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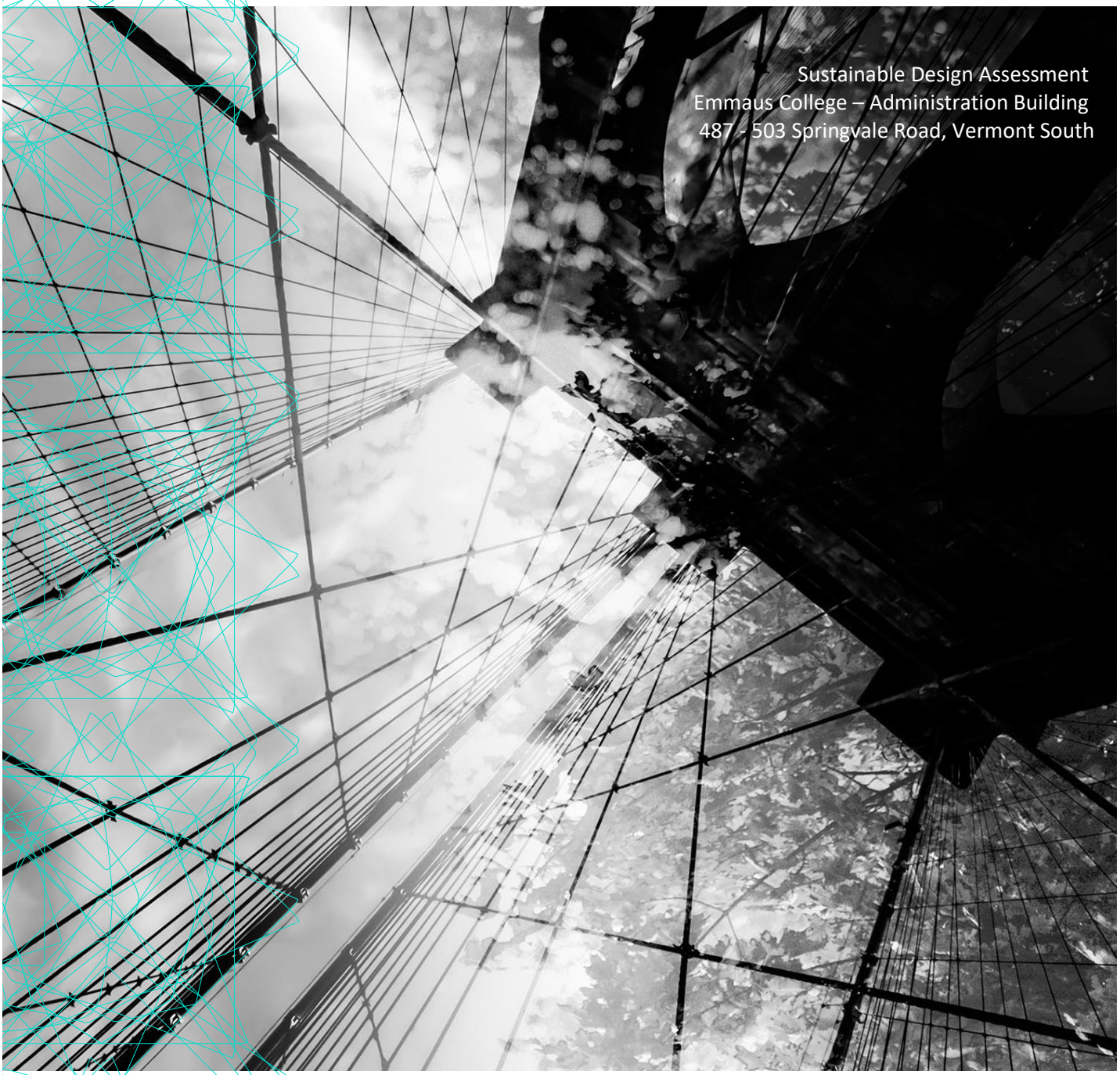

Sustainable Design Assessment
Emmaus College – Administration Building
487 - 503 Springvale Road, Vermont South

SUSTAINABLE DEVELOPMENT
_CONSULTANTS

Proposed Administration Building
487 - 503 Springvale Road, Vermont South

Sustainable Design Assessment

October 2024

S3748 SDA.V1

PREPARED BY:

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Version	Date of Issue	Description	Author	Approved
D1	01-10-2024	For Client Review	SS	BdW
V1	10-10-2024	For Council Approval	SS	BdW

1. Introduction

This Sustainable Design Assessment (SDA) has been prepared to assist the design, construction and operation of the proposed Administration Building at Emmaus College, 487 - 503 Springvale Road, Vermont South.

Sustainable Development Consultants have assessed the proposed development and provided input to the design team. This SDA captures initiatives necessary to ensure that the development meets the sustainability requirements of City of Whitehorse, as outlined in Section 1.3 of this report.

This document has been prepared by Sustainable Development Consultants with reference to the architectural drawings prepared by Branch Architects.

1.1 Site Description

The site at 487 - 503 Springvale Road, Vermont South is approximately 20km east of the Melbourne CBD, close to the intersection of Hawthorn Road. The project site area is 552m^2 and is located within Emmaus College. The existing building on the site will be demolished prior to construction of the proposed Administration Building.

The planning application also includes paved areas outlined in Appendix 2.

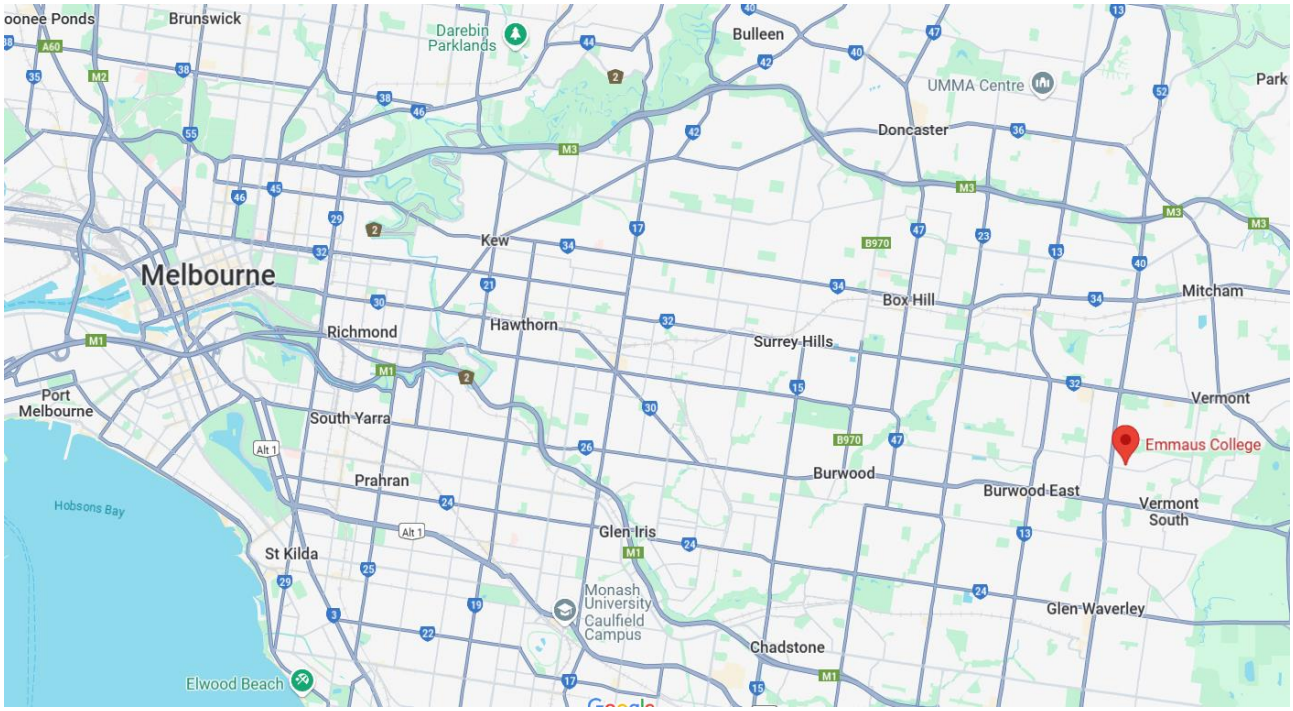


Figure 1: Location of 487-503 Springvale Road, Vermont South in relation to the Melbourne CBD (Source: Google Maps)

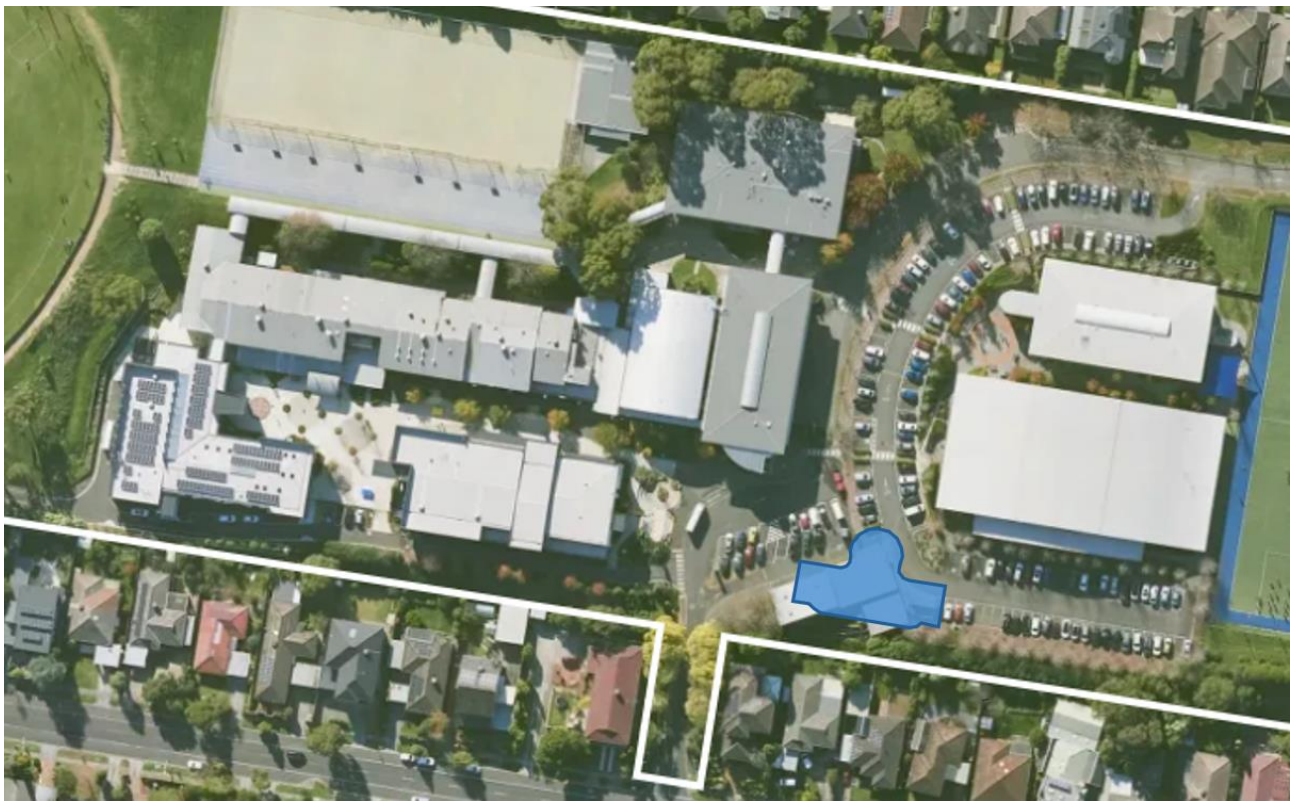


Figure 2: Aerial view of proposed Administration Building at 487 - 503 Springvale Road, Vermont South (Source: Landchecker; mark-up by SDC)

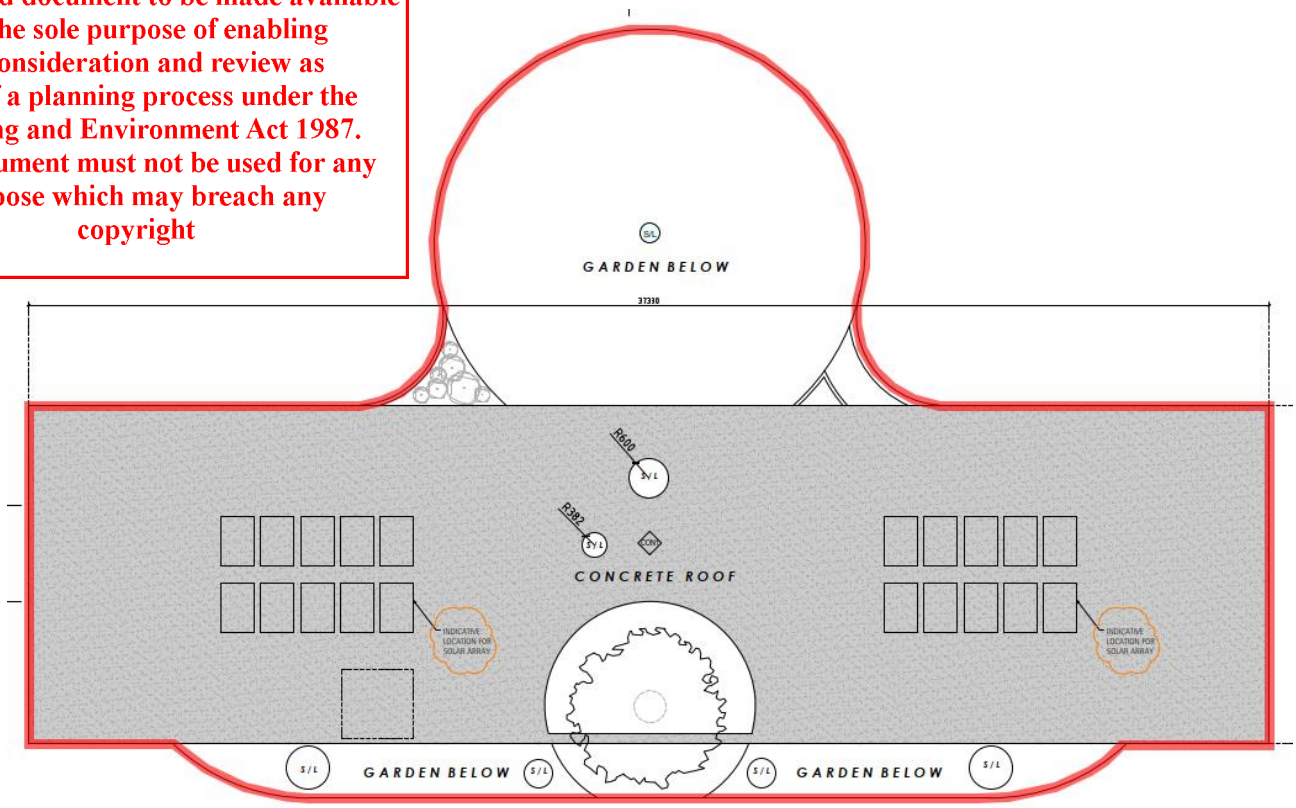


Figure 3: Proposed Site Area (red boundary line; mark-up by SDC)

1.2 Development Summary

Set out in Table 1 below is a development summary for this project.

Table 1: Development Summary

Development Information	
Total Site Area	10,726m^2
Administration Building Footprint	362m^2
Ground Floor	3 x Meeting rooms 1 x Board Room 1 x Sick Bay 2 x Reception 1 x Courtyard 3 x Offices
First Floor	13 x Offices 1 x waiting area
Footpath	137m^2
Impervious Surfaces (Carparking etc.)	8,950m^2
Landscaping	1,277m^2

1.3 City of Whitehorse Requirements

The City of Whitehorse is committed to creating an environmentally sustainable city. Critical to achieving this commitment is for developments to meet appropriate environmental design standards.

The City of Whitehorse requires new developments with a gross floor area between 500m^2 and 1000 m^2 within their municipality to include, as part of the town planning application, a Sustainable Design Assessment (SDA) in line with Clause 22.10-4. The SDA is to be in line with the SDAPP[1] guidelines and address sustainability considerations to ensure that the development is designed, built and maintained at a level that reflects best practice outcomes. This will be in line with expectations set for similar development proposals in other parts of the municipality. Whitehorse City Council, as a member/participant of SDAPP, has identified 10 Key Sustainable Building Categories to be addressed. These are:

- Energy Efficiency;
- Water Efficiency;
- Stormwater Management;
- Indoor Environment Quality;
- Building Materials;
- Waste Management;
- Transport;
- Urban Ecology;
- Construction and Building Management; and
- Innovation.

This SDA captures initiatives to ensure that the ESD requirements of the City of Whitehorse are met, including relevant objectives within Clause 22.10 *Environmentally Sustainable Development* of the Whitehorse Planning Scheme.

1.4 ESD Assessment Tools

There are several calculators and modelling programs available in Victoria to assess proposed developments against benchmarks for ESD, as set by the Victorian government, local councils and the Building Code of Australia.

For this project, set out below are the assessment tools that have been adopted for this project.

1.4.1 BUILT ENVIRONMENT SUSTAINABILITY SCORECARD (BESS)

BESS was developed by the Council Alliance for Sustainability in the Built Environment (CASBE). This tool assesses the energy and water efficiency, thermal comfort and overall environmental sustainability performance of new buildings or alterations. It was created to demonstrate that new development meets sustainability requirements as part of a planning permit application.

A BESS assessment has been conducted for the proposed development. This provides a guide as to the level of sustainability achieved by the proposed development in line with the Council's ESD requirements.

Each target area within the BESS tool generally receives a score of between 1% and 100%. A minimum score of 50% is required for the energy, water, stormwater and Indoor Environment Quality (IEQ) areas. An overall score of 50% for the project represents 'Best Practice' while a score over 70% represents 'Excellence'.

The result of the BESS assessment can be found in Appendix 1 of this report.

1.4.2 MELBOURNE WATER STORM CALCULATOR

Melbourne Water has developed the STORM calculator to simplify the analysis of stormwater treatment methods. The calculator is designed to enable a simple assessment of Water Sensitive Urban Design (WSUD) measures. The STORM Calculator determines the amount of treatment that typical WSUD measures will provide in relation to best practice targets.

The results of the STORM assessment can be found in Appendix 2 of this SDA.

1 SDAPP – Sustainable Design Assessment in the Planning Process, a joint initiative of over 23 councils aimed at streamlining and improving the application of sustainability requirements.

1.4.3 DESIGNBUILDER

DesignBuilder is a comprehensive analytical software package that analyses the energy and economic impacts of building-related selections such as architectural features; heating, ventilation and air-conditioning (HVAC) systems; HVAC equipment; building utilisation or scheduling, and financial options. DesignBuilder includes weather data including, latitude, longitude, altitude, time zone, and summer and winter design conditions; hourly observations information such as dry-bulb and wet-bulb temperatures (OADB, OAWB), humidity ration (HR), cloud cover (CCM), wind velocity, and outdoor air pressure (OAP). DesignBuilder was used for both the thermal performance modelling (verification method J1V3) and daylight modelling of the proposed building.

Results of the thermal performance modelling are presented in Appendix 4.

Results of the daylight modelling can be found in Appendix 5.

2. Sustainability Initiatives

The following sections outline the initiatives that will be incorporated into the development throughout its design, construction and operation. Initiatives that are included to contribute towards the BESS benchmark have a reference next to them, e.g. (BESS Management 4.1). Some initiatives without the BESS reference have also been included as they also contribute to the overall sustainability of the development.

The following sections, as well as nominating the sustainability initiatives, also identify the party/parties responsible for implementation of the initiative, and the stage at which implementation will be demonstrated.

The following are the broad project stages:

1	Design Development	• Consultants develop conceptual design drawing to a detailed stage suitable as a basis for preparing working drawings - Integration of architectural, services, structure and site attributes • Checking compliance with all statutory requirements, codes and standards • Arranging special surveys or reports as required
2	Construction Documentation	• Architectural and services drawing sets completed • All specialist reports completed • All necessary planning and building consents obtained as required by authorities
3	Construction	• All work carried out onsite – site preparation, construction, alteration, extension, demolition • Purchase of all materials / certification • Evidence gathering from subcontractors • Commissioning
4	Post Occupancy	• Operation and Maintenance • Education – Building Users Guides

2.1 Energy Efficiency

The proposed education building will minimise energy use through an efficient hot water system, heating & cooling, lighting and superior building envelope.

Design Requirements	Responsibility & Implementation	Project Stage
Thermal Performance (Management 2.3 & 2.4, BESS Energy 1.1)		
The building will be designed to achieve an improvement on NCC 2022 minimum energy efficiency requirements for the conditioned spaces (which include offices, studios, tutorial rooms, corridors, student breakout area, kitchen, computer lab and theatre). This will be achieved with the selection of appropriate building fabric and efficient HVAC systems. A preliminary J1V3 modelling assessment has been completed, including a preliminary Section J façade assessment, to determine the necessary thermal performance of envelope walls, ceilings, floors and glazing to achieve compliance not only with the NCC, but also the BESS Energy section. The J1V3 modelling includes the addition of skylights to Level 1, to ensure that energy compliance could still be achieved whilst reaching compliance with the daylight requirement. Refer Appendix 4 for further details.	Architect/ Services Consultant	Construction Documentation
Double Glazing		
All new skylights/external windows/external glazed doors provided to the new Administration Building will be specified as double glazed units. Double glazing brings multiple benefits such as better thermal performance and helps to reduce condensation. Properly specified in conjunction with acoustic consultant's advice, double glazing can also provide a quieter internal environment.	Architect/ Services Consultant	Construction Documentation
Heating and Cooling Systems (BESS Energy 2.3)		
Heating and cooling in the development will be provided by energy efficient air conditioners. Refer Appendix 4 for further details.	Mechanical Engineer	Design Development
Hot Water (BESS Energy 3.2)		
Hot water for the development will be provided via an energy efficient electric heat pump system (COP of ≥3.5). Refer to Appendix 6 for detail on the assumptions and considerations made.	Services Consultant	Design Development
Internal Lighting (BESS Energy 3.7)		
Lighting levels will be reduced by installing LED lighting throughout the building. The development will aim for compliance against the maximum illumination power densities listed in Table J7D3a of the NCC 2022.	Electrical Engineer	Design Development
External Lighting		
External lighting will be LED and will have controls (e.g. motion detectors, and timers) to minimise consumption during off-peak times (e.g. 11pm-5am).	Electrical Engineer	Design Development
Energy Efficient Appliances		
Any appliances provided in the development as part of the base building works will be selected within one energy efficiency star of the best available.	Developer	Construction Documentation

Design Requirements	Responsibility & Implementation	Project Stage
Building Sealing		
All windows, doors, exhaust fans and pipe penetrations will be constructed to minimise air leakage as required by the provisions outlined in Part J5 of the NCC 2022. This will include the use of seals around operable windows and doors as well as caulking to pipe penetrations, and the addition of self-closing louvers or dampers to exhaust fans.	Builder	Construction
Mechanical Ventilation		
The ventilation system in control common, service and lift area will be fitted with timers and motion sensors.	Services Engineer	Construction Documentation
PV Panels (BESS Energy 4.2)		
The roof of the development will host a 30kW (min.) solar photovoltaic (PV) system for renewable energy generation. This will offset a portion of greenhouse gas emissions and energy use by producing over 39,000 kWh of green electricity per year[2], assuming an inclination of 30˚ and orientation to the north.	Electrical Engineer	Construction Documentation

2.2 Water Resources & Stormwater Treatment

Water will be used efficiently in the proposed education building through efficient fixtures and fittings, and collection and reuse of rainwater, which helps to reduce mains water requirements and diverts stormwater.

Design Requirements	Responsibility & Implementation	Project Stage
Water Fixtures and Fittings (BESS Water 1.1)		
The development will include efficient fittings and fixtures to reduce the volume of mains water used. The following minimum Water Efficiency Labelling Scheme (WELS) star ratings will be specified: • Toilets: ≥ 4 Star; • Taps (bathroom and kitchen): ≥ 5 Star; and • Showers: ≤7.5L/min (4 Star)	Architect	Construction Documentation
Rainwater Collection and Reuse (BESS Water 2.1)		
Rainwater will be collected from a minimum effective roof area of 362m^2. Runoff will drain to a 10kL tank for reuse for toilet flushing in the staff toilets (i.e., all toilets within this building). Any overflow from the 10kL rainwater tank capacity will be directed to the legal point of discharge (LPD) onsite. Refer Appendix 2 – STORM Assessment.	Hydraulics consultant	Design Development
Water Efficient Appliances		
Any other appliances provided will be within one Water Efficiency Labelling Scheme (WELS) star of the best available (if provided by the developer).	Developer	Construction Documentation
Water Efficient Landscaping (BESS Water 3.1)		
The landscaping will be designed in accordance with xeriscape principles, emphasizing drought tolerance and grouping plants with similar water demand characteristics together. This will not be connected to irrigation.	Landscape Architect	Design Development

[2] Energy generation estimate calculated as per BESS Energy 4.2

Design Requirements	Responsibility & Implementation	Project Stage
Waterless HVAC System (BESS Water 4.1)		
Air-conditioning units will use air-cooled condenser components which will help to reduce the development's overall water usage, whilst also preventing the growth of legionella bacterium which thrive in warm stagnant water.	Mechanical Engineer	Construction Documentation
Fire System Water (BESS Water 4.1)		
The fire test system will not expel potable water for testing, or a minimum 80% of test water from fire sprinkler systems to be captured for reuse.	Fire Services Consultant	Design Documentation

Figure 4: Examples of drought tolerant landscaping that could be incorporated into the development design

2.3 Indoor Environment Quality

Indoor Environment Quality (IEQ) addresses initiatives that help create a healthy indoor environment free from toxins, with ample supply of daylight and outside air.

Design Requirements	Responsibility & Implementation	Project Stage
Volatile Organic Compounds (VOCs)		
All paints, adhesives and sealants and flooring will not exceed the limits outlined in Appendix 3. Alternatively, products with no VOCs will be selected.	Architect	Construction Documentation
Formaldehyde Minimisation		
All engineered wood products will have 'low' formaldehyde emissions, certified as E0 or better. Alternatively, products will be specified with no formaldehyde. Emissions limits are listed in Appendix 3.	Architect	Construction Documentation
Daylight (BESS IEQ 1.4)		
Access to natural daylight is extremely important for all occupants and will provide an essential connection with nature and improve occupants' health and well-being. Glazing to Administration Building the addition of skylight is designed to provide daylight access and external views to reduce reliance on artificial lighting and improve indoor amenity. This provision has been tempered by the requirement to control the solar gains which come through large windows. Daylight penetration through windows/openings will be enhanced with the use of light internal colours, allowing for a better internal reflection of daylight.	Architect	Design Development

Design Requirements	Responsibility & Implementation	Project Stage
Daylight modelling has been completed for the proposed design, with the regular use spaces achieving a minimum daylight factor of 2% across at least 37% of the nominated floor area.		
Daylight Improvement		
Daylight penetration through windows/openings will be enhanced with the use of clear glazing and light internal colours, allowing for a better internal reflection of daylight.	Architect	Construction Documentation
Ventilation – Non-Residential (BESS IEQ 2.3)		
Operable windows will be specified to facilitate natural ventilation, to 60% of regular use areas. The central HVAC system of the will provide outside air at a rate that exceeds the minimum required rate per person outlined in AS 1668.2:2012, by a minimum of 100%, to provide a comfortable and healthy internal environment to the occupants throughout. The ventilation systems are to be designed to achieve, monitor and maintain a maximum CO_2 concentration of maximum 700ppm to regular use areas.	Mechanical Engineer	Design Development

2.4 Building Materials

Materials initiatives help reduce the use of virgin materials and generating waste and promote the use of materials with lower embodied energy and environmental impacts.

Design Requirements	Responsibility & Implementation	Project Stage
Concrete		
Concrete mix water will contain a minimum of 50% captured or reclaimed water.	Builder	Construction Documentation
Steel		
Wherever possible, steel for the development will be sourced from a Responsible Steel Maker[3]. Reinforcing steel for the project will be manufactured using energy reducing processes.	Builder / Structural Engineer	Construction Documentation
Timber		
All timber used in the development will be Forest Stewardship Council (FSC) or Program for the Endorsement of Forest Certification (PEFC) certified or recycled / reused.	Architect/ Builder	Construction Documentation
Cables, pipes, floors and blinds		
At least 95% of standard uses of cables, pipes, flooring and blinds within the development will either not contain any PVC or will be sourced from a supplier that adheres to the Green Building Council of Australia's *Best Practice Guidelines for the Use of PVC in the Built Environment.*	Builder	Construction Documentation

[3] A Responsible Steel Maker must have facilities with a currently valid and certified ISO 14001 Environmental Management System (EMS) in place and be a member of the World Steel Association's (WSA) Climate Action Program (CAP).

2.5 Construction and Waste Management

Design Requirements	Responsibility & Implementation	Project Stage
Construction Waste Management		
The builder will develop a construction waste management plan (CWMP) for the construction phase. This will include the following: • Waste generation; • Any waste systems; • Minimisation Strategy; • Performance / Reduction targets; • Bin quantity and size; • Collection frequency; • Signage; and • Monitoring and reporting including frequency and method. The CWMP will include a requirement for not less than 80% of all civil works and built form construction waste to be recycled or re-used. The CWMP will require that all hazardous substances, pollutants and contaminants must be managed and disposed of in accordance with all state regulatory requirements. Where these materials are treated, or used on site, they must be in accordance with a sanctioned remediation process. The CWMP may form part of a broader Construction Environmental Management Plan (CEMP).	Builder	Construction
Operational Waste – Food & Garden Waste (BESS Waste 2.1)		
Dedicated bin spaces will be provided for organic & green waste (FOGO). This will assist to minimise the risk of food and garden waste ending up in landfill.	Architect/ Building Owner	Design Development/ Post Occupancy
Operational Waste – Convenience of Recycling (BESS Waste 2.2)		
Dedicated bin areas will be provided for general waste (landfill), commingled recyclables and FOGO. This will assist to minimise the risk of commingled recyclables ending up in landfill. Recycling facilities will be adjacent general waste, but bin colouring and signage will ensure distinction between different waste streams. The recycling facilities of the development will be just as convenient to access as the general waste facilities.	Architect/ Building Owner	Design Development/ Post Occupancy

Figure 5: Examples of bins separated by waste stream which may be suitable for a development of this type

2.6 Transport

The proposed site has been assessed using the "Walk Score" locational performance tool. The tool was developed in 2007 by Front Seat using the Google Maps tools. This tool considers the number of facilities within close proximity and provides a numerical score of between 1 and 100, with 1 being heavily car dependent with access to community facilities that are located some distance away, and 100 reflecting a location that is easily accessible to abundant facilities by foot. The proposed development achieves a score of 54 out of 100, which is classified as "Somewhat Walkable." High Walk Scores above 70+ indicate that the building occupants can complete most errands on foot.

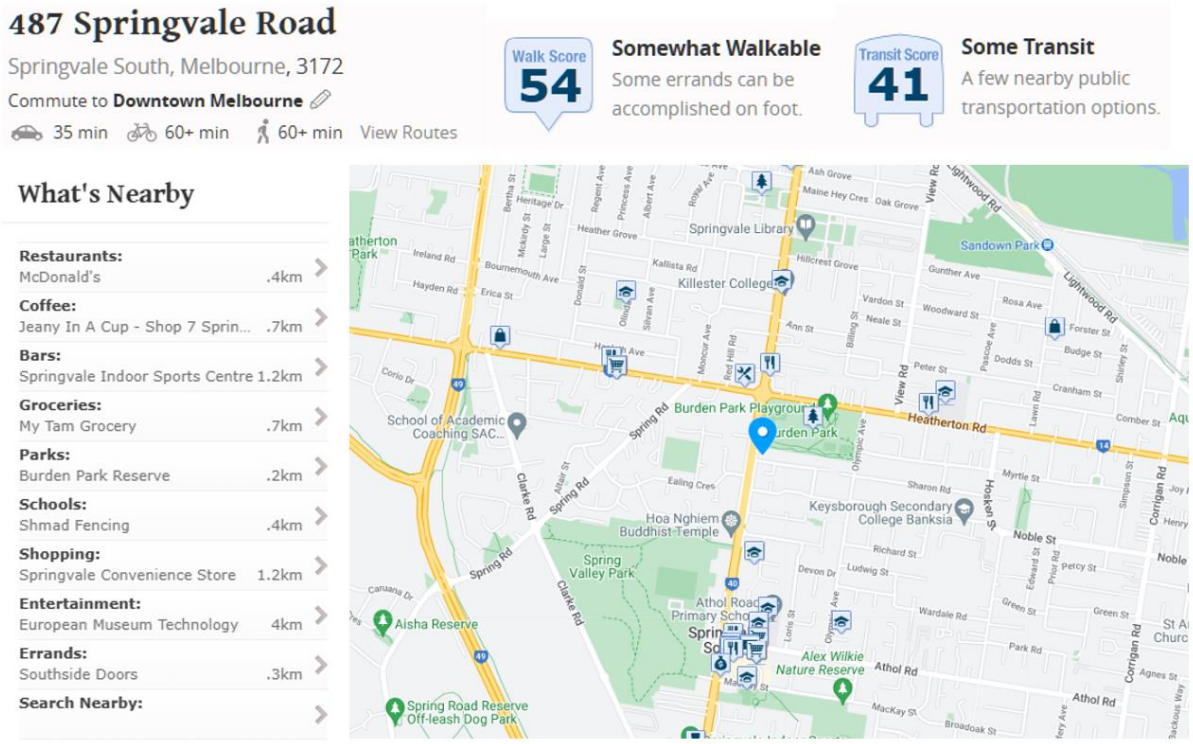


Figure 6: Walkscore map for 487-503 Springvale Road, Vermont South (Source: walkscore.com)

Design Requirements	Responsibility & Implementation	Project Stage
Public Transport		
The development has direct access to the following public transport options within walking distance: **Buses** • 765 - Mitcham - Box Hill via Brentford Square, Forest Hill, Blackburn • 703 - Middle Brighton - Blackburn via Bentleigh, Clayton, Monash University • 735 - Box Hill to Nunawading • 736 - Mitcham - Blackburn via Vermont South, Glen Waverley, Forest Hill **Tram** • 75 - Marvel Stadium Docklands - Vermont South	Inherent in Location	

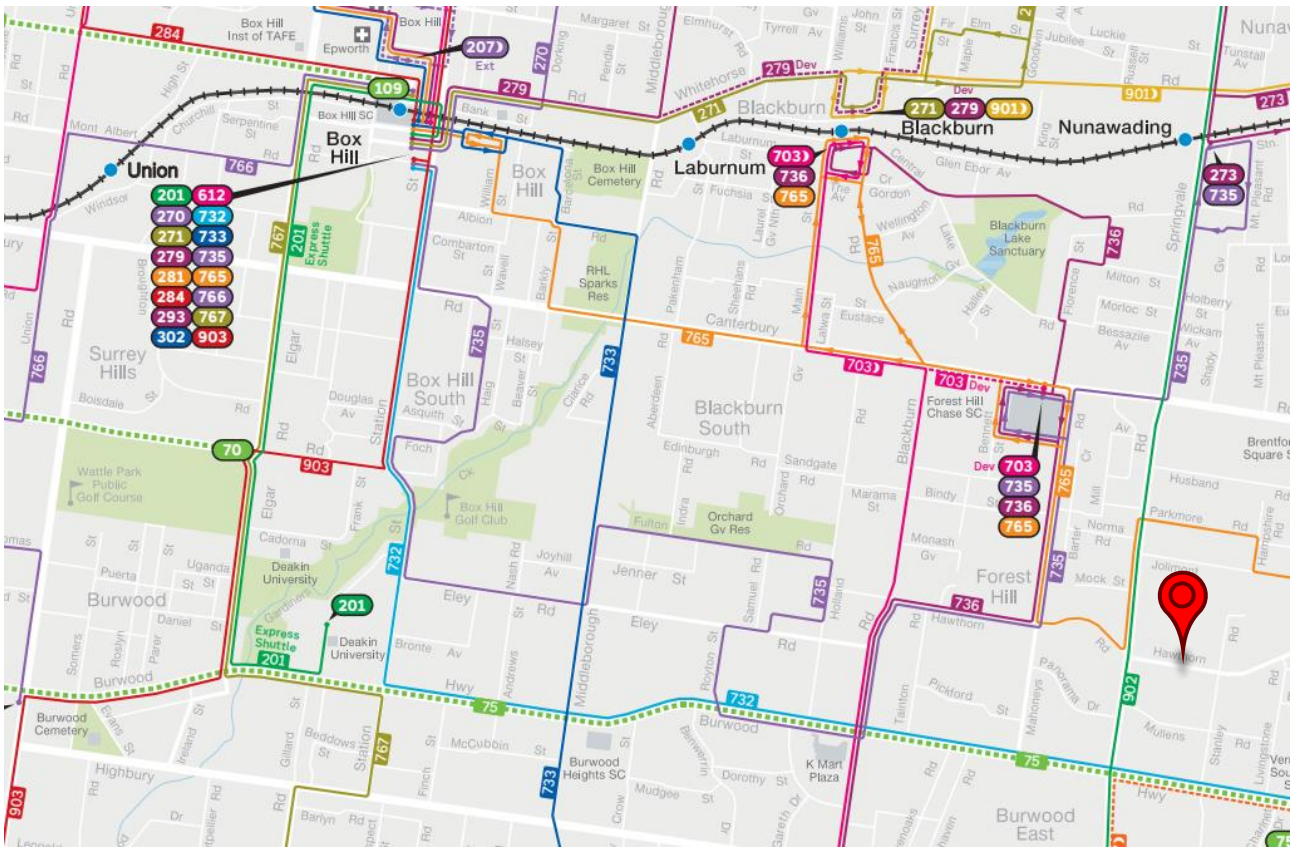


Figure 6: Public transport options near the development site (red balloon)

2.7 Urban Ecology

Design Requirements	Responsibility & Implementation	Project Stage
Vegetation (BESS Urban Ecology 2.1)		
There is 155.2m^2 (28% of site) dedicated to landscaping/vegetation. Plant and land cover selection for these areas should give preference to indigenous species as these will best suit the local climate and soil and attract native birds and insects.	Landscape Architect	Design Development
Communal Spaces (BESS Urban Ecology 1.1)		
The courtyard on the Ground Floor, and waiting area on Level 1, will provide sufficient space where individuals can gather for social exchange and interaction.	Architect	Design Development
Green Roof (BESS Urban Ecology 2.2)		
A green roof could be an eye-catching addition to the building, helping to mitigate the impacts of urban heat island effect.	Architect/ Landscape Architect	Design Development
Refrigerant ODP		
All HVAC refrigerants used in the development will be selected to have an Ozone Depletion Potential (ODP) of zero.	Mechanical Engineer	Construction Documentation
Insulation Ozone Depleting Potential		
All thermal insulation used in the development will not contain any ozone-depleting substances and will not use any when being manufactured.	Architect	Design Development

2.8 Building Management

Initiatives included in management promote adoption of environmental initiatives at different stages of the project – not just in the project's design stage.

Design Requirements	Responsibility & Implementation	Project Stage
Metering and Monitoring		
Separate utility meters (water and electricity) will be provided for each major use in the building. Any major equipment will also be separately sub metered.	Services Consultant	Construction Documentation
Building User Guide (BESS Management 4.1)		
A Building User's Guide (BUG) will be developed for the building occupants. The BUG will be comprehensive and will include descriptions of all systems installed in the building as well as suggestions for sustainable operation.	Architect/ ESD Consultant	Construction Documentation

3. Conclusion

The proposed education building will meet the Environmentally Sustainable Development requirements of Whitehorse City Council's Planning Policy *Clause 21.10* through implementation of several initiatives, such as environmentally preferred materials initiatives, inclusion of solar PV, rainwater tank with reuse and energy efficient thermal envelope and design for good indoor environmental quality, as well as reduced environmental impacts during the construction stage.

The initiatives that have been included within this SDA all have a proven track record of serving their individual purpose and can be easily maintained with any failures obvious to the occupants of the development. This helps to ensure the ongoing sustainability of the development as the systems installed in the beginning are maintained for purpose throughout the life of the building.

The implementation of this SDA requires a clear process that will include:

- Full integration with architectural and building services plans and specifications;
- Endorsement of the SDA Report with town planning drawings; and
- SDA Report initiatives to be included in plans and specifications for building approval.

Appendix 1 – BESS Assessment

BESS, Administration Building - Emmaus College, 487-503 Springvale Rd, Vermo...

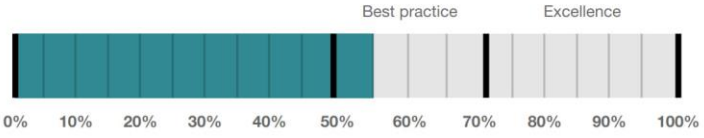
BESS Report

Built Environment Sustainability Scorecard

This BESS report outlines the sustainable design commitments of the proposed development at Emmaus College Vermont South Victoria 3133. The BESS report and accompanying documents and evidence are submitted in response to the requirement for a Sustainable Design Assessment or Sustainability Management Plan at Whitehorse City Council.

Note that where a Sustainability Management Plan is required, the BESS report must be accompanied by a report that further demonstrates the development's potential to achieve the relevant environmental performance outcomes and documents the means by which the performance outcomes can be achieved.

Your BESS Score

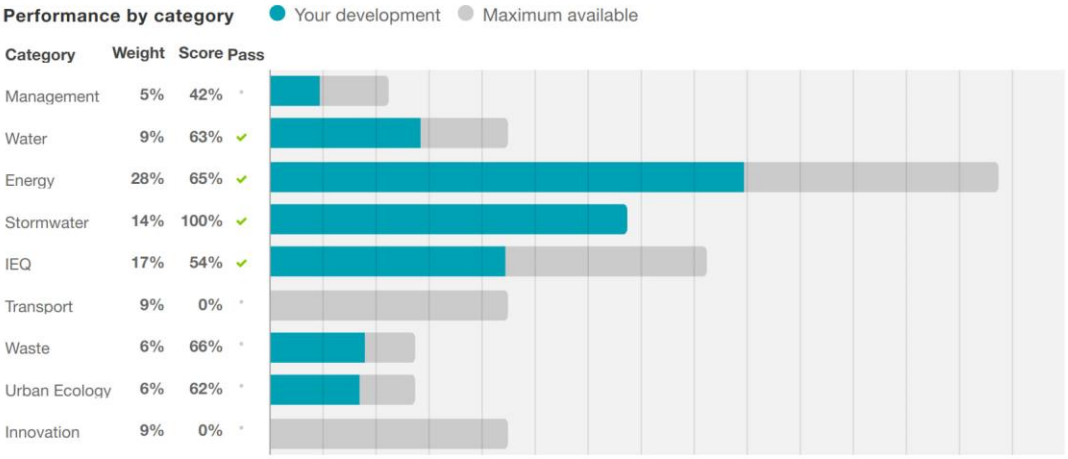


55%

Project details

Address	Emmaus College Vermont South Victoria 3133
Project no	CE6CCBAF-R2
BESS Version	BESS-8
Site type	Non-residential development
Account	sabrina@sdconsultants.com.au
Application no.	
Site area	552.00 m²
Building floor area	860.00 m²
Date	11 October 2024
Software version	2.0.1-B.570

Performance by category



The Built Environment Sustainability Scorecard is an initiative of the Council Alliance for a Sustainable Built Environment (CASBE).
For more details see **www.bess.net.au**

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Buildings

Name	Height	Footprint	% of total footprint
Administration Building	2	552 m²	100%

Dwellings & Non Res Spaces

Non-Res Spaces

Name	Quantity	Area	Building	% of total area
Public building				
Admin Building	1	860 m²	Administration Building	100%
Total	**1**	**860 m²**	**100%**	

Supporting information

Floorplans & elevation notes

Credit	Requirement	Response	Status
Water 3.1	Annotation: Water efficient garden details	To be printed Landscape designer to ensure that landscape documentation includes reference to a water efficient garden, with suitable indigenous species selected. If Landscape Designer not yet engaged, architectural documentation to show.	✔
Energy 4.2	Location and size of solar photovoltaic system	To be printed Ensure location and size of solar panels are shown on the roof plan.	✔
Stormwater 1.1	Location of any stormwater management systems (rainwater tanks, raingardens, buffer strips)	To be printed Ensure all stormwater management systems are shown on documentation.	✔
Waste 2.1	Location of food and garden waste facilities	To be printed Ensure location of food and garden waste is shown within waste area.	✔
Waste 2.2	Location of recycling facilities	To be printed Ensure location of recycling is shown within waste area.	✔
Urban Ecology 1.1	Location and size of communal spaces	To be printed Ground Floor Courtyard and Level 1 Waiting Area are shown on architectural documentation.	✔
Urban Ecology 2.1	Location and size of vegetated areas	To be printed Ensure that Landscape and Architectural documentation shows all vegetated areas.	✔
Urban Ecology 2.2	Location and size of green roof	To be printed Green Roof shown on architectural documentation.	✔

Supporting evidence

Credit	Requirement	Response	Status
Management 2.3b	Preliminary modelling report	To be printed Refer to Appendix 4 of SDA.	✔
Energy 1.1	Energy Report showing calculations of reference case and proposed buildings	To be printed Refer to Appendix 4 of SDA.	✔
Energy 3.7	Average lighting power density and lighting type(s) to be used	To be printed Ensure the Electrical documentation shows IPD and lighting types.	✔
Energy 4.2	Specifications of the solar photovoltaic system(s)	To be printed Solar PV specifications (size, orientation, inclination) to be detailed within electrical documentation.	✔
Stormwater 1.1	STORM report or MUSIC model	To be printed STORM Assessment - Refer to Appendix 2 of SDA.	✔
IEQ 1.4	A short report detailing assumptions used and results achieved.	To be printed Refer to Appendix 5 of SDA.	✔

Credit summary

Management Overall contribution 4.5%

	42%	
1.1 Pre-Application Meeting	0%	
2.3 Thermal Performance Modelling - Non-Residential	100%	
3.2 Metering - Non-Residential	N/A	Scoped Out
	No commercial tenancies.	
3.3 Metering - Common Areas	0%	
4.1 Building Users Guide	100%	

Water Overall contribution 9.0%

	Minimum required 50% 63%	✔ Pass
1.1 Potable Water Use Reduction	49%	
3.1 Water Efficient Landscaping	100%	
4.1 Building Systems Water Use Reduction	100%	

BESS, Administration Building - Emmaus College, 487-503 Springvale Rd, Vermo...

Energy Overall contribution 27.5%

	Minimum required 50%	65%	Pass
1.1 Thermal Performance Rating - Non-Residential		16%	
2.1 Greenhouse Gas Emissions		100%	
2.2 Peak Demand		0%	
2.6 Electrification		100%	
2.7 Energy consumption		100%	
3.1 Carpark Ventilation		N/A	Scoped Out
No Car park on site.			
3.2 Hot Water		100%	
3.7 Internal Lighting - Non-Residential		100%	
4.1 Combined Heat and Power (cogeneration / trigeneration)		N/A	Scoped Out
No cogeneration or trigeneration system in use.			
4.2 Renewable Energy Systems - Solar		100%	
4.4 Renewable Energy Systems - Other		N/A	Scoped Out
No other (non-solar PV) renewable energy is in use.			

Stormwater Overall contribution 13.5%

	Minimum required 100%	100%	Pass
1.1 Stormwater Treatment		100%	

IEQ Overall contribution 16.5%

	Minimum required 50%	54%	Pass
1.4 Daylight Access - Non-Residential		37%	Achieved
2.3 Ventilation - Non-Residential		100%	Achieved
3.4 Thermal comfort - Shading - Non-Residential		0%	
3.5 Thermal Comfort - Ceiling Fans - Non-Residential		0%	
4.1 Air Quality - Non-Residential		100%	

The Built Environment Sustainability Scorecard is an initiative of the Council Alliance for a Sustainable Built Environment (CASBE).
For more details see **www.bess.net.au**

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Transport Overall contribution 9.0%

	0%
1.4 Bicycle Parking - Non-Residential	0%
1.5 Bicycle Parking - Non-Residential Visitor	0%
1.6 End of Trip Facilities - Non-Residential	0% ⊘ Disabled
	Credit 1.4 must be complete first.
2.1 Electric Vehicle Infrastructure	0%
2.2 Car Share Scheme	0%
2.3 Motorbikes / Mopeds	0%

Waste Overall contribution 5.5%

	66%
1.1 - Construction Waste - Building Re-Use	0%
2.1 - Operational Waste - Food & Garden Waste	100%
2.2 - Operational Waste - Convenience of Recycling	100%

Urban Ecology Overall contribution 5.5%

	62%
1.1 Communal Spaces	100%
2.1 Vegetation	75%
2.2 Green Roofs	100%
2.3 Green Walls and Facades	0%
3.2 Food Production - Non-Residential	0%

Innovation Overall contribution 9.0%

	0%
1.1 Innovation	0% ⊘ Disabled
	Achieve a project score of 50% or above to enable this credit.

Credit breakdown

Management Overall contribution 2%

1.1 Pre-Application Meeting		0%
Score Contribution	This credit contributes 42.9% towards the category score.	
Criteria	Has an ESD professional been engaged to provide sustainability advice from schematic design to construction? AND Has the ESD professional been involved in a pre-application meeting with Council?	
Question	Criteria Achieved ?	
Project	No	
2.3 Thermal Performance Modelling - Non-Residential		100%
Score Contribution	This credit contributes 28.6% towards the category score.	
Criteria	Has a preliminary facade assessment been undertaken in accordance with NCC2022 Section J4D6?	
Question	Criteria Achieved ?	
Public building	No	
Criteria	Has preliminary modelling been undertaken in accordance with either NCC2022 Section J (Energy Efficiency), NABERS or Green Star?	
Question	Criteria Achieved ?	
Public building	Yes	
3.2 Metering - Non-Residential		N/A ◈ Scoped Out
This credit was scoped out	No commercial tenancies.	
3.3 Metering - Common Areas		0%
Score Contribution	This credit contributes 14.3% towards the category score.	
Criteria	Have all major common area services been separately submetered?	
Question	Criteria Achieved ?	
Public building	No	
4.1 Building Users Guide		100%
Score Contribution	This credit contributes 14.3% towards the category score.	
Criteria	Will a building users guide be produced and issued to occupants?	
Question	Criteria Achieved ?	
Project	Yes	

Water Overall contribution 6% Minimum required 50%

Water Approach	
What approach do you want to use for Water?:	Use the built in calculation tools
Do you have a reticulated third pipe or an on-site water recycling system?:	No
Are you installing a swimming pool?:	No
Are you installing a rainwater tank?:	Yes
Fixtures, fittings & connections profile	
Showerhead:	4 Star WELS (>= 6.0 but <= 7.5)
Bath:	Scope out
Kitchen Taps:	>= 5 Star WELS rating
Bathroom Taps:	>= 5 Star WELS rating
Dishwashers:	Scope out
WC:	>= 4 Star WELS rating
Urinals:	Scope out
Washing Machine Water Efficiency:	Scope out
Which non-potable water source is the dwelling/space connected to?:	Rainwater Tank 1
Non-potable water source connected to Toilets:	Yes
Non-potable water source connected to Laundry (washing machine):	No
Non-potable water source connected to Hot Water System:	No
Rainwater tank profile	
What is the total roof area connected to the rainwater tank?: Rainwater Tank 1	362 m²
Tank Size: Rainwater Tank 1	10,000 Litres
Irrigation area connected to tank: Rainwater Tank 1	0.0 m²
Is connected irrigation area a water efficient garden?: Rainwater Tank 1	No
Other external water demand connected to tank?: Rainwater Tank 1	0.0 Litres/Day

1.1 Potable Water Use Reduction		49%
Score Contribution	This credit contributes 71.4% towards the category score.	
Criteria	What is the reduction in total potable water use due to efficient fixtures, appliances, rainwater use and recycled water use? To achieve points in this credit there must be >25% potable water reduction.	
Output	Reference	
Project	2831 kL	
Output	Proposed (excluding rainwater and recycled water use)	
Project	2212 kL	
Output	Proposed (including rainwater and recycled water use)	
Project	1927 kL	
Output	% Reduction in Potable Water Consumption	
Project	31 %	
Output	% of connected demand met by rainwater	
Project	55 %	
Output	How often does the tank overflow?	
Project	Never / Rarely	
Output	Opportunity for additional rainwater connection	
Project	508 kL	
3.1 Water Efficient Landscaping		100%
Score Contribution	This credit contributes 14.3% towards the category score.	
Criteria	Will water efficient landscaping be installed?	
Question	Criteria Achieved ?	
Project	Yes	
4.1 Building Systems Water Use Reduction		100%
Score Contribution	This credit contributes 14.3% towards the category score.	
Criteria	Where applicable, have measures been taken to reduce potable water consumption by >80% in the buildings air-conditioning chillers and when testing fire safety systems?	
Question	Criteria Achieved ?	
Project	Yes	

Energy Overall contribution 18% Minimum required 50%

Use the BESS Deem to Satisfy (DtS) method for Non-residential spaces?:	No
Non-residential buildings profile	
Heating, Cooling & Comfort Ventilation - Electricity Reference fabric & services:	20,810 kWh
Heating, Cooling & Comfort Ventilation - Electricity - proposed fabric and reference services:	20,487 kWh
Heating, Cooling & Comfort Ventilation - Electricity Proposed fabric & services:	20,487 kWh
Heating - Wood - reference fabric and services:	0.0 MJ
Heating - Wood - proposed fabric and reference services:	0.0 MJ
Heating - Wood - proposed fabric and services:	0.0 MJ
Hot Water - Electricity - Reference:	6,150 kWh
Hot Water - Electricity - Proposed:	4,044 kWh
Lighting - Reference:	9,066 kWh
Lighting - Proposed:	9,066 kWh
Peak Thermal Cooling Load - Reference:	11,981 kW
Peak Thermal Cooling Load - Proposed:	12,300 kW
Solar Photovoltaic system profile	
System Size (lesser of inverter and panel capacity): Solar Photovoltaic system 1	30.0 kW peak
Orientation (which way is the system facing)?: Solar Photovoltaic system 1	North
Inclination (angle from horizontal): Solar Photovoltaic system 1	30.0 Angle (degrees)

1.1 Thermal Performance Rating - Non-Residential	16%
Score Contribution	This credit contributes 36.4% towards the category score.
Criteria	What is the % reduction in heating and cooling energy consumption against the reference case (NCC2022 Section J)?
Output	Total Improvement
Public building	1 %

2.1 Greenhouse Gas Emissions	100%
Score Contribution	This credit contributes 9.1% towards the category score.
Criteria	What is the % reduction in annual greenhouse gas emissions against the benchmark?
Output	Reference Building with Reference Services (BCA only)
Public building	22,916 kg CO2
Output	Proposed Building with Proposed Services (Actual Building)
Public building	20,851 kg CO2
Output	% Reduction in GHG Emissions
Public building	9 %

2.2 Peak Demand		0%
Score Contribution	This credit contributes 4.5% towards the category score.	
Criteria	What is the % reduction in the instantaneous (peak-hour) demand against the benchmark?	
Output	Peak Thermal Cooling Load - Baseline	
Public building	11,981 kW	
Output	Peak Thermal Cooling Load - Proposed	
Public building	12,300 kW	
Output	Peak Thermal Cooling Load - % Reduction	
Public building	-3 %	
2.6 Electrification		100%
Score Contribution	This credit contributes 13.6% towards the category score.	
Criteria	Is the development all-electric?	
Question	Criteria Achieved?	
Project	Yes	
2.7 Energy consumption		100%
Score Contribution	This credit contributes 18.2% towards the category score.	
Criteria	What is the % reduction in annual energy consumption against the benchmark?	
Output	Reference Building with Reference Services (BCA only)	
Public building	97,056 MJ	
Output	Proposed Building with Proposed Services (Actual Building)	
Public building	88,312 MJ	
Output	% Reduction in total energy	
Public building	9 %	
3.1 Carpark Ventilation		N/A ✣ Scoped Out
This credit was scoped out	No Car park on site.	
3.2 Hot Water		100%
Score Contribution	This credit contributes 4.5% towards the category score.	
Criteria	What is the % reduction in annual energy consumption (gas and electricity) of the hot water system against the benchmark?	
Output	Reference	
Public building	22,140 MJ	
Output	Proposed	
Public building	14,558 MJ	
Output	Improvement	
Public building	34 %	

3.7 Internal Lighting - Non-Residential		100%	
Score Contribution	This credit contributes 9.1% towards the category score.		
Criteria	Does the maximum illumination power density (W/m2) in at least 90% of the area of the relevant building class meet the requirements in Table J7D3a of the NCC 2022 Vol 1?		
Question	Criteria Achieved ?		
Public building	Yes		
4.1 Combined Heat and Power (cogeneration / trigeneration)		N/A	Scoped Out
This credit was scoped out	No cogeneration or trigeneration system in use.		
4.2 Renewable Energy Systems - Solar		100%	
Score Contribution	This credit contributes 4.5% towards the category score.		
Criteria	What % of the estimated energy consumption of the building class it supplies does the solar power system provide?		
Output	Solar Power - Energy Generation per year		
Public building	39,092 kWh		
Output	% of Building's Energy		
Public building	116 %		
4.4 Renewable Energy Systems - Other		N/A	Scoped Out
This credit was scoped out	No other (non-solar PV) renewable energy is in use.		

Stormwater

Overall contribution 14% Minimum required 100%

Which stormwater modelling software are you using?:	Melbourne Water STORM tool	
1.1 Stormwater Treatment		100%
Score Contribution	This credit contributes 100% towards the category score.	
Criteria	Has best practice stormwater management been demonstrated?	
Annotation	STORM rating for extended development site (Administration Building, Chapel and Plaza) is 6%. Contributions will be paid towards 0312 Vermont South Drainage Scheme.	
Question	STORM score achieved	
Project	100	
Output	Min STORM Score	
Project	100	

IEQ Overall contribution 9% Minimum required 50%

1.4 Daylight Access - Non-Residential		37%	✔ Achieved
Score Contribution	This credit contributes 35.3% towards the category score.		
Criteria	What % of the nominated floor area has at least 2% daylight factor?		
Question	Percentage Achieved?		
Public building	37 %		
2.3 Ventilation - Non-Residential		100%	✔ Achieved
Score Contribution	This credit contributes 35.3% towards the category score.		
Criteria	What % of the regular use areas are effectively naturally ventilated?		
Question	Percentage Achieved?		
Public building	60 %		
Criteria	What increase in outdoor air is available to regular use areas compared to the minimum required by AS 1668.2:2012?		
Question	Percentage Achieved?		
Public building	100 %		
Criteria	What CO2 concentrations are the ventilation systems designed to achieve, to monitor and to maintain?		
Question	Value		
Public building	700 ppm		
3.4 Thermal comfort - Shading - Non-Residential		0%	
Score Contribution	This credit contributes 17.6% towards the category score.		
Criteria	What percentage of east, north and west glazing to regular use areas is effectively shaded?		
Question	Percentage Achieved?		
Public building	42 %		
3.5 Thermal Comfort - Ceiling Fans - Non-Residential		0%	
Score Contribution	This credit contributes 5.9% towards the category score.		
Criteria	What percentage of regular use areas in tenancies have ceiling fans?		
Question	Percentage Achieved?		
Public building	0 %		
4.1 Air Quality - Non-Residential		100%	
Score Contribution	This credit contributes 5.9% towards the category score.		
Criteria	Do all paints, sealants and adhesives meet the maximum total indoor pollutant emission limits?		
Question	Criteria Achieved ?		
Public building	Yes		
Criteria	Does all carpet meet the maximum total indoor pollutant emission limits?		
Question	Criteria Achieved ?		
Public building	Yes		

Criteria	Does all engineered wood meet the maximum total indoor pollutant emission limits?
Question	Criteria Achieved ?
Public building	No engineered wood

Transport Overall contribution 0%

1.4 Bicycle Parking - Non-Residential		0%	
Score Contribution	This credit contributes 22.2% towards the category score.		
Criteria	Have the planning scheme requirements for employee bicycle parking been exceeded by at least 50% (or a minimum of 2 where there is no planning scheme requirement)?		
Question	Criteria Achieved ?		
Public building	No		
Question	Bicycle Spaces Provided ?		
Public building	0		
1.5 Bicycle Parking - Non-Residential Visitor		0%	
Score Contribution	This credit contributes 11.1% towards the category score.		
Criteria	Have the planning scheme requirements for visitor bicycle parking been exceeded by at least 50% (or a minimum of 1 where there is no planning scheme requirement)?		
Question	Criteria Achieved ?		
Public building	No		
Question	Bicycle Spaces Provided ?		
Public building	0		
1.6 End of Trip Facilities - Non-Residential		0%	⊘ Disabled
This credit is disabled	Credit 1.4 must be complete first.		
2.1 Electric Vehicle Infrastructure		0%	
Score Contribution	This credit contributes 22.2% towards the category score.		
Criteria	Are facilities provided for the charging of electric vehicles?		
Question	Criteria Achieved ?		
Project	No		
2.2 Car Share Scheme		0%	
Score Contribution	This credit contributes 11.1% towards the category score.		
Criteria	Has a formal car sharing scheme been integrated into the development?		
Question	Criteria Achieved ?		
Project	No		
2.3 Motorbikes / Mopeds		0%	
Score Contribution	This credit contributes 22.2% towards the category score.		
Criteria	Are a minimum of 5% of vehicle parking spaces designed and labelled for motorbikes (must be at least 5 motorbike spaces)?		
Question	Criteria Achieved ?		
Project	No		

Waste Overall contribution 4%

1.1 - Construction Waste - Building Re-Use		0%
Score Contribution	This credit contributes 33.3% towards the category score.	
Criteria	If the development is on a site that has been previously developed, has at least 30% of the existing building been re-used?	
Question	Criteria Achieved ?	
Project	No	
2.1 - Operational Waste - Food & Garden Waste		100%
Score Contribution	This credit contributes 33.3% towards the category score.	
Criteria	Are facilities provided for on-site management of food and garden waste?	
Question	Criteria Achieved ?	
Project	Yes	
2.2 - Operational Waste - Convenience of Recycling		100%
Score Contribution	This credit contributes 33.3% towards the category score.	
Criteria	Are the recycling facilities at least as convenient for occupants as facilities for general waste?	
Question	Criteria Achieved ?	
Project	Yes	

Urban Ecology Overall contribution 3%

1.1 Communal Spaces		100%
Score Contribution	This credit contributes 12.5% towards the category score.	
Criteria	Is there at least the following amount of common space measured in square meters : * 1m² for each of the first 50 occupants * Additional 0.5m² for each occupant between 51 and 250 * Additional 0.25m² for each occupant above 251?	
Question	Common space provided	
Public building	71.4 m²	
Output	Minimum Common Space Required	
Public building	68 m²	
2.1 Vegetation		75%
Score Contribution	This credit contributes 50% towards the category score.	
Criteria	How much of the site is covered with vegetation, expressed as a percentage of the total site area?	
Question	Percentage Achieved ?	
Project	28 %	
2.2 Green Roofs		100%
Score Contribution	This credit contributes 12.5% towards the category score.	
Criteria	Does the development incorporate a green roof?	
Question	Criteria Achieved ?	
Project	Yes	
2.3 Green Walls and Facades		0%
Score Contribution	This credit contributes 12.5% towards the category score.	
Criteria	Does the development incorporate a green wall or green façade?	
Question	Criteria Achieved ?	
Project	No	
3.2 Food Production - Non-Residential		0%
Score Contribution	This credit contributes 12.5% towards the category score.	
Criteria	What area of space per occupant is dedicated to food production?	
Question	Food Production Area	
Public building	0.0 m²	
Output	Min Food Production Area	
Public building	22 m²	

Innovation Overall contribution 0%

1.1 Innovation		0%	⊘ Disabled
This credit is disabled	Achieve a project score of 50% or above to enable this credit.		

Disclaimer

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Appendix 2 – STORM Assessment & WSUD Report

Objectives

The quality and quantity of stormwater leaving a site can have a significant impact on the surrounding infrastructure and waterways. Impervious surfaces move water quickly and efficiently out of built-up areas straight into stormwater infrastructure, which in turn quickly moves the untreated water into natural watercourses. This process does not treat the stormwater and as the water flows into natural water courses, it causes erosion and pollution of those waterways with the rubbish, sediments, pathogens, and other pollutants that run off the impervious surfaces into the stormwater drains.

New developments in the City of Whitehorse must comply with *Clause 53.18* and the best practice performance targets for suspended solids, total phosphorous and total nitrogen, as set out in the Urban Stormwater Best Practice Environmental Management Guidelines, Victoria Stormwater Committee 1999. Currently, these water quality performance targets require:

- Suspended Solids - 80% retention of typical urban annual load.
- Total Nitrogen - 45% retention of typical urban annual load.
- Total Phosphorus - 45% retention of typical urban annual load.
- Litter - 70% reduction of typical urban annual load.

New developments must also incorporate treatment measures that improve the quality of water and reduce flow of water discharged into waterways (such as collection and use of rainwater/stormwater on site) and encourage the use of measures to prevent litter being carried off-site in stormwater flows. The proposed development has addressed these requirements by identifying the impervious surfaces within the site and implementing treatments to mitigate the impacts of stormwater leaving the site. To assess these initiatives, the STORM tool – which is an industry accepted tool – was used to determine the treatment effectiveness of these initiatives.

Stormwater Quality Contribution

A contribution has been or will be paid to the relevant authority to facilitate the infrastructure and treatment trains implemented under the Vermont South Drainage Scheme (0312), ensuring that the local area meets the Best Practice Environmental Management Guidelines. Prior to outflow a minimum of 362 m^2 of Administration Building roof area will drain to a 10kL rainwater tank. The remainder of the site will discharge to the Vermont South Drainage Scheme.

Site Characteristics

For the purposes of the stormwater assessment, the assessed area has been delineated into basic surface types listed below and highlighted in mark-up plans following:

- Total site area: 8,950 m^2 *
- Roof as catchment area (orange): 362 m^2
- Permeable landscape (green): 1,277 m^2
- Impervious Footpath (yellow): 137 m^2
- Remaining impervious surfaces (unshaded): 8,950 m^2

*Note: this site area includes Stages 1A/B/C and Stage 2.

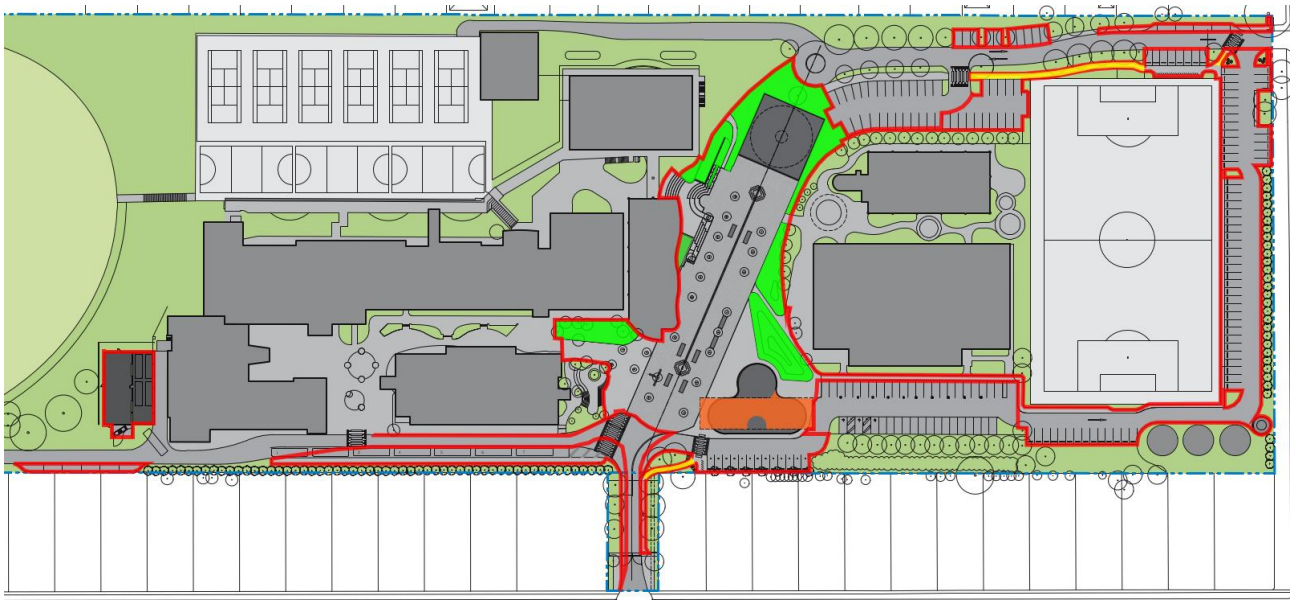


Figure 7: Site delineation

Stormwater Management Initiatives

Stormwater treatment initiatives will need to be implemented. The following section presents the different surfaces that have been identified for treatment, and the required treatment. The initiatives to manage stormwater flows for the building area will underpin the overall performance of the building and its ability to meet stormwater management objectives.

Table 2: List of areas and their stormwater treatment measures.

Surfaces	Topographic Area (m^2)	Required Treatment
Roof Catchment Area (orange)	362 m^2	Rainwater will be collected from the Administration Building roof area of 362m^2. Runoff will drain firstly to a 10kL tank for reuse for toilet flushing in the staff toilets (i.e., all toilets within the Administration building). Any overflow from the rainwater tank will be directed to the Vermont South Drainage Scheme (0312).
Landscaped Areas (green)	1,277 m^2	Permeable ground. No treatment required. Runoff will be directed to the Vermont South Drainage Scheme (0312).
Impervious Footpath (yellow)	137 m^2	Impervious footpaths are to drain to surrounding permeable areas and will not require further treatment.
Remaining impervious area (no colour)	8,950 m^2	No treatment required (including green roof of Administration Building). Runoff will be directed to the Vermont South Drainage Scheme (0312).

Rainwater Reuse

The Administration Building will include a rainwater tank with an effective capacity of at least 10kL. The rainwater will be used for toilet flushing throughout the Administration building.

The Green Star Potable Water Calculator (PWC) was used to calculate the runoff from the roof catchment and estimate the expected water consumption from toilet flushing, assuming occupancy rates based on the total number of seats provided across the 2 levels of the administration building and WELS ratings as detailed in the Water section of this report.

The STORM tool allocates 20L of water demand per day per bedroom. The estimated rainwater reuse demand for toilet flushing of the development is 129kL/year, which is equivalent to 17 bedrooms/occupants within STORM (15 was used to be conservative).

Results

The recommended treatments have been applied to the STORM tool and as a result, the proposed development has achieved score of 6%, which is a non-compliant score. However, contributions will be made to the Vermont South Drainage Scheme (0312). With the proposed stormwater treatment measures incorporated into the development, the design will meet the minimum performance standards required by BESS.

Melbourne Water **STORM Rating Report**

TransactionID:	0	
Municipality:	WHITEHORSE	
Rainfall Station:	WHITEHORSE	
Address:	487-503 Springvale Rd	
	Vermont South	
	VIC	3133
Assessor:	SDC	
Development Type:	Other	
Allotment Site (m2):	10,726.00	
STORM Rating %:	6	

Description	Impervious Area (m2)	Treatment Type	Treatment Area/Volume (m2 or L)	Occupants / Number Of Bedrooms	Treatment %	Tank Water Supply Reliability (%)
Roof Catchment	362.00	Rainwater Tank	10,000.00	15	156.40	82.40
Impervious	8,950.00	None	0.00	0	0.00	0.00

Figure 8: Stormwater calculator result

Management and Maintenance Guidelines

Inspections and maintenance of the proposed stormwater treatment systems should occur regularly to ensure their ongoing performance. It is the responsibility of the Building Manager to ensure the appropriate measures are undertaken for the rainwater tank maintenance. Some general maintenance requirements are provided in the table below. However, any specific maintenance requirements nominated by the product's manufacturer may also apply and would supersede those outlined below. The proposed system will be nominated at the detailed design stage.

Rainwater Tank

Task	When?	Requirement
Inspect rainwater tanks	Every 6 months	- Check for any damage/compression - Check any blockage of first flush diverter - Correct operation of potable mains back up switch - Check that mesh covers have not deteriorated and intact. - Check that supporting base is free of cracks and movement. - Mosquito infestation
	Every 3-5 years	- Sludge Build up – if sludge build up occurs a vacuum tank needs to be called out to site
Inspect pumps	Every 2 years	- Serviced to prolong the pump life
Inspect roofs & gutters	Every 6 months	- Clean out of leaves / debris - Remove any overhanging branches onsite

Disposal of Waste Materials

The accumulated pollutants found in the stormwater treatment systems must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes.

Stormwater Runoff

Treatment – Rainwater Tanks

Rainwater tanks are considered one of the most practical and effective mechanisms to reduce the quantity and velocity of stormwater leaving a site. Rainwater will be collected from a minimum effective roof area of 362m^2. Runoff will drain to a 10kL tank for reuse for toilet flushing in the staff toilets (i.e., all toilets within the Administration Building), effectively reducing the actual volume of water leaving the site.

Instead of rainwater being considered as waste and a burden on the infrastructure, it is seen as a resource which has the double benefit of reducing demand on potable water supplies and as a stormwater mitigation initiative.

Stormwater System Maintenance

The proposed stormwater management devices will require regular maintenance and monitoring to ensure they function as designed. An operation maintenance manual will be prepared for the site. The following section outlines key maintenance tasks and recommended frequency. The property owner will be responsible for continuous implementation of stormwater management device maintenance.

Rainwater Tank Systems

The standard maintenance activities that typically take place as part of an ongoing maintenance schedule for the rainwater tank system is as follows:

Rainwater tank system element	Frequency	Maintenance Task
Rainwater tanks – Minor service	Quarterly	• Check for any damage/compression • Check that supporting base is free of cracks and movement • Empty and clean first flush diverters • Remove and clean inlet and outlet/overflow strainers • Check correct operation of potable mains back up switch • Check that mesh covers have not deteriorated and intact • Check for mosquito infestation
Rainwater tanks – Major service	Every 2 years	• Clean tank to remove accumulated sludge
Pumps	Every 6 months	• Service water pump to prolong life
Roof and gutters	Every 6 months	• Clean out of leaves/debris

Disposal of Waste Materials

The accumulated pollutants found in the stormwater treatment systems must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes.

Stormwater Runoff Treatment during the Construction Stage

Stormwater management in the construction stage will include implemented measures to minimise the likelihood of contaminating stormwater discharge from the site as well as reduce the velocity of the flows generated from the building as it is being constructed. This will mean ensuring buffer strips are in place, and the site will be kept clean from any loose rubbish. More information is available from "*Keeping Our Stormwater Clean – A Builder's Guide*" by Melbourne Water[4]. The diagram below is an illustration of the various objectives which assist in minimising the impacts of stormwater runoff typical during the construction phase. Typical pollutants that are generated from a construction site during a rainfall event include:

- Dust
- Silt
- Mud
- Gravel
- Stockpiled materials
- Spills/oils
- Debris/litter

[4] For copies, please contact Melbourne Water on 131 722.

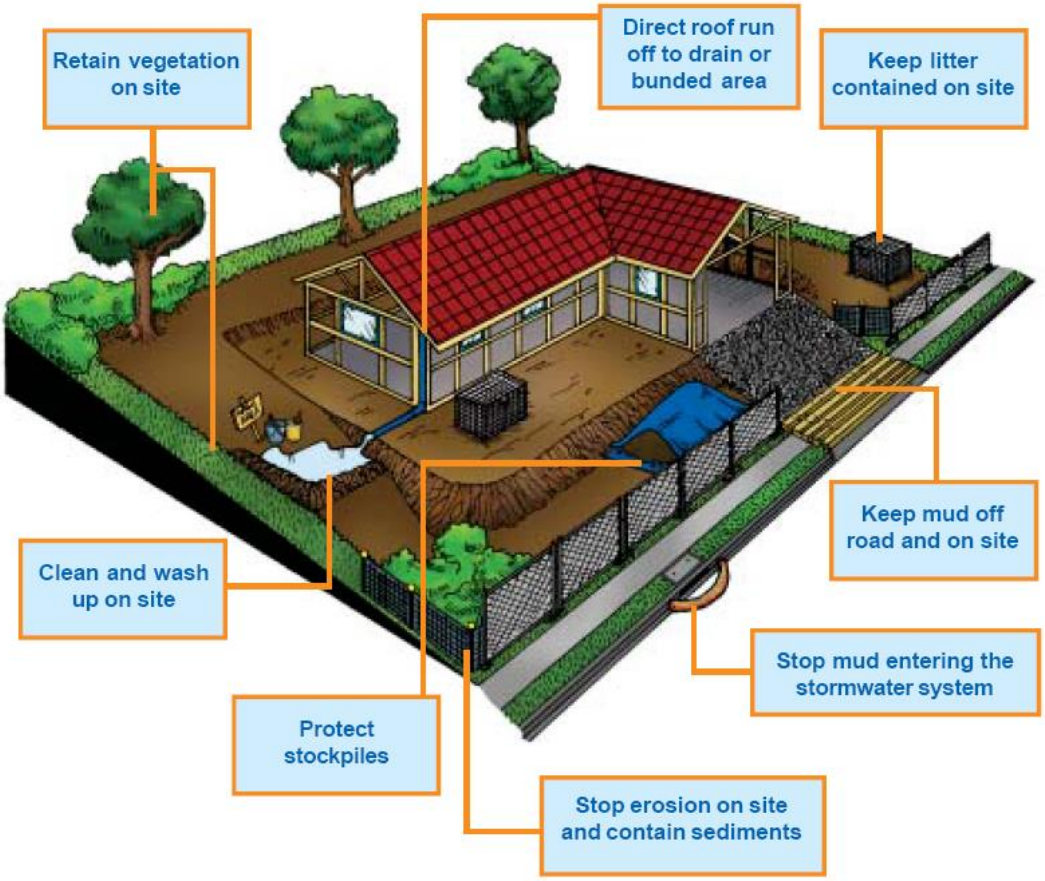
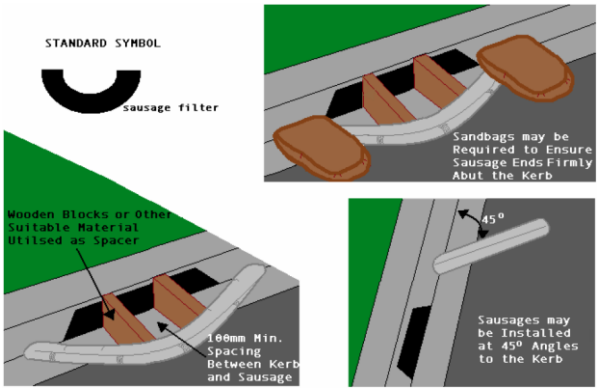


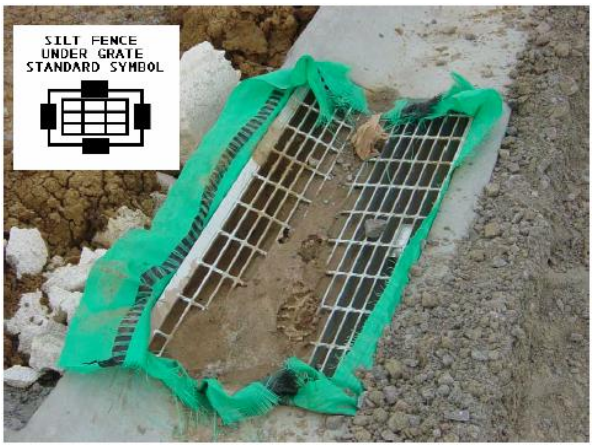
Figure 10: Stormwater will effectively be managed during construction phase according to the requirements listed in "Keeping Our Stormwater Clean – A Builder's Guide".

To reduce the impacts and minimise the generation of these pollutants the following measures are proposed. The symbols embedded within each image are typically used for Construction Environmental Management Plans.

- Gravel Sausage filters – to be placed at the entrance of pits/side stormwater inlets. These permeable sacks will filter the suspended soils and sediments and any other litter carried by the stormwater to prevent the pollutants entering the system



- Silt Fences Under Grates - Silt fence material may be placed under the grate of surface-entry inlets to prevent sediment from entering the stormwater system.



- Temporary Rumble Grids – these are designed to open the tread on tires and vibrate mud and dirt off the vehicle (in particular the chassis). This will heavily minimise the amount of soil/dirt deposited on surrounding roads where it can be washed (by rainfall or other means) into the stormwater drains.

Appendix 3 – Green Star VOC and Formaldehyde Limits

Table 3: Maximum Volatile Organic Compound Levels for construction materials (Source: Green Building Council Australia – Green Star Buildings Submission Guidelines Version 1, 2021)

Product Type/Sub Category	Max TVOC Content (g/L of ready-to-use-product)
Paints, Adhesives and Sealants	
General purpose adhesives and sealants	50
Interior wall and ceiling paint, all sheen levels	16
Trim, varnishes and wood stains	75
Primers, sealers and prep coats	65
One and two pack performance coatings for floors	140
Acoustic sealants, architectural sealant, waterproofing membranes and sealant, fire retardant sealants and adhesives	250
Structural glazing adhesive, wood flooring and laminate adhesives and sealants	100
Carpets	
Total VOC limit	0.5 mg/m² per hour
4-PC (4-Phenylcyclohexene)	0.05mg/m² per hour
ISO 16000 / EN 13419 - TVOC at three days	0.5 mg/m² per hour
ISO 10580 / ISO/TC 219 (Document N238) - TVOC at 24 hours	0.5 mg/m² per hour

Table 4: Maximum Formaldehyde levels for processed wood products. (Source: Green Building Council Australia – Green Star Buildings Submission Guidelines Version 1, 2021)

Formaldehyde emission limit values for different testing methods	
Test Method	**Emission Limit/ Unit of Measurement**
AS/NZS 2269:2004, testing procedure AS/NZS 2098.11:2005 method 10 for Plywood	**≤1mg/ L**
AS/NZS 1859.1:2004 - Particle Board, with use of testing procedure AS/NZS 4266.16:2004 method 16	**≤1.5 mg/L**
AS/NZS 1859.2:2004 - MDF, with use of testing procedure AS/NZS 4266.16:2004 method 16	**≤1mg/ L**
AS/NZS 4357.4 - Laminated Veneer Lumber (LVL)	**≤1mg/ L**
Japanese Agricultural Standard MAFF Notification No.701 Appendix Clause 3 (11) - LVL	**≤1mg/ L**
JIS A 5908:2003- Particle Board and Plywood, with use of testing procedure JIS A 1460	≤1mg/ L
JIS A 5905:2003 - MDF, with use of testing procedure JIS A 1460	≤1mg/ L
JIS A1901 (not applicable to Plywood, applicable to high pressure laminates and compact laminates)	≤0.1 mg/m²hr
ASTM D5116 (applicable to high pressure laminates and compact laminates)	≤0.1 mg/m²hr
ISO 16000 part 9, 10 and 11 (also known as EN 13419), applicable to high pressure laminates and compact laminates	≤0.1 mg/m²hr (at 3 days)
ASTM D6007	≤0.12mg/m³
ASTM E1333	≤0.12mg/m³
EN 717-1 (also known as DIN EN 717-1)	≤0.12mg/m³
EN 717-2 (also known as DIN EN 717-2)	≤3.5mg/m²hr

Appendix 4 – Preliminary J1V3 Modelling Report

This assessment has been undertaken in relation to BCA Performance Requirement J1P1 and is prepared in accordance with Verification Method J1V3, Verification using a reference building, where a Building Solution is proposed as an Alternative Solution to the Deemed-to-Satisfy Provisions.

This notice is only relevant to BCA Section J, Parts J2 (Energy Efficiency), J4 (Building Fabric), J5 (Building Sealing) and J9 (Energy Monitoring and On-site Distributed Energy Resources).

The proposed development underwent a preliminary energy modelling assessment - both as a deemed-to-satisfy designed building and as currently proposed on plans and specifications (available to this point) with deemed to satisfy services. It has been found that at present the proposed design can meet both the greenhouse gas emissions and thermal comfort requirements of Verification Method J1V3 of the 2022 BCA, assuming the following parameters (or equally approved equivalents) are met.

The modelling parameters used in the preliminary assessment are outlined in the table below:

Building Fabric Element	Description
Walls	Walls forming part of the building envelope were modelled using the wall types listed below and are required to be insulated with minimum below specified insulation to achieve compliance. Note that wall construction details such as stud / frame sizes were not available at the time of this assessment. Assumptions were made based on provided elevations and floor plans. Thermal envelope walls, excluding the lift cavity, require added R2.5 insulation installed in the stud members. • **Precast Concrete Wall (CON1, CON2, C1)** Solar Absorptance: C1 - 0.60 (natural concrete); CON1 – 0.73 (Colourbond Monument); CON2 – 0.64 (Colourbond Gully) Construction Details and Insulation Requirement: ○ 150mm concrete panel ○ 90mm R2.5 added insulation installed between steel studs ○ 13mm plasterboard lining • **Brick Wall (BR1)** Solar Absorptance: 0.60 (brick finish) Construction Details and Insulation Requirement: ○ 110 mm Brickwork ○ 40mm ventilated Cavity ○ 92mm Steel Stud, 0.75 BMT Web, 35mm Flange and 90mm R2.5 Insulation batt ○ Plasterboard lining Walls that do not form part of the thermal envelope do not require additional thermal insulation. See below 'Wall Insulation Calculations' section for details of the wall construction R-value calculations used in the modelling. Please refer to below 'HVAC Layout and Thermal Envelope' section for a mark-up of the wall insulation requirements to the thermal envelope. *Note: All exterior walls that are part of the thermal envelope must run to the roof frame and the wall insulation must form a continuous barrier with the ceiling insulation and roof blanket.*

<table>
<tr><th>Building Fabric Element</th><th>Description</th></tr>
<tr><td>Floors</td><td>Ground floor was modelled as concrete slab on ground and does not require insulation.

First Floor was modelled as suspended concrete slab, with additional insulation required to achieve a total system R-value of R2.0 for sections of the floor that lie outside of the ground floor thermal envelope.

Please refer to ‘Insulation Requirements’ below for the mark up of applicable floor sections.</td></tr>
<tr><td>Roof & Ceiling</td><td>The administration building roof has been modelled as suspended concrete with suspended ceilings and a solar absorptance value of 0.73 (likened to Colourbond Monument).

Roof sections of the ground floor and first floor which form part of the thermal envelope require added thermal insulation installed to achieve a total system R-value of R3.2.

Please refer to ‘Insulation Requirements’ below for the mark up of applicable roof sections.</td></tr>
<tr><td>Windows and Glazed Doors</td><td>As window/door schedules are not available at this stage, sizes of all fenestrations were measured from provided elevations and floor plans.

All external windows/glazed doors that form the thermal envelope are required to have the following thermal performance values for glass and frame combined:

<table>
<tr><th></th><th>U-value</th><th>SHGC</th><th>VLT</th></tr>
<tr><td>External fixed windows</td><td>3.80</td><td>0.64</td><td>70%</td></tr>
<tr><td>External fixed windows – one way</td><td>3.80</td><td>0.64</td><td>70%</td></tr>
<tr><td>External Hinged Door</td><td>4.20</td><td>0.48</td><td>48%</td></tr>
<tr><td>Skylights</td><td>2.90</td><td>0.28</td><td>61%</td></tr>
</table>
The above glazing system values are based on clear double-glazed glass in Capral aluminium frames.

The non-thermal envelope internal glazing has been modelled as clear single-glazing in aluminium framing.

The windows and frames specified for the development must, as a minimum, meet the modelled thermal performance values above for the remainder of this design advice to hold true.</td></tr>
<tr><td colspan="2">Please note the above selected products are an example only. These have been identified as being able to meet the energy efficiency requirement of Section J of the BCA. Please check with the glazing contractor for other products that may meet the above energy efficiency requirements along with any specific considerations to other project requirements such as structural adequacy, safety, wind loads, acoustics etc.</td></tr>
<tr><td>Shading</td><td>External overhangs and screens that provide shading to glazing have been modelled as per the proposed design.</td></tr>
<tr><td>Blinds</td><td>To comply with thermal comfort, internal blinds have been modelled to office, waiting, meeting rooms and sick bay.

Blinds have been modelled as standard roller blinds and must have a VLT less than 10%.</td></tr>
<tr><td>Insulation</td><td>Part J4D3 for general thermal construction & installation must be followed, which require insulation to be installed to comply with AS/NZS 4859.1 and so that it forms</td></tr>
</table>

Building Fabric Element	Description
	a continuous barrier and installed with the required air space. Also, insulation must maintain its position and thickness. Downlights should be 'IC' rated (Insulation Contact) to allow for insulation to be placed over the top, and be sealed units to prevent air-leakage. Otherwise, downlight covers must be installed to allow for insulation to be placed over the top and no air leakage between habitable room and ceiling.
Sealing	A seal to restrict air infiltration must be fitted to each edge of a door and operable window in accordance with Provision J5D5, other than glazed elements which comply with AS 2047. All entry doors leading to conditioned spaces must be fitted with a self-closing device. Exhaust fans serving any conditioned spaces must be fitted with self-closing dampers. Roofs, ceilings, walls, floors and any opening such as a window frame, door frame, roof light frame or the like will be constructed to minimise air leakage via the enclosure by internal lining systems or sealed by caulking, skirting, architraves, cornices or the like.
Artificial Lighting	The default BCA 2022 illumination power density (W/m^2) values were used for each space. It is recommended that the proposed design not exceed the maximum wattages listed Table J7D3(1) of the BCA without the use of any adjustment factors.
Heating, Ventilation & Air-Conditioning (HVAC)	VRF systems have been modelled for the proposed buildings. The systems were zoned as outlined below (refer below to 'HVAC Layout and Thermal Envelope'). All ventilation systems must be selected to meet DTS requirements of Part J6. If alternative HVAC zoning or equipment types are proposed, please notify SDC of the proposed system types and zoning so that we can update the energy model and confirm that the building fabric advice provided is still relevant.
Access & Monitoring	Access must be provided to all plant, equipment and components of services that require maintenance. The building must have energy meters configured to record individual time-of-use consumption of electricity, including the energy consumption of the air-conditioning plant, artificial lighting, appliance power, central hot water supply, and other ancillary plant uses. These energy meters 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.
Facilities for electric vehicle charging equipment	The requirements of NCC 2022 Clause J9D4 are to be discussed and confirmed in relation to the project, with the relevant building surveyor and electrical engineer.
Facilities for solar photovoltaic and battery systems	The requirements of NCC 2022 Clause J9D5 are to be discussed and confirmed in relation to the project, with the relevant building surveyor and electrical engineer.

HVAC Layout and Thermal Envelope

Coloured area mark-ups indicate the assumed HVAC zones and areas not highlighted indicate assumed non-conditioned spaces. The pink perimeter indicates the building's thermal envelope and requires R2.5 added insulation. Lift cavities do not require any insulation.

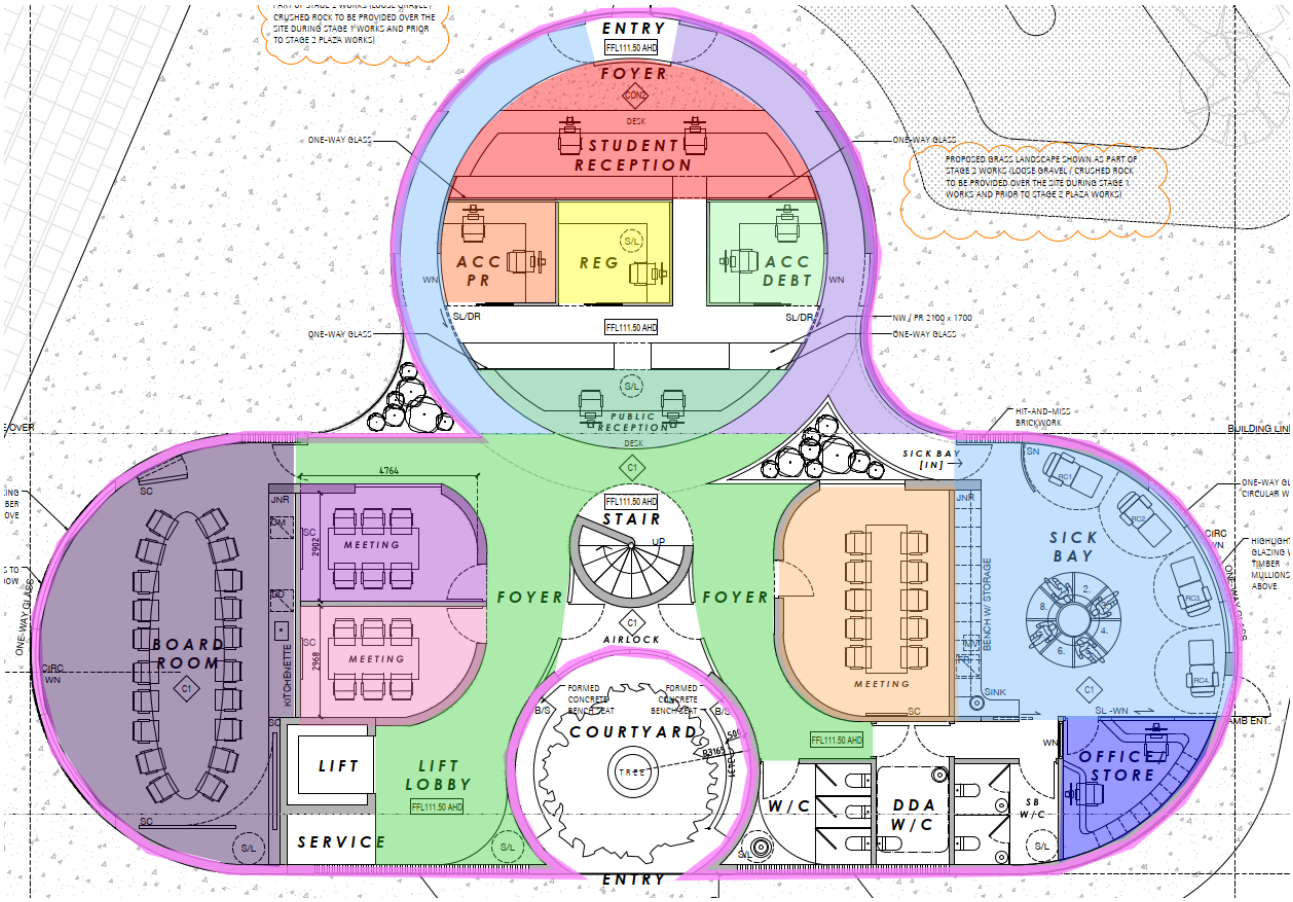


Figure 9: Ground Floor HVAC zones and thermal envelope

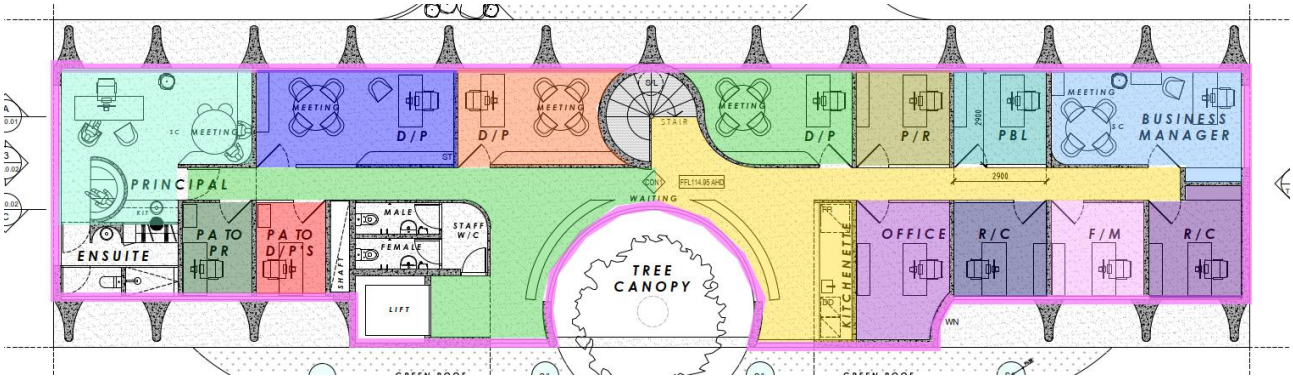


Figure 10: First Floor HVAC zones and thermal envelope

Insulation Requirements

Floor Insulation Requirements

Colour Key	Floor Insulation Requirements
	Required total system R-value of R2.0.

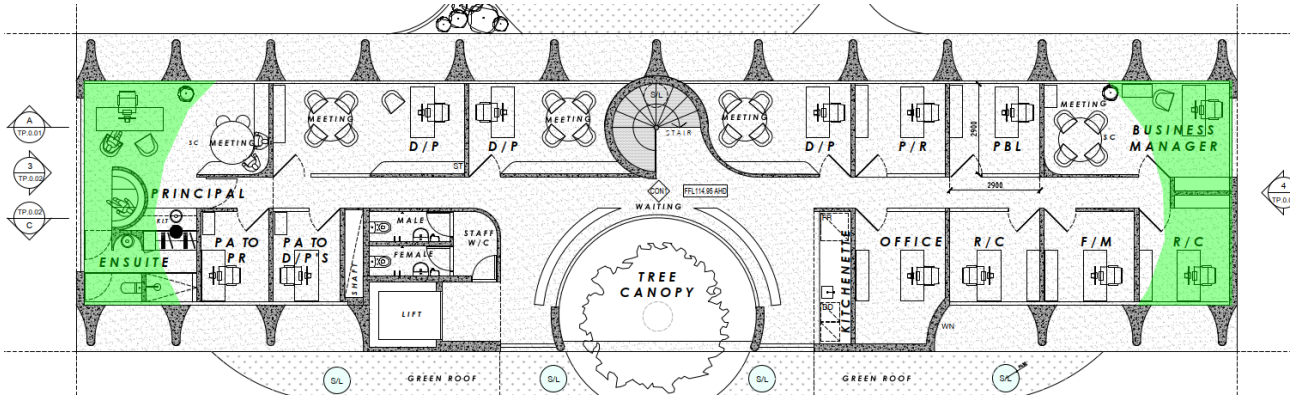


Figure 11: First Floor insulation requirement mark up

Roof Insulation Requirements

Colour Key	Roof Insulation Requirements
	Required total system R-value of R3.2

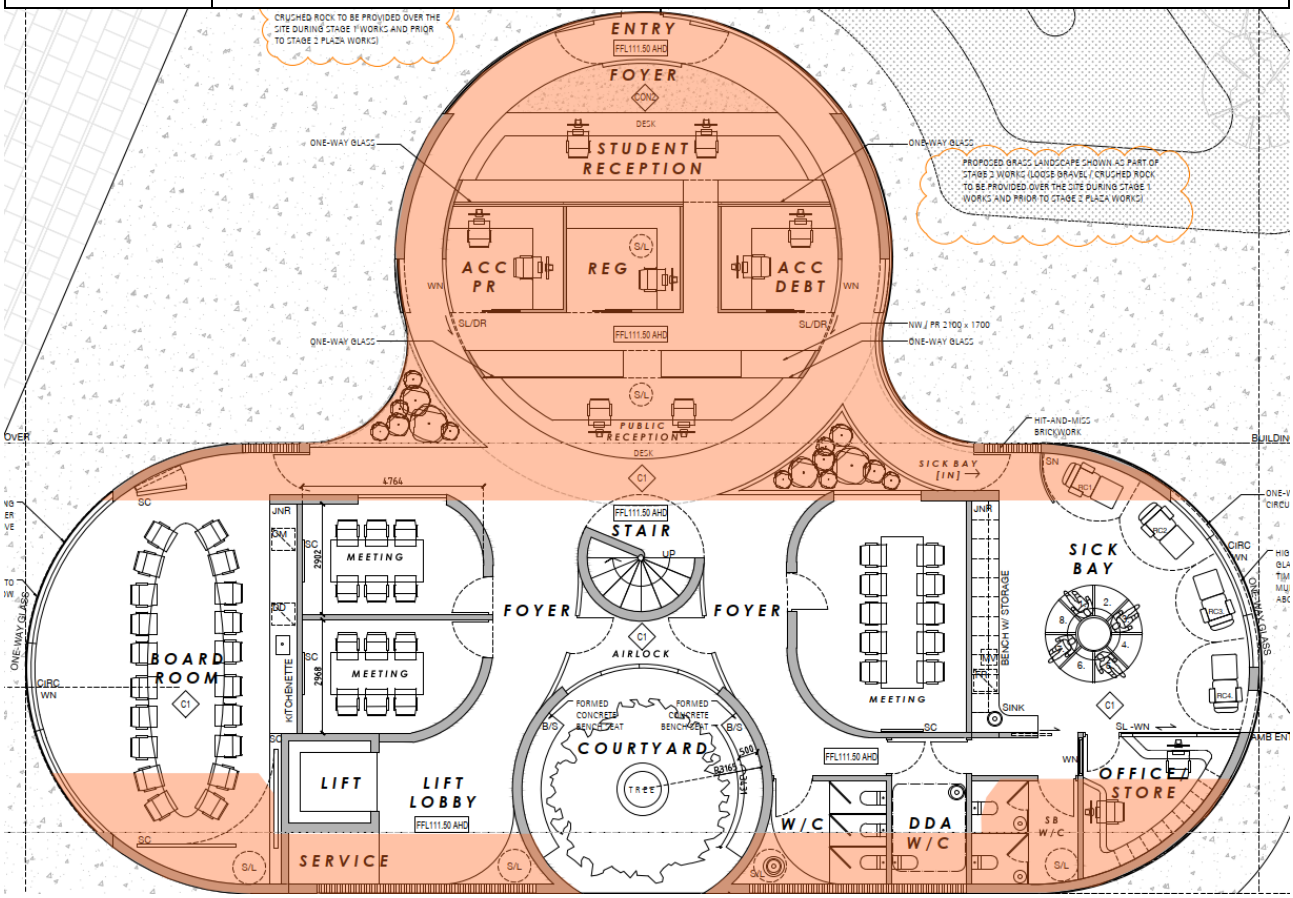


Figure 13: Ground Floor roof insulation requirement mark up

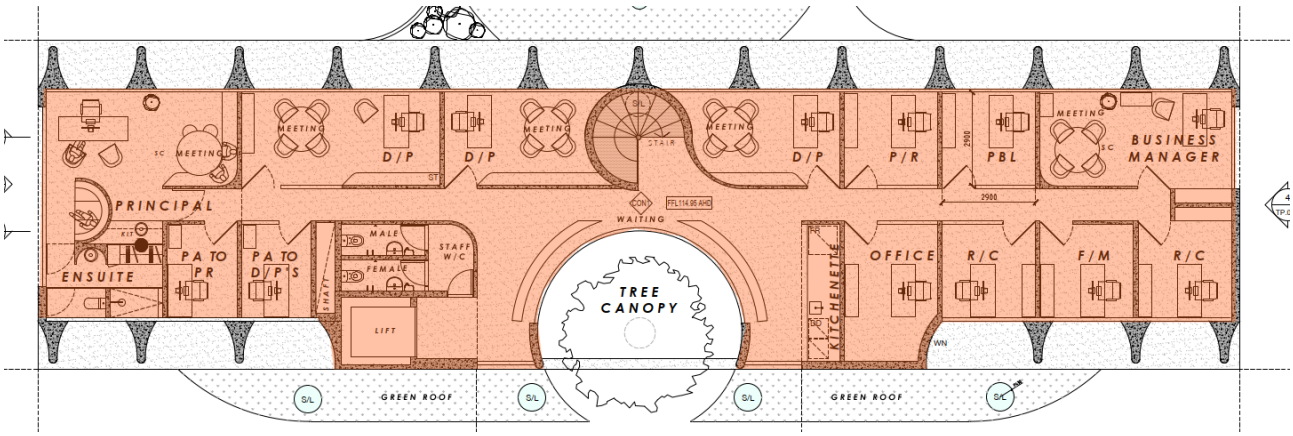


Figure 14: First Floor roof insulation requirement mark up

Results

Compliance with BCA Section J (based on Verification Method J1V3) is achieved if the respective predicted annual greenhouse gas emissions of Simulation B are 'less than' or 'equal to' the predicted energy consumption of Simulation A. It has been found that at present the proposed design can meet the requirements of Verification Method J1V3 of the 2022 BCA, assuming the parameters outlined above are met. See the table below for the results of the assessment.

Energy End Use	SIMULATION A BCA 'Deemed to Satisfy' Fabric and Services (Reference Building) (kWh)	SIMULATION B Proposed building fabric with 'Deemed to Satisfy' Services (kWh)
Space Heating	16,922	16,079
Space Cooling	2,560	2,965
Air Handling Units (Supply Fans)	1,328	1,443
Lighting	9,066	9,066
TOTAL (kWh)	**29,876**	**29,553**
TOTAL (HVAC – heating + cooling + fans) (kWh)	**20,810**	**20,487**
TOTAL Greenhouse Gas Emissions ($KgCo^2$/year)	**34,954**	**34,577**

For the thermal comfort, the below calculation is based on occupancy equating to 2,313 hours per year for office spaces. As such, it is confirmed that the project will comply with the NCC 2022 J1V3 requirement to maintain PMV levels between -1 and +1 across 95% of the floor area of all occupied zones for over 98% of the year in each space.

The table below lists the results of the thermal comfort assessment.

Zone	Annual Occupied Hours	Annual Hours Within Threshold	% of Annual Hours Within Threshold
Ground Floor ACC Debt office	2313	2313	100%
Ground Floor REG office	2313	2313	100%
Ground Floor ACC PR office	2313	2313	100%
Ground Floor board room	2313	2313	100%
Ground Floor meeting room 1	2313	2313	100%
Ground Floor meeting room 2	2313	2313	100%
Ground Floor meeting room 3	2313	2313	100%
Ground Floor sick bay	2313	2313	100%
Ground Floor office/store	2313	2313	100%
Ground Floor student reception	2313	2313	100%
Ground Floor public reception	2313	2313	100%
Level 1 Business Manager Office	2313	2313	100%
Level 1 DP Office 1	2313	2313	100%
Level 1 DP Office 2	2313	2313	100%
Level 1 DP Office 3	2313	2313	100%
Level 1 FM Office	2313	2313	100%
Level 1 Office	2313	2313	100%
Level 1 PA to DPS Office	2313	2313	100%
Level 1 PA to PR Office	2313	2313	100%
Level 1 PBL Office	2313	2313	100%
Level 1 PR Office	2313	2313	100%
Level 1 Principal Office	2313	2313	100%
Level 1 RC Office	2313	2313	100%
Level 1 RM Office	2313	2313	100%
Level 1 Waiting area 1	2313	2313	100%
Level 1 Waiting area 2	2313	2313	100%

Compliance with the thermal comfort requirements of the 2022 BCA J1V3 verification method is demonstrated as the proposed building achieves a Predicted Mean Vote ranging between -1 and +1 for more than 98% of the annual hours of operation of the administration building.

Wall Insulation Calculations

The total wall system R-value for each wall type used in the proposed building model are calculated from the NCC Façade Calculator.

If alternative wall specifications are proposed, please notify SDC of the proposed specification types and layers so that the calculations can be revised and confirm that the building fabric advice provided is still relevant.

Note: The wall structure and insulation types specified for the development must, as a minimum, meet the thermal performance values detailed here for this design advice to hold true.

The following calculations were input for non-spandrel walls forming the thermal envelope in the NCC Façade Calculator:

Precast Concrete Wall (CON1, CON2, C1)

Wall Systems

	Layer 1	Layer 2 (Air space)	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7
Ventilation		Unventilated					
Material	Concrete - solid	Insulation 90mm R2.5	Gypsum plasterboard				
Thickness (mm)	150	90	13				
Conductivity (W/mK)	1.440	0.036	0.170				
Framing Material		Steel					
Metal Frame, Web Thickness (mm)		0.75					
Metal Frame, Flange Width (mm)		35					
Framing Area %		13.0%					
Thermal Break Material							
Thermal Break Thickness (mm)							
Thermal Break Overlap Area %							
Resistance (m².K/W)	0.10	0.55	0.08	0	0	0	0
Wall Construction	Concrete 150mm		External Surface Resistance (moving air, more than 3m/s and not more than 7/ms wind speed)				0.03
						Internal Surface Resistance (still air, on a wall)	0.12
						System R-Value (m².K/W)	0.88
						System U-Value (W/m².K)	1.14

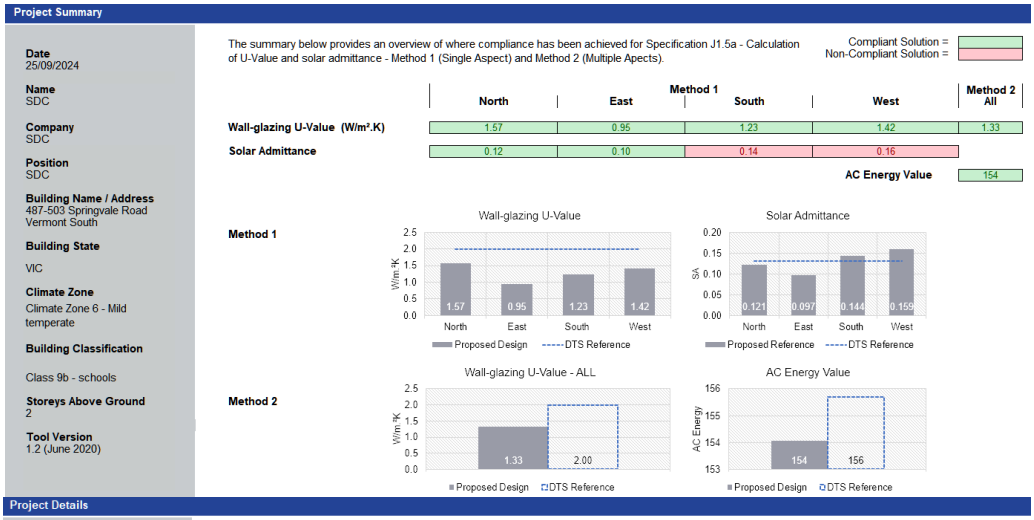
Brick Wall (BR1)

Wall Systems

	Layer 1	Layer 2 (Air space)	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7
Ventilation		Unventilated					
Material	Clay brick - 3.25kg	Airspace - non-reflective unventilated	Insulation 90mm R2.5	Clay brick - 3.25kg			
Thickness (mm)	110	20	90	110			
Conductivity (W/mK)	0.650		0.036	0.650			
Framing Material			Steel				
Metal Frame, Web Thickness (mm)			0.75				
Metal Frame, Flange Width (mm)			35				
Framing Area %			13.0%				
Thermal Break Material							
Thermal Break Thickness (mm)							
Thermal Break Overlap Area %							
Resistance (m².K/W)	0.17	0.00	1.21	0.17	0	0	0
Wall Construction	Double Brick 3.25kg		External Surface Resistance (moving air, more than 3m/s and not more than 7/ms wind speed)				0.03
						Internal Surface Resistance (still air, on a wall)	0.12
						System R-Value (m².K/W)	1.69
						System U-Value (W/m².K)	0.59

Preliminary NCC Façade Calculator

Preliminary NCC Façade Calculator (used to prepare the reference building for the J1V3 assessment) is provided below. Please note that the most likely building fabric for the proposed development is provided in the J1V3 modelling advice above, the below is for comparison purposes only.



Appendix 5 – Daylight Assessment

The daylight assessment was carried out using DesignBuilder with the same inputs as the thermal performance modelling, including the building geometry and orientation, and the following reflectivity (building fabric) / visible light transmittance (fenestration):

Building Fabric	Reflectivity
Brick Wall	0.40
Concrete External Wall	0.40
Plasterboard Wall Lining	0.80
Plasterboard Ceiling Lining	0.80
Floor Tiles	0.20
Carpet	0.30
Bare Concrete Floor	0.40
Concrete Roof	0.40
Fenestrations	**Visible Light Transmittance**
External fixed windows	0.70
External fixed windows – one way	0.70
External Hinged Door	0.48
Skylights	0.61

The above glazing system values are based on clear double-glazed glass in Capral aluminium frames.

Below is an image of the rendered view of the daylight model for the proposed development. Note that the colour is for display purposes only.

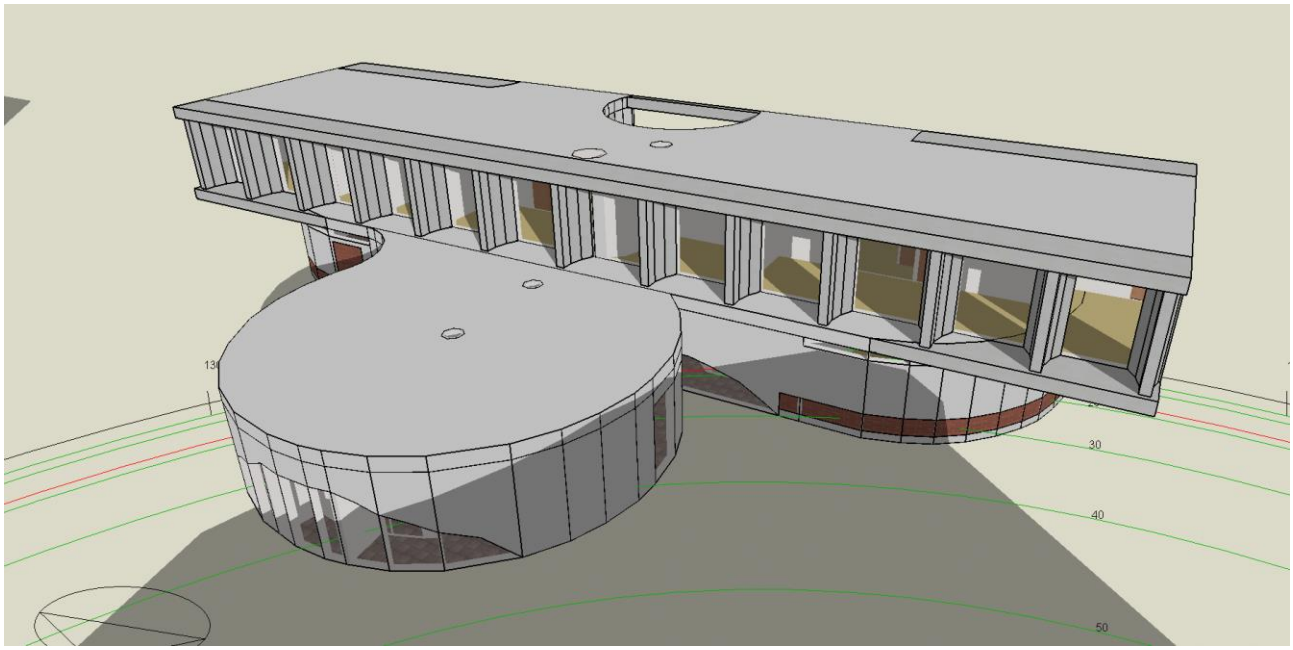


Figure 16: An overall view of the daylight model for the proposed development, showing the sun-path at 3pm on 15th July as an example

Results

The images in this section are lux/daylight factor map exported from the modelling program DesignBuilder which were produced by the Radiance simulation engine. Please note that they are a graphical representation of the results only, for accurate results please refer to the summary in Table 5 below, and Table 6 following for details.

Table 5: Summary of Daylight Analysis Result

	Total Floor Area (m^2)	Floor Area above Threshold (m^2)	Floor Area above Threshold (%)
Administration Building	381.6	141.3	37.0%

The summary table above presents the daylight modelling results of the applicable regular use spaces which indicate that at least 37% of the Administration Building will achieve more than 2% daylight factor.

Table 6: Detailed Results of Daylight Analysis

Zone	Nominated Area (m^2)	Area Achieving >2% Daylight Factor (m^2)	Percentage of Nominated Area Achieving >2% Daylight Factor
Ground Floor board room	62.3	1.3	2.1%
Ground Floor sick bay	46.4	0.0	0.0%
Ground Floor meeting room 1	13.8	0.0	0.0%
Ground Floor meeting room 2	25.8	0.0	0.0%
Ground Floor meeting room 3	12.8	0.0	0.0%
Ground Floor Office/Store	10.1	0.0	0.0%
Ground Floor REG office	7.6	0.0	0.0%
Ground Floor ACC Debt office	8.1	0.3	3.1%
Ground Floor public reception	17.1	2.1	12.0%
Ground Floor ACC PR office	8.0	0.5	5.7%
Ground Floor student reception	26.6	6.1	22.9%
Level 1 Principal Office	22.1	22.1	100.0%
Level 1 DP Office 1	16.9	16.9	100.0%
Level 1 DP Office 2	12.6	12.6	100.0%
Level 1 DP Office 3	12.2	12.2	100.0%
Level 1 PR Office	8.1	8.1	100.0%
Level 1 PBL Office	8.1	8.1	100.0%
Level 1 Business Manager Office	16.3	16.3	100.0%
Level 1 PA to PR Office	6.0	6.0	100.0%
Level 1 PA to DPS Office	5.8	5.8	100.0%
Level 1 Office	12.0	0.0	0.0%
Level 1 RM Office	7.8	7.8	100.0%
Level 1 FM Office	7.8	7.8	100.0%
Level 1 RC Office	7.6	7.6	100.0%

Lux/daylight factor map legend:

- Black < 2.0% DF (non-compliant area)
- Blue to Red >2.0% DF (compliant area)

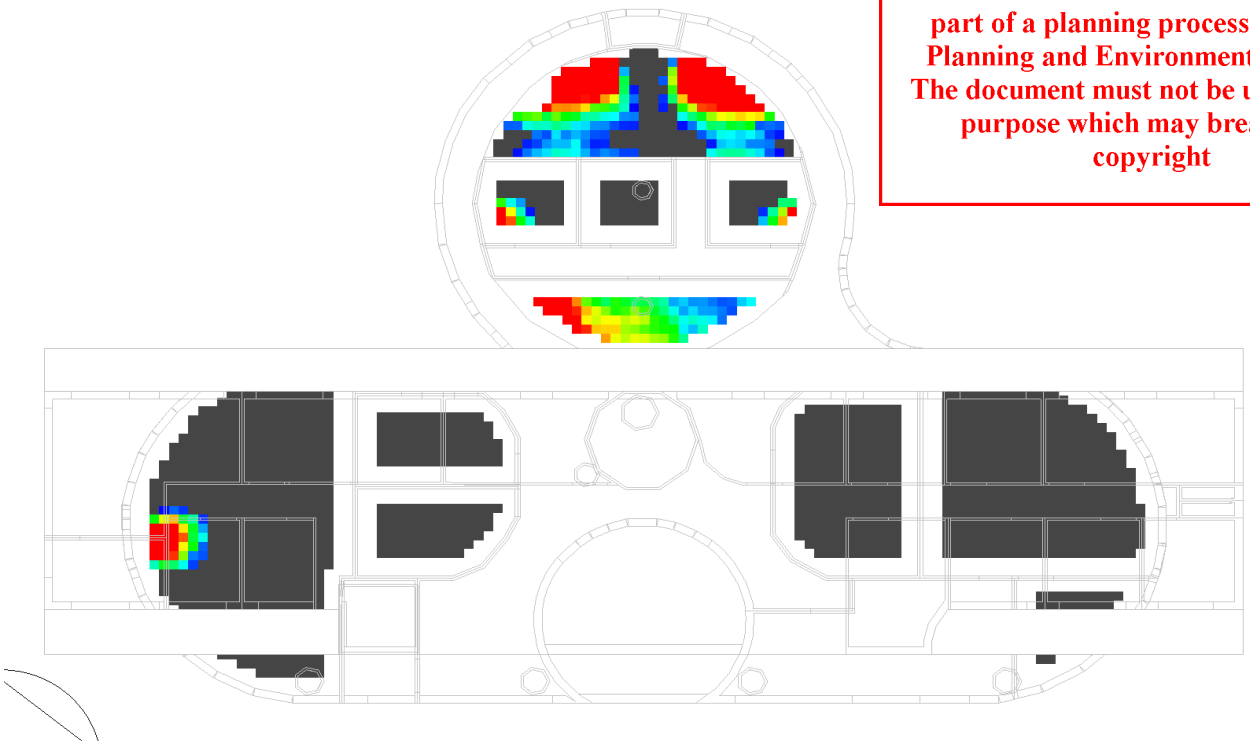


Figure 17: Ground Floor Daylight Factor Map

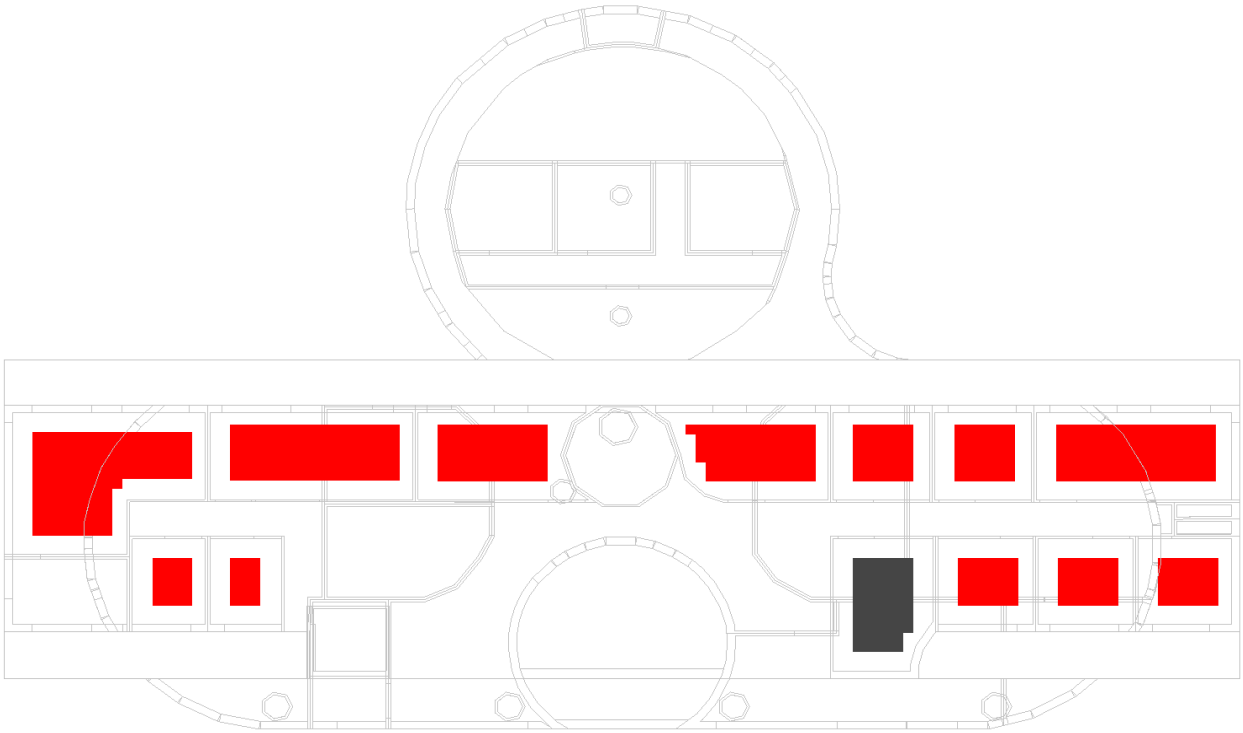


Figure 17: Level 1 Daylight Factor Map

Appendix 6 – BESS Domestic Hot Water Calculations

The proposed building domestic hot water is based on an energy efficient electric heat pump system (COP of ≥3.5).

	Proposed Building	Reference Building
Annual Domestic Hot Water Usage (kL/Year)	63	76

The annual domestic hot water usage figures determined by the Green Star Potable Water Calculator (used as a reference point) are provided above. These values were used for the predicted hot water demand of both the reference and proposed building.

	Reference Building System	Proposed Building System
Energy to Heat Water		
Amount of water to be heated (kL/Year)	76	63
System Type	Electric with Storage Tank	Electric Heat Pump with Storage Tank
Water Heater Efficiency	99%	99%
Energy to Heat Water $\frac{q_{DHW}C_p\Delta T}{1000n_{heater}}$	= 76,000 x 4.19 x 45 / (1000 x 99%) = 14,475 MJ	= 63,000 x 4.19 x 45 / (1000 x 99%) = 11,999 MJ
System Losses Factors		
No. of Storage Tank	1	1
Storage Tank Volume (each, L)	302	250
Storage Tank Turnover Ratio	0.69	0.69
No. of Hot Water System	1	1
Recirculation Pump	Without Recirculation Pump	Without Recirculation Pump
Number of Outlets	1-10	1-10
Standing Loss Factor $f_{standing}$	0.52	0.2
Distribution Loss Factor $f_{distribution}$	0.01	0.01
Total Estimated Annual Energy Consumption $\frac{q_{DHW}C_p\Delta T}{1000n_{heater}}(1+f_{standing}+f_{distribution})$		
Q_{input}	= 14,475 (1 + 0.52+ 0.01) = 22,142 MJ = 6,150 kWh	= 11,999 (1 + 0.2+ 0.01) = 14,558 MJ = 4,044 kWh