AMRF - FIRST BUILDING BRADFILED

11 February 2022

Prepared for:
Western Parkland City Authority

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Executive Summary

Located in the future Western Sydney suburb of Bradfield, the proposed AMRF First Building will be a place to work, innovate, gather and celebrate. This report presents the sustainability strategy for the project.

The proposal will be located in the Bradfield City Centre, Western Sydney's future city. The city is being designed to provide a new generation of high performance environmental, economic and socially sustainable outcomes. The proposed framework for Bradfield City Centre includes six key sustainability commitments and focus areas being, and the design, construction and operation of the AMRF First Building project will also follow these objectives:

- Achieve net-zero operational carbon emissions by 2030
- Provide an unrestricted supply of water that is resilient to drought and enable unrestricted use to activate blue/green connections and reduce reliance on potable supplies
- Eliminate waste to landfills and promote circular economy initiatives that create a symbiotic relationship between the residential and advanced manufacturing industries within Bradfield.
- Create a healthy environment for people and the natural ecology
- Be resilient to climate impacts and mitigate the urban heat island effect
- Generate sustainable social outcomes through placemaking and community building

This proposal is also investigating a Living Building Challenge certification. Living Building Challenge certificate has seven petals and the requirements for each petal need to be met to make the project eligible for the certification. Each petal has a different focus area in sustainability which will contribute to achieving a holistic approach in sustainability for the project.

To achieve the sustainability targets of the proposal, a number of different strategies will be implemented in the building design, construction and building services of the project. These include:

- Sustainable materials
- Efficient mechanical and lighting systems
- On-site energy generation
- Reducing potable water consumption for non-potable water demand
- Waste management
- Sustainable transport facilities

On-site solar PV is one of the key strategies in achieving the net-zero operational carbon emission target. The objective for the proposed AMRF First Building is to generate an amount of renewable electricity onsite not less than the energy demand of the base building, office fit-out, common areas and outdoor spaces to deliver a Net Zero Outcome.

To reduce potable water consumption rainwater harvesting and reuse is one of the main strategies for the project. It is estimated that a 150 kL tank size can harvest 72% of annual rainfall and meet 92% of the project's annual non-potable water requirements.

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Document Control

Project Name	AMRF - First Building - Bradfield
Project Number	144
Document Title	Environmental Sustainability Design Report

Revision	Date	Prepared By	Approved By	Changes
Draft	4 November 2021	NM	MJ	
Final	12 November 2021	NM	MJ	Report updated based on the Western Parkland City Authority comments on water, energy, wast and digital sections
B - Final	11 February 2022	MJ	MJ	Updated figure 5 to respond to SSDA feedback

1. Introduction

1.1. Location and climate

The proposal will be located in the proposed Bradfield city centre which will be the nation's newest city centre with the vision for a 24-hour global metropolis.

Bradfield City Centre is located 45km WSW of the Sydney CBD. It features a climate that is distinct to that of the existing urban areas of Greater Sydney. This climate is influenced by its location between two natural barriers, the Blue Mountains National Park and Nepean River to the West and the Georges River and Dharawal National Park in the East. The land currently largely not impacted by anthropogenic heat sources beyond the modification of the native flora to grassland.

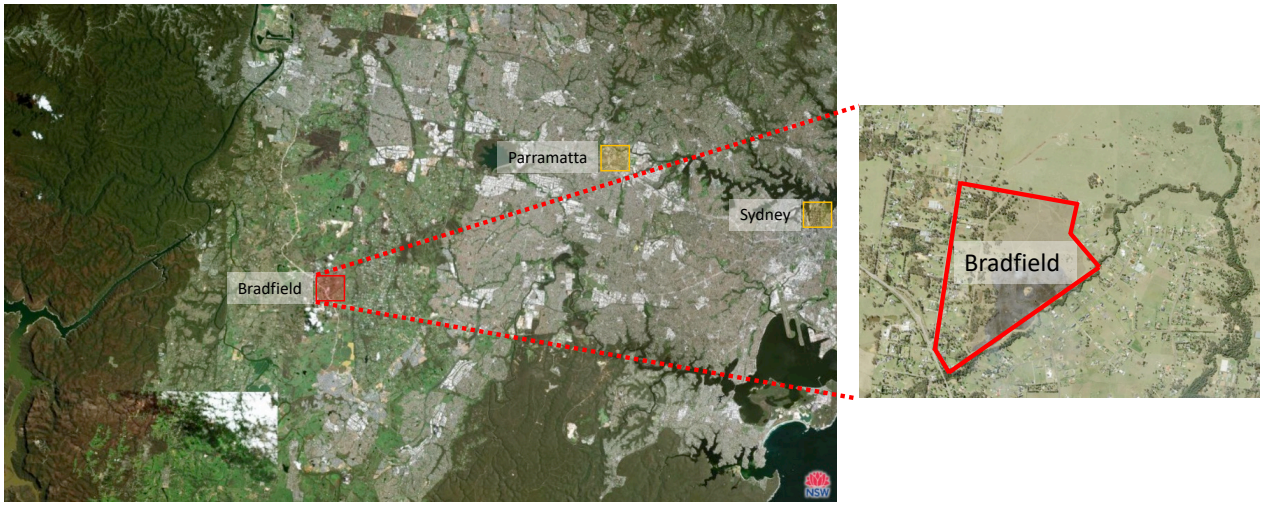

Figure 1. Bradfield Town Centre Location Context and Existing Condition

The site proposed for the Bradfield City is located on Thompsons Creek which runs in a NE direction flowing into South Creek. This corridor forms the SE boundary the site and is highly significant both to the site and downstream ecosystems. Much of the area the new town centre will be developed on is known as Moores Gully. The site was a defence facility for much of last century and is generally primarily covered in grassland with some remnant native vegetation.

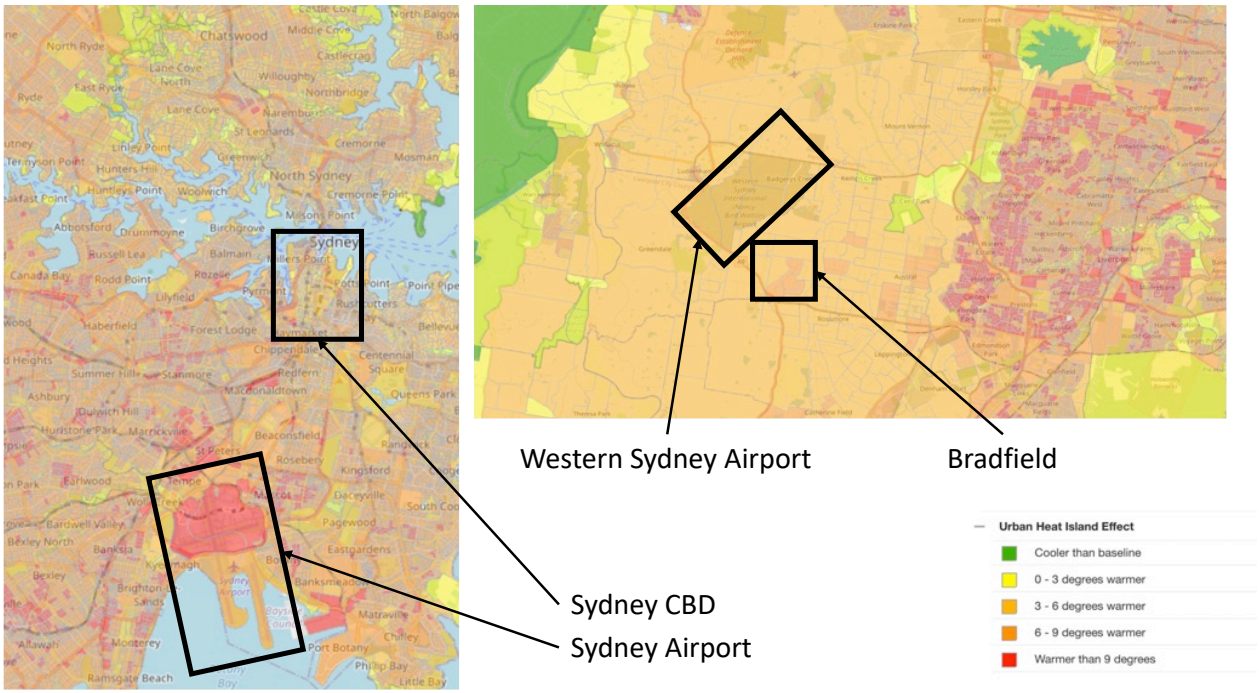

Figure 2. Comparison of current UHI conditions between Sydney Airport and CBD (left) and the Bradfield's site

The development of the Bradfield and broader Aerotropolis area will modify this climate through the presence of the new Airport, significant man-made structures and heat loads associated with vehicles, industry and building systems.

At present, the site experiences 56 days above 30 degrees C annually compared to 15 days in the Sydney CBD. The highest recorded temperature is 47.3C. It is reasonable to expect that there is the potential for 50C to be exceeded within the future Bradfield City Centre once climate change and urban heat island impacts are included.

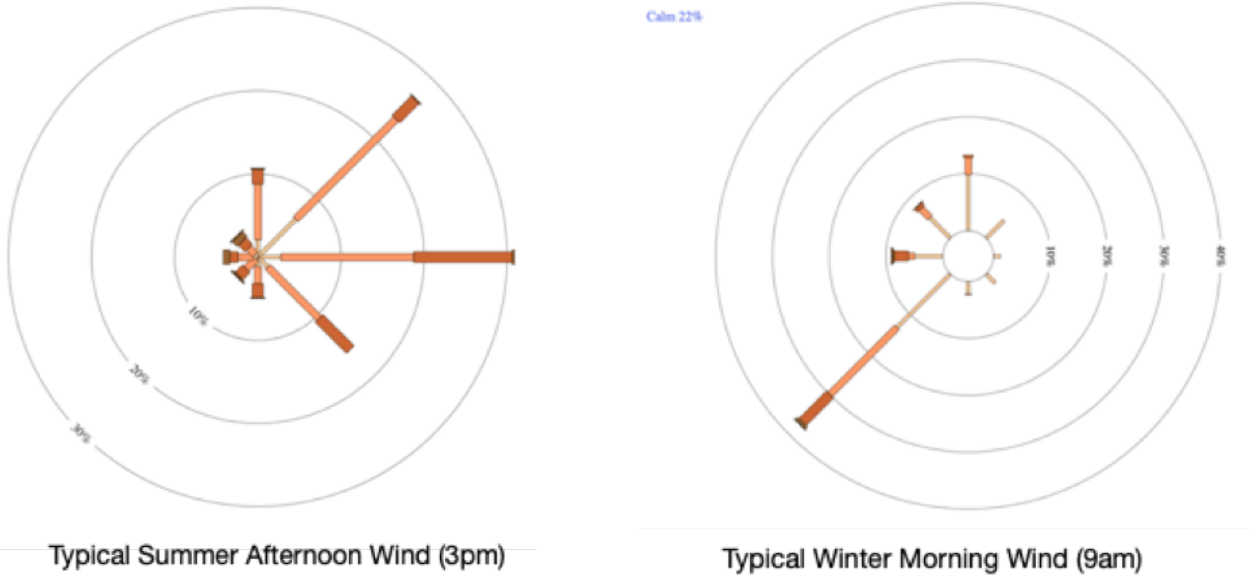

Figure 3. Prevailing wind conditions

The site also has 24 days a year where the minimum temperature falls below 2C.

The site has a dominant prevailing wind condition during the summer from within the NE to SE quadrant at 3pm in the afternoon. These breezes will be essential to daytime purging of heat. It is calm at this time less than 0.5% of the time.

During winter the wind is highly dominant from the SW in the mornings. Whilst it is desirable to design to protect from this wind condition, such protection must be balanced with the benefits provided by this breeze during summertime mornings.

1.2. Limitations

This report has been prepared for planing approval. Final performance of design elements will be subject to actual equipment selection, design optimisation, controls and actual utilisation.

2. Secretary's Environmental Assessment Requirements

The overall ESD design strategy for the building and its site has been developed to respond to Bradfield City Centre sustainability strategy and also the Secretary's Environmental Assessment Requirements named "Environmentally Sustainable Design (ESD)". The ESD design strategies respond to the following elements within SEARs:

Requirement	Response
Greenhouse Gas and Energy Efficiency – including: - an assessment of the energy use of the proposal and all reasonable and feasible measures that would be implemented on site to minimise the proposal's greenhouse gas emissions (reflecting the Government's goal of net zero emissions by 2050).	Refer to section 3 and 4.2.2 of this report
Ecologically Sustainable Development – including: - A description of how the proposal will incorporate the principles of ecologically sustainable development in the design, construction and ongoing operation of the development. - Consideration of the use of green walls, green roofs and/or cool roofs in the design of the development. - A description of the measures to be implemented to minimise consumption of resources, especially energy and water.	Refer to section 4 of this report

3. Greenhouse gas and energy efficiency

Bradfield City Centre is committed to Net Zero certification under Climate Active Standard by 2030 which is 20 years ahead of the 2050 Net-Zero emission target of the NSW Government.

The project's ambition is to outperform a five 5 star NABERS Energy rated office building (with the same scale) in terms of energy consumption. Therefore, the office space's energy consumption per annum must be less than 143.3 kWh/sqm, which is equivalent to annual energy consumption of a 5-star NABERS energy rated office building.

Additionally, electric building strategy will be implemented in the building to remove reliance on fossil fuels for building operation, and onsite PV generation will be used to respond to the energy requirements of the building and its site.

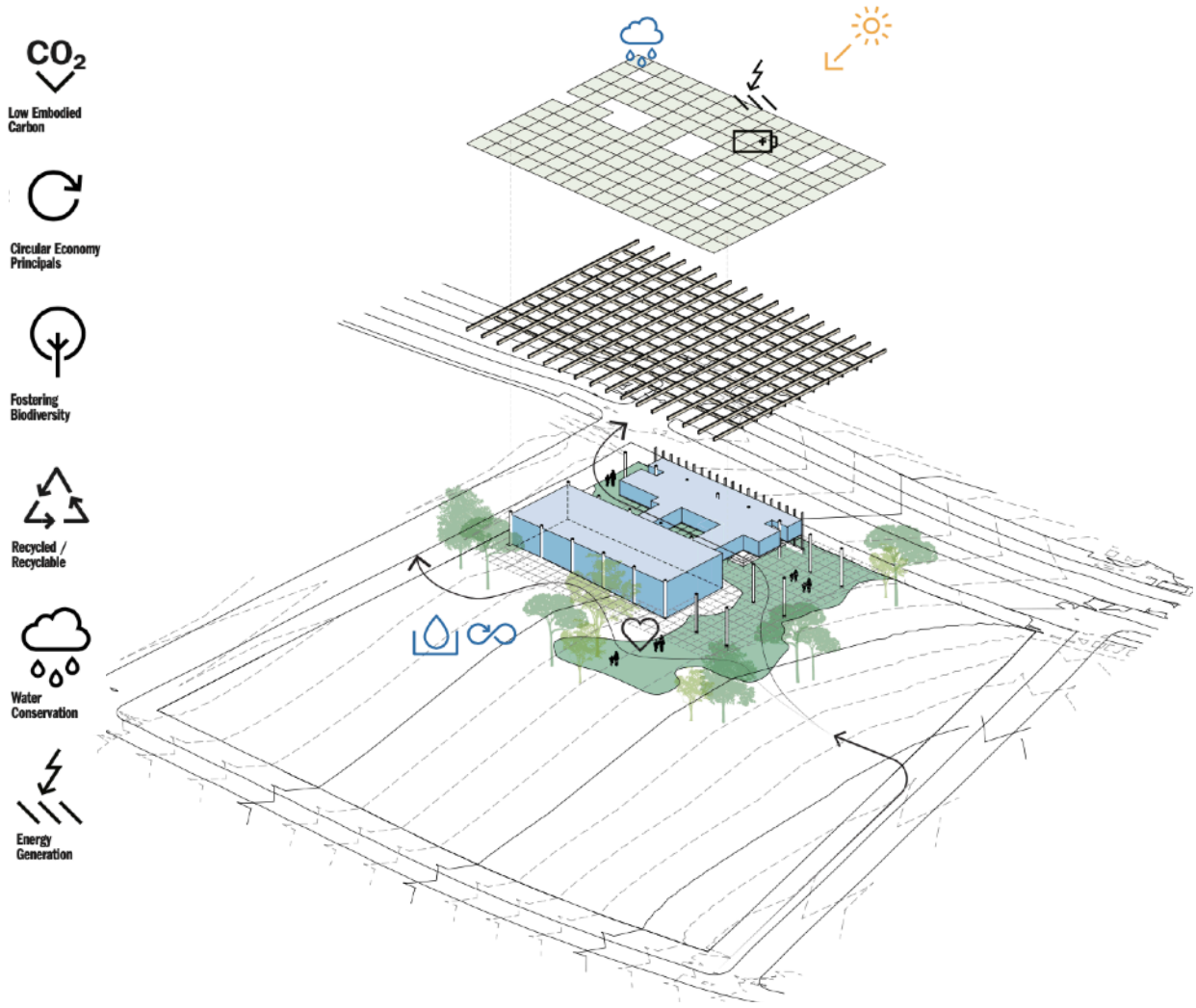

Figure 4. Overall sustainability strategies of the project

4. Ecologically Sustainable Development

The proposal is targeting Living Building Challenge certification. Living Building Challenge has seven petals, and the requirements of each petal must be met by the project for certification. Satisfying the requirements of each petal complements the sustainability targets of the project and contributes to achieving environmental, economic and socially sustainable outcomes.

ESD principles of the project will be incorporated in the design, construction and operation of the proposed building and its site, this includes commitments to globally relevant benchmarks and best practice in zero carbon and a circular economy approach to waste and water management strategy (figure 4 and 5).

	Strategies	Notes
1	Resilient and water efficient landscape	The landscape has been designed to minimise water demand through the use of native low water species. Any water requirements will be supplied by a rainwater collection tank that has been sized to have a maximum 14 day empty period using 50 years of recorded weather data. The plants have been selected to have a watering frequency of greater than 14 days. Refer to the Landscape Design submitted with the SSDA.
2	Permeable paving	All paving will be permeable to provide deep soil soak away and promote WSUD outcomes. Outdoor hardstand has been minimised. Material selection for paving will be undertaken prior to commencement of construction in line with these objectives. Refer to the Landscape Design submitted with the SSDA.
3	Green roof	The roof is designed to comply with the Green Star Urban Heat Island requirements and provides both Green Roof and Solar panels to promote cool roof outcomes, create habitat and generate renewable energy. Refer to Section 4.1 of this report.
4	Non-reflective materials	Roof materials are nor reflective and low reflective solar panels will be used. Solar panel selection will occur prior to the commencement of construction. Facade glazing is well shaded during peak periods to prevent heat reflection into the street canyon. Refer to the Architectural Design Report for envelope details.
5	Materials with low embodied carbon	Bradfield is committed to promoting the circular economy and the AMFR building features a predominantly timber structure, green concrete and is designed for disassembly to reduce whole of life carbon emissions in excess of the requirements of the Green Star credit for embodied emissions. Refer to the Architectural Design report for materials details.
6	Recycled and recyclable materials	The primary material for the building structure is timber that has been designed for disassembly. This promoted best practice circular economy outcomes. Recycled materials will be provided within the steel, concrete and aluminium elements of the building to help the project achieve the Green Star credit for sustainable structure and finishes.
7	Responsibly sourced materials	The project will ensure all timber product is FSC certified and additionally meet the responsible sourcing requirements of Green Star

	Strategies	Notes
8	Efficient lighting system	Lighting will be addressable LED lights with a control system featuring occupancy sensing and daylight linking. The well shaded facade will promote natural lighting within the building and prevent reliance on blinds for the majority of working hours. Refer to the Services Design report.
9	Efficient mechanical system	The building is fully electrified and designed to exceed 5.5 star NABERS energy. Refer to the Services Design report.
10	On site PV generation	PVs have been sized to generate 100% net electricity demand of the building (exclusive of manufacturing equipment) Refer to Section 4.2.2
11	EV ready car spaces	Conduit will be provided to all car-parking spaces to permit installation of charging facilities as demand grows. Charging will be initially installed in line with Bradfield City Centre guidelines.
12	End of Trip facilities	End of trip and cycling facilities are provided in line with the requirements of Green Star. E-bide charging will be provided within the storage facility.
13	Grey water and black water reuse for non potable uses	The rainwater tank has been sized to provide non-potable water demand offset of the building through supplying non potable water demands on site and providing capacity to supply future buildings as Bradfield Grows. Bradfield Town Centre is investigating a centralised district facility of water recycling and reticulation and the building is designed to ebanle future connection.
14	Rainwater harvesting and reuse for non potable uses	A significant rainwater capture tank is provided. Refer to Section 4.2.1
15	Sustainability education in operation	The building will meet the Green Star requirements for this credit.
16	High star rated WELS fittings	Water consumption will be reduced to beyond the Green Star requirements. Highest available fittings and fixtures will be used to be selected by the architect prior to construction.
17	Onsite storm water management	The building incorporates significant WSUD within the landscape and is supported by a substantial rainwater collection facility to minimise roof water being discharged from the site. Refer to the Landscape Architecture report.
18	On site resource separation (for waste management)	Resource separation is provided for the office space and dedicated facilities will be provided for the manufacturing component once the manufacturing processes have been designed. Refer to the Architectural Design Report.
19	Design out waste approach	Waste has been designed out through the design for manufacture, assembly and dis-assembly approach tacken for the predominantly timber structure. The building will support Bradfield Town Centres commitment to promoting the circular economy. Refer to the Architectural Design Report.

	Strategies	Notes
20	Reducing construction waste	Waste has been designed out through the design for manufacture, assembly and dis-assembly approach tacken for the predominantly timber structure. The building will support Bradfield Town Centres commitment to promoting the circular economy. Refer to the Architectural Design Report and Section 4.2.3 of this report.
21	Digital	The building will feature smart controls and be capable if integrating with the future Bradfield Town Centre smart city systems. Refer to Section 4.2.4

Figure 5. ESD strategies of the project

4.1. Green roofs

To Improve the microclimate of the project's site which will be impacted by Urban Heat Island Effect and also global warming, green roof will be incorporated into the proposal's roof.

Additional benefits of green roof:

- Enhancing biodiversity within the site
- Social impact
- Human-nature connection
- Enhancing building's thermal performance by blocking solar radiation on the roof, and providing insulation
- Reducing stormwater runoff
- Pollution reduction to natural waterways
- Providing an opportunity for local food production
- Improving energy generation from co-located solar panels
- Improved air quality

The roof of the building will also be utilised for solar power collection. However, green roof and rooftop solar can be integrated together and not compete with each other. Integration of rooftop solar and green roofs can enhance the efficiency of the panels as well.

4.2. Minimising consumption of natural sources

4.2.1. Water

The extensive roof area of the proposal will provide a great opportunity for rainwater harvesting. The harvested rainwater will be used for landscape irrigation and also non-potable uses within the building such as toilet flushing.

The non potable water demand of the project was estimated to be 4200 L/day. A 150 kL rainwater tank can harvest 72% of annual rainfall from roof area of 3543 m^2. This will respond to 92% of the annual non-potable water demand of the project and therefore 1,410,360 litres potable water can be saved per year (figure 6).

Rainwater Tank Volume (kL)	Tank Average Level	Rainwater collected	Potable Water Used to supply demand	Rainwater Water Used to supply demand	Number Empty Days	Number of Consecutive Empty Days
150	52%	72%	8%	92%	32	16

Figure 6. 150 kL rainwater tank performance analysis

The remaining non-potable water demand of the proposal need to be addressed through the other water reuse strategies.

Sustainability education in operation will be part of the overarching sustainability strategy. Further reduction in operational water use will be encouraged by working with tenants to minimise water consumption in operation.

4.2.2. Energy

The building's site context and also orientation of the building provide an ideal condition for rooftop solar. On site energy generation is critical in achieving the project's net zero emission target.

The PVs were sized considering around 50% of the roof to be occupied by the PV panels. The capacity on the PVs are indicative capacity based on performance equivalent to a 5 star NABERS Whole Building rating.

The project's total module area is estimated to be around 1044 m^2. To optimise energy generation, the PV arrays need to have a tilt angle of 33.4º, North. It is estimated that the electricity production for the first year will be around 334,637 kWh (figure 7). The NABERS energy consumption benchmark for an office building with the similar scale is 166,657.9 kWh per annum. Considering the project's energy consumption targets, to require less energy than the NABERS energy rated building, it can be concluded that 100% of the proposal's office building's annual energy demand will be met by the PVs. The excess electricity generated will be used for the process loads as well as landscape lighting which have been excluded from the electricity demand calculation of the building. The PVs will contribute to around 314 tones GHG saving.

Other design features such as deep eaves are designed to limit heat load into the building and reduce energy consumption necessary to cool the building.

Total roof area	3543 m2
Total roof area used by the PV modules	1619 m2
Number of modules	624
Total module area	1044 m2
Indicative array size	230 kWdc
Nameplate DC capacity	228.254 kWdc
Total inverter DC capacity	217.753 kWdc
Annual energy (year 1)	334,637 kWh
Energy yield (year 1)	1,466 kWh/kw

Figure 7. Indicative PV specifications

4.2.3. Waste

The building is designed with waste reduction in mind. The building is designed to use Cross Laminated Timber (CLT) and minimise mixed materials in construction. The building itself is designed to be disassembled at the end of life for ease of reuse and recycling of building materials.

4.2.4. Digital

The proposed Digital Strategy for Bradfield will mean that the building is digitally connected and integrated data loggers will be used to support the fine-tuning of the building to ensure the most efficient use of energy and water in operation.

5. Conclusion

The AMRF First Building is committed to providing an exemplar Green Building. The project will be utilising various strategies in the design, construction and operation of the building and in water, energy and waste to ensure achieving its sustainability targets.

PVs are core to achieving the project's net-zero emission target, and rainwater harvesting is essential in meeting the project's water efficiency objectives.