance with Table J1.4; and
      ii. for Total system U-Value, not more than U3.9.

3. The roof light shaft index is determined by measuring the distance from the centre of the shaft at the roof to the centre of the shaft at the ceiling level and dividing it by the average internal dimension of the shaft opening at the ceiling level (or the diameter for a circular shaft) in the same units of measurement.
4. The area of a roof light is the area of the roof opening that allows light to enter the building. The total area of roof lights is the combined area for all roof lights serving the room or space.
5. The performance requirements of the total glazing system (glass + frame) must be demonstrated under NFRC100-2001 conditions and based on AFRC requirements and in compliance with the NCC

7.1.6 J1.5 Walls and Glazing (addressed through JV3)

For wall and glazing constructions that form part of the building envelope of the conditioned space, NCC Section J Compliance shall be achieved as follows: J1.6 Floors. The requirements of walls and glazing thermal properties are listed in Table 17.

Table 17. Walls and Glazing.

Walls	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.
Glazing	All Glazing Components: • Total system U-Value $\leq$ 4.9; • Total system SHGC $\leq$ 0.49.

7.1.7 J1.6 Floors

For floors without in-slab heating or cooling system:

- There are no requirements for floor insulation for the floors which are concrete slab on ground (assuming the wall thickness is 250mm or higher).
- NCC compliance shall be achieved with a minimum total thermal insulation of R2.0 for any suspended floors separating a conditioned space from a non-conditioned space.

7.2 Part J3 – Building Sealing

Part J3 of the NCC 2019 contains the requirements of the Deemed-to-Satisfy compliance for building sealing. The purpose of this subsection is to ensure that additional heating and cooling loads will not be introduced through building leakage.
Part J3 is applicable to the development.
Clause J3.2 refers to chimneys and flues. The chimney or flue of an open solid-fuel burning appliance must be provided with a damper or flap that can be closed to seal the chimney or flue.
Clause J3.3 refers to roof lights.
Clause J3.4 outlines that a seal to restrict air infiltration must be fitted to each edge of doors, openable windows or the like that separate conditioned spaces from non-conditioned spaces or external areas. This provision is not required for windows complying with Australian Standard AS2047, a fire door or smoke door; or a roller shutter door, roller shutter grille or other security door or device installed only for out-of-hours security.
A seal to restrict air infiltration—

i. for the bottom edge of a door, must be a draft protection device; and
ii. for the other edges of a door or the edges of an openable window or other such opening, may be a foam or rubber compression strip, fibrous seal or the like.

An entrance to a building, if leading to a conditioned space must have an airlock, self-closing door, rapid roller door,
revolving door or the like, other than—

i. where the conditioned space has a floor area of not more than 50 m 2; or
ii. where a café, restaurant, open front shop or the like has—

(A) a 3 m deep un-conditioned zone between the main entrance, including an open front, and the conditioned space; and

(B) at all other entrances to the café, restaurant, open front shop or the like, self-closing doors.
A loading dock entrance, if leading to a conditioned space, must be fitted with a rapid roller door or the like.
Clause J3.5is related to exhaust fans. An exhaust fan must be fitted with a sealing device such as a self-closing damper or the like when serving—

i. a conditioned space; or
ii. a habitable room in climate zones 4, 5, 6, 7 or 8.

Clause J3.6is related to construction of ceilings, walls and floors.
Ceilings, walls, floors and any opening such as a window frame, door frame, roof light frame or the like must be
constructed to minimise air leakage in accordance with (b) when forming part of—

i. the envelope; or
ii. in climate zones 4, 5, 6, 7 or 8.

Construction required by (a) must be—

i. enclosed by internal lining systems that are close fitting at ceiling, wall and floor junctions; or
ii. sealed at junctions and penetrations with—

(A) close fitting architrave, skirting or cornice; or
(B) expanding foam, rubber compressible strip, caulking or the like.
(C) The requirements of (a) do not apply to openings, grilles or the like required for smoke hazard management.

Clause J3.7 is related to evaporative coolers. An evaporative cooler must be fitted with a self-closing damper or the like—

(a) when serving a heated space; or
(b) in climate zones 4, 5, 6, 7 or 8.

7.3 Part J4

Part J4 of the NCC 2019 Amendment 1 is blank and therefore not applicable to this development

7.4 Part J5 – Air Conditioning and Ventilation Systems

Part J5 of the NCC outlines the performance requirements for air conditioning and ventilation systems to ensure these services operate in an efficient manner.
Furthermore, in compliance with the JV3 method, the proposed building is required to achieve a thermal comfort level of between a Predicted Mean Vote of -1 to +1 across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building.
All services consultants and contractors shall design the air conditioning and ventilation systems to ensure compliance with the PMV requirements noted above, Part J5 of the NCC Section J and all subsections associated therein.

7.5 Part J6 – Artificial Lighting and Power

Part J6 of the NCC outlines the performance requirements for illumination power density and the efficient use of lighting power and controls.
All services consultants and contractors shall design the artificial lighting systems to ensure compliance with Part J6 of the NCC Section J and all subsections associated therein with regards to power.

7.6 Part J7 – Hot Water Supply

Part J7 of the NCC outlines the provisions for the energy efficient use of hot water supply systems.
Clause J7.2 of Part J7 states that a hot water supply system for food preparation or sanitary purposes must be designed and installed in accordance with Section 8 of AS/NZS 3500.4.
All services consultants and contractors shall design the Hot Water supply systems to ensure compliance with Part J7 of the NCC Section J and all subsections associated therein.

7.7 Part J8 – Facilities for Energy Monitoring

Part J8 of the NCC outlines the provisions of facilities for energy monitoring. Facilities for energy monitoring shall be provided in accordance to Part J8 of the NCC.
A building or sole-occupancy unit with a floor area of more than 500 m2 must have the facility to record the consumption of gas and electricity.

A building with a floor area of more than 2,500m2 must have the facility to record individually the energy consumption of the following services. Energy meters required by must be interlinked by a communication system that collates the time-of-use energy consumption data to a single interface monitoring system where it can be stored, analysed and reviewed.

i. air-conditioning plant including, where appropriate, heating plant, cooling plant and air handling fans; and
ii. artificial lighting; and
iii. appliance power; and
iv. central hot water supply; and
v. internal transport devices including lifts, escalators and travelators where there is
more than one serving the building; and

vi. other ancillary plant.

All services consultants and contractors shall design for access for maintenance and facilities for monitoring to ensure compliance with Part J8 of the NCC Section J and all subsections associated therein.

8 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 based on the preliminary building services and architectural 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. Building fabric inputs require verifiable manufacturer data to confirm thermal properties.

This report is intended as a guide to assist with the application of NCC Section J. It should be read in conjunction with the NCC 2019 Amendment 1, specific applications may vary during the design development of the project.

The JV3 Verification Methodology is for NCC Section J compliance purposes only and compares the proposed hypothetical building design to a DTS reference building with the same geometry using defined occupancy and operational control schedules. The annual energy output calculated in the software is used only to demonstrate whether the proposed building envelope has a higher (fail) or lower (pass) value than the DTS reference building.

The modelling therefore does not estimate the actual energy consumption of the building and the outputs must not be used for this purpose.

GLOSSARY

Air-conditioning, for the purposes of Section J of Volume One, means a service that actively cools or heats the air within a space, but does not include a service that directly

(a) cools or heats cold or hot rooms; or

(b) maintains specialised conditions for equipment or processes, where this is the main purpose of the service.

Annual energy consumption

This is the amount of energy calculated to be consumed under certain specific conditions in consideration of operating profiles, internal loads and plant efficiencies. It is used in Verification Method JV3 that compares the calculated energy consumption with that of a complying reference building. It should not be considered a prediction of the actual energy consumption of an actual building as there could be major differences in the conditions such as the internal loads of the building and the hours of operation. It differs from annual energy load because it is affected by the type of heating or cooling appliance used, for example, heating by a reverse cycle air-conditioner uses less than half the energy that a gas fired heater would use to meet the same annual energy load.

Annual greenhouse gas emissions mean the theoretical amount of greenhouse gas emissions attributable to the energy used annually by a building's services, excluding kitchen exhaust and the like.

Assessment Method means a method that can be used for determining that a Performance Solution or Deemed-to-Satisfy Solution complies with the Performance Requirements.

Boiler means a vessel or an arrangement of vessels and interconnecting parts, wherein steam or other vapour is generated, or water or other liquid is heated at a pressure above that of the atmosphere, by the application of fire, the products of combustion, electrical power, or similar high temperature means, and—

(a) includes superheaters, reheaters, economisers, boiler piping, supports, mountings, valves, gauges, fittings, controls, the boiler settings and directly associated equipment; but

(b) excludes a fully flooded or pressurised system where water or other liquid is heated to a temperature lower than the normal atmospheric boiling temperature of the liquid.

Carpark means a building that is used for the parking of motor vehicles but is neither a private garage nor used for the servicing of vehicles, other than washing, cleaning or polishing.

Climate zone means an area defined in Figure 2 and in Table 2 for specific locations, having energy efficiency provisions based on a range of similar climatic characteristics.

Conditioned space, means a space that is likely (i.e., expected) to be air-conditioned and is not limited to the space where an air-conditioning system is installed. In some cases, chilled and hot water may be reticulated through duct risers as part of the building design to enable conditioning to be provided as part of a later fit out. A conditioned space may include a ceiling or under-floor space that is open to the conditioned space such as a space separated by only a perforated or grille ceiling or floor where the space is a supply air or return air plenum.

Cooling load means the calculated amount of energy removed from the cooled spaces of the building annually by artificial means to maintain the desired temperatures in those spaces.

Deemed-to-Satisfy Provisions means provisions which are deemed to satisfy the Performance Requirements.

Deemed-to-Satisfy Solution means a method of satisfying the Deemed-to-Satisfy Provisions.

Display glazing means glazing used to display retail goods in a shop or showroom directly adjacent to a walkway or footpath, but not including that used in a café or restaurant.

Domestic services mean the basic engineering systems that use energy or control the use of energy; and—

(a) includes—

(i) heating, air-conditioning, mechanical ventilation and artificial lighting; and

(ii) pumps and heaters for swimming pools and spa pools; and

(iii) heated water systems; but

(b) excludes cooking facilities and portable appliances.

Envelope, for the purposes of Section J in Volume One, means the parts of a building's fabric that separate a conditioned space or habitable room from—

(a) the exterior of the building; or

(b) a non-conditioned space including—

(i) the floor of a rooftop plant room, lift-machine room or the like; and

(ii) the floor above a carpark or warehouse; and

(iii) the common wall with a carpark, warehouse or the like.

External wall, for the purposes of Volume One, means an outer wall of a building which is not a common wall.

Fabric means the basic building structural elements and components of a building including the roof, ceilings, walls, glazing and floors.

Floor area, for the purposes of Volume One, means—

(a) in relation to a building — the total area of all storeys; and

(b) in relation to a storey — the area of all floors of that storey measured over the enclosing walls, and includes—

(i) the area of a mezzanine within the storey, measured within the finished surfaces of any external walls; and

(ii) the area occupied by any internal wall or partitions, any cupboard, or other built-in furniture, fixture or fitting; and

(iii) if there is no enclosing wall, an area which has a use that—

(A) contributes to the fire load; or

(B) impacts on the safety, health or amenity of the occupants in relation to the provisions of the BCA; and

(c) in relation to a room — the area of the room measured within the finished surfaces of the walls, and includes the area occupied by any cupboard or other built-in furniture, fixture or fitting; and

(d) in relation to a fire compartment — the total area of all floors within the fire compartment measured within the finished surfaces of the bounding construction, and if there is no bounding construction, includes an area which has a use which contributes to the fire load; and

(e) in relation to an atrium — the total area of all floors within the atrium measured within the finished surfaces of the bounding construction and if no bounding construction, within the external walls.

Glazing, for the purposes of Section J in Volume One, means a transparent or translucent element and its supporting frame located in the envelope, and includes a window other than a roof light. For the purposes of Section J, the glazing provides an aperture by which light and energy can flow into or from the conditioned space.

Heated water means water that has been intentionally heated. It is normally referred to as hot water or warm water

Heating load means the calculated amount of energy delivered to the heated spaces of the building annually by artificial means to maintain the desired temperatures in those spaces.

Hours of operation means the number of hours when the occupancy of the building is greater than 20% of the peak occupancy.

Illuminance means the luminous flux falling onto a unit area of surface.

Illumination power density (W/m^2) means the total of the power that will be consumed by the lights in a space, including any lamps, ballasts, current regulators and control devices other than those that are plugged into socket outlets for intermittent use such as floor standing lamps, desk lamps or work station lamps, divided by the area of the space.

Internal wall, for the purposes of Volume One, excludes a common wall or a party wall.

Latent heat gain means the heat gained by the vaporising of liquid without change of temperature.

Minimum Energy Performance Standards (MEPS) means the Minimum Energy Performance Standards for equipment and appliances established through the Greenhouse and Energy Minimum Standards Act 2012.

Mezzanine means an intermediate floor within a room.

NABERS Energy for Offices means the National Australia Built Environment Rating Systems for office energy efficiency, which is managed by the New South Wales Government.

Outdoor air means air outside the building.

Performance Requirement means a requirement which states the level of performance which a Performance Solution or Deemed-to-Satisfy Solution must meet.

Performance Solution means a method of complying with the Performance Requirements other than by a Deemed-to-Satisfy Solution.

Predicted Mean Vote (PMV) means the Predicted Mean Vote of the thermal perception of building occupants determined in accordance with ANSI/ASHRAE Standard 55.

R-Value ($m^2.K/W$) means the thermal resistance of a component calculated by dividing its thickness by its thermal conductivity.

Reference building, for the purposes of Volume One, means a hypothetical building that is used to calculate the maximum allowable annual greenhouse gas emissions and determine the Thermal comfort level for the proposed building.

Reflective insulation means a building membrane with a reflective surface such as a reflective foil laminate, reflective barrier, foil batt or the like capable of reducing radiant heat flow.

Renewable energy means energy that is derived from sources that are regenerated, replenished, or for all practical purposes cannot be depleted and the energy sources include, but are not limited to, solar, wind, hydroelectric, wave action and geothermal.

Residential care building means a Class 3, 9a or 9c building which is a place of residence where 10% or more of persons who reside there need physical assistance in conducting their daily activities and to evacuate the building during an emergency (including any aged care building or residential aged care building) but does not include a hospital.

Sensible heat gain means the heat gained which causes a change in temperature

Service, for the purposes of Section J in Volume One, means a mechanical or electrical system that uses energy to provide air-conditioning, mechanical ventilation, heated water supply, artificial lighting, vertical transport and the like within a building, but which does not include—

(a) systems used solely for emergency purposes; and

(b) cooking facilities; and

(c) portable appliances.

Site means the part of the allotment of land on which a building stands or is to be erected

Solar admittance means the fraction of incident irradiance on a wall-glazing construction that adds heat to a building's space.

Sole-occupancy unit means a room or other part of a building for occupation by one or joint owner, lessee, tenant, or other occupier to the exclusion of any other owner, lessee, tenant, or other occupier and includes—

(a) a dwelling; or

(b) a room or suite of rooms in a Class 3 building which includes sleeping facilities; or

(c) a room or suite of associated rooms in a Class 5, 6, 7, 8 or 9 building; or

(d) a room or suite of associated rooms in a Class 9c building, which includes sleeping facilities and any area for the exclusive use of a resident.

Thermal comfort level means the level of thermal comfort in a building expressed as a PMV sensation scale.

Total R-Value (m^2.K/W), for the purposes of Volume One, means the sum of the R-Values of the individual component layers in a composite element including any building material, insulating material, airspace, thermal bridging and associated surface resistances.

Total System Solar Heat Gain Coefficient (SHGC), for the purposes of Volume One, means the fraction of incident irradiance on a wall-glazing construction or a roof light that adds heat to a building's space.

Total System U-Value (W/m^2. K), for the purposes of Volume One, means the thermal transmittance of the composite element allowing for the effect of any airspaces, thermal bridging and associated surface resistances.

Ventilation opening means an opening in the external wall, floor or roof of a building designed to allow air movement into or out of the building by natural means including a permanent opening, an openable part of a window, a door or other device which can be held open.

Verification Method means a test, inspection, calculation or other method that determines whether a Performance Solution complies with the relevant Performance Requirements.

Wall-glazing construction, for the purposes of Section J in Volume One, means the combination of wall and glazing components comprising the envelope of a building, excluding—

(a) display glazing; and

(b) opaque non-glazed openings such as doors, vents, penetrations and shutters.

Ward area means that part of a patient care area for resident patients and may contain areas for accommodation, sleeping, associated living and nursing facilities.

Window includes a roof light, glass panel, glass block or brick, glass louvre, glazed sash, glazed door, or other device which transmits natural light directly from outside a building to the room concerned when in the closed position.