Pymble Ladies' College Grey House Precinct

ESD Report

SEARS Ecologically Sustainable Design Report

Prepared for: Pymble Ladies' College

Attention: Kate Bimson

Date: 06 August 2021

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Revision

Revision	Date	Comment	Prepared By	Approved By
01	16/07/2021	Draft issue	ANG	LHT
02	06/08/2021	For issue	ANG	LHT

Contents

1. Executive Summary

This Ecologically Sustainable Design (ESD) report has been prepared to support a State Significant Development Application (SSDA) submitted to the Department of Planning, Industry and Environment (DPIE) for the proposed development of Pymble Ladies' College (PLC) Grey House Precinct (GHP), located within the school grounds at 20 Avon Road, Pymble, New South Wales, 2073.

This report is intended to provide an overview of the sustainable initiatives to be considered within the project as a design response to the Secretary's Environmental Assessment Requirements (SEARs). The report further addresses other ecologically sustainable aspects that will be considered during the detailed design phase.

Information contained within this report has been prepared in response to:

- The Secretary's Environmental Assessment Requirements (SEARs) for this development including:
  - Building design response statement to NARCliM projections
  - Integrated Water Management Plan
- NCC 2019 Section J Volume 1, Amendment 1 Compliance

Consideration has also been made with regards to:

- Ku-ring-gai Local Environment Plan (LEP) 2015
- Ku-ring-gai Development Control Plan (DCP) 2016

In coordination with the above, the project will consider and implement appropriate sustainable design principles including initiatives to mitigate the environmental impact through the following:

- **Energy & Carbon**– including on-site renewable energy and improved energy efficiency across the building
- **Water Management** – including water reuse, reduced potable water demand and improved stormwater quality.
- **Health & Wellbeing** – improving indoor air quality, maximising daylight, and providing comfortable amenities through improved indoor environmental quality features to enhance wellbeing among students and staff.
- **Materials**– Careful material selection to reduce embodied energy and focus on natural products with biophilic qualities.
- **Future Resilience** – 100% electric building services design, no fossil fuels burnt on-site within the building.

The following sections describe the development's specific sustainable design response in more detail.

2. Introduction

2.1 Project Overview

Established in 1916, Pymble Ladies College is a non-selective, independent school for girls from Kindergarten to Year 12, with Boarding available from Year 7. The school grounds are located within Sydney's metropolitan area at 20 Avon Road, Pymble, NSW, 2073. The location context of the site is illustrated in Figure 1.

The proposed Grey House Precinct is a new school building that aims to be a world-class educational and co-curricular facility. The new development will house a new Early Learning Centre, Out of School Hours Care (OSHC), Dance studios, year 5 & 6 learning spaces, including STEM (Science, Technology, Engineering and Mathematics) labs, and outdoor learning spaces.

Figure 1 PLC GHP render image, Source: BVN Architecture

2.2 Project Site

The proposed development is located on the southeast side away from Avon Road. The proposed works are to be built towards the southern portion of the site, along the southeast boundary. The GHP PLC site is identified as Lot 1 DP69541 by the NSW Land Registry Services. (LRS)

The area slopes towards the southeast and is surrounded by a number of school buildings. The historic, two storey, Goodlet House building is located directly to the northwest, the double storey Junior School is located directly to the northeast and the contemporary multistorey Aquatic and Fitness Centre is located to the southwest. To the south, the site is adjacent to the school boundary, with a number of private, residential dwellings on the opposite side.

The site currently contains several contemporary, single storey, demountable classroom structures located towards the southwest portion of the site, which will be replaced with the new facility.

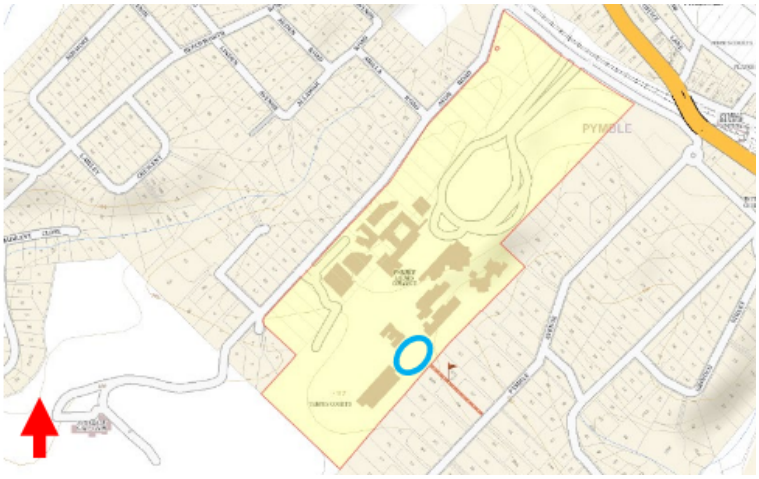

Figure 2: Context plan. PLC school grounds and site location circled in blue. Source: Six Maps, NSW

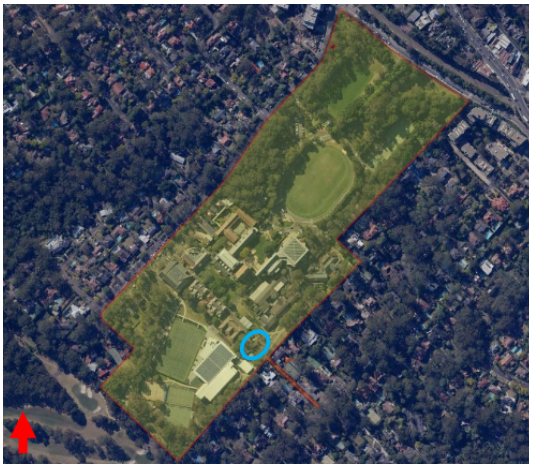

Figure 3: Aerial Photo. PLC school grounds and site location circled in blue - Source: Six Maps, NSW

3. Project ESD Drivers

PLC's design intent is to achieve the sustainability targets while maintaining minimal impact to the overall form, function, and aesthetic of the space. The following section presents an overview of the applicable ESD drivers for this project.

3.1 Secretary's Environmental Assessment Requirements

This report has been prepared having regard to the Secretary's Environmental Assessment Requirements (SEARs) issued on 17th May 2021, Application No SSD-17424905. The SEARs document outlines the general requirements and key issues that the development must address as part of the Environmental Impact Statement (EIS). The following excerpt has been extracted from the EIS outlining the ESD specific matters that must be identified and delivered within this report:

Ecologically Sustainable Development SEARs	Reference
Identify how ESD principles (as defined in clause 7(4) of Schedule 2 of the Regulation) would be incorporated in the design and ongoing operation phases of the development.	Refer to section 4 of this report. Section 4 outlines each of the ESD targets which in whole respond to this SEAR.
Identify proposed measures to minimise consumption of resources, water (including water sensitive urban design) and energy.	
Identify how the future development would be designed to consider and reflect national best practice sustainable building principles to improve environmental performance and reduce ecological impact. This should be based on a materiality assessment and include waste reduction design measures, future proofing, use of sustainable and low-carbon materials, energy and water efficient design (including water sensitive urban design) and technology and use of renewable energy.	
Identify how environmental design will be achieved in accordance with the GANSW Environmental Design in Schools Manual (GANSW, 2018)	
Provide an assessment against an accredited ESD rating system or an equivalent program of ESD performance. This should include a minimum rating scheme target level.	Refer to Section 4.1 of this report.
Provide a statement regarding how the design of the development is responsive to the NARClim projected impacts of climate change	Refer to Section 4.4 of this report.
Provide an integrated Water Management Plan detailing any proposed alternative water supplies, proposed end uses of potable and non-potable water, and water sensitive urban design.	Refer to Section 4.5 of this report.

3.2 NSW Environmental Planning and Assessment Regulation 2000

The following summarizes the ESD principles outlined in clause 7(4) of Schedule 2 of the EPA Regulation 2000:

- "Precautionary principle": Where possible the design is to be developed to avoid serious and irreversible environmental degradation.
- "Inter-generational equity": the design is to maintain, or enhance the health, diversity and productivity of the environment for future generations.
- "Conservation of biological diversity and ecological integrity": the design is to consider the conservation of biological diversity and ecological integrity.
- "improved valuation, pricing and incentive mechanisms": design decisions should be made in consideration of environmental factors, including the ongoing operation of systems and how this will impact the environment over the course of the projects lifetime.

3.3 GANSW Environmental Design in Schools Manual 2018

The SEARs requirements reference the GANSW Environmental Design in School's Manual which identifies strategies and recommendations to drive sustainable design in schools including:

- **Passive design features:** These include thermal mass to absorb and store heat energy for use during cooler times, cross ventilation to reduce energy consumption, passive heating/cooling through orientation of new buildings, shading and glazing selection to control solar heat gain.
- **Biophilic design:** to facilitate a connection with nature. This can be done through the use of indoor planting, green walls, use of natural materials and nature views.
- **Specialist environmental design initiatives:** These include Covered outdoor learning areas (COLA) to promote engagement with nature and outdoors, and the use of solar photovoltaic (PV) panels as the energy production during the day enables most to be used on site.

3.4 NCC Section J – Energy Efficiency

NCC Section J establishes the minimum energy efficiency provisions for all classes of buildings. The provisions are designed to achieve the functional objective of Section J which is to reduce greenhouse gas emissions.

NCC Section J 2019 Amendment 1 [1] will likely apply to the design and construction of the development. NCC Section J 2019 represents a 'step change' substantial increase in the minimum energy efficiency requirements for a building. The energy efficiency performance requirements are now significantly more stringent, with the overall aim of reducing future operational energy consumption and greenhouse gas emissions.

The development will demonstrate compliance with the minimum design provisions as identified within National Construction Code (NCC) 2019 Volume One, Amendment 1 Section J – Energy Efficiency, including:

- Part J1 – Building Fabric
- Part J3 – Building Sealing
- Part J5 – Air-Conditioning and Ventilation Systems
- Part J6 – Artificial Lighting and Power
- Part J7 – Heated water supply and swimming pool and spa pool plant; and
- Part J8 – Facilities for energy monitoring

3.5 Ku-ring-gai Council DCP ESD Considerations

The following items include the ESD principles outlined in the local Ku-ring-gai DCP for non-residential developments:

- Water Efficiency: provide systems to minimise mains water usage.
- Energy Generation: building design is to demonstrate a reduced reliance on mains power and provision of alternate energy sources.
- Heating and Cooling: use of mechanical air conditioning and heating is to be minimised. Where it is unavoidable, the systems are to be of a high efficiency in technology choice to reduce peak energy demand.
- Lighting: buildings are to be designed to reduce the need for artificial light use.

4. Project Sustainability Design Response

The design response for the proposed development will consider and implement (where feasible) the relevant ESD requirements and drivers (identified within Section 3) as follows. Where relevant, industry-based rating tools such as Green Star Design & As Built v1.3 [2] by the Green Building Council of Australia have been referenced to assist with suggestions of efficiency measures.

4.1 Best Practice Sustainable Development Framework

The SEARs requirements call for an "*assessment of the proposed development against an accredited ESD rating system or an equivalent program of ESD performance*". **Accordingly, the project will be designed to target an ESD performance level that is comparable to a 5 Star Green Star Design & As Built v1.3 Equivalent standard**.

The Green Building Council of Australia's Green Star Design & As Built v1.3 rating scheme is the most appropriate reference ESD tool for this project. Green Star is a credits-based star rating system ranging from one through to six stars.

Green Star assesses the environmental performance of projects in design, construction, and operation via the following category frameworks:

- Management
- Indoor Environment Quality
- Energy
- Transport
- Water
- Materials
- Land use & Ecology
- Emissions; and
- Innovation

A provisional 5 Star Green Star Equivalent benchmarking pathway is included in **Appendix A** of this report. It is noted that the provisional list of ESD initiatives will be subject to further amendment and feasibility analysis during project detailed design phase.

4.2 NCC Section J Compliance

NCC 2019, Volume 1, Amendment 1, Section J – energy efficiency provisions will likely apply to the design & construction of the development with the intent to ensure the building envelope and associated building services demonstrate a minimum level of energy efficiency performance.

4.3 ESD Opportunities & Initiatives

The following section identifies ESD opportunities and initiatives for consideration on the project (including the Green Star equivalent related items). The main initiatives have been outlined in this section and are separated into the following categories:

4.3.1 Energy and Carbon

- **Building envelope:** High performance thermally insulated building fabric will significantly reduce peak cooling and heating loads on HVAC systems. High performance energy efficient double glazing will be utilised as required to improve the overall building energy performance. This passive design strategy aligns with the GANSW Environmental Design in School's Manual recommendations.
- **Floor plan layout:** Relevant windows in the perimeter area of the building may be openable to allow for natural ventilation under optimal external ambient conditions.
- **Natural ventilation and Mixed Mode Ventilation:** The project will accommodate the possibility of mixed mode ventilation for the most relevant spaces. Openable windows will allow for natural ventilation when external ambient conditions are suitable. High efficiency mechanical HVAC systems will operate in the relevant spaces outside of the favourable ambient conditions.
- **Ceiling Fans:** Ceiling mounted fans will be installed in relevant areas to reduce cooling air-conditioning energy.
- **Lighting:** Energy efficient LED electric lighting will be utilised in conjunction with good natural daylight levels. Occupancy sensors and daylight sensors will be installed where required.
- **Natural daylighting:** the design intent is to utilise good levels of daylighting and reduce the use of electric lighting. Potential design strategies to achieve this include access to natural daylighting through windows, doors, and atrium.
- **On site energy generation:** PV solar panels (approx. 70 kW) and a solar hot water system will be installed to supplement the building energy and domestic hot water demand. This initiative aligns with the GANSW Environmental Design in School's Manual recommendations.
- **Internal Equipment Power:** Where possible, energy efficient tenancy fit-out equipment (computers, printers, dishwashers, Boiling & Chilled Water units, whitegoods etc.) will be considered for installation

4.3.2 Water Management

- **Fixtures and fittings:** Low-flow (high WELS Star rated) showers, WCs and taps will reduce the potable (and domestic hot water) demand across the development.
- **Rainwater harvesting:** A 20kL Rainwater tank is proposed for rainwater harvesting to reduce the consumption of potable water for landscape irrigation.
- **On-site stormwater run-off management:** an OSD tank will be incorporated in the project to assist in reducing peak discharge and mitigate stormwater run-off.
- **Landscape:** Selection of local native planting to reduce water consumption for irrigation where possible.

4.3.3 Health & Wellbeing

- **Daylighting:** Daylighting has several benefits for human health and wellbeing, including improving the levels of alertness, mood, sleep, regulation of body temperature, and hormones release. Thus, the project will aim to maximize controlled levels of natural daylight while considering the negative impact of glare and unwanted solar heat gain.
- **Thermal Comfort:** thermal comfort is one of the most important factors for occupant satisfaction inside a building. The building design aims to achieve optimum thermal comfort through a high performing building fabric and a mixed-mode ventilation system.

- **Views:** The project's surrounding area is characterized by mature gardens with large trees as well as the areas of retained Blue Gum Forest. The design aims to maximize views to the exterior and enhance connection to nature for the students and staff.

- **Biophilia**: The project will prioritize the selection of biophilic elements and materials for the interior spaces (e.g. timber finishes, green plants) with the aim of creating positive learning environments, and improving occupant experience, mood and happiness. This design strategy aligns with the GANSW Environmental Design in School's Manual recommendations.

- **Covered Outdoor Learning**: As recommended within the GANSW Environmental Design in School's Manual, the building will incorporate covered learning areas (COLAs) in each level to promote engagement with nature and outdoors. COLAs within the Atrium spaces will count with ceiling fans and a louvered façade for improved outdoor thermal comfort and weather protection.

4.3.4 Materials

Choice of materials is a key aspect for sustainable outcomes both in terms of reducing embodied carbon and in creating healthy environments. The material strategy includes the following:

- **Timber finishes**: timber and warm colours have psychological benefits for people. The selection of these materials will have a positive impact on students and teachers' health and wellness. Consideration will be given to the use of environmentally responsibly sourced timber (FSC/PEFC certified).

- **Volatile Organic Compounds (VOCs) reduction:** high concentrations of VOCs in internal finishes are known to trigger nausea, headaches, asthma and allergies. These result from the off gassing of building materials such as paints, adhesives, coatings, carpets, and insulation. A selection of low VOC verified products in line with Green Star general requirements will help create a healthier environment.

- **PVC elements:** Materials such as pipes, cables, flooring, blinds, and electrical, shall be PVC free, or meet best practice guidelines for PVC, in line with Green Star general requirements.

4.3.5 Future Resilience

- **Future Resilience** – 100% electric building services design, including for HVAC and Domestic Hot Water production. No fossil fuels burnt on-site within the building

- **Urban Heat Island effect:** The proposed development will endeavour to reduce heat island impacts at the local scale through the following strategies:

    - External Façade Glazing Selection: The glazing will be selected to have a lower solar energy reflectivity. This reduces the energy being reflected from the sun, down into the local school precinct

    - Greenery on Roofs & Terraces: Green planting will be adopted for the roof and terrace areas where feasible. The planting intent is to increase vegetation cover, improve local biodiversity, and help mitigate stormwater runoff.

4.4 NARCliM Design Response Statement

The SEARs requirements call for a statement regarding how the design of the development is responsive to the NARClim projected impacts of climate change. The proposed Greyhouse Precinct development for PLC is located within the school grounds at 20 Avon Road, Pymble, New South Wales, 2073. Given its location, the site is found within the **Metropolitan Sydney Region**; thus, the corresponding region has been analysed.

Known for its large natural harbour and its status as a global city, the Metropolitan Sydney Region encompasses the Cumberland Plain and extends west to the Blue Mountains in the Great Dividing Range. The Metropolitan Sydney Region extends from Broken Bay in the north to Garie Beach in the Royal National Park in the south. With over 4 million people, the Metropolitan Sydney Region is the most populous region in New South Wales. NARCliM's modelling is on a regional basis.

4.4.1 Temperature & Heat Projections and Design Responses

Temperature Projections

2020-2039	2060-2079
Mean temperatures are projected to rise **by 0.7 ºC** by 2030. The increases are occurring across the region. All models show there are no declines in mean temperatures across Metropolitan Sydney.	Mean temperatures are projected to rise **by 1.9 ºC** by 2070. The greatest increases are being seen during summer and spring. All models show there are no declines in mean temperatures across the Metropolitan Region.

Heat Projections

2020-2039	2060-2079
+3.9 days a year with temperature > 35˚C, mostly to occur in summer.	+10.4 days a year with temperature > 35˚C, mostly to occur in summer but will see more hot days in spring also.
Hot days are projected to increase across the region by an average of 4 days per year by 2030. The greatest increases are seen in the central part of the region near Penrith during summer and spring, where they are projected to experience an additional 5-10 more days per year. There is little change along the coast.	Hot days are projected to increase across the region by an average of 11 days per year by 2070. The greatest increases are seen in the central part of the region from Picton to north of Wiseman's Ferry and out to Katoomba. These regions are projected to have additional 10-20 hot days per year.

Project's Design Responses to Temperature & Heat Projections:

Since NARCliM's projections are showing an overall increase in temperature, the project's design responses for climate predictions of temperature and heat significantly overlap. These are outlined below:

Building Envelope

- Provision of high-performance glazed systems in conjunction with reasonable façade window-to-wall area ratio to avoid excessive solar heat gains,
- Façade design incorporates shading devices to glazed façades
- Well insulated building fabric (walls, roof, floors) to reduce external heat gains

Project Design

- Floor plan layout and operable glazing type selection to improve natural ventilation

- Consideration of well shaded outdoor spaces for blocking of summer sun
- Inclusion of greenery on roofs and terraces,
- Reduction of hard surfaces and increased landscaping

Mechanical Air Conditioning System

- HVAC systems adequately sized with sufficient spare capacity for future whilst still allowing for efficient operation.
- Amend building comfort expectations (room temperature bands) during peak temperature days and educate occupants for tolerance to wider temperature bands (adaptive thermal comfort)
- Installation of high efficiency VRV heat recovery system.
- Installation of 70kW system of Solar PV to reduce grid energy consumption of HVAC systems
- User-controlled systems via local control points.

4.4.2 Rainfall Projections

2020-2039	2060-2079
By 2030 there is little change in annual rainfall. Rainfall is projected to increase across the region during autumn with the largest increase seen north of Wiseman's Ferry. Rainfall is variable across the region during the other seasons.	Annual rainfall is projected to increase by 2070. Increases are projected across the whole region for summer and autumn. Winter and spring rainfall is more variable, with a slight decrease in rainfall in the Blue Mountains during winter.
The projected annual rainfall increase for the region is +1.7%	The projected annual rainfall increase for the region is +8.9%

Project's Design Response to Rainfall Projections:

Although an average increase in annual rainfall is expected, rainfall is expected to come in infrequent short downpours. Therefore, water conservation management between rain events and flood management are important and are addressed below.

Water Conservation:

- Design air-conditioning system with waterless heat rejection (air-cooled)
- Use of drought tolerant and native plants where possible
- Provide subsoil irrigation system to improve watering effectiveness where possible.
- Design rainwater tanks for rainwater reuse for toilet flushing and landscape irrigation
- Water efficient appliances and hydraulic fixtures
- Rainwater tank provision

Flood Mitigation:

- Provide multiple access to the building and safer access routes that are above the peak flood levels.

- On-site stormwater tank will be incorporated in the project to assist in reducing peak discharge and mitigate stormwater run-off.
- Critical building infrastructure (switchboards etc.) to be in appropriate locations to reduce risk of damage from flood events

4.4.3 Fire Projections

2020-2039	2060-2079
+0 Changes in number of days a year FFDI > 50 Forest Fire Danger Index (FFDI) is used in NSW to quantify fire weather. The FFDI combines observations of temperature, humidity, and wind speed. Fire weather is classified as severe when the FFDI is above 50. By 2030 severe fire weather is projected to have a slight increase in summer and along the Blue Mountains during spring. Decreases are projected during autumn and across the Sydney Basin in spring. Declines during Autumn are likely due to increases in rainfall. These increases are seen during the peak fire risk season (summer).	+0.6 Changes in number of days a year FFDI > 50 Forest Fire Danger Index (FFDI) is used in NSW to quantify fire weather. The FFDI combines observations of temperature, humidity and wind speed. Fire weather is classified as severe when the FFDI is above 50. Severe fire weather is projected to increase during summer and spring by 2070. Declines are projected for autumn and winter. These increases are being seen during the peak prescribed burning season (spring) and peak fire risk season (summer).

Project's Design Response to Fire Projections:

- Provisions of compliant fire and life safety design of the building to protect fire and life safety strategy (e.g. provisions of exits and egress, fire hydrant systems, smoke hazard management, etc.)
- Provide multiple access routes to the site

4.4.4 Risk Matrix for PLC GHP as a response to NARClim Projections

Risk	2020-2039	2060-2079	Comment	Design Response
Extreme temperatures within the building causing discomfort to indoor occupants.	Low	Medium	Peak temperatures increasing and becoming more common creating larger loads upon HVAC to maintain thermal comfort inside. Also, can lead to deterioration and failure of HVAC equipment.	High performance building envelope and façade. HVAC system to support natural ventilation during extreme external conditions, sized with sufficient spare capacity to maintain acceptable comfort conditions during peak days.
Increase in temperatures causing discomfort to occupants outdoors.	Medium	High	Peak temperatures increasing and becoming more common creating outdoor amenity space to exceed thermal comfort.	Well shaded outdoor spaces blocking summer sun. Incorporation of ceiling mounted fans to outdoor circulation area (atrium) for improved thermal comfort.
Heat island effect	Low	Medium	The number of days a year with temperature > 35˚C, will increase slightly and will mostly occur during summer break so it's not considered a high risk in the short term. However, the risk increases in the 2070s scenario so reducing heat at local scale is critical.	To reduce heat island effect during peak days, the project will include greenery on roofs where possible, reduce hard surfaces where possible and increase landscaping
Access to site blocked, preventing, or restricting access and egress to the site caused by flooding.	Low	Medium	The site is not located in a flood prone area therefore, this is considered a low risk. However, stormwater management strategy should be set to mitigate the 8.9% projected annual rainfall increase for the 2070s scenario.	An OSD tank will be installed to mitigate stormwater runoff and the project will ensure multiple access points above flood plain level.
Structural integrity of the buildings undermined by extreme weather events	Low	Low	Instances of flooding in the area with high erosion soils are low, therefore it is considered a low risk.	Structural works to plan foundations accordingly
Increased costs of mains potable water due to hotter and drier climate	Low	Medium	Projections depict hotter drier climate with short intense storms. This suggests water scarcity between storms and therefore an increase in price.	A 20 kL Rainwater to be implemented for toilet flushing and irrigation. Solar hot water system will be installed to reduce energy loads for hot water.
Access to site blocked, preventing, or restricting access to the site caused by bushfire	Low	Medium	Due to the nature of the site, localised bushfire is unlikely in the short-term projection. However, the risk increases toward the 2070s scenario where temperatures and number of hot days during summer increase.	Ensure multiple access points to site.

4.5 Integrated Water Management Plan

The SEARs requirements call for an Integrated Water Management Plan detailing proposed alternative water supplies and proposed end uses of potable and non-potable water.

Alternative (non-potable) water supplies include rainwater collection and re-use, and this will be utilised for toilet flushing and landscape irrigation. Potable water will be utilised for all other end-uses relevant to the building. The building design will seek to reduce the building's overall potable water consumption. The following water sensitive design initiatives will be pursued by the project and can be treated as the project's integrated water management plan.

4.5.1 Potable water conservation

The sustainable water strategy will focus on reducing potable water consumption through efficient fixtures, alternative sources of water, and monitoring water use. The following water sensitive design strategies are to be implemented:

Rainwater collection

Rainwater harvesting and reuse will be key to reduce the demand on drinking water supplies. A 20kL rainwater harvesting tank water will be installed in the building to collect rainwater from non-trafficable areas. The tank will supply non-potable water to toilets for flushing and to landscape irrigation systems for adjacent landscape/gardens. The major preference will be for gravity fed supply to minimise ongoing maintenance.

Fixture efficiency

It is recommended that all relevant hydraulic fixtures and fittings have high Water Efficiency Labelling and Standards (WELS) star ratings. For example:

- Taps to target 5 Star WELS ratings
- WCs to target 4 Star WELS ratings
- Showers to target 4 Star WELS ratings
- Relevant appliances (dishwashers etc.) to target high levels of WELS Star ratings or equivalent water efficiency

In addition, flow restrictors and/or flow timers can be utilised where relevant to minimise water usage and wastage for staff and students' amenities.

Water sub-metering

In addition to the main water meter for the site, the project will provide cold water sub meters that will allow manual monitoring of major water consumption end uses and help identify potential water leaks early enough.

Waterless HVAC Heat Rejection

The proposed HVAC system will be an air-cooled VRV heat recovery system, thus avoiding the need for evaporative heat rejection systems such as cooling towers.

4.5.2 Stormwater Pollution Management

The project design will aim to minimise the transportation of pollutants to waterways and other offsite environments and maintain the existing hydrological regimes by mitigating stormwater runoff. This will be achieved through the incorporation of the following:

- On-site stormwater run-off management: an OSD tank will be incorporated in the project to assist in reducing peak discharge and mitigate stormwater run-off.
- Rainwater capture & Reuse for irrigation
- Soft landscaping areas

4.5.3 Hydraulic services

Hydraulic services will be designed to:

- Support sustainable design principles including reducing water consumption and waste production.
- Appropriately treat any trade waste to ensure minimal environmental impact.
- Be accessible and serviceable - easy to maintain with minimal impact on school use when maintenance is being performed.
- Use products with a long-life span – many hydraulic services are concealed so durability is essential.

4.5.4 Water Conservation Awareness

The importance of reducing potable water consumption should be recognized throughout the school precinct and building to engage staff and students in the strategies for water conservation. This can be done by educating users through communication of a water conservation strategy.

Water Conservation Signs located in kitchens and toilet amenities are a good approach for raising awareness for the occupants. Students can also be reminded of water conservation strategies periodically during teaching sessions.

The development of the water conservation strategy for staff and students should include messaging consistent with the following general principles:

- Reduce: avoid water use when possible and when it can't be done try to use as little as possible.
- Report Leaks: Identification and repairing of leaks are critical for water savings.
- Re-use: when possible and safe, try to re-use potable water before discharge

5. Summary

Ecologically Sustainable Design is a driving consideration in the development of the proposed Pymble Ladies College Grey House Precinct new development located at 20 Avon Road, Pymble, New South Wales. As described, the project will incorporate ESD initiatives in both design and operation, aimed at ensuring the principles of sustainable development are implemented in accordance with the project drivers.

The ESD initiatives cover a range of categories including:

- **Energy & Carbon**– including on-site renewable energy and improved energy efficiency across the building
- **Water Management** – including water reuse, reduced potable water demand and improved stormwater quality.
- **Health & Wellbeing** – improving indoor air quality, maximising daylight, and providing comfortable amenities through improved indoor environmental quality features to enhance wellbeing among students and staff.
- **Materials**– Careful material selection to reduce embodied energy and focus on natural products with biophilic qualities.
- **Future Resilience** – 100% electric building services design, no fossil fuels burnt on-site within the building.

These ESD initiatives together with the benchmarking against Green Star, NARClim design response statement and the Integrated Water Management Plan were developed in response to the Secretary's Environmental Assessment Requirements (SEARs). The development's commitment to reducing its overall environmental impact is a holistic approach in relation to long-term sustainability.

6. References

[1] NCC Section J 2019 Amendment 1, ABCB, 2019

[2] Green Star Design & As Built Guidelines v1.3, Green Building Council of Australia, September 2019

Appendix A – Preliminary benchmarking comparison against Green Star

Green Star - Design & As Built v1.3 Benchmarking

Project:	PLC GreyHouse	**Round:**	
Targeted Rating:	5 Star - Australian Excellence		

Core Points Available	Total Score Targeted
100	62

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA		POINTS AVAILABLE	POINTS TARGETED	COMMENT
Management					14		
Green Star Accredited Professional	To recognise the appointment and active involvement of a Green Star Accredited Professional in order to ensure that the rating tool is applied effectively and as intended.	1.1	Accredited Professional		1	1	GSAP to be engaged from schematic design through to construction completion.
Commissioning and Tuning	To encourage and recognise commissioning, handover and tuning initiatives that ensure all building services operate to their full potential.	2.0	Environmental Performance Targets		-	Complies	Project Design Intent Report to be developed with energy and potable water targets.
		2.1	Services and Maintainability Review		1	1	Services and Maintainability Review to be carried out prior to construction commencement. Include reviewing services items for commissionability, controllability, maintainability, operability and safety as per GS criteria.
		2.2	Building Commissioning		1	0	Requires air permeability performance testing. Not feasible for this project.
		2.3	Building Systems Tuning		1	1	PLC to commit to tuning for 12 months after occupation with quarterly ajustments. Building tuning team will include contractor and facilities management
		2.4	Independent Commissioning Agent		1	0	Credit not targeted.
Adaptation and Resilience	To encourage and recognise projects that are resilient to the impacts of a changing climate and natural disasters.	3.1	Implementation of a Climate Adaptation Plan		2	2	Requires preparation and implementation of a Climate Adaptation Plan
Building Information	To recognise the development and provision of building information that facilitates understanding of a building's systems, operation and maintenance requirements, and environmental targets to enable the optimised performance.	4.1	Building Information		1	1	Building Log Book, Building Users Guide and O&M manuals to be developed in line with Green Star requirements. Building information to be provided in digital format such as training matieral, phone application, website etc.
Commitment to Performance	To recognise practices that encourage building owners, building occupants and facilities management teams to set targets and monitor environmental performance in a collaborative way.	5.1	Environmental Building Performance		1	1	PLC to commit to setting and monitoring environmental building performance targets (commonly, energy and potable water consumption).
		5.2	End of Life Waste Performance	A. Contractual Agreements	1	1	PLC to commit to extending the life of interior fitout for at least 10 years, barring minor wear and tear or minor repairs. This can be achieved through careful selection of finishes, furniture etc.
Metering and Monitoring	To recognise the implementation of effective energy and water metering and monitoring systems.	6.0	Metering		-	Does not comply	Metering to be provided to all major uses of electricty and water (uses greater than 5% or 100kW). All meters are to be commissioned to NABERS protocols.
		6.1	Monitoring Systems		1	0	Automatic system to monitor all meters and produce alarms where energy and water use increases beyond certain parameters and produce alerts if inaccuracies in meter network are found.
Responsible Construction Practices	To reward projects that use best practice formal environmental management procedures during construction.	7.0	Environmental Management Plan		-	Complies	Project specific EMP to be developed in line with Green Star requirements.
		7.1	Environmental Management System		1	1	Head Contractor to be ISO14001 Certified throughout construction process.
		7.2	High Quality Staff Support		1	1	Head Contractor to promote mental and physical health information for all site workers as well as knowledge of sustainable health practices.
Operational Waste	A. Performance Pathway	8A	Performance Pathway: Specialist Plan		1	1	Operational Waste Management Plan to be developed for project including diversion from landfill targets, waste streams, storage areas and monitoring procedures.
Total					**14**	**11**	

Indoor Environment Quality					17		
☐	To recognise projects that provide high air quality to occupants.	9.1	Ventilation System Attributes		1	1	Requires access to both sides of coils (or equivalent), filters and bagging of all ductwork during construction.
☐ **Indoor Air Quality**		9.2	Provision of Outdoor Air	☐A. Comparison to Industry Standards ☐B. Performance Based Approach ☐C. Natural Ventilation	2	0	Requires increase in outdoor air by 50% compared to AS1668.2. Not targeted.
☐		9.3	Exhaust or Elimination of Pollutants	☑A. Removing the Source of Pollutants ☑B. Exhausting the Pollutants Directly to	1	1	Kitchens to be ventilated in accordance with AS1668.2. Printers/photocopiers to comply with Green Star emissions criteria or be located in an enclosed print room that is exhausted directly to the outside.
☐	To reward projects that provide appropriate and comfortable acoustic conditions for occupants.	10.1	Internal Noise Levels		1	1	Internal noise levels to be no more than 5dB(A) above the lower figure in Table 1 of AS/NZS2107:2016.TBC with acoustic consultant.
☐ **coustic Comfort**		10.2	Reverberation		1	1	Reverberation times below the maximum in Table 1 of AS/NZS2107:2016.TBC with acoustic consultant.
☐		10.3	Acoustic Separation	A. Sound Reduction	1	0	Noise transmission between enclosed spaces to be minimised. Enclosed spaces include classrooms, meeting rooms, offices. Typically difficult to achieve in School context.
☐ **Lighting Comfort**	To encourage and recognise well-lit spaces that provide a high degree of comfort to users.	11.0	Minimum Lighting Comfort		-	Complies	All luminaires to have minimum CRI of 80 and 12 bit resolution for drivers.
		11.1 General Illuminance and Glare Reduction	11.1.1 General Illuminance	☑A. Non Residential Spaces ☐B. Residential Spaces	1	1	Lighting levels to comply with best practice guidelines in AS/NZS 1680. Isolux calculations required to demonstrate this.
			11.1.2 Glare Reduction	☑A. Prescriptive Method 1 ☐B. Prescriptive Method 2 ☐C. Performance Method			Glare from electric lighting to be minimised by providing diffusers to all luminiares or UGR calculations.
☐		11.2	Surface Illuminance	☐A. Prescriptive Method ☐B. Performance Method ☐C. Residential Spaces (Prescriptive Met	1	0	Not targeted, typically requires indirect lighting system and light coloured walls & ceilings.
☐		11.3	Localised Lighting Control		1	0	Not targeted, requires individual control of luminiares and dimming.
☐ **sual Comfort**	To recognise the delivery of well-lit spaces that provide high levels of visual comfort to building occupants.	12.0	Glare Reduction	☑A. Fixed Shading Devices ☐B. Blinds or Screens ☐C. Daylight Glare Model	-	Complies	Glare from daylight minimised through fixed shading devices, blinds.
		12.1	Daylight	☐A. Prescriptive Methodology ☑B. Compliance Using Daylight Factor ☐C. Compliance Using Daylight Autonom	2	1	Requires good level of natural daylight to relevant areas
☐		12.2	Views		1	1	Minimum 60% of relevant areas to have clear line of sight to high quality internal or external view
☐ **Indoor Pollutants**	To recognise projects that safeguard occupant health through the reduction in internal air pollutant levels.	13.1 Paints, Adhesives, Sealants and Carpets	13.1.1 Paints, Adhesives and Sealants	☑A. Product Certification ☐B. Laboratory Testing ☐C. No Paints, Adhesives or Sealants	1	1	Internally applied paints, adhesives and sealants to meet Green Star VOC limits.
			13.1.2 Carpets	☑A. Product Certification ☐B. Laboratory Testing ☐C. No Carpets			Carpets to comply with Green Star emissions limits. This can be demonstrated with GECA/GreenTag/ECS certification.
☐		13.2	Engineered Wood Products	☑A. Product Certification ☐B. Laboratory Testing	1	1	Engineered wood products to meet Green Star formaldehyde limits. This can be demonstrated with product certification from GECA/GreenTag.
☐ **Thermal Comfort**	To encourage and recognise projects that achieve high levels of thermal comfort.	14.1	Thermal Comfort	☐A. Naturally Ventilated Spaces ☑B. Mechanically Ventilated Spaces ☐C. Residential Spaces	1	1	Indoor thermal comfort to meet -1<PMV<+1
☐		14.2	Advanced Thermal Comfort	☐A. Naturally Ventilated Spaces ☐B. Mechanically Ventilated Spaces ☐C. Residential Spaces	1	1	Requires demonstraion of -0.5 < PMV < +0.5
Total					**17**	**11**	

Energy						
Greenhouse Gas Emissions	E. Reference Building Pathway	15E.0	Conditional Requirement: Reference Building Pathway		-	Complies
		15E.1	GHG Emissions Reduction: Building Fabric		4	0
		15E.2	GHG Emissions Reduction		16	5
		15E.3	Off-Site Renewables		8	
		15E.4	District Services		7	
		15E.5 Additional Prescriptive Measures	15E.5.1 Transition Plan		1	
			15E.5.2 Fuel Switching		2	2
			15E.5.3 On-Site Storage		1	
Peak Electricity Demand Reduction	B. Performance Pathway	16B	Modelled Performance Pathway: Reference Building		2	1
Total					**22**	**8**

GHG emissions of proposed building to be less than 10% improvement on NCC 2019 reference building.
Requires imrpovement upon a reference building with NCC 2019 deemed-to-satisfy building fabric.
Estimated improvement compared to NCC 2019 deemed-to-satisfy services. Estimate includes provision of solar PV, efficient lighting and services
Requires procurement of off-site rebewable electricity
Only awarded for projects with district wide services
Requires plan to reduce fossil fuel use and develop a transition plan to phase them out
All electric building, no on site combustion
Requires battery storage to be installed.
Target to reduce peak electricity demand of building by 20% compared to reference building.

Transport						
Sustainable Transport	A. Performance Pathway	17A	Performance Pathway		10	4
Total					**10**	**4**

Green Star Performance pathway 4 points estimated pending provision of Green Travel Plan. Potential site wide transport plan can achieve a better outcome.

Water						
Potable Water	A. Performance Pathway	18A	Potable Water - Performance Pathway		12	5
Total					**12**	**5**

Estimate based on 20KL rainwater tank serving toilet flushing and irrigation, efficient fixtures & fittings.

Materials						
Life Cycle Impacts	B. Prescriptive Pathway - Life Cycle Impacts	19B.1 Concrete	19B.1.1 Portland Cement Reduction		2	1
			19B.1.2 Water Reduction		0.5	0.5
			19B.1.3 Aggregates Reduction	B. Fine Aggregate Reduction	0.5	0.5
		19B.2 Steel	A. Reduced Mass of Steel Framing	A. High Strength Steel	1	
		19B.3	Building Reuse	19B.3.1 Façade Reuse	2	
				19B.3.2 Structure Reuse	2	
		19B.4	Structural Timber	19B.4.0 Responsible Sourcing	-	Does not comply
				19B.4.1 Reduced Embodied Impacts	3	0
Responsible Building Materials	To reward projects that include materials that are responsibly sourced or have a sustainable supply chain.	20.1	Structural and Reinforcing Steel	20.1.0 Responsible Steel Maker	-	Complies
				B. Energy-Reducing Processes in Steel Reinforcement Production	1	1
		20.2	Timber	☑ A. Certified Timber	1	1
				☐ B. Reused Timber		
		20.3	Permanent Formwork, Pipes, Flooring, Blinds and Cables	B. Best Practice Guidelines for PVC	1	1
Sustainable Products	To encourage sustainability and transparency in product specification.	21.1	Product Transparency and Sustainability	☐ A. Reused Products ☐ B. Recycled Content Products ☑ C. Environmental Product Declarations ☑ D. Third Party Certification ☐ E. Stewardship Programs	3	2
Construction and Demolition Waste	B. Percentage Benchmark	22.0	Reporting Accuracy	A. Compliance Verification Summary	-	Complies
		22B	Percentage Benchmark		1	1
Total					**12**	**8**

30% Portland Cement reduction for concrete required
Min 50% Reclaimed Water for Concrete
Min 25% fine aggregate as manufactured sand or alternative
Structural Timber to be FSC/PEFC certified
Structural timber to be used for at least 30% GFA - CLT structure removed, credit no longer targeted
Steel is to be sourced from a member of the World Steel Association's Climate Action Programme
At least 60% by mass of all reinforing bar and mesh is produced using energy-reducing processes
Requires timber products to be FSC/PEFC certified or reuse
90% by cost of all permanent formwork, pipes, flooring, blinds and cables have best practice PVC certification, or do not contain PVC.
6% of the project's total material cost is to have third party certifications such as GECA, GreenTag, EPDs. This can include steel with EPDs, plasterboard and flooring with certification.
Waste contractors and processing facilities to hold Green Star Compliance Verification Summaries.
Min. 90% of waste generated during demolition and construction to be diverted from landfill.

Land Use & Ecology						
Ecological Value	To reward projects that improve the ecological value of their site.	23.0	Endangered, Threatened or Vulnerable S	A. EPBC	-	Complies
		23.1	Ecological Value		3	0
Sustainable Sites	To reward projects that choose to develop sites that have limited ecological value, re-use previously developed land and remediate contaminate land.	24.0	Conditional Requirement		-	Complies
		24.1	Reuse of Land	A. Previously Developed Land	1	1
		24.2	Contamination and Hazardous Materials	☐ A. Site Contamination ☑ B. Hazardous Materials	1	1
Heat Island Effect	To encourage and recognise projects that reduce the contribution of the project site to the heat island effect.	25.1	Heat Island Effect Reduction		1	0
Total					**6**	**2**

Project does not contain 'critically endangered, endangered or vulnerable species or ecological communities'.
Likely not achievable, needs significant ecological improvement of site through landscaping etc.
Site is not an old growth forest, prime agricultural land, wetland of high national significance or impacts on matters of national significance.
Min. 75% of the site was previously developed land.
Hazmat survey to be carried out and hazardous materials to be removed in accordance with best practice guidelines.
Requires min 75% of the site to have low SRI roof, landscaping or light coloured hardscaping elements. Not targeted for now

Emissions							
					5		
Stormwater	To reward projects that minimise peak stormwater flows and reduce pollutants entering public sewer infrastructure.	26.1	Stormwater Peak Discharge		1	1	Post-development stromwater discharge must be less than pre-development discharge
		26.2	Stormwater Pollution Targets		1	1	Column B Stormwater pollution reduction targets to be targeted
Light Pollution	To reward projects that minimise light pollution.	27.0	Light Pollution to Neighbouring Bodies		-	Complies	External lighting to comply with AS4282:1997 Control of the obtrusive effects of outdoor lighting.
		27.1	Light Pollution to Night Sky	A. Control of Upward Light Output Ratio (ULOR)	1	1	External luminiares to have a ULOR of less than 5%
Microbial Control	To recognise projects that implement systems to minimise the impacts associated with harmful microbes in building systems.	28	Legionella Impacts from Cooling Systems	B. Waterless Heat Rejection Systems	1	1	Air-cooled HVAC system
Refrigerant Impacts	To encourage operational practices that minimise the environmental impacts of refrigeration equipment.	29.1	Refrigerants Impacts	A. Calculating TSDEI	1		Not targeted. Requires use of low ODP and low GWP refrigerants
Total					**5**	**4**	

Innovation						
				10		
Innovative Technology or Process	The project meets the aims of an existing credit using a technology or process that is considered innovative in Australia or the	30A	Innovative Technology or Process		1	Renewable Energy Contribution of 15% (1 point)
Market Transformation	The project has undertaken a sustainability initiative that substantially contributes to the broader market transformation towards	30B	Market Transformation			
Improving on Green Star Benchmarks	The project has achieved full points in a Green Star credit and demonstrates a substantial improvement on the benchmark	30C	Improving on Green Star Benchmarks		2	Ultra low VOC paints (1 point) Stormwater Run off Pollution Reduction Column B (1 point)
Innovation Challenge	Where the project addresses an sustainability issue not included within any of the Credits in the existing Green Star rating tools.	30D	Innovation Challenge		3	Financial Transparency (1 point) High Performance Site Office (1 point) Building as Education Tool (1 point)
Global Sustainability	Project teams may adopt an approved credit from a Global Green Building Rating tool that addresses a sustainability issue that is currently outside the scope of this Green Star rating tools.	30E	Global Sustainability		3	Green Cleaning Policy (1 point) Quality of Amenities from Green Star Interiors v1.2 (1 point) Local Procurement (1 point)
Total				**10**	**9**	

TOTALS	AVAILABLE	TARGETED
CORE POINTS	100	53.0
CATEGORY PERCENTAGE SCORE		53.0
INNOVATION POINTS	10	9.0
TOTAL SCORE TARGETED		62.0

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community in mind

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