WOOD & GRIEVE ENGINEERS

One Circular Quay: Hotel Tower B
Section 4.55 Application

Ecological Sustainable Development Report

Revision 3

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Revision

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1. Introduction

This Ecological Sustainable Development (ESD) report is prepared on behalf of Yuhu Group Australia in support of the Section 4.55 "Application to Modify a Development Consent" in relation to the proposed Tower B Hotel development at 1 Alfred Street, Sydney, NSW.

The proposed project involves the construction of a hotel (Tower B) from Ground Level to Level 25. Hotel Tower B is located over a six level basement for shared use by the hotel and an adjoining residential tower. The hotel mainly utilizes a portion of basement levels B1 and B2 (that is also shared with the residential tower).

The Tower B building includes a ground floor retail and hotel lobby, hotel facilities, restaurants, a bar, hotel rooms, plantroom space and back-of-house/service areas.

The following image identifies the project site in Sydney, NSW:

Figure 1: Tower B Site Location. Source: Google Maps

2. Project Sustainability Drivers

The proposed ecological sustainable design framework for the project includes various associated drivers including:

- Ecological Sustainable Design principles and visions identified within the City of Sydney LEP and DCP - 2012 (minimum regulatory planning provisions).
- City of Sydney – Environmental Action 2016-2021 Strategy & Action Plan; and
- Industry recognised best practice environmental standards;

Recent proposed design amendments to Tower B have necessitated a "Section 4.55 Application to Modify a Development Consent" submission to council. Commentary around the proposed key design changes including potential ESD improvements are identified in Section 3 of the report.

It is emphasised that the proposed design amendments will not alter nor lower the aspirational ESD targets for the project as a whole. The overall ESD targets remain consistent with 'Australian Excellence' levels.

From an ESD perspective, the Hotel Tower B project (including proposed Section 4.55 changes) is committed to targeting the following:

- Compliance with the statutory energy efficiency requirements of NCC BCA Section J Part J1 to Part J8 (Design & construction)
- 5 Star Green Star Design & As Built v1.1 certified rating (Design & construction)
- Earthcheck certified rating (Operational)

The above ESD targets/ratings will be delivered through a variety of Hotel Tower B design, as-built and operational requirements. Please refer to Section 4 for further information.

3. Proposed Key Design Changes and ESD Improvements

The following sections identify the key Section 4.55 Tower B design amendments in relation to ESD outcomes, including commentary on the implications and resulting potential ESD improvements. Where required, additional ESD measures and amelioration strategies are identified.

It is noted that proposed design amendments not explicitly listed in this section are not expected to have substantially material ESD impacts/effects when compared to the previously approved Stage 2 DA scheme (2017).

3.1 Rationalisation of Hotel Basement Areas

The proposed extent of hotel basement areas has reduced, driven mainly by spatial planning efficiencies/optimisation and building services rationalisation.

When compared to the Stage 02 DA scheme (2017) this amendment includes a net reduction in hotel back-of-house requirements, reduced hotel car parking, removal of one hotel basement parking level and reduced basement footprint.

The following lists the ESD improvements associated with this proposed amendment:

Item	**Potential ESD Improvement**
Reduced extent of Hotel Basement Excavation and Construction	• Improved materials life-cycle impacts with embodied energy savings, due to reduced amount of new construction materials required. • Reduced hotel component excavation and reduced generation of waste & spoil materials • Reduced construction phase energy and water consumption • Reduced site pollution during construction phase
Reduced Hotel Basement Car Parking	• Reduced Hotel car park component operational energy consumption (internal lighting, mechanical ventilation etc.)
Reduced Hotel Basement Back of House Areas	• Reduced services energy consumption (lighting, ventilation etc.)
Reduced basement plant and service areas	• Reduced materials embodied energy based on reduced services installation. • Likely reduced operational maintenance energy & water consumption

3.2 Removal of Operable Windows to Hotel Rooms

This design amendment involves the deletion of operable awning windows to hotel rooms. The hotel rooms will be mechanically ventilated in compliance with the requirements of the NCC Building Code of Australia.

While it is recognized that this amendment would remove the possibility of hotel room occupants utilizing natural ventilation as a form of personalized thermal comfort, the following observations are noted:

- For a majority of the hotel rooms, operable awning windows can only be located on one elevation of the hotel room façade (i.e. single aspect ventilation), thus limiting the potential for cross-flow natural ventilation. Due to security and privacy reasons, hotel occupants will not leave their room doors open, further reducing the natural ventilation potential. These factors substantially reduce the ability for natural ventilation alone to maintain comfort conditions for occupants (outside of ideal ambient conditions).
- The operability of the awning windows would be subject to compliance with the safety fall prevention requirements of NCC Clause D2.24 (as applicable to a bedroom of a Class 3 hotel building component). If window opening restrictors were utilised to reduce the risk of children accidently falling out, the corresponding natural ventilation effectiveness of the awning window would also be reduced.
- Unless the air-conditioning to the hotel room is programmed to stop automatically when an awning window is opened, there could be a corresponding waste of HVAC space conditioning energy due to external air infiltration (especially during warm/cold external conditions).
- Based on the above, having operable windows to the hotel rooms is expected to make a negligible to minimal contribution towards the overall achievement of the targeted ESD performance levels.

The removal of operable windows can improve indoor environment quality (IEQ), simplify HVAC system operations and enhance energy efficiency as discussed in the table below. Additional measures to be investigated to further improve indoor air quality and energy efficiency are also identified:

Item	**Potential ESD Improvement and Additional ESD Measures**
Removal of operable windows to hotel rooms	• Improved internal noise levels with fixed windows due to lower external noise intrusion compared to open windows (i.e. improved acoustic comfort for occupants, particularly on lower floor levels) • Possibility of comparatively better indoor air quality with fixed windows compared to open windows for lower floors/rooms (e.g. rooms exposed to traffic/surrounding air pollution) • Improved thermal performance (Total System U-value, combined glass + frame) of fixed windows compared to operable awning windows. This will result in lower heat transfer through the façade by conduction • Improved HVAC Energy savings by having a well-sealed façade and elimination of uncontrolled infiltration from outside during peak conditions • Reduced complexity for hotel room HVAC system operation. For example, potential for undesired conflicts in HVAC operation is eliminated (e.g. Air-conditioning system to hotel room operational while window is opened) Additional IEQ and Energy ESD Measures: • Indoor Air Quality to hotel rooms proposed to be improved through (mechanical ventilation) provision of outdoor air at a rate +50% greater than the minimum (statutory code required) rates. This will assist with further diluting indoor carbon dioxide (CO_2) concentration levels and improve indoor air quality.

Item	Potential ESD Improvement and Additional ESD Measures
	• A regular and rigorous air handling filter cleaning maintenance regime during building operation • The use of mixed mode ventilation to the Level 25 bar (via openable roof) will be investigated as an energy saving initiative

3.3 Addition of 2 Levels of Hotel Rooms

Spatial efficiencies and building services plant rationalization has presented the opportunity for a modest addition to the number of hotel rooms on two levels (Level 05 and on Level 23).

There may be a slight increase in the total energy & water consumption of the hotel component of the building, however additional ESD measures will be implemented to ameliorate any potential impacts as follows:

Item	Additional ESD Measures
Additional hotel rooms	Additional Energy & Water ESD Measures: • Additional hotel rooms will be designed to be energy and water efficient as per the rest of the building, including efficient building envelope thermal performance and low demand fit-out equipment/services/fixtures • Hotel will incorporate automatic operational energy efficiency measures including monitoring & controls to ensure that air-conditioning & lighting to all unoccupied hotel rooms are capable of being deactivated (if vacant or unused). • Energy & water consumption monitoring system in conjunction with Building Management Control Systems can also alert building management to any local plant that should not be operational (in the event of vacancy).

3.4 Water-cooled HVAC chiller to Air-cooled HVAC chiller

This design amendment includes the change of the Hotel base building HVAC system from 'central water-cooled chillers and evaporative cooling towers' to 'central air-cooled chillers without cooling towers'. This amendment is mainly related to method of chilled water production and method of heat rejection. The basic design intent for the remainder of the HVAC services remain unchanged. Plantrooms and services locations/reticulation are proposed to be revised accordingly.

It is recognized that the overall HVAC cooling energy usage component of the hotel building will increase generally, due to the higher cooling efficiencies (COP) of water-cooled chillers (with cooling towers) versus air-cooled chillers.

However, the following observations are noted:

- A larger portion of the hotel HVAC cooling demand may occur during the summer/spring evenings and nights when occupants are inside their rooms. During these times, the average Sydney ambient dry-bulb temperature has dropped substantially, thus improving air-cooled chiller cooling COP efficiencies and reducing thermal loads. As a result, the impact of additional cooling energy consumption traditionally associated with air-cooled chillers will be tempered.
- A substantial amount of water required for HVAC heat rejection will be saved through deletion of the evaporative cooling towers.

The following table lists the ESD improvements associated with this amendment. Additional measures to be investigated to further improve energy efficiency are also identified:

Item	**Potential ESD Improvement & Additional ESD Measures**
Water-cooled mechanical HVAC chillers changed to air-cooled chillers. Deletion of evaporative cooling towers for heat rejection.	• Large water consumption savings (for HVAC heat rejection) through deletion of evaporative cooling towers • The use of air-cooled (waterless) HVAC heat rejection eliminates health risks associated with legionella, especially to occupants and surrounding neighbouring buildings • Removal of cooling towers allows for subsequent increase in planted green roof area (above Level 25) to reduce urban heat island impact and improve local amenity • Removal of cooling towers will result in reduced energy & water consumption associated with cleaning and maintaining cooling towers. • Elimination of chemical use necessary for cooling tower water treatment, maintenance and cleaning • Elimination of cooling tower bleed discharge (including polluted water) to sewer Additional Energy ESD Measures: • High efficiency air-cooled chillers (for cooling) will be selected to reduce operational energy costs and electricity consumption • The use of hybrid high efficiency 4-pipe air-sourced multifunction chiller (for simultaneous heating and cooling year round) in combination with standard 2-pipe chillers will be investigated. Such 4-pipe chillers have excellent combined Total Heating + Cooling COPs when the cooling and heating demands are balanced • Post-occupancy building tuning and monitoring will be undertaken to ensure that mechanical chillers are operating as efficiently as possible • Energy monitoring system in conjunction with Building Management Control Systems will also alert building management to excessive energy consumption

3.5 Potential Breathing External Green Wall

The design team will investigate the possibility of incorporating an 'active' external Breathing Green Wall on the hotel lower podium levels, in order to further improve the amenity of the surrounding public domain areas.

This breathable external green wall system would be similar to a Junglefy Breathing Wall [3]. The Junglefy Breathing Wall is an active modular green wall system that is able to accelerate the removal of air pollutants (including carbon dioxide, particulate matter (PM) and volatile organic compounds) compared to passive systems. The actively ventilated system provides airflow across plants and growing medium, and increases the volume of air that can be filtered and cooled. Microbes in the soil work symbiotically with the plant to use air-pollutants as a food source.

The following table lists the ESD improvements associated with this potential amendment.

Item	**Potential ESD Improvement**
Breathable External Green Wall System on hotel lower podium levels	Breathable Green Wall for public domain areas can improve local air quality through: • Reduction in particulate matter concentration from vehicle exhausts and adjacent rail corridor • Reduction in carbon dioxide levels A Breathable External Green Wall can also: • Assist with local air temperature reduction • Act as a sound barrier, by assisting with noise reduction in relation to traffic noise frequencies

4. ESD Response: Tower B ESD Targets & Initiatives

The Tower B project (including proposed Section 4.55 amendments) will maintain the same unchanged ESD aspirational targets as follows:

- Compliance with the statutory energy efficiency requirements of NCC BCA Section J Part J1 to Part J8
- 5 Star Green Star Design & As Built v1.1 certified rating
    - This scheme covers the holistic implementation of ESD initiatives during the design, construction and As-Built/completion phases of the project
- Earthcheck certified rating
    - This scheme covers the holistic implementation of ESD initiatives during the operational phase of the hotel building

4.1 Design & construction compliance with NCC BCA Section J

Where applicable, the development will be designed and constructed to comply with or exceed the minimum energy efficiency requirements of NCC BCA Section J 2016 in full. This includes:

- Part J1 – Building Fabric
- Part J2 – External Glazing;
- Part J3 – Building Sealing;
- Part J5 – Air Conditioning & Ventilation Systems;
- Part J6 – Artificial Lighting & Power;
- Part J7 – Heated water supply and swimming pool and spa pool plant, and
- Part J8 – Facilities for Energy Monitoring

Compliance with the Section J Performance Requirements will be demonstrated either through a Deemed-To-Satisfy solution or a Performance Solution.

4.2 5 Star Green Star Design & As Built v1.1 certified rating

Hotel Tower B has already been registered with the Green Building Council of Australia for a "Green Star Design & As Built v1.1" certified 'as-constructed' rating. This well-established building sustainability rating scheme will cover the holistic implementation of ESD initiatives during the design, construction and completion phases of the project.

A minimum of 60 credit points in addition to an adequate point's safety buffer will be targeted in order to achieve a 5 Star rating after project completion.

The following section identifies the main Green Star ESD initiatives that will be considered during the design and construction of phases of Tower B (including the relevant Section 4.55 amendments):

4.2.1 Management

- Commitment to a comprehensive building services commissioning and post-occupancy building tuning and monitoring. This will assist with optimizing energy and water consumption efficiency of building services.
- Inclusion of comprehensive energy and water consumption sub-metering & monitoring system, with automatic monitoring and reporting to building management
- Building owner commitment to setting operational targets for energy and water consumption
- Head Contractor will be ISO 14001 accredited and implement comprehensive construction environmental management plan in compliance with statutory requirements
- Comprehensive building handover information & training by contractor to building owner and hotel operator
- Implementation of best practice design for waste collection/storage/separation facilities (including recycling) and waste management processes during operations

4.2.2 Indoor Environment Quality

- Indoor air quality improved with provision of required filtration and mechanical fresh air ventilation rates exceeding minimum statutory requirements
- Energy efficient flicker free lighting
- Improved acoustic comfort through appropriate treatment of façade, building services and finishes
- Extensive access to high quality external views to city and harbour
- Improved natural daylight levels (while controlling unwanted solar heat gain through high performance facade)
- Low Volatile Organic Compound (VOC) finishes and low formaldehyde emission products
- High level of thermal comfort for staff and occupants through passive design (including high levels of building fabric thermal insulation and energy efficient high performance double glazing) and active systems (energy efficient air-conditioning with BMCS close control)

4.2.3 Energy

- Passive design principles to minimize external cooling and heating loads including:
    - High performance double glazed façade with improved thermal performance reduces façade heat gains/loss
    - High levels of thermal insulation to boost building envelope energy efficiency
- High efficiency central chilled water and heating hot water based air-conditioning
- Automated control systems to disable air-conditioning and lighting operation in unoccupied rooms
- Energy efficient lighting that is predominantly LED based
- Automatic lighting control system with timeclock, daylight sensor, motion sensor and programmable control
- Energy efficient appliances
- Energy efficient lifts (e.g. regenerative lifts)
- Possibility of micro co-generation system for electrical energy generation and heating demands

4.2.4 Transport

- Building site has excellent public transport connectivity (by train, bus, ferry, future tram) and is in close proximity to surrounding amenities, thus reducing the need to utilize private transportation
- Provision of bicycle parking spaces and amenities (lockers, showers) for building staff
- Further reduced hotel car parking spaces will encourage the use of more eco-friendly modes of transport, even for hotel occupants and visitors.
- Green Travel Plan for building staff to encourage uptake of green transport options

4.2.5 Water Consumption

- Significant improvement in overall building water consumption based on proposed use of air-cooled chillers in lieu of traditional evaporative cooling towers
- Selection of high water efficiency (low flowrate) taps/showers/toilets
- Selection of water efficient appliances (dishwashers, clothes washing machines etc.)
- Recycling of fire system test water (through redirecting test water back to fire storage tank)
- Water sub-metering and monitoring
- Water efficient landscape irrigation (low demand planting, automatic irrigation systems including incorporation into green wall system)

4.2.6 Materials

- Life Cycle Analysis to be undertaken to show the embodied and operational energy savings
- Sustainably sourced construction products potentially including steel, timber, PVC and the like
- Proposed high levels (>90% by mass) of construction waste recycling

4.2.7 Land Use and Ecology

- Construction on previously developed land
- Green landscaping, green roof and external extensive green wall to improve local amenity and urban heat island effect

4.2.8 Emissions

- Reduced stormwater discharge quantity
- Improved stormwater discharge quality to best practice levels
- Avoidance of external light pollution
- Reduced risk of legionella through waterless HVAC heat rejection

4.2.9 Innovation

- Sustainability education & information provided for contractors
- Project requirement for contractors to utilise/deploy 'eco-friendly green' 'high performance' site shed/offices
- Proportional usage of ultra-low TVOC paints

4.3 Earthcheck Certified (Operational)

Earthcheck is a "world leading sustainability benchmarking certification and advisory group for travel and tourism" [1].

The hotel will be Earthcheck Certified during the operational phase, in order to demonstrate its environmental and social performance credentials.

The Earthcheck Certified program will require the hotel to measure, monitor and improve its [2]:

- Greenhouse gas emissions
- Energy efficiency, conservation & management
- Management of Freshwater Resources
- Ecosystem Conservation & Management
- Social and Cultural Management
- Land Use Planning & Management
- Air Quality Protection
- Wastewater management
- Solid waste management
- Environmentally harmful substances

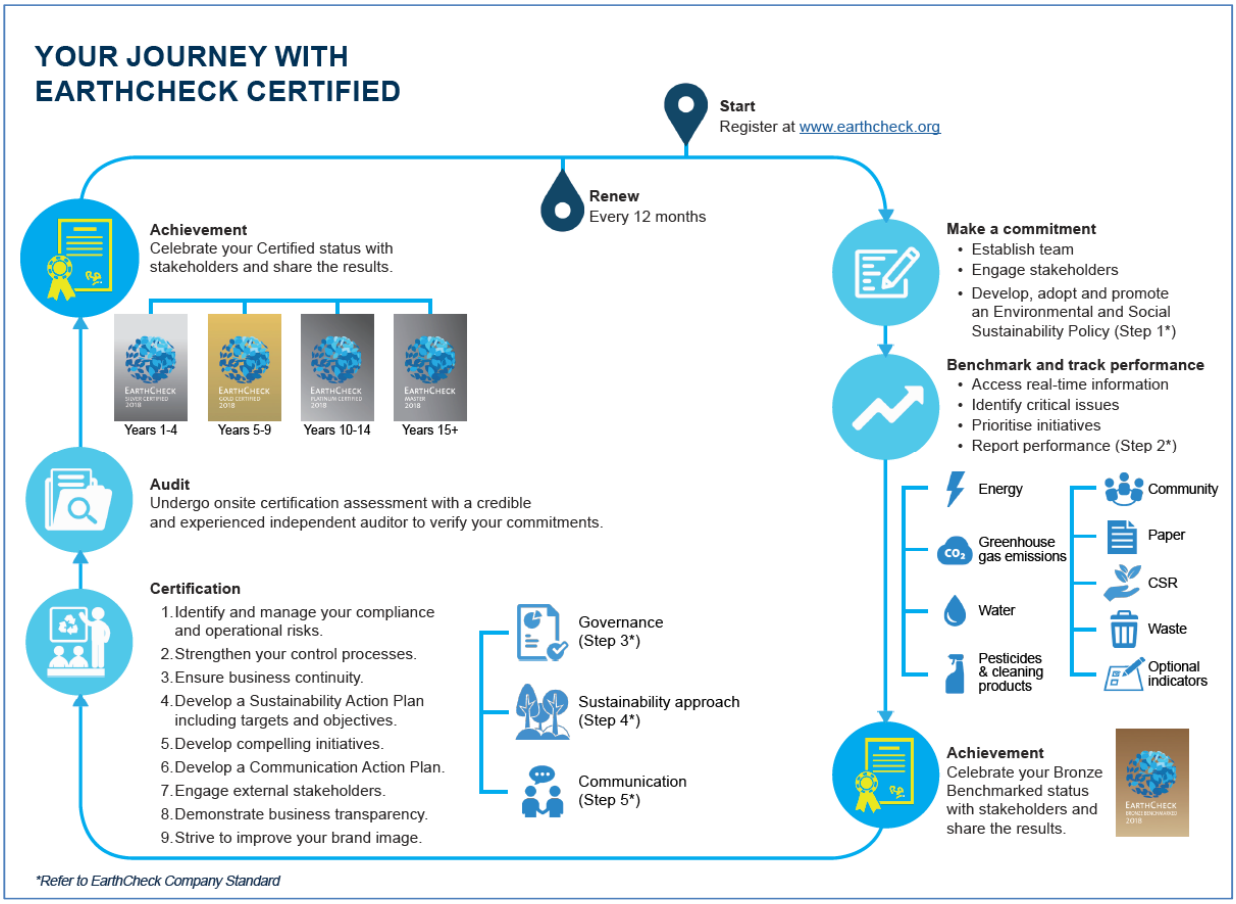

Figure 2: Earthcheck Certified Process [2]

On-going Earthcheck certification in operation will enable the Hotel to benchmark and continually improve/sustain its sustainable performance.

5. Conclusion and Summary of Design Response

This Ecological Sustainable Development Report has been prepared in support of the Tower B "Section 4.55 Application to Modify a Development Consent".

This report aims to reiterate that the overall project ESD targets remain consistent with 'Australian Excellence' levels and have not changed with the proposed design amendments. The proposed design amendments will result in improved environmental outcomes including:

- Reduced construction material & resources use
- Reduced waste
- Improved indoor environment quality
- Simplified HVAC operation
- Enhanced thermal comfort
- Significant operational water consumption savings
- Reduced microbial pollution (legionella) risks
- Reduced polluted water discharge to sewer
- Reduced energy & water consumption associated with operational maintenance
- Improved ecology value outcomes through additional greenery
- Improved urban heat island impact outcomes

Additional ESD measures will be implemented in order to ameliorate potential impacts associated with the design amendments. These initiatives will complement the substantial ESD benefits of the proposed design amendments and enhance the overall environment outcomes.

Ultimately, the ESD targets will be achieved through a variety of Hotel Tower B design, as-built and operational requirements.

We trust that the information contained within this report provides a suitable overview of the project's commitment to ecological sustainable development and a reduced environmental impact.

6. References

[1] https://earthcheck.org/about/

[2] https://earthcheck.org/products-services/certification/benchmarking-and-certification/

[3] https://junglefy.com.au/breathingwall/