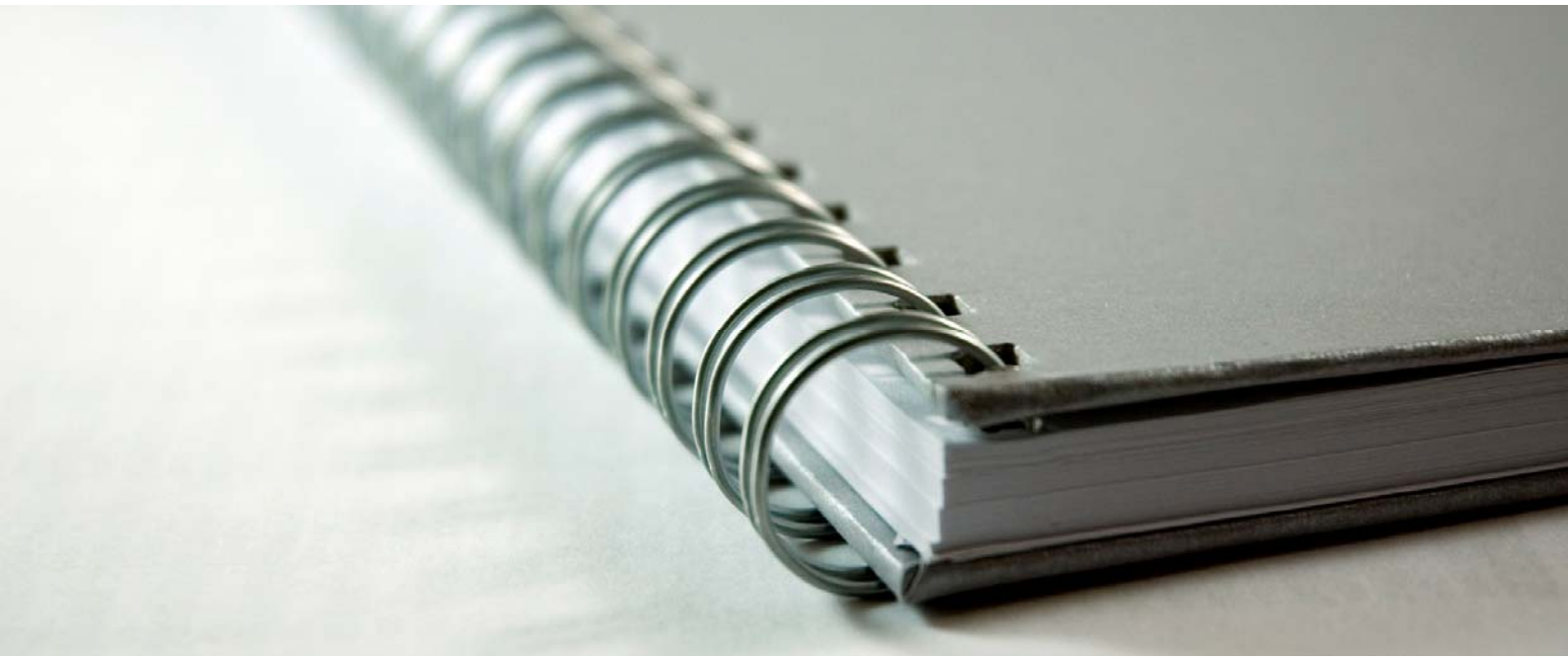


Schools Infrastructure NSW

Marsden Park New Primary School

ESD Report

July 2019

Acronyms

Acronym	
EIS	Environmental Impact Statement
ESD	Ecologically Sustainable Development
SEARs	Secretary's Environmental Assessment Requirements
SINSW	Schools Infrastructure NSW
SSD	State Significant Development

Table of contents

Table index

Figure index

Appendices

1. Introduction

This ESD (Ecologically Sustainable Development) Report has been prepared by GHD on behalf Schools Infrastructure NSW (SINSW) (the Applicant). It accompanies an Environmental Impact Statement (EIS) in support of State Significant Development Application (SSD-9809) for the Marsden Park New Primary School at the corner of Northbourne Drive (to the east) and a proposed future road (to the north) within the Elara Estate, Marsden Park (the site). The site is legally described as Lot 2889 in Deposited Plan 1230906. The development footprint does not include a portion of the site to the west as this is reserved for a future alternative use.

The Marsden Park New Primary School will cater for 1,000 primary school students at completion. The proposal seeks consent for:

- Construction Stage 1 (Temporary School): a temporary school facility constructed within the western portion of the development site located on the future sports grounds. This temporary school facility is to accommodate a maximum of 500 students at any given time. Should the permanent school progress as per the program, the temporary school will not be required.
- Construction Stage 2 (Construction of Permanent School Facility): a permanent consolidated two storey courtyard building with capacity to accommodate a maximum of 1,000 students. This new school building is to comprise
    - 40 teaching spaces;
    - A canteen;
    - Library;
    - Multipurpose hall;
    - Office and administration space;
    - Staff and student amenities; and
    - Out of school hours care accommodation.
- Multi-purpose sporting facilities and outdoor play spaces;
- Associated site landscaping and public domain improvements;
- An on-site car park for 48 parking spaces including 1 accessible car parking space and a drop-off and pick-up area; and
- Construction of ancillary infrastructure and utilities as required.

The purpose of this ESD Report is to outline the project's environmental design response in accordance to the Planning Secretary's Environmental Assessment Requirements (SEARs).

Response to SEARs

The ESD Report is required by the Secretary's Environmental Assessment Requirements (SEARs) for SSD-9809. This table (Table 1) identifies the SEARs and relevant reference within this report.

Table 1 SEARs 9809 Ecologically Sustainable Development (ESD) Items

SEARs 9809 Item	Action to Address Requirement	Addressed in section of ESD Report
Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Regulation) will be incorporated in the design and ongoing operation phases of the development.	Prepare an ESD report outlining ESD principles (as defined by EPAR 2000) applied to the project design.	Section 2.1 & Section 5
Include a framework for how the future development will 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.	Prepare an ESD report that incorporates national best practice sustainable building principles.	Section 5
Include preliminary consideration of building performance and mitigation of climate change, including consideration of Green Star Performance.	Assessment of preliminary building performance and comparison to Green Star Design & 'As Built' performance	Section 255.3 & Appendix A
Detail how sustainable design measures, such as green and/or a cool roof, will be incorporated into the development to maximise long-term ecologically sustainable outcomes.	Incorporate onsite renewable energy e.g. rooftop solar photovoltaic (PV) system.	Section 5
Detail sustainability targets and integration of these in the design approach	Address how sustainability targets will be met in the design	Section 2.5 & 5
Demonstrate how environmental design will be achieved in accordance with the Environmental Design in Schools Manual	Design of new development based on Environmental Design in Schools Manual	Section 2.3
Provide a statement regarding how the design of the future development is responsive to the CSIRO projected impacts of climate change, specifically: • hotter days and more frequent heatwave events • extended drought periods • more extreme rainfall events • gustier wind conditions How these will inform landscape design, material selection and social equity aspects (respite/shelter areas).	Response to NARCliM predictions for climate change	Section 6

1.1 Purpose of this Report

This Ecologically Sustainable Development (ESD) Report for the proposed Marsden Park New Primary School has been prepared by GHD for the Department of Education (DoE) to outline the project's environmental design response in accordance to the Planning Secretary's Environmental Assessment Requirements (SEARs).

1.2 Scope and limitations

This report: has been prepared by GHD for Schools Infrastructure NSW and *may only be used and relied on by Schools Infrastructure NSW for the purpose agreed between GHD and the Schools Infrastructure NSW as set out in section 1.2 of this report.*

GHD otherwise disclaims responsibility to any person other than Schools Infrastructure NSW arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Schools Infrastructure and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Statutory Regulations

ESD is governed by certain statutory regulations and guidelines, as well as GHD's standing best practice ESD principles and methodology. This includes the BCA NCC codes of practice, Education Facilities Standards and Guidelines and the Government Resource Efficiency policy Requirements.

As a State Significant Development (SSD) the ESD requirements has been addressed in accordance with the Department of Education Secretary's Environmental Assessment Requirements (SEARs), Item 9, Ecologically Sustainable Development (ESD). For the definition of ESD SEARS refers to Environmental Planning Assessment Regulation (EPAR, 2000). As a guide to how this should best be implemented, this assessment refers to EFSG (Education Facilities Standards and Guidelines) DG02 Ecologically Sustainable Development.

2.1 Environmental Planning Assessment Regulation (EPAR,2000)

Section 7.4 of Schedule 2 (Environmental Impact Statements) of the Environmental Planning and Assessment Regulation (EPAR, 2000) defines the principles of **ecologically sustainable development** as the following:

1) the precautionary principle, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

    a) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and

    b) an assessment of the risk-weighted consequences of various options,

2) inter-generational equity, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,

3) conservation of biological diversity and ecological integrity, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,

4) improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:

    a) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,

    b) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,

    c) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

2.2 Education Facilities Standards and Guidelines (ESFG) DG02

The EFSG are standards and guidelines established by the NSW Department of Education, intended to assist those responsible for the management, planning, design, construction and maintenance of new and refurbished school facilities. This ESD study has used EFSG to guide our approach to ESD on points not specifically outlined by SEARS.

EFSG 02.01 Ecologically Sustainable Development (ESD) is defined in Australia as:

Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.

ESD principles are to be applied in the design, development and operation of all state assets, and are an important contribution to developing a considered whole of life cost development approach.

EFSG 02.02 NSW Government Resource Efficiency Policy (GREP)

NSW Government Resource Efficiency Policy (GREP) to reduce Government's operating costs and lead by example in increasing resource productivity, in three main areas; energy, water and waste and reduce harmful emissions from government operations. Refer to the NSW Whole of Government Sustainability Principles (2006). Sustainability in the NSW public sector means addressing the needs of current and future generations through the integration of social justice, economic prosperity and environmental protection in ways that are transparent, accountable and fiscally responsible.

EFSG 02.03 Energy Conservation

In accordance with the NSW Resource Efficiency Policy all new facilities must be designed and built so that energy consumption is predicted to be at least 10% lower than if build to minimum compliance with National Construction Code requirements

EFSG 02.04 Water Conservation

In accordance with the NSW Government Resource Efficiency Policy, all new water-using appliances, shower heads, taps and toilets purchased by agencies must be at least the average WELS star rating by product type. Where WELS rating is not available, use the alternative WaterMark rating scheme.

Rainwater tanks can be incorporated where there is a locally identified end use such as irrigation or toilet flushing.

Stormwater management should aim to minimise the transportation of toxicants to waterways and other offsite environments, and maintain the existing hydrological regimes.

EFSG 02.05 Sustainable materials

The use of the following materials in the construction of school buildings are encouraged:

- Adequately and economically perform their intended functions, and also have lower adverse environmental impacts throughout their life cycle
- Contain reduced or no hazardous substances (e.g. low VOC) to ensure effective indoor environmental quality
- Reduce the demand for rare or non-renewable resources
- Have low embodied energy and water

- Are made from or contain recycled materials or can be recycled at the end of their useful life

EFSG 02.06 Ecological Conservation

School's sites must conserve for future generations, the biological diversity of genetic materials, species and ecosystems on that site. The design of the facilities also provide unique and valuable environmental conservation learning opportunities and effective environmental modelling to the wider community.

Schools can model best practice design, material use, systems and operational methodology, demonstrating human's connections to nature and the operation of natural cycles of sun, wind, rain and the four seasons.

The site's open space should allow for exploration, bio diversity and earth education to enhance the site's outdoor learning potential.

EFSG 02.07 Waste management

- Eliminate unnecessary waste by better planning and more efficient use of natural and manufactured resources. This could incorporate opportunities including:
- The re-use and recycling of materials in the construction and operation of the facilities.
- The use of building materials which are able to be disassembled for re-use, in conjunction with considerations for the addition and removal of accommodation over time.

EFSG 02.08 Climate Change Adaption

Consideration to be given to how sites and school communities will be able to adaptively respond to climate change over time, especially for projects involving vulnerable communities e.g. climate generating exacerbated flood, storm surge, inundation, heatwaves, bush fires, extreme storm and weather events

EFSG 02.09 Sustainable benchmarking

Ecologically Sustainable Development principles must be included in any new school buildings to a level that the building could be benchmarked to achieve a 4 Star Green Star rating, which is considered to be best practice within the Australian building industry.

2.3 NSW Design Guide for Schools

The following are ESD requirements under "Sustainable, efficient and durable" design considerations for a new school development as specified in the second issue of the NSW Design Guide for Schools.

1. Be responsive to local climate including sun, wind and aspect
2. Select materials and approaches to detailing that are robust and durable
3. Integrate landscape, planting and Water Sensitive Urban Design (WSUD) principles to enhance amenity and building performance
4. Include deep soil zones for ground water recharge and planting
5. Minimise reliance on mechanical systems
6. Include initiatives to reduce waste, embodied energy and emissions, through passive design principles and the use of advanced energy production systems where possible
7. Maximise opportunities for safe walking, cycling and public transport access to and from the school

The NSW Design Guide for Schools Manual requirements have been addressed for the environmental design of the Marsden Park New primary school in Section 5 ‘Sustainability Targets’.

2.4 Environmental Design in Schools

The following are environmental design strategies that can be implemented in schools to provide a holistic understanding of environmental design as per the NSW Environmental Design in Schools Manual.

1. Use of passive heating and cooling
   i) Utilise high performance glass and various shading devices to block out unwanted sun and heat.
   ii) Utilise fans to create air movement
   iii) Efficient use of air conditioning
2. Re-design learning experiences
   i) Create noisy and quiet zones with the use of soft furnishings and passive acoustic strategies
   ii) Incorporate biophilic design by designing spaces with natural light, materials, vegetation and nature views
   iii) Expose building services via colour coding to encourage awareness
   iv) Encourage outdoor classes for engagement with nature
3. Communication of careful use of resources
   i) Encourage staff and students to be mindful of the resources used and reduce consumption accordingly
   ii) Displaying data for energy/water consumption and waste generation for easier monitoring

2.5 Environmental Performance Targets

In order to achieve ESD outcomes for the project in line with SEARS and EFSG requirements and guidelines, environmental performance targets were established during concept design phase.

A complete sustainable building strategy includes a multitude of tactics including, but not limited to, energy efficiency, air quality, and water use reduction. The aim of the design is to develop a building and landscape where the culture of environmental awareness and minimising our ecological impact is manifested in the building design and in how user groups utilise the building. In this way, the building is an educational tool for learning about sustainability.

The design of the school aims to be intrinsically sustainable by:

- Maintaining and restoring local landscape and creating habitat
- Optimising built forms for natural ventilation and cooling
- Minimising building depths
- Optimising for natural daylighting
- North-South orientation, and minimising exposure to the West

- Reducing building footprint by having a two storey building
- Treating run-off on site and capture run-off and rainfall for re-use on site

2.5.1 Sustainable Design Strategies

Sustainable design strategies that shall be incorporated in the Schematic Design include:

Site Sustainability

- Use of native plants, and revegetation of site
- Integrated storm water management best practices, including a rain garden and retention systems for dealing with stormwater runoff.
- Above or below ground rain water tank storage
- Kitchen, Food and Science garden areas

Water Efficiency

- Low flow fixtures
- Rainwater capture and recycling

Materials & Resources

- Use of material containing recycled content wherever possible
- Use of material from sustainable manufacturers wherever possible
- Use of materials with low VOC emissions

Indoor Environment Quality

- Use of shading devices on west façades to minimize glare and solar gain
- Use of skylights to increase daylight in spaces.

Energy & Atmosphere

- Employment of photo-voltaic panels
- Provide immediate feedback on energy use to facilitate student monitoring and learning.
- Employment of solar thermal panels for hot water.

3. Green Star Benchmarking

Green Star is an internationally recognised rating system that delivers independent verification of sustainable outcomes throughout the life cycles of the built environment. **'Green Star – Design & 'As Built'** certification identifies projects that have demonstrated the achievement of a specific level of sustainability. The rating describes to the industry the sustainability attributes of the project in terms that are widely understood and accepted.

Green Star – Design & As Built v1.2 assesses the sustainability attributes of a building through nine categories:

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

The design of Marsden Park new primary school will be benchmarked against a 4 star Green Star rated building. The preliminary scorecard including responsibility of point and method of achievement can be found in Appendix A.

4. Overview of Site

Marsden Park is evolving as a new urban environment, supporting the growth of wider Sydney. The New Marsden Park School site is a greenfield site in an emerging neighbourhood that was once rural but now consists of 1-2 storey modern townhouses and houses. The addition of the school will provide a great asset and education facility for this new community.

The topography of the site is relatively flat with a slight undulation, with a high point near Northbourne Ave, and the land slopes to the west. The landscape character of the site is semi-rural, with neighbouring patches of remnant vegetation and is sparse. The general area has been completely cleared ready for development.

4.1 Climate

The Marsden Park New Primary School site is located within Climate Zone 6, Sydney West. This climate zone is characterised as mild temperate, which has low diurnal temperature range near the coast to high diurnal range inland, and has four distinct seasons. Summer and winter can exceed human comfort ranges, while spring and autumn are ideal for human comfort. Figure 1 shows the maximum and minimum average monthly temperatures based on data collected from the Bureau of Meteorology. Zone also has variable humidity, with mild to cool winters with low humidity and hot to very hot summers with moderate humidity.

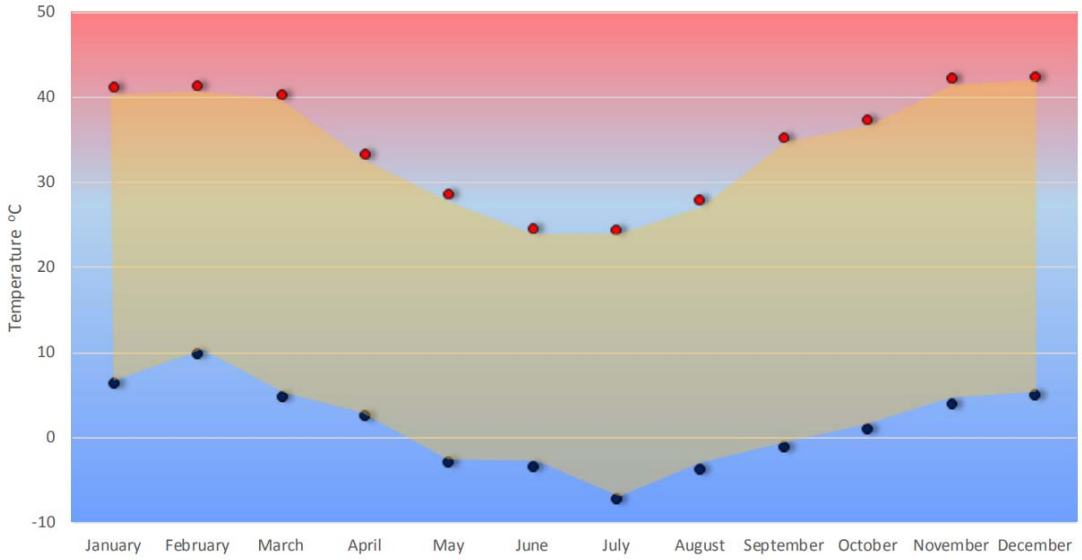


Figure 1 Temperature range expressing the highest and lowest recorded temperatures per month for Richmond, NSW (Source: BOM Climate Station 067021)

Marsden Park is susceptible to hot dry winds from the north-west in summer and cold winter winds from the west as seen by the Sydney wind rose (Figure 2). The site experiences cooling summer breezes from the southeast that swing around to north-westerly in the afternoon but can also be subject to severe hail and wind storms, carried by cold winter winds from the west and south (Figure 3).

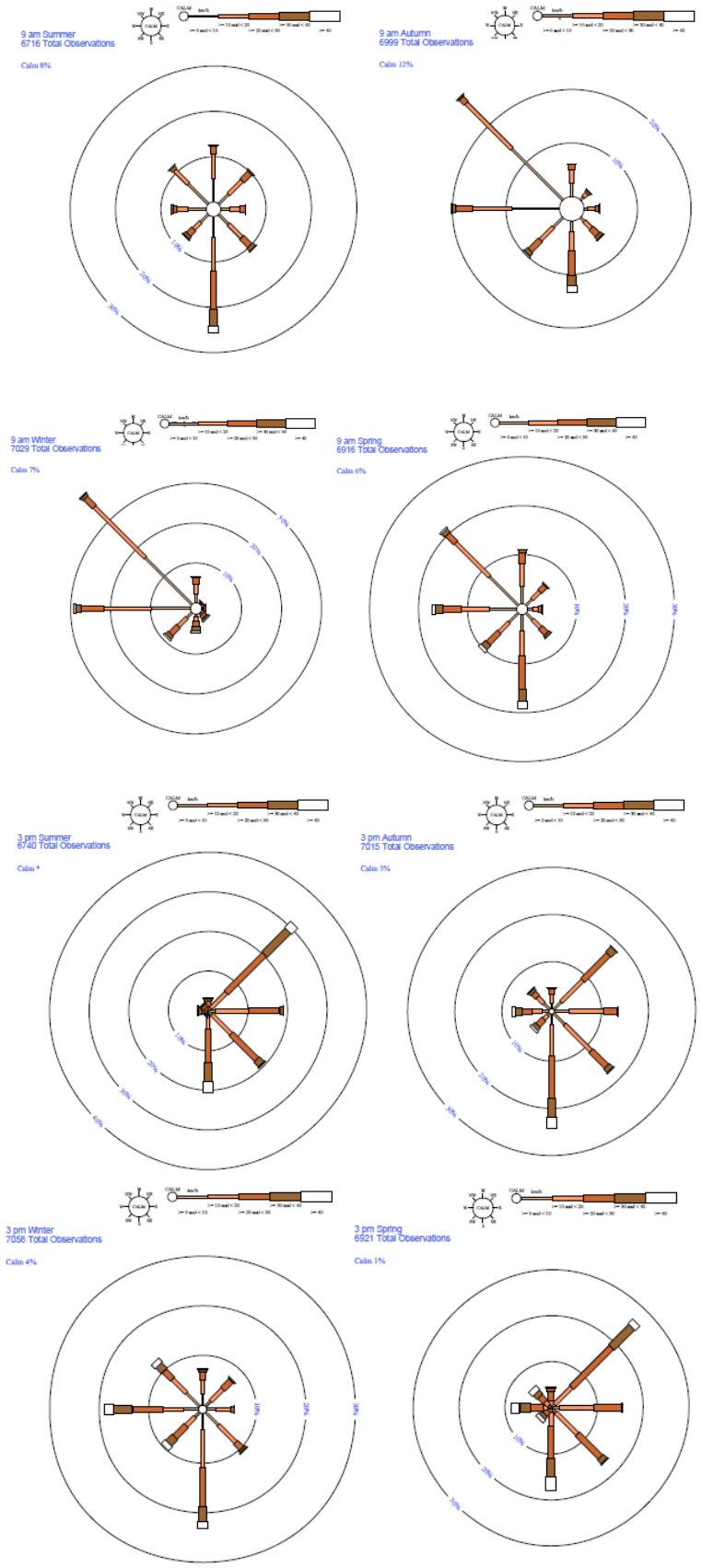


Figure 2 Wind rose for the Sydney region for 9 am and 3 pm by season (Source: BOM Climate)

As per the NSW NARCliM current data analysis, Sydney experiences large variations in temperature between the coast, Western Sydney and in the Blue Mountains. In summer, average temperatures in Western Sydney range from 22-24˚C whereas average temperatures in winter range from 12-14˚C.

The NARCliM predicted climate changes for Metropolitan Sydney Region are:

- Maximum temperature to increase by 0.7 ˚C in near future and 1.9 ˚C in far future
- Minimum temperature to increase by 0.6 ˚C in near future and 2.0 ˚C in far future
- More hot days(above 35 ˚C) and fewer cold nights (below 2 ˚C)
- Autumn rainfall will increase in both near and far future
- Spring rainfall will decrease in near future but not clear for far future.

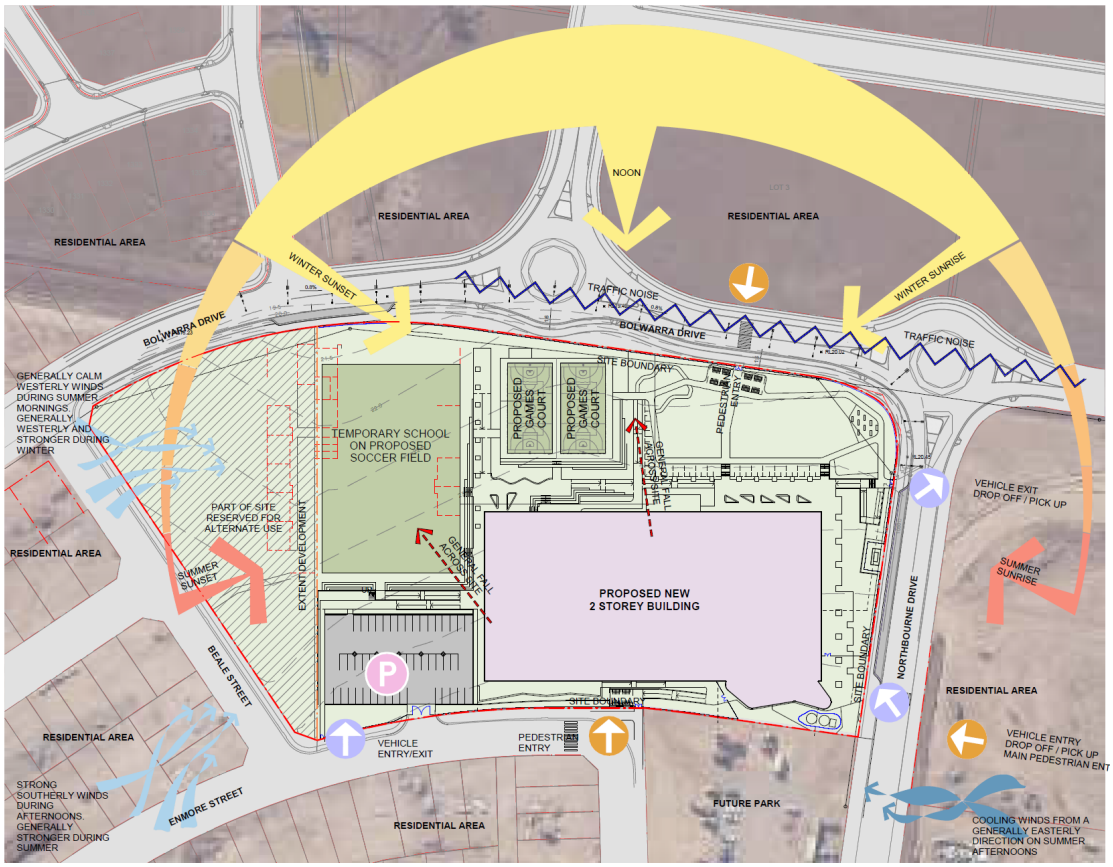


Figure 3 Site Analysis (Source: NBRS Architects)

5. Sustainability Targets

An ESD report is required to satisfy the Planning SEARS for the Concept Proposal for the new Marsden Park Public School (Application No. SSD 9809), that addresses the requirements outlined in this section.

The ESD report sustainability targets are prepared in line with the Design Quality Principles of State Environmental Planning Policy for Schools, the Environmental Design in Schools Manual, Green Star 'Design & As Built' guidelines and the NARCliM projected impacts of climate change for the Metropolitan Sydney Region.

5.1 Future Proofing

Future proofing of a building comes with incorporating sustainable building principles and practices early in the design phase so that the development is capable to withstand future environmental and energy changes. A building that is well equipped for future conditions will exude benefits to not only itself but to the wider community and habitat.

5.1.1 Materials

Materials used in the construction have been chosen in accordance to principles regarded from the NSW design guide for Schools, Green Star Design & As built guidelines and Educational Facilities Standards and Guidelines. The principles of material selection are:

- Low to no VOC emissions
- Low carbon emissions
- Recycled or manufactured from a sustainable source
- Are robust and durable to withstand weather conditions and deterioration over time
- Have low embodied energy, water and waste
- Have lower adverse environmental impacts throughout their life cycle

5.1.2 Energy Efficiency

Energy efficiency is a large contributor to future proofing a development and may involve a number of passive solar heating/cooling such as the consideration of a well-insulated building envelope, high performance glazing, orientation of building to take advantage of passive solar gains and minimise the need for artificial lighting during the day.

Marsden Park New Primary School will be targeting an energy consumption of at least 10% lower than the specified consumption requirements as per the NCC requirements (TBC if it will be with accordance to 2016 or 2019 NCC provisions). This will meet the EFSG standard as well as benchmarking against Green Star Design and As Built.

5.1.3 Technology and Renewable Energy generation

The installation of efficient lighting controls (motion, sound, time and daylight sensors) is a technological measure proposed to reduce energy consumption by switching off lighting when not in use. This measure will additionally reduce the number of times a light bulb will need to be changed as the lifespan of the bulb will be utilised only when required.

Real-time energy usage monitoring and communication is proposed to encourage students and staff to be mindful of the amount of resources consumed.

Renewable Energy Generation in the form of solar photovoltaic (PV) systems is proposed to reduce energy consumed from the electrical grid as well as offsetting the carbon emissions emitted from the development. A 90kW solar PV system has been proposed in the preliminary design stage.

5.2 Indoor Environment Quality

5.2.1 Passive Design Principles

Passive design principles are incorporated in the early stages of the project and are crucial to the design of year-round liveable spaces. Incorporation of passive design principles can significantly improve comfort, reduces energy consumption and greenhouse gas emissions from heating, cooling, lighting and mechanical ventilation. Thereby promoting a healthy learning and development environment as well as reducing ongoing cost of operations.

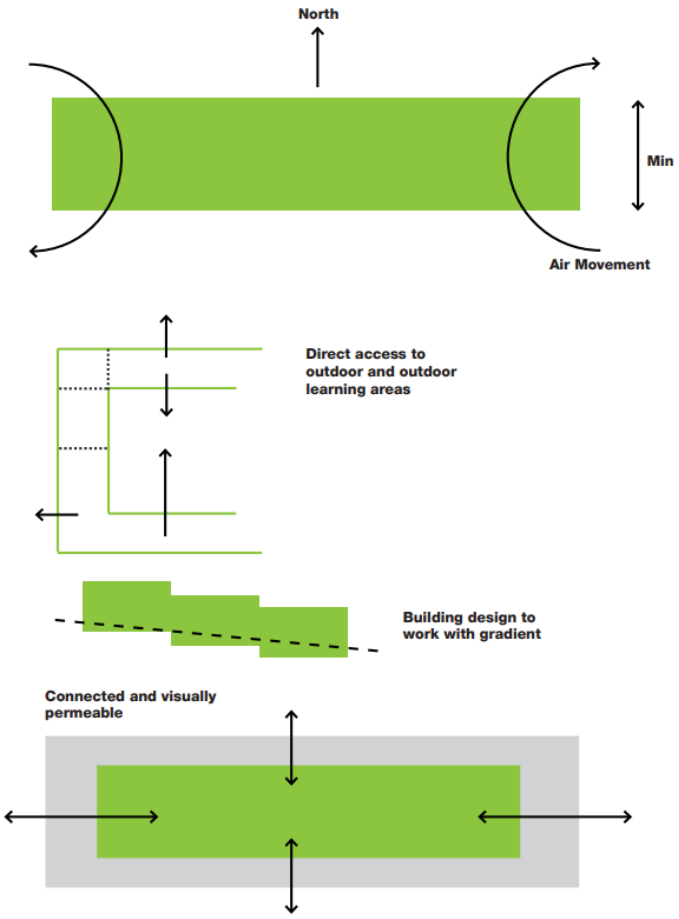


Figure 4 Passive Design Principles

The Courtyard

Building design for this project adopts a courtyard typology, In line with EFSG DG90.07; In warm climates, utilise courtyards as cooling zones. Consider the use of shade structures and water. The planning utilises a series of courtyard forms to consolidate the built forms into reasonably compact footprints, maximising the open space and playing fields as seen in Figure 4. The Courtyards are varied in height: higher components are located to the east to allow solar access into the courtyard.

The courtyard spaces themselves are proportioned to be attractive green landscaped spaces with signature trees. A landscaped “street" runs through and connects the block and link to the playing areas to the west. This street breaks the mass of the courtyards and allows views in and out of the cloister areas. An upper level bridge connect the blocks. The courtyard structures incorporates the core facilities such as hall, library and administration.

Formal landscaping is used in the spaces between the blocks. The open space areas of the school are well connected to the building form. The areas of native trees, shrubs, grasses, groundcovers and trees will occur throughout the school as a resource for learning (science and visual arts). Playing fields are wrapped around to the west and north to allow good solar access to the learning areas.

Advantages	Disadvantages
Provides protected spaces from winds	Some west facing areas may be required
Provides visual privacy	Difficult to provide deeper floor plans for Learning Centre type planning
Orthogonal spaces respond well to the site geometry	Design solutions required to reduce the impact of the buildings mass
Allows good cross ventilation air flow for single loaded learning areas	Increases in natural ventilation may impact thermal performance

Glazing and Shading

The quality of glazing and choice of shading devices can significantly affect the overall energy performance of the building. This is particularly important for buildings that encounter both very warm and very cold temperatures.

It is recommended to incorporate high quality glazing aiming for at least a 10% above the BCA minimum compliance requirements.

Shading structures such as horizontal overhang shading and fins can largely impact the heating and cooling needs of a building. In Sydney climate, where heating is required in winter, the shading devices should exclude summer sun but allow for winter sun to penetrate.

Marsden Park new primary school has incorporated a number of sun exclusion and glare control elements in line with EFSG 07.01, sun shades, eave extensions and vertical blades.

5.2.2 Daylight and Solar Access

Natural daylight improves the indoor environmental quality of spaces and encourages beneficial learning. Natural daylight is to be provided to all teaching spaces unless identified otherwise. It can be provided via windows, skylights and roof lights.

On exposed façades subject to direct sunlight, external window shading have been considered as part of the building design to ensure energy efficiency and thermal comfort. The predominant axis of the building is north – south. A large proportion of the buildings' surface area faces north and is subject to significant solar heat gain. Glazing that faces the sun is screened appropriately.

The condition along the western face of the building often creates a high level of solar heat gain. Sun screening has been designed to overcome this effect. Shading that limits solar gain on the western face of the building will respond to the low angle of the sun late in the day. The northern and south-eastern faces of the building has also be designed to reduce solar heat gain in the middle of the day by employing horizontal shading

In addition, daylight modelling were undertaken to inform the daylight performance in Marsden Park New Primary School. Some of the factors that influence the daylight performance are types and size of glazing, surface properties of materials in a space and shading devices. For example, whilst low-e glazing reduces the solar heat gain into a space, it typically has a low solar transmittance which restricts daylight access.

Daylight modelling was completed using the recognised Radiance simulation engine on Integrated Environmental Solutions Virtual Environment (IESVE). Some modelling parameters include:

- Working Plane (WP) height: 720mm
- Sky conditions: Standard CIE overcast sky at 12PM
- External Glazing Transmittance: 0.800

Description	Reflectance
External Wall (ext)	0.630
Internal Partition	0.903
Roof (ext)	0.802
Ground (int)	0.582
Floor/Ceiling (ceiling)	0.900

Note: The above reflectance values may not be representative of the design as no building finishes were nominated at the time when this model is completed.

To illuminate a space, light coloured internal surfaces are generally preferred as they have higher light reflectance. When daylight is transmitted through the window and reaches the internal surfaces, a proportion is reflected back to the indoor space and lit the working plane.

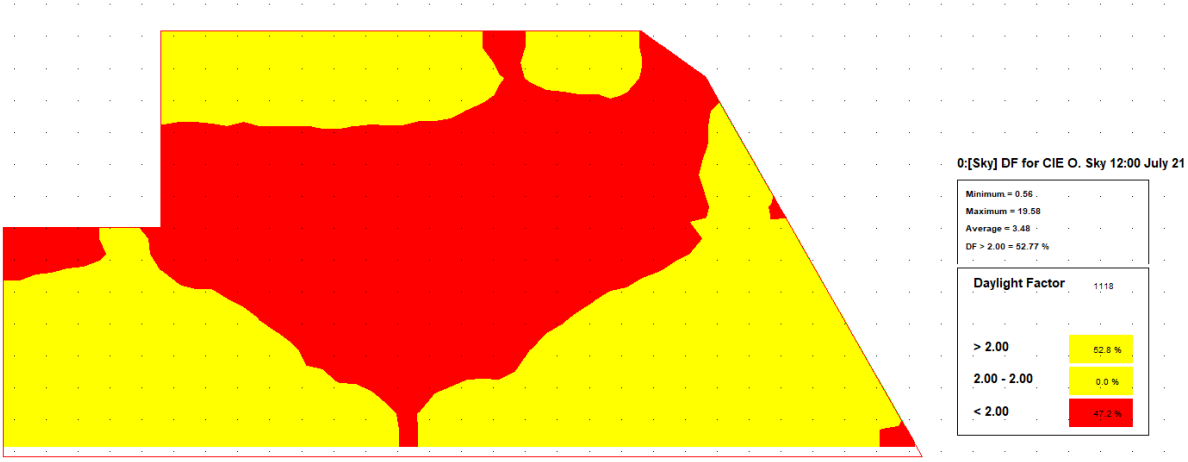


Figure 5 Daylight Factor (DF) – Main Library

- Average DF – 3.48%
- DF > 2% - 52.77%

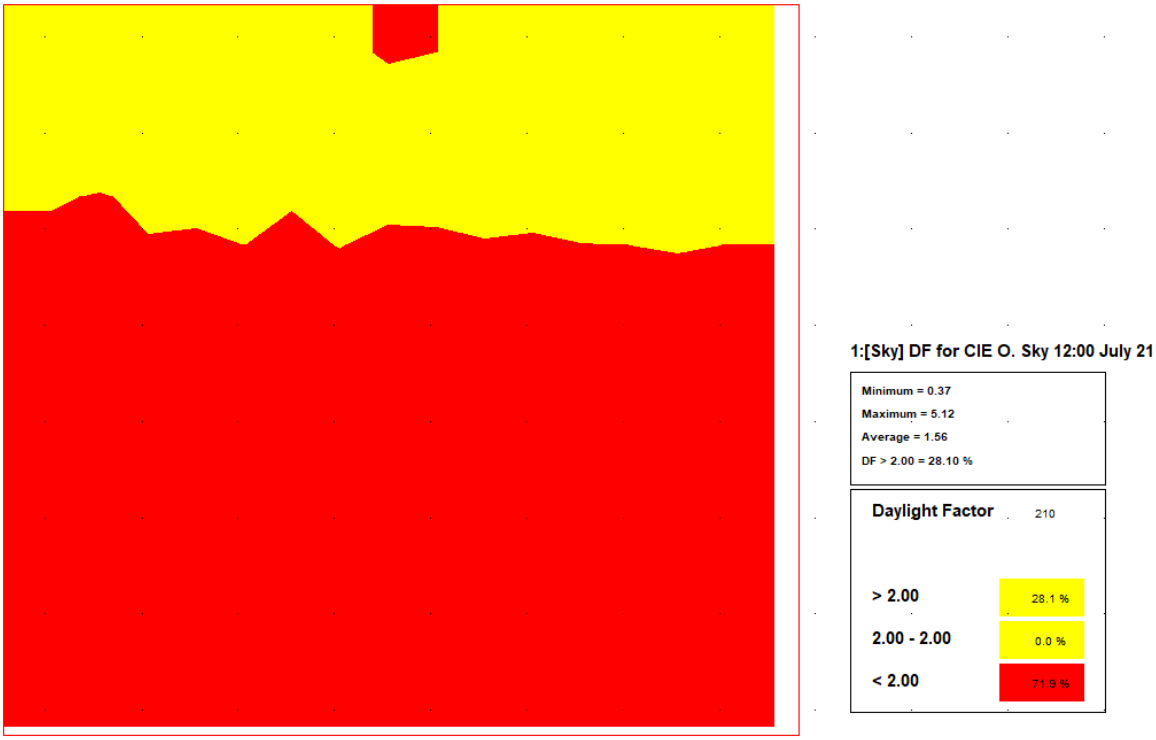


Figure 6 Daylight Factor (DF) – Homebase

- Average DF – 1.56%
- DF > 2% - 28.1%

Shading is currently designed to ensure thermal comfort during the extreme temperatures experienced in summer by the site and save on energy consumption related to building cooling.

Shading devices should be optimised as the design progresses, to balance between high daylight levels and unwanted solar heat gain.

5.2.3 Thermal Comfort

Thermal comfort in a building is influenced by its:

- Envelope shape and material composition
- Spatial planning
- Ventilation area

In response to;

- Ambient temperature
- Relative humidity
- Wind speed and direction

In addition to how the building is used (opening of windows and doors etc.), Section J of the NCC (ABCB) determines minimum standards for building fabric and sealing, ventilation areas and amount of glazing for a building.

The courtyard form was employed to minimise the cross section width of the building, to allow for good cross ventilation of learning areas, which may be supplemented by ceiling fans. The occupants will discover by trial and error, the ambient (external) conditions that will prove to be beneficial in enhancing the internal comfort conditions. As per DG55 (Version 4)

As a rule of thumb, when the ambient is below about 15°C it will probably be too cool to operate the windows for long periods of time; and similarly when the ambient is over about 28°C it will probably be too warm.

Design Evaluation

Thermal comfort modelling was undertaken to inform passive design decisions and tests concepts and evaluate the design against EFSG DG55 – Cooling Policy. Two representative spaces within the building were analysed for thermal comfort. The Main Library on Ground Floor and a representative Homebase on the northern façade were chosen. At this stage of design, thermal comfort has been assessed for the building as naturally ventilated. This has been done to evaluate the thermal performance of the passive design of the building in order to reduce the reliance of the building on air-conditioning, reduce energy consumption and decrease the carbon footprint of the building during operation. At a later stage of design when the air-conditioning design is advanced, this can be added to the assessment.

As per DG55 (Version 4), Section 2.0, internal space thermal conditions were analysed against occupant thermal comfort during a typical year using the Predicted Mean Vote (PMV). PMV is an index that predicts the mean value of the votes of a large group of persons on the 7-point thermal sensation scale, from +3 (hot) to -3 (cold), based on the heat balance of the human body. A PMV of -1 to +1 corresponds to a Predicted Percent Dissatisfied (PPD) of no more than 25% (i.e. 25% of people are dissatisfied or uncomfortable). A PMV of -0.5 to +0.5 corresponds to a PPD of 10%. A PMV of zero would still mean 5% of occupants are dissatisfied or uncomfortable.

The effectiveness of shading, ventilation and glazing were first investigated independently through modelling which include the following:

- Single sided ventilation vs. cross flow ventilation at 30% window openability.

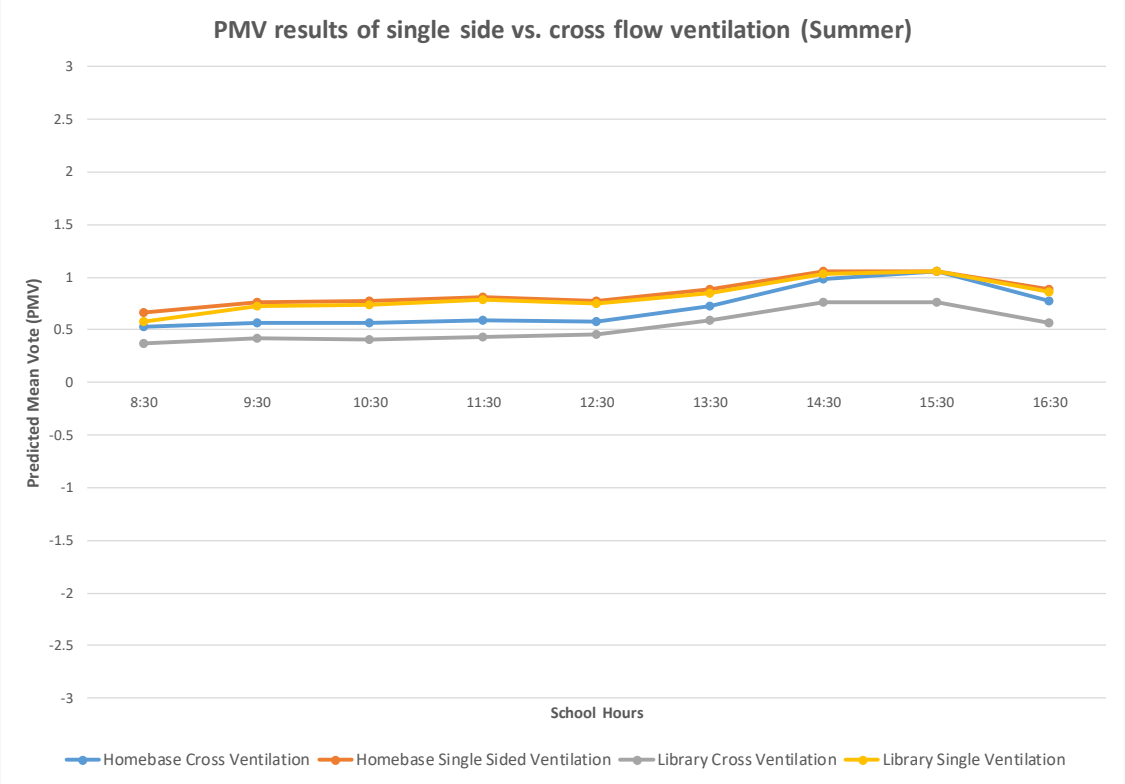


Figure 7 Single sided ventilation vs cross-flow ventilation PMV results - homebase & main library

On a summer day, having openable windows and doors opposite one another, allowing for cross-flow ventilation that regulates internal temperatures through air movement across spaces, improving the overall PMV/thermal comfort.

- Glazing performance with U-value 4.5 & Solar Heat Gain Coefficient (SHGC) 0.45 and U-value 4.5 & SHGC 0.28

Table 2 PMV results for main library and homebase on winter day with different SHGC

Winter Day		Main Library		Homebase	
Date	Time	SHGC 0.28	SHGC 0.45	SHGC 0.28	SHGC 0.45
Mon, 21/Jul	8:30	-2.46	-2.44	-2.27	-2.22
	9:30	-1.77	-1.71	-1.71	-1.65
	10:30	-1.28	-1.21	-1.29	-1.23
	11:30	-1.09	-1.03	-1.11	-1.06
	12:30	-0.90	-0.85	-0.91	-0.87

Winter Day		Main Library		Homebase	
	13:30	-0.81	-0.75	-0.82	-0.78
	14:30	-0.79	-0.75	-0.81	-0.76
	15:30	-1.02	-1.00	-1.03	-1.00
	16:30	-1.38	-1.37	-1.40	-1.38

Windows with low SHGC, such as low-emissivity glazing generally provide improvements on thermal comfort through reducing the incoming solar heat gain. Table 2 shows that PMV are *lower* (more discomfort) with glazing with low SHGC, this is an expected result as amount of sun entering during winter is reduced.

- Extend northern façade's overhang projection from 0.9m to 1.5m

Whilst increasing overhang on northern façade will typically improve the thermal comfort on north facing spaces, the current design with overhang of 0.9m is adequate in shading from the summer sun. Additional increase in overhang projection does not provide justifiable benefits.

- Increasing cross flow ventilation from 30% to 45%

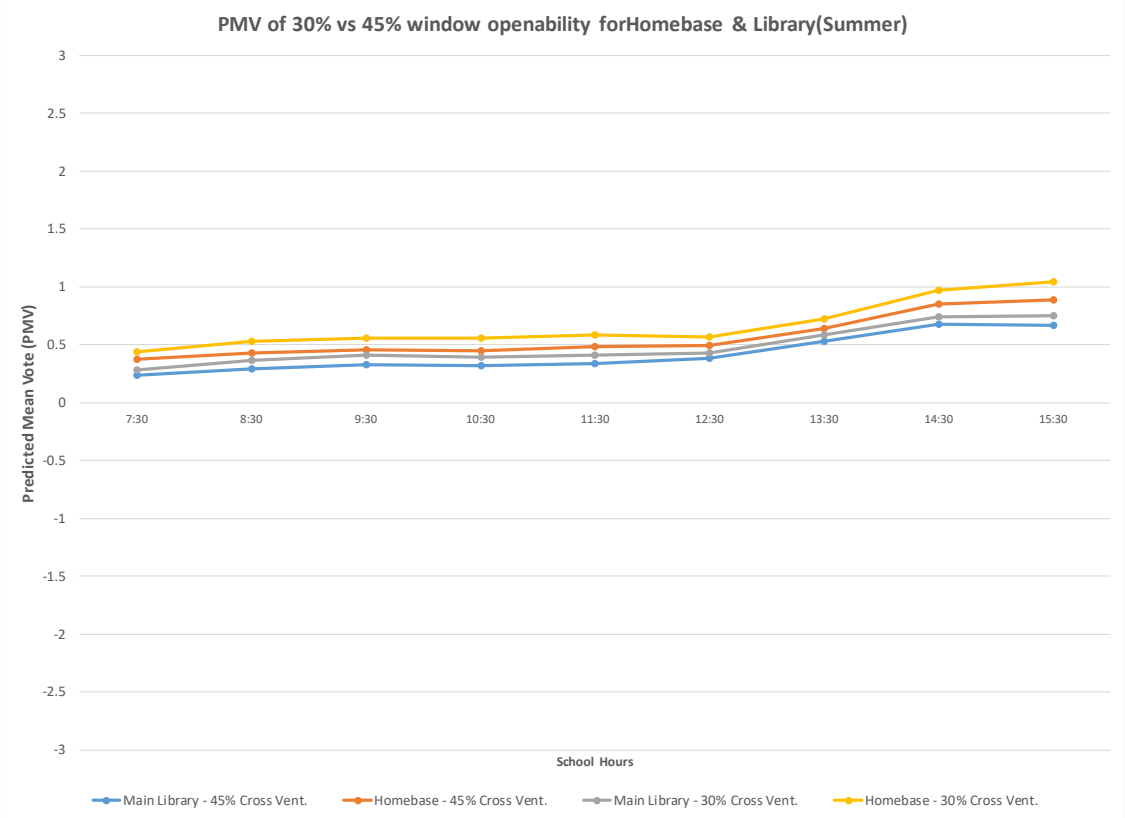
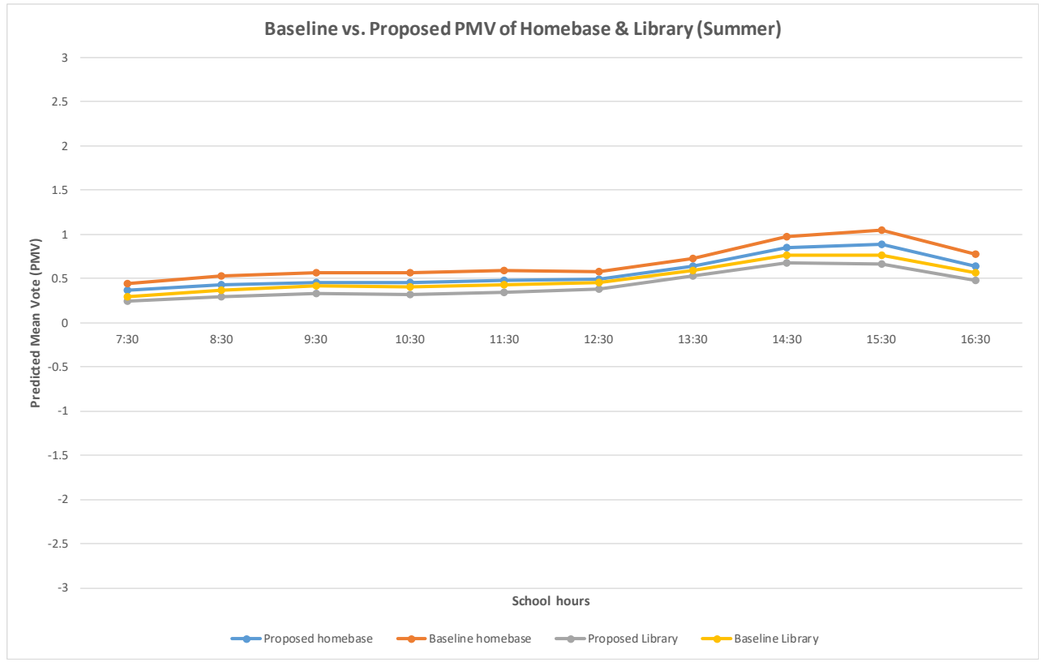


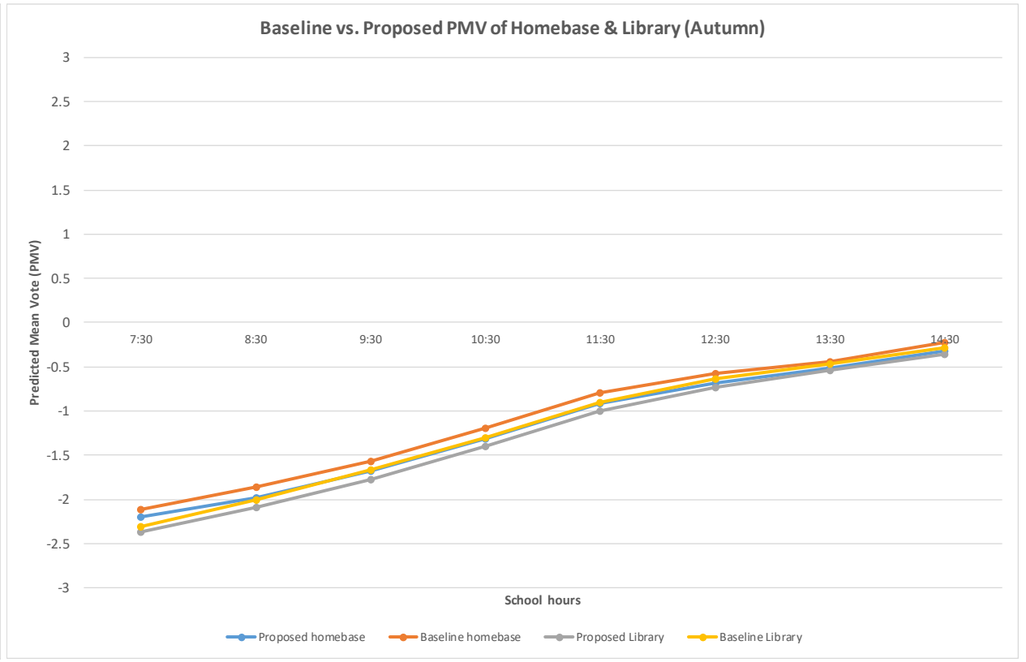
Figure 8 PMV results for main library and homebase at 30% and 45% window openability

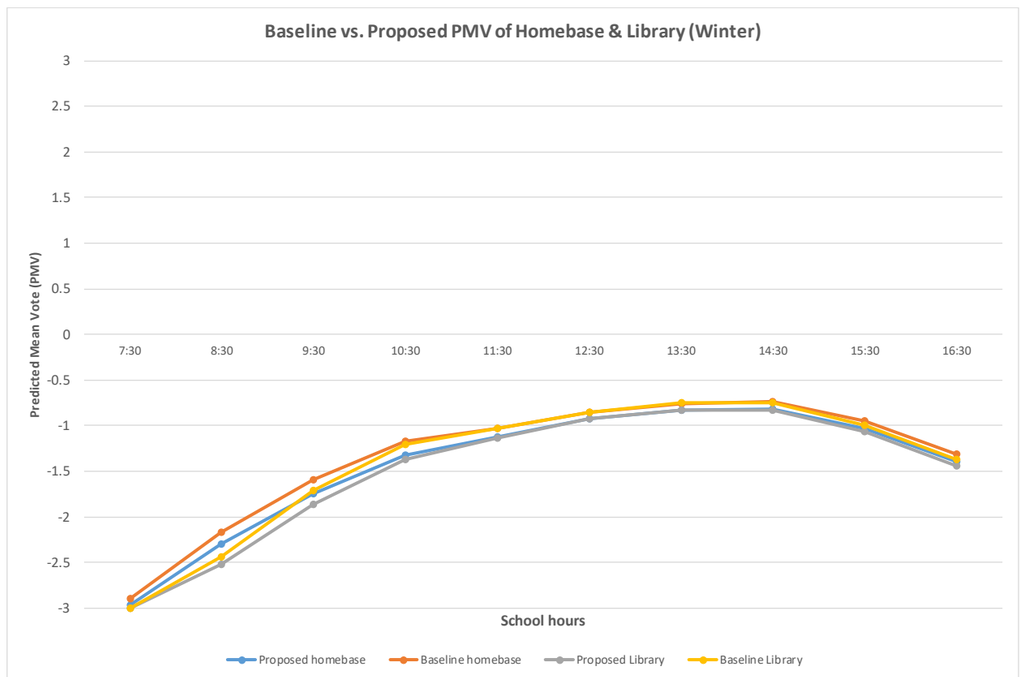
During the summer day, increased windows to an openability of 45% improved the PMV results for homebase and library as higher flow of outside air is distributed to the internal spaces and removing heat gains.

These parameters are combined to form a baseline and a proposed model to demonstrate the cumulative benefit, summarised in table and shown in Figures below:

Baseline Parameters	Proposed Parameters
- Cross flow ventilation @30% openability ON continuously	- Cross flow ventilation @45% openability ON continuously
- U-value 4.5 SHGC 0.45	- U-value 4.5 SHGC 0.28
- Shading	- Shading







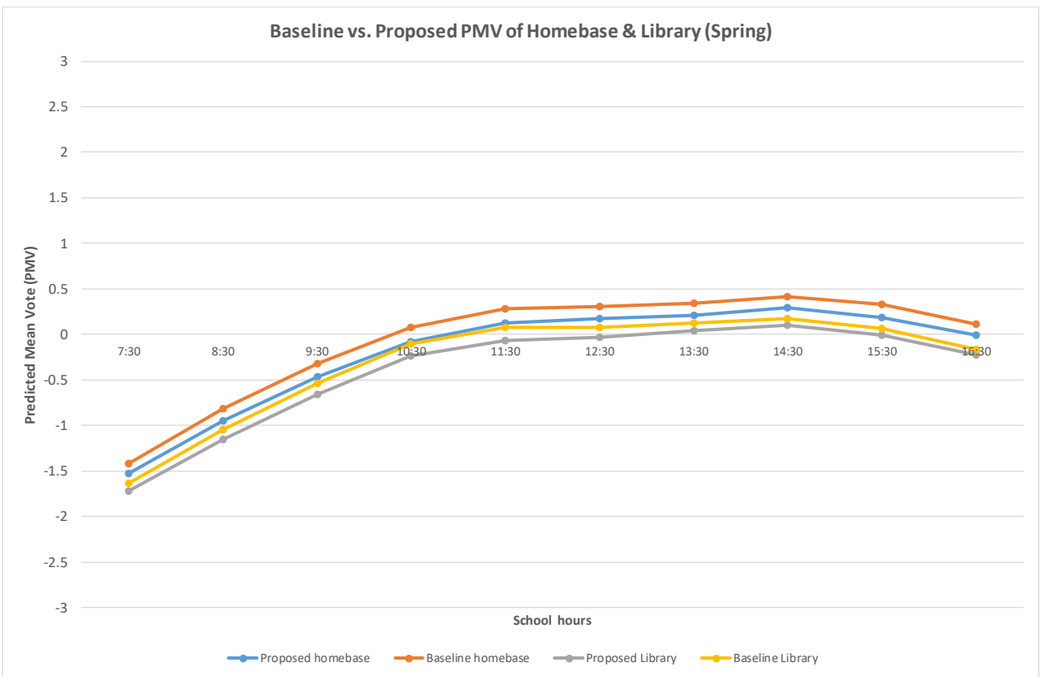
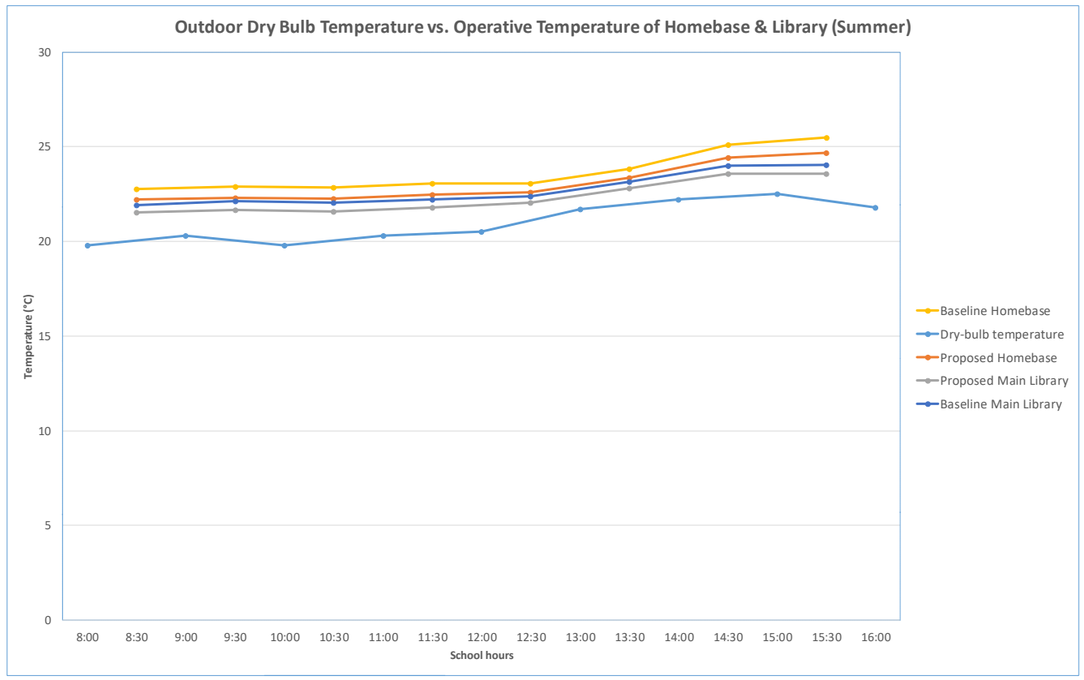
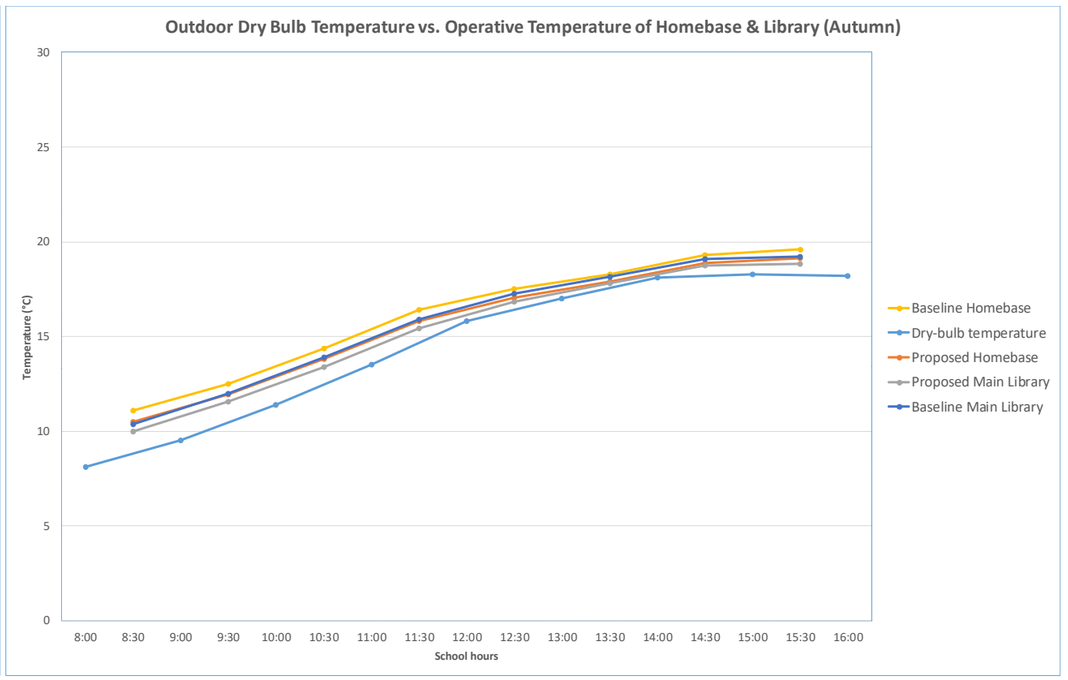


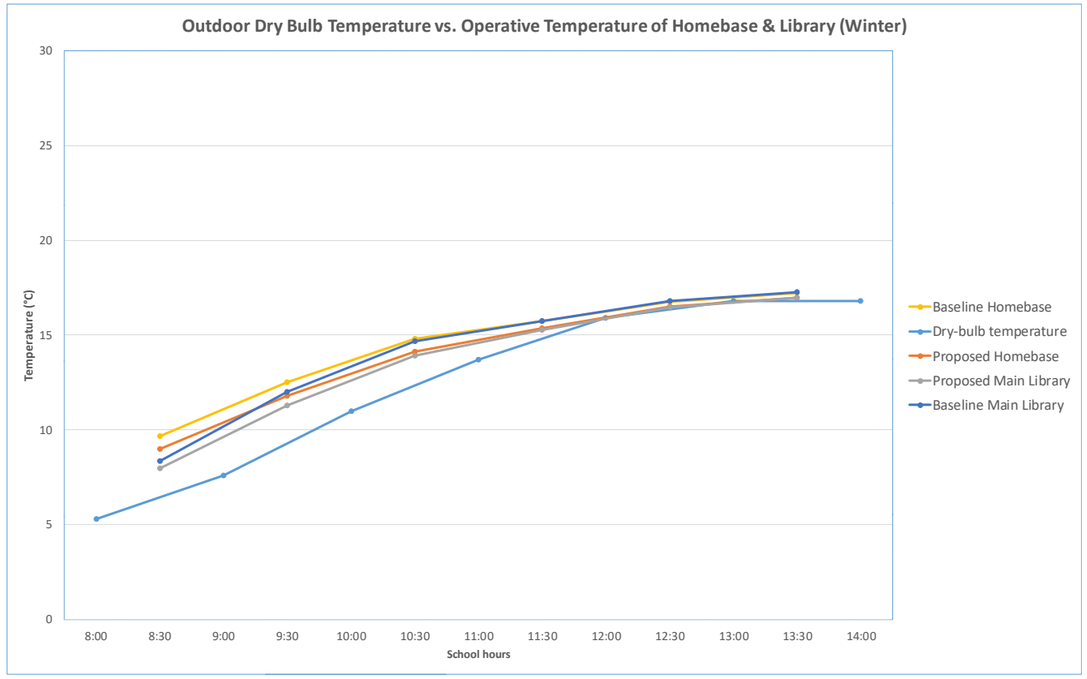
Figure 9 PMV results of homebase and the main library for baseline and proposed option across a typical primary school day in four different semesters

Figure 10 above show a typical day in each season and an indication on the thermal comfort in the homebase and main library. Proposed higher performance glazing (i.e. lower SHGC) reduces the amount of solar heat gain while still maintaining good levels of visible light transmission is another factor for the improvement in in PMV during summer day. However, because windows were modelled as ‘open’ at 100% of the time, large openable of windows have a

negative effect on the PMV as the internal spaces becomes very cold overnight in the winter. Although this does not necessarily represent how windows may be operated, these model demonstrates that having larger operable windows will promote natural cross flow ventilation.







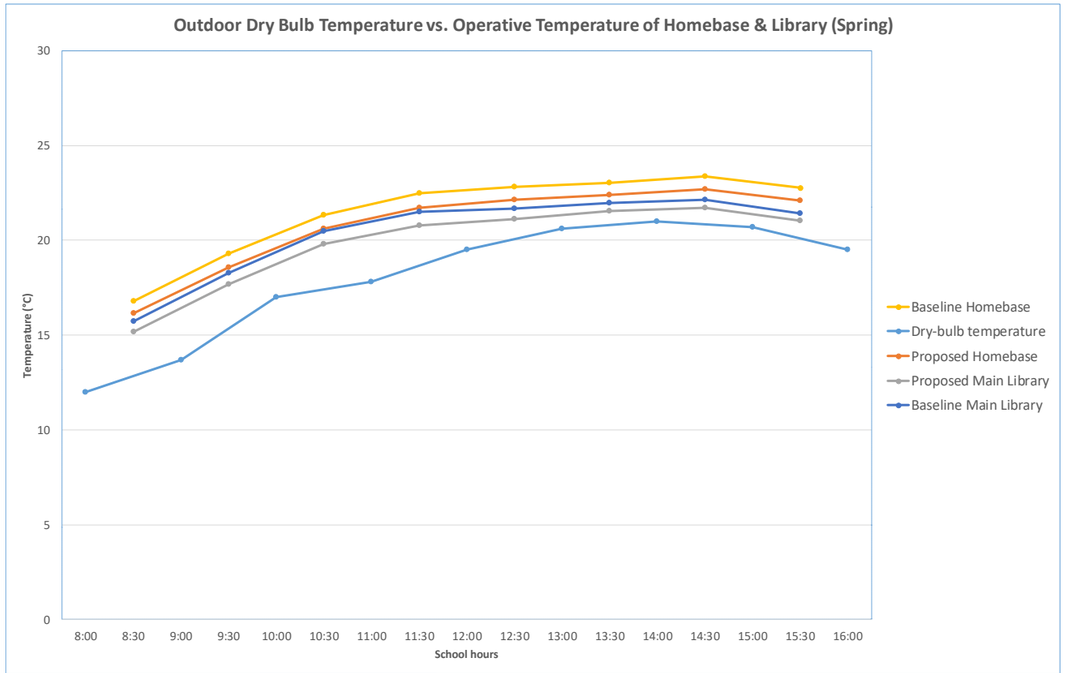


Figure 10 Comparison of outdoor dry bulb temperature vs. operative temperature in homebase and the main library with baseline and proposed parameters.

Figure 11 show the difference between outside dry bulb temperature and the operative temperature of library and homebase. Operative temperature is used for comparison instead of air temperature in these spaces because it takes into account both air temperature and radiant temperatures of surfaces. As a result, it is a more accurate reflection of the temperature a person actually experiences in the space, and therefore a more accurate predictor of occupant comfort than air temperature alone. Homebase and library with proposed parameters have lower operative temperature than baseline for a typical summer day and winter day. Other parameters/factors which are not considered in this modelling but could affect overall thermal comfort in these spaces are the level of insulation to walls, ceiling/roof and floor, U-value of glazing and thermal mass.

Ventilation

The new school development will be serviced with Heating, Ventilation, Air Conditioning (HVAC) systems and when suitable, natural ventilation through operable windows/doors.

The mechanical HVAC systems will be in accordance to ESFG DG 56, 57 & 06 requirements.

Although the building will be mechanically ventilated, natural ventilation should be employed as much as possible as it can maintain good indoor environmental air quality and does not use energy. As per DG 57.05, the building will provide means for cross ventilation by openable windows and louvres.

When it is not feasible to utilise natural ventilation, mechanical ventilation systems will be utilised. To increase effectiveness of mechanical ventilation, it is encouraged to implement technological systems that inform occupants that the room is being mechanically conditioned and therefore all windows must be closed.

Standards and Guidelines for Mechanical Heating & Cooling

As per DG 06.04 Heating strategy of the school is to be developed using Whole of Life considerations and consider initial capital costs and ongoing resources costs (electricity, gas and water consumption). Additionally, the equipment life-cycle cost shall be calculated as per DG 56.03. Details of HVAC systems to be installed will be determined in future stages of the design

5.3 Building Performance

Building performance is a significant Sustainability target that incorporates efficient design technology and use of renewable energy.

5.3.1 Overall Energy Requirements

Energy requirement assumptions include:

- Heating for the homebases may be achieved through gas heating systems, not requiring electric heaters
- Cooling will be achieved through the use of air conditioning and natural ventilation where possible.
- 1 lift will be required to serve the school.

Lighting control will be automatic and comply with the EFSG guidelines including motion sensor and photoelectric cell overrides for external lighting circuits. A CBUS lighting system is proposed to appropriately switch and dim luminaires both external and internal to the building.

Energy demand of the school will be addressed at the later design stage and will meet the requirements of NCC and ESFG. At least 10% lower than the specified consumption requirements as per the NCC requirements can be generally achieved with high performance glazing, additional insulation where appropriate and more efficient HVAC systems. In this design stage, there is nothing that precludes the project from meeting this target.

5.3.2 Energy Use Reduction and Generation Methods

Renewable Energy Generation is identified as an environmental design feature of education facilities. Onsite generation of electricity is proposed to supplement base load demand at the school. A 90kW grid connected solar PV system will be installed on the roof of the new school to offset the energy usage in accordance with EFSG design guidelines.

The NSW Government Resource Efficiency Policy sets out the minimum standards for new appliances and equipment. All new electrical equipment purchased by DoE where relevant, available and fit for purpose, must have minimum Greenhouse and Energy Minimum Standards (GEMS) star ratings stipulated under target E3 of the Policy.

5.3.3 Building Performance Monitoring Systems

An interest exists in the department in having better access to energy consumption data at the school. A complete sustainable building strategy includes a multitude of tactics including, but not limited to, energy efficiency, air quality, and water use reduction. The strategies employed are often hidden to the occupants of the building. However, in a learning environment, it is particularly important to implement techniques that are expressive and are reinforced throughout the built environment. The concept design proposes identifying a cohesive sustainability story that illustrates multiple sustainable methods for addressing an important environmental theme. This story or grouping of strategies should be graphically illustrated in a cohesive way both inside and outside the building.

An interface for the building energy systems has been proposed to allow real-time web based monitoring of building performance and provides education on the ESD systems of the building, and creates an opportunity for ESD within the building to be maximised. In this way the building itself becomes an education tool on the principles of ESD.

5.4 Water: Demand and Conservation

An Integrated Water Management Plan (IWMP) has been developed to ensure a secure, reliable and sustainable water supply system for Marsden Park new primary school.

The proposed IWMP includes the following goals:

- Meet the potable water needs for the total number of occupants in the new proposed development;
- Manage the proposed water supply source to maximise usage efficiency;
- Potable water quality needs to be protected against any contaminants.

The key strategies of the IWMP in order to achieve the above goals are summarised below:

- A new permanent potable water supply connection into Sydney Water street infrastructure;
- Utilisation of sanitary fixtures with a high efficiency level as per EFSG Guidelines and minimum WELS rating as per Table 3.1 from AS6400;
- Rainwater recycling system consisting roof rainwater harvesting and reuse for non potable applications such as toilet flushing, washdown hose taps and landscape irrigation;
- Backflow prevention devices in accordance with DG53.05, proposed for potable water supply in area with potential contamination hazard;

5.4.1 Water Use Reduction

EFSG states fittings of minimum Water Efficiency Labelling and Standards Scheme (WELS) ratings. As per the EFSG, sanitary fixtures (toilets and urinals) must be rated to AS 6400, to a minimum four star rating. For future proofing the development, it is suggested to adhere to more stringent WELS rating requirements as per Green Star guidelines (Table 3).

Table 3 Green Star WELS Ratings for Sanitary Fixtures and Equipment

Fixture/ Equipment Type	Green Star WELS Rating
Taps	6 Star
Urinals	6 Star
Toilet	5 Star
Showers	3 Star
Clothes Washing Machines	5 Star
Dishwashers	6 Star

5.4.2 Water Efficiency Analysis

It was identified that the water usage from toilets, basins, sinks, wash down hose taps and irrigation forms the largest component of water used for the proposed development. Achievable potable water savings proposed were:

- Up to 20-30% potable water saving for installation of water-efficient tapware for potable water applications;

- Up to 80% potable water saving for implementation of a rainwater recycling system for non-potable water applications

The potable water efficiency analysis is summarised in Table 4.

Table 4 Water Efficiency Proposed Fixtures (Source: LUCID Hydraulic Infrastructure Report)

Fixture	Standard Rating	Proposed Efficient Rating
Basins	7.2 L/min	4.5 L/min
Sinks	13.2 L/min	6.0 L/min
Showers	12.0 L/min	7.5 L/min
WC Pan	6/3 L per flush	Rainwater supply
Washdown Hose Tap	13.2 L/min	Rainwater supply
Landscape Irrigation	See LCE17386-002	Rainwater supply

5.4.3 Water Recycling

Fire Service Water Consumption

The fire services water consumption is estimated based on the commissioning requirements of AS 2419.1, AS 2118.1, AS 2118.6 and the maintenance testing requirements of AS 1851. Table 5 outlines the values utilised in the Integrated Water Management analysis. Fire test water recycling is to be considered in accordance with Green Star requirements.

Table 5 Water consumption of Fire Services Maintenance Testing (Source: LUCID Hydraulic Infrastructure Report)

Test	Volume of Water Consumed per Test	Frequency of test	Reference
Fire Hydrants	150 Litres per fire hydrant	Annually	AS 1851, Table 4.4.3, item 3.2. Allowance to observe water at each fire hydrant.
Fire Hose Reel	5 Litres per fire hose reel	Six-monthly	AS 1851, Table 9.4.1, item 10.1. Allowance to observe water at each fire hose reel
Fire Hydrant Flow and Pressure Testing	9,000 Litres	Annually	AS 1851, Table 4.4.3, item 3.7. Allowance for fire hydrant flow and pressure testing. 10L/s per operational fire hydrant for 5 minutes.
Fire Pump Flow Test	18,000 Litres	Monthly	AS 1851, Table 3.4.1, item 3.7. Allowance for pump flow and pressure testing. 10L/s per

Test	Volume of Water Consumed per Test	Frequency of test	Reference
			operational fire hydrant for 10 minutes.
Fire Brigade Booster Assembly Flow and Pressure Testing	21,000 Litres	5-yearly	AS 1851, Table 4.4.4, item 4.2. Allowance for fire brigade booster assembly boost test. 20L/s for fire hydrants and 15L/s for automatic fire sprinklers for 10 minutes.

Rainwater Recycling

In order to reduce the ongoing costs associated with the potable water consumption for the new proposed development and in accordance with the EFSG requirements, the harvesting and reuse of roof rainwater for non-potable water supply is proposed for the project.

The roof rainwater from all downpipes is proposed to be collected by a separate below ground drainage system (Figure 11) and discharged into a below ground rainwater storage tank, including metered domestic cold water supply for top up for periods when there is no rainwater storage. The rainwater collected in the below ground storage tank is proposed to be pumped through a non-potable dedicated pipework system by a submersible rainwater pump set, which after filtering and UV treatment (as per DG 53.17) will be reused for toilet/urinal flushing, hose taps wash down and landscape irrigation.

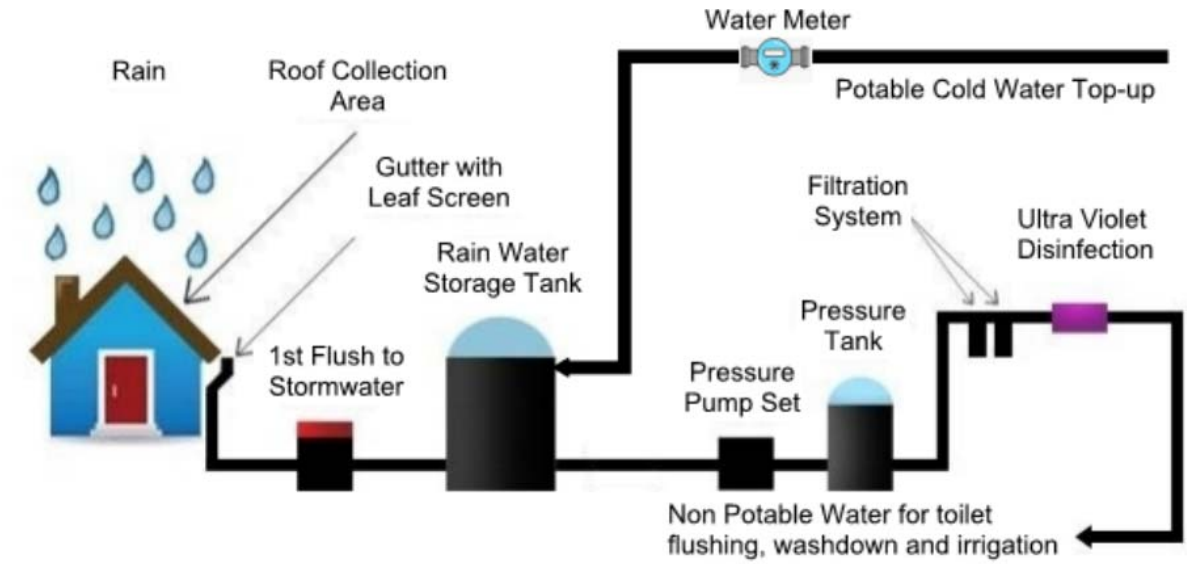


Figure 11 Rainwater Recycling System Diagram (Source: LUCID Hydraulic Infrastructure Report)

As per City of Blacktown requirements, for school developments a minimum of 80% of the non-potable water used on site must be supplied from the rainwater harvesting system. Calculations

conducted in the 'Rainwater Harvesting and Reuse Report' indicate a rainwater tank with an effective capacity of 120kL.

Stormwater

The in-ground drainage has been designed to meet the following criteria:

- In the minor design storm event (20 year) there will be no surcharging of the in ground drainage system and;
- In the major design storm event (100 year) there will be no uncontrolled discharge from the site onto the residential properties to the east of the site.

Surface runoff from the development sites will be directed to stormwater inlet structures using the design topography of these elements. The inlet structures have been designed to adequately convey the surface runoff into the in ground drainage network.

The runoff will then be conveyed underground across the site through a pit and pipe system and then to the legal point of discharge using gravity and the geometric falls of the pipe system.

5.4.4 Water Sensitive Urban Design (WSUD)[1]

The management of stormwater across the site is integral to not only providing a suitable environment for operation of a school but also to mitigate any downstream impacts on neighbouring properties from this new development. Post-construction (occupation) phase stormwater management objectives are to be achieved by all development through the innovative application of WSUD

The principles for surface water management in the context of WSUD should aim to retain as much stormwater as possible on site, transport as little stormwater pollutants as possible to receiving waters, 'lose' an appropriate amount of stormwater along the treatment train and slow the transmission of stormwater to receiving waters. Key planning and design objects are generally:

- Integrate stormwater treatment into the landscape by incorporating multiple-use corridors that maximise the visual and recreational amenity of the development.
- Protect water quality draining from the development, providing primary stormwater treatment measures that target litter, gross pollutants and coarse sediments and secondary treatment measures that target fine sediment, nutrients and bacteria
- Reduce run-off and peak flows from developments by employing local detention measures, minimising impervious areas and maximising re-use.
- Orientate paths and roadways to traverse across contours, providing gentler slopes to promote the provision of above ground conveyance mechanisms, such as vegetated swales, into the paths and streetscape
- Maintain and re-establish vegetation where possible
- Manage the quality and quantity of stormwater at or near the source, which could involve a component of public education. Treatment practices such as bioretention/detention facilities, to manage water quality, could be provided downstream or close to the point of discharge from development areas, before discharge from the site

[1] Marsden Park New Primary School Stormwater Management Report, Wood & Grieve Engineers, 2019

The existing topography of the site will largely remain unchanged with construction of the school and therefore the management of any potential flooding impacts is centred on the management of overland flowpaths. Bunding around the outside edges of the school fields will facilitate the management of overland flowpaths and mitigate any impacts on downstream residential properties from overland flow from the school site

A number of management measures have been considered with a focus on reducing polluted runoff volumes from the site. The WSUD principals proposed for stormwater treatment includes:

- 15 x Enviropods,
- 1 x Jellyfish Unit,
- Rainwater Tank

The effectiveness of the treatment device proposed in the above section has been modelled using MUSIC with the overall treatment train efficiency results shown in the table below (Table 6).

Table 6 Treatment Train Pollutant Reduction

Pollutant	DCP Reduction Target (%)	Proposed Treatment Reduction (%)
Gross Pollutants	90%	100%
Total Suspended Solids (TSS)	85%	92.2%
Total Phosphorus (TP)	65%	65%
Total Nitrogen (TN)	45%	55.2%

EnviroPod Pit Inlet Trap

EnviroPod's (or other similar approved equivalents) provide effective removal of TSS and gross pollutants. EnviroPod's are a filter cage system which are inserted into roadway gully pits to filter and remove pollutants before the water enters the piped drainage system.

It is proposed to place a total of 15 x enviropods throughout the site

Figure 12 EnviroPod Pit Inlet Trap (Source: Stormwater 360)

Stormwater 360 Jellyfish

The Stormwater 360 Jellyfish filter unit used filtration cartridges to remove high levels of stormwater pollutants including:

- Total Suspended Solids (TSS), median removal efficiency of 89%, including particles down to two microns
- Total Nitrogen (TN), median removal efficiency of 55%
- Total Phosphorous (TP), median removal efficiency of 65%
- Total Copper (Cu), median removal efficiency of 61%
- Total Zinc (Zn), median removal efficiency of 91%.
- Total Oil and Grease, median removal efficiency of 62%

One Jellyfish JF-3250-24-4 has been proposed for the development, located in the Northern part of the site.

The MUSIC modelling parameters for this device are set by the manufacturer, Stormwater360.

Figure 13 Jellyfish infiltration Unit (Source: Stormwater360)

5.5 Waste

Waste reduction design measures including; operational and construction waste, measures to encourage recycling, and provisions for education about waste reduction.

5.5.1 Waste Systems Overview

Green Star recommends an approach for achieving best practice outcomes in operational waste management, which includes:

• Separation of Waste Streams;

• Dedicated Waste Storage Area; and

• Access to Waste Storage Area.

Details of how these best practice outcomes have been adopted by the project are outlined in the Marsden Park New Primary School Waste Management Plan[2].

5.5.2 Separation of Waste Streams

On the basis of the Blacktown City Council guidelines, the waste generation rates for 1,000 students would be 1,500 litres per week of waste and 500 litres per week of recycling.

This would require two 1,100 litre rear lift bin per week for garbage, and one 660 litre bin per week for recyclables. It may also be necessary to have a third 660 litre bin for bulky cardboard. Some contractors may also provide a separate bin for office paper. Additionally items such as batteries and fluorescent tubes, may be separated by staff for recycling (GHD Waste Management Plan).

5.5.3 Dedicated Waste Storage Areas

The proposed bin storage area is located in the North West corner of the car park. The car park has allowed adequate distance between parking spaces to allow collection trucks to travel through the car park.

5.5.4 Access to Waste Storage Areas

Road and Driveway Construction and Geometry

According to the NSW EPA Better Practice Guidelines for Waste Management and Recycling in Commercial and Industrial Facilities, there are certain desired requirements for roads used to access waste bins.

Designers are encouraged to consult with council and other relevant authorities prior to the design of roads and access points to ascertain specific requirements for the proposed development. Appropriate heavy vehicle standards should be incorporated into the development design, including those specified in Acts, regulations, guidelines and codes administered by Austroads, Standards Australia, the NSW Roads and Traffic Authority, NSW WorkCover and any local traffic requirements. Roads and driveways must be designed and constructed in accordance with the relevant authority requirements to allow the safe passage of a laden collection vehicle in all seasons.

Factors to be considered in design include:

- gradients for turning heads

[2] Marsden Park New Primary School Waste Management Plan, GHD, 2019

- longitudinal road gradients
- horizontal alignments
- vertical curves
- cross-falls
- carriageway width
- verges
- pavement widths
- turning areas (see below)
- local area traffic management requirements (for example speed humps)
- sight distance requirements
- clearance heights (for example a vertical clearance of 6.5 metres is required to load front lift vehicles)
- manoeuvring clearance
- road strength (industrial-type strength pavement required, designed for a maximum wheel loading of seven tonnes per axle to accommodate garbage and recycling collection vehicles).

Turning Circles

Turning circles for medium and heavy rigid vehicles are 10 m and 12.5 m respectively. The car park traffic route needs to be designed to accommodate vehicle movements associated with collecting the bins

5.5.5 Storage and Collection

It is anticipated that cleaners, operating after classes have finished each day, will collect the contents of the bins in each area and on each level. Bins with waste and recycling sections are expected to be located in outdoor common areas, rather than having bins in every classroom.

Waste materials are expected to be collected in bags and transported by the cleaners to the garbage bin area using trolleys. This area will have outdoor lighting, and it is securely within the school grounds.

Waste collection contractors will enter the school after normal hours, pull out bins as required for servicing and replace them when emptied.

5.6 Transport

Based on information contained in the Marsden Park Precinct Development Control Plan, (DCP), the planning for the precinct responds to the need for new and diverse housing in Sydney that is well connected to major centres and employment, protects the natural assets and encourages sustainable living.

The Marsden Park Precinct is proposed to provide land for approximately 10,300 homes and 30,000 residents. Marsden Park New Primary School is intended to support the educational needs of the precinct's future population.

Low to medium density housing will be located around village centres, schools and open spaces. Higher density housing is proposed in proximity to the town centre where retail, community facilities, schools, recreational facilities and public transport are at a short distance for improved convenience and accessibility

5.6.1 Public Transport Linkages[3]

Train Services

Riverstone Station is the closest station to the Marsden Park New Primary School and is served by the T1 Western Line and T5 Cumberland Line.

Riverstone Station is located approximately 3.8 km from Marsden Park New Primary School which exceeds a reasonable walking catchment from the school. However, the 757 and 6508 bus services operate as a feeder route between the Marsden Park Precinct and Riverstone Station and may provide future utility to teachers seeking to access the school via public transport.

Bus Services

The nearest public bus stops from Marsden Park New Primary School are located along Elara Boulevard. The nearest bus stop as shown in Figure 14 is approximately 800 m away from the proposed school.

[3] Marsden Park New Primary School Green Travel Plan, GHD, 2019

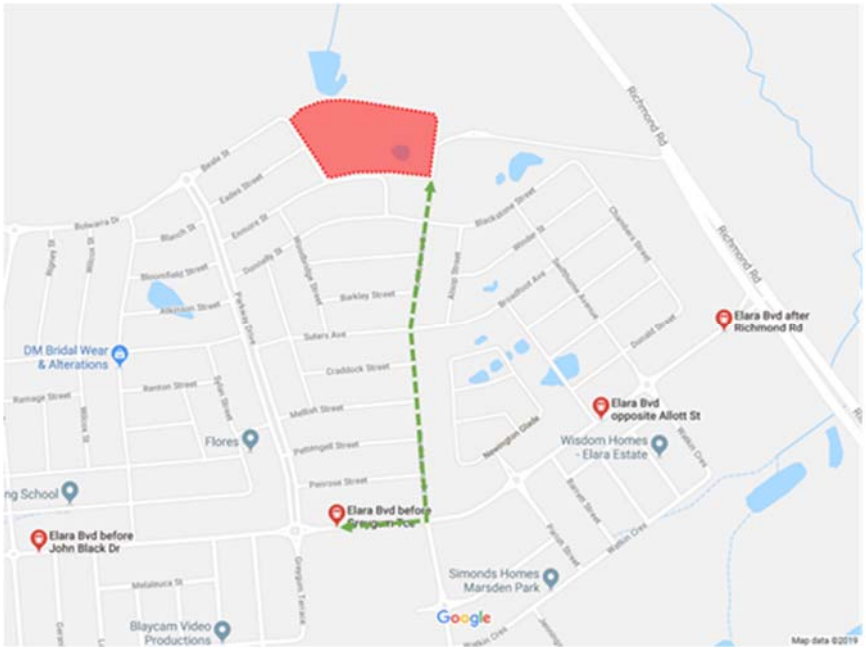


Figure 14 Distance from Marsden Park School to the nearest bus stop (Source: Green Travel Plan)

Future bus services have been detailed in the Blacktown City Council Integrated Transport Management Plan (2013):

- As part of the NSW Long Term Transport Master Plan, the NSW Government will secure a public transport corridor into Marden Park.
- This public transport corridor will ensure the growing North West continues to have access to quality public transport services. Bus Stops.

Future Transport 2056, envisages Marsden Park as a centre being served by a “turn up and go” public transport network.

Based on discussions with TfNSW for this project:

- Bus services at Marsden Park will continue to expand and evolve in response to new development as part of the North West Growth Area.
- Marsden Park and Elara Estate are on the very rural-urban fringe and current bus routes are only interim services pending the construction and opening of new roads that will enable the future permanent bus network to be delivered in coming years.
- Bus links to Mt Druitt, Penrith, Blacktown, Schofields, Riverstone, Tallawong, Rouse Hill and the future Marsden Park Town Centre are being taken into account in planning future bus services in the area.

5.6.2 Sustainable Transport Infrastructure

On-site car parking has been limited to 48 spaces, including 1 accessible car bay, as to provide sufficient parking for teachers and visitors whilst encouraging the utilisation of public or active transport.

Various end-of-trip facilities will be provided to encourage the use of non-motorised transport such as; lockers, showers for staff, bicycle and scooter parking

There are two standards that relate to bike parking provision in schools in NSW, as follows:

- NSW Government, 2004, Planning Guidelines for Walking and Cycling; and

- Austroads, 2017, Cycling Aspects of Austroads Guidelines.

The NSW Government's Planning Guidelines for Walking and Cycling recommends the rate for staff and visitor bike parking and the Austroads Guidelines puts forward the recommended rate for student bike parking provision (Table 7).

Table 7 NSW Government recommended rate for student parking provision (Source: Green Travel Plan)

User Group	Rate	No of people	Rate Applicable for Marsden Park New School	Guideline Reference
Staff	3-5% of staff are to have bike storage	70	2-4	NSW Government Planning Guidelines for Walking and Cycling
Visitor	5-10% of visitors are to have bike storage	NA	NA	NSW Government Planning Guidelines for Walking and Cycling
Students	1 per 5 students over year 4	249*	86	Austroads Cycling Aspects of Austroads Guidelines

5.7 Materials

5.7.1 Life Cycle Impacts Considerations

The specification of materials on projects has a twofold effect on environmental outcomes. The life-cycle of materials used in the structure of the building can pose significant environmental impacts, largely due to the volumes used, while the post-construction/installation toxicity of materials can have implications on the health of the environment, particularly inside a building.

As per Green Star material requirements, it is proposed to select materials that have comparatively low embodied energy and material mass as well as being sourced from a responsible manufacturer (with the appropriate accreditation, product declarations and certificates). It is important to select materials with low carbon emissions and low embodied energy as to avoid risk of reducing carbon offsets and sustainability benefits obtained from renewable energy systems.

5.7.2 Low Pollutant Materials

Green Star addresses the overall emitted toxicity by prescribing VOC and formaldehyde limits for common materials used in the interior fit-out of a design. Marsden Park complies with the Green Star maximum total volatile organic compounds (TVOC) contents as described in Table 8 and tested in Table 9 and Table 10.

Table 8 Green Star Maximum TVOC content

Product Category	Max TVOC Content (g/L) of ready to use product
General purpose adhesives and sealants	50
Interior wall and ceiling paint, all sheen levels	16
Trim, varnishes and wood stains	75
Primers, sealers and prep coats	65
One and two pack performance coatings for floors	140
Acoustic sealants, architectural sealant, waterproofing membranes and sealant, fire retardant sealants and adhesives	250
Structural glazing adhesive, wood flooring and laminate adhesives and sealants	100

Table 9 Compliance Testing

Compliance option	Test Protocol	Limit
ASTM D5116	ASTM D5116 - Total VOC limit*	0.5mg/m2/hr
	ASTM D5116 - 4-PC (4-Phenylcyclohexene)*	0.05mg/m2/hr

Compliance option	Test Protocol	Limit
ISO 16000 / EN 13419	ISO 16000 / EN 13419 - TVOC at three days	0.5 mg/m2/hr
ISO 10580 / ISO/TC 219 (Document N238)	ISO 10580 / ISO/TC 219 (Document N238) - TVOC at 24 hours	0.5mg/m2/hr

Table 10 Green Star Emissions Test Protocol

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

**mg/m²hr may also be represented as mg/m²/hr.*

***The test report must confirm that the conditions of Table 3 comply for the particular wood product type, the final results must be presented in EN 717-1 equivalent (as presented in the table) using the correlation ratio of 0.98.*

****The final results must be presented in EN 717-1 equivalent (as presented in the table), using the correlation ratio of 0.98.*

The prescribed materials are compliant with industry best practice in accordance with material selection for interior usage. The exterior cladding system will be determined based on a set of criteria that has been generated from the DOE requirements and school/community input.

The intent is to explore a series of cladding options that will be vetted based on their ability to meet these needs. Due to the scale of the building and the number of functions, a variety of systems will likely be employed.

The criteria that we have identified to be a part of the assessment criteria to assist in determining where to best locate the cladding options include:

- Contributes to sustainability of the whole building in the following categories:
- Energy Efficiency - including solar loading and insulation
- Local and Regional Materials
- Renewable Resources
- Daylight to interior spaces
- Acoustics

Exterior cladding systems and materials considered during the schematic design development included, but was not limited to:

- Curtain Wall - Stick Built
- Curtain Wall - Unitized
- Fritted glass for curtain wall systems and skylights
- Metal screen panels with custom cut openings
- Metal panel system, such as Alucobond,
- Fiber Cement Panel rain screen systems
- Brick cavity wall
- Pre-cast concrete panels

The current proposed façade ensemble under consideration consists of durable and robust materials at the low levels and lightweight cladding and glazing systems at the upper levels.

Green Star Credit 19B addresses life cycle impacts of structural materials including concrete, steel and structural timber. This project is committed to sourcing responsible construction materials and has made allowances in the structural design of the project to select products based on their ability to reduce life cycle impacts.

5.7.3 Durability of Materials

As per the EFSG DG 40.01 internal and external materials and finishes should be chosen from a whole of Life framework designed to prove:

- Value for money
- Fit for purpose
- Long term durability
- Minimal maintenance requirements
- Low maintenance costs.

Material selection shall be based on the durability, adaptability and resilience to changes in climate, harsh weather conditions and ongoing ‘wear and tear’ as to future proof the school.

Structural timber shall have a natural durability classification to AS 5604 Table A1 (minimum): Durability class 2, or preservative treated timber of equivalent durability as a requirement of SG 381.2.

The materials selected for the development of the school will be confirmed in further stages of the design.

5.8 Biophilic Design

Biophilic design relates to the environmental amenity of the site, access to landscape and outdoor spaces and integrating planting in the design, including indoor plants, green walls and roofs.

5.8.1 Indigenous and native trees

The new school development has been designed to incorporate many trees both indigenous to Marsden Park and native to Australia. Deciduous tree planting in front of north facing facades provides summer shading (cooling) of buildings and pavements and allows winter sun access for warming. The number of trees to be planted are to be decided in the future stages of detailed design.

The design reflects the colours and textures of the Cumberland Plains. It will reflect the emerging character of being an education hub, multicultural, creative, community connected, youthful, supportive and adaptable.

A dedicated space for food production (herb, vegetable and bush tucker) is also described in the design. Garden areas close to the building and main circulation paths will feature native planting and allows for student observation of a variety of plant species and the birds and insects they attract.

5.8.2 Non geometric design

Breakout areas were designed in non-geometric formations to simulate structures found in nature. Circular formations and spaces can promote gathering and teamwork learning modalities that can encourage ongoing learning.

5.8.3 Outdoor Spaces

The design of the school incorporates a large courtyard structure and multiple outdoor landscaped recreational areas that are connected via a DDA compliant access ramp. This includes a number of outdoor games courts and a sports field.

The Learning Courtyard concept creates a symbol of protection, an embracing form which centres the school focussing on an inclusive heart to the campus. The final design will explore connections between indoor and outdoor learning. It will embrace partnerships between the school and the wider community and it will add to the significance of the new built environment in Marsden Park.

Readily accessible, flexible and inviting landscape open spaces will contribute the health of the students and users by providing spaces for learning, passive and active recreation.

A two-level atrium in the centre of the eastern façade is expressed as a large window to provide visual connection from the street through to learning areas and to the green courtyard heart of the school. At night this will be lit to present a warm glowing interior to the street.

6. Climate Change

A statement has been prepared that addresses how the proposed future development is responsive to the CSIRO projected impacts of climate change, which will specifically address:

- hotter days and more frequent heatwave events
- extended drought periods
- more extreme rainfall events
- gustier wind conditions

The identification of specific risks and how these risks have informed landscape design, material selection and social equity aspects (respite/shelter areas) have been documented in the following section.

The NSW and ACT Government Regional Climate Modelling (NARCliM) climate change projections will be referred to as the guideline for this assessment. This guideline states, according to long-term (1910–2013) observations, air temperatures have been increasing since the 1950s, with the highest temperatures on record being experienced in recent decades. The rate of change has also increased, with mean temperatures rising by 0.5°C per decade since 1990, compared to about 0.1°C per decade during the 1950s to 1980s. NSW is projected to continue to warm in the near future (2020–2039) and far future (2060–2079). The warming is projected to average about 0.7°C in the near future, increasing to up to 2.2°C in the far future in the Sydney Metropolitan area.

Table 11 Climate Change Risks and Design Mitigation

1. Hotter days and more frequent heatwave events	
Risk	
Significant risk is posed by the increase in average temperatures, including hotter days and more frequent heatwave events. Recommended mitigation measures include reducing the intensity of the urban heat island effect created by built forms with natural ventilation and soft scaping and increasing the resilience of infrastructure to heat-related failures through upgraded engineering design standards. For the Site: • Change in annual mean number of days with temperatures greater than 35ºC (1990 – 2009 to 2020-2039): 5 – 10 • Change in annual mean number of days with temperatures greater than 35ºC (1990 – 2009 to 2020-2039): 10 – 20	
Designed Mitigation	
Building scale	The proposed building has been kept to two levels to reduce its mass while maintaining adequate outdoor areas for school use for play, sports and recreation. The building is stepped with the fall of the land to the west. The courtyard form is compact and consolidated on the site.

Shade	All major play structures would include a shade structure as well as a designated covered play area that could be incorporated into the internal courtyards. Light coloured pavements are proposed in order to reduce heat loading and reduce the heat island effects caused by dark surfaces.
Planting	Tree planting within pavements and adjoining paved areas will also shade pavements further reducing heat loading. The new landscape will feature Cumberland Plain Woodland species to reinstate appropriate species endemic to the local area that will be more adapted and resilient to the local climate. Deciduous tree planting in front of north facing facades provides summer shading (cooling) of buildings and pavements and allows winter sun access for warming.
Roof Protection	A photovoltaic array has been designed to cover a large portion of the building's roof, to passively generate energy on site as well as to mitigate the risks of heat island effects resulting from large exposed roof areas.

2. Extended drought periods	
Risk	
NARClim states changes in rainfall patterns have the potential for widespread impacts. Seasonal shifts in rainfall can impact native species' reproductive cycles as well as impacting agricultural productivity; for example crops that are reliant on winter rains for peak growth. Rainfall changes are also associated with changes in the extremes, such as floods and droughts, as well as secondary impacts such as water quality and soil erosion that occur as a result of changes to rainfall intensity.	
Designed Mitigation	
Reduce Water Use	All bathroom and kitchen facilities have been fitted with water efficient fixtures to conserve water. Native plant species have been selected which are drought tolerant and require less water than introduced species.
Rainwater Collection	Rainwater runoff from hardstands is collected and re used on site.
Recycled Water Use	Irrigation if landscaped areas uses 80% recycled water. A generous water storage tank has been designed for the site, which exceeds national best practice standards (larger than the green star recommended size for this site).

3. More extreme rainfall events	
Risk	
Autumn rainfall is projected by the majority of models to increase across NSW in the near future and the far future.	
Designed Mitigation	
Detention	The detention of stormwater on site, including an on-site detention tank, has been designed to reduce the developed 1% AEP peak flow to the pre-developed flows through the incorporation of stormwater detention and management devices. A flood impact assessment has been conducted for the site, which determined the site is located outside the flood planning area. WSUD (Water Sensitive Urban Design) measures, such as terracing of landforms, slope stabilisation and vegetated drainage swales have been used to detain flows on site and reduce their impact downstream, which naturally improving water quality.
Capacity	On site stormwater drainage has been designed to accommodate the 100 year ARI rainfall event.
Protection of Infrastructure	The flows from the proposed development are designed to be conveyed towards proposed pit and pipe system on the site and away from built forms to minimise risk to infrastructure

4. Gustier wind conditions	
Risk	
The CSIRO and the Australian Bureau of Meteorology's State of the Climate Report (2018) that climate change can have a significant influence on the frequency, magnitude and impact of some types of compound events, such as high wind events. Extreme high wind events along the New South Wales coast are often associated with the simultaneous occurrence of an intense low pressure system, cold front and thunderstorms.	
Designed Mitigation	
Built Form	The sheltered courtyard affords a wind break to occupants The building has minimised its footprint, which reduces its impact on local wind funnelling
Robustness of chosen building materials	Building materials have been chosen for their durability. Quality in construction will ensure the building can withstand high wind loading to the façade.

Appendices

Appendix A – Green Star Design & 'As Built' Scorecard

Green Star - Self Assessment Scorecard

Project:	**Marsden Park New Primary School**
Targeted Rating:	**4 Star - Best Practice**

Core Points Available	Total Score Targeted
100	50.6

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED	Discipline	Compliance Requirements
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.	1.0	Accredited Professional	1	1	Management	GSAP must run at least one workshop covering the following: eligibility, environmental categories, point allocation and scores, documentation and compliance requirements, Technical Questions (TQs), certification process and Green Star branding and marketing rules.
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	Management	Must commit to set and document performance targets.
		2.1	Services and Maintainability Review	1	1	Management	Must demonstrate a comprehensive services and maintainability review has been conducted - summarised in a report.
		2.2	Building Commissioning	1	1	Management	Contractual tender or construction docs must list commissioning requirements for each system.
		2.3	Building Systems Tuning	1	1	Management	Commit to a tuning process - At a minimum, the commitment must include quarterly adjustments and measurement for the first 12 months after occupation and a review of building system manufacturer warranties.
		2.4	Independent Commissioning Agent	1	1	Management	Requires verification by an independent commissioning agent
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	Management	Needs to develop a project-specific Climate Adaptation Plan by a qualified, environmental scientist/engineer or planner including stakeholder consultation in accordance with AS5334:2013 or ISO 31000 - 2009 and The AGO's Climate Change Risks and Impacts: A Guide for Government and Business.
Building Information	To recognise the development and provision of building information that facilitates understanding of a	4.1	Building Information	1	1	Building Services	Operations and maintenance information will be developed and made available to the facilities management team and relevant and current building user information is developed and made available to all relevant stakeholders.
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	Management	At least 80% of GFA (ex carpark) is covered by commitment to set, measure and report env performance, incl; GHG emissions, potable water, operational waste, indoor environmental quality.
		5.2	End of Life Waste Performance	1	1	Waste	At least 80% of the project's GFA, excluding carparking areas, has a formal commitment in place to reduce demolition waste at the end of life of an interior fitout or base building component. A smaller proportion of compliant space may be rewarded partial points on a sliding-scale to one decimal place. Compliance must be demonstrated by providing a commitment to either: A. Establish contractual agreements, in accordance with 5.2A; or B. Achieve a certified operational performance rating for the building, addressing waste from refurbishments, in accordance with 5.2B.

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED	Discipline	Compliance Requirements
Metering and Monitoring	To recognise the implementation of effective energy and water metering and monitoring systems.	6.0	Metering	-	Complies	Building Services	Project teams must provide accessible metering to all energy and water common uses and major uses, and to energy and water sources provided by the project.
		6.1	Monitoring Systems	1	1	Building Services	One (1) point is awarded where a monitoring system is provided capable of capturing and processing the data produced by the installed energy and water meters. The monitoring system must accurately and clearly present the metered data and include reports on consumption trends, in accordance with Green Star requirements
Responsible Building Practices	To reward projects that use best practice formal environmental management procedures during construction.	7.0	Environmental Management Plan	-	Complies	Management	It is a minimum requirement of this credit that a project-specific best practice EMP is developed and implemented, to assist the Principal/Head Contractor and its service providers to manage environmental performance, conditions and impacts arising from demolition, excavation and construction. The EMP must cover environmental impacts arising from construction works, and it must be site-specific.
		7.1	Formalised Environmental Management System	1	1	Management	One (1) point is awarded where project teams demonstrate that a formalised systematic and methodical approach to planning, implementing and auditing is in place during construction, to ensure compliance with the EMP. The plan must be implemented by a responsible party with a formal environmental management system in place. For the purposes of this credit, this is achieved through a formalised environmental management system implemented by the key party responsible for managing the site. For projects with a contract value greater than $10 million, the formalised Environmental Management System must have been independently certified to a recognised standard, such as AS/NZS ISO 14001, BS 7750 or the European Community's EMAS. The certification party must be members of the International Accreditation Forum.
		7.2	High Quality Staff Support	1	1	Management	One (1) point is available where high quality staff support practices are in place that: - Promote positive mental and physical health outcomes of site activities and culture of site workers, through programs and solutions on site in accordance with 7.2.1; and,. - Enhance site workers' knowledge on sustainable practices through on-site, off-site, or online education programs in accordance with 7.2.2.
Operational Waste	Prescriptive Pathway	8A	Performance Pathway - Facilities	1	1	Waste	1 point is available where a waste professional prepares and implements an Operational Waste Management Plan (OWMP) for the project in accordance with best practice approaches and this is reflected in the building's design.
		8B	Prescriptive Pathway - Facilities	1			
Total				14	14		

Indoor Environment Quality				17			
Indoor Air Quality	To recognise projects that provide high air quality to occupants.	9.1	Ventilation System Attributes	1	1	Mechanical	1 point is available where: - The entry of outdoor pollutants is mitigated; - The system is designed for ease of maintenance and cleaning; and - The system has been cleaned prior to occupation and use.
		9.2	Provision of Outdoor Air	2	1	Mechanical	2 points are available where the nominated area is provided with sufficient outdoor air to ensure levels of indoor pollutants are maintained at acceptable levels. - One (1) point is awarded where outdoor air is provided at a rate 50% greater than the minimum required by AS 1668.2:2012, or carbon dioxide (CO2) concentrations are maintained below 800ppm; or - Two (2) points are awarded where outdoor air is provided at a rate 100% greater than the minimum required by AS 1668.2:2012, or CO2 concentrations are maintained below 700ppm.
		9.3	Exhaust or Elimination of Pollutants	1	1	Mechanical	One (1) point is awarded where project teams demonstrate that pollutants from printing and photocopying equipment, cooking processes and equipment, and vehicle exhaust, are limited from the nominated area by either: A. Removing the source of pollutants, in accordance with 9.3A; or B. Exhausting the pollutants directly to the outside, in accordance with 9.3B.
	To reward projects	10.1	Internal Noise Levels	1	1	Acoustic	One (1) point is awarded where project teams demonstrate that internal ambient noise levels in the nominated area are no more than 5dB(A) above the lower figure in the range recommended in Table 1 of AS/NZS2107:2016. - qualified acoustic consultant and in accordance with AS/NZS 2107:2016.

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED	Discipline	Compliance Requirements
Acoustic Comfort	that provide appropriate and comfortable acoustic conditions for occupants.	10.2	Reverberation	1	1	Acoustic	One (1) point is awarded where the reverberation time in the nominated area is below the maximum stated in the 'Recommended Reverberation Time' provided in Table 1 of AS/NZ 2107:2016. Reverberation refers to the persistent prolonged reflections of sound in a space. A technical definition is provided in AS/NZS 2107:2016. For residential projects, this criterion is 'Not Applicable'.
		10.3	Acoustic Separation	1	0	Acoustic	1 point is available where the nominated enclosed spaces have been built to minimise crosstalk between rooms, and between rooms and open areas.
Lighting Comfort	To encourage and recognise well-lit spaces that provide a high degree of comfort to users.	11.0	Minimum Lighting Comfort	-	Complies	Electrical	It is a minimum requirement of this credit that lights in the nominated area are flicker-free and accurately address the perception of colour in the space.
		11.1	General Illuminance and Glare Reduction	1	1	Architecture	One (1) point is awarded where project teams can demonstrate that for 95% of the nominated area, lighting levels comply with best practice guidelines and glare is eliminated in accordance with the following requirements.
		11.2	Surface Illuminance	1	1	Architecture	One (1) point is awarded where project teams can demonstrate that a combination of lighting and surfaces improve uniformity of lighting to give visual interest in the nominated area. There are two options provided for demonstrating compliance with this requirement, a prescriptive method and a performance method. A combination of methods is acceptable for demonstrating compliance.
		11.3	Localised Lighting Control	1	1	Electrical	One (1) point is awarded where project teams can demonstrate that for 95% of the nominated area, occupants have the ability to control the lighting in their immediate environment. This includes turning the lights on and off and adjusting their light levels.
Visual Comfort	To recognise the delivery of well-lit spaces that provide high levels of visual comfort to building occupants.	12.0	Glare Reduction	-	Complies	Architecture	It is a minimum requirement for this credit that glare from sunlight through all viewing façades and skylights in the nominated area is reduced through a combination of blinds, screens, fixed devices, or other means. Three options are provided and a combination of the methods outlined can be used to demonstrate compliance with this minimum requirement. For viewing facades (except skylights) , the nominated plane is at ground level and is a narrow band along the entire length of viewing façade, 1.5m in from the viewing façade. For skylights, the nominated plane is the skylight. The nominated plane must be shown to be shaded from direct sunlight for 80% of the nominated hours for each day of the autumn and spring equinoxes and the summer and winter solstices
		12.1	Daylight	2	0	Architecture	Need to demonstrate that a specific proportion of nominated area receives a high level of daylight. For 1 point - 40% of the nominated area and for 2 points - 60% of the nominated area (nominated area includes all primary spaces).
		12.2	Views	1	1	Architecture	One (1) point is awarded where at least 60% of the nominated area has a clear line of sight to a high quality internal or external view. All floor areas within 8m from a compliant view can be considered to meet this credit criterion.
Indoor Pollutants	To recognise projects that safeguard occupant health through the reduction in internal air pollutant levels.	13.1	Paints, Adhesives, Sealants and Carpets	1	0	Architecture	1 point is available where at least 95% of all internally applied paints, adhesives, sealants and carpets meet stipulated 'Total VOC Limits', or, where no paints, adhesives, sealants or carpets are used in the building.
		13.2	Engineered Wood Products	1	1	Architecture	1 point is available where at least 95% of all engineered wood products meet stipulated formaldehyde limits or no new engineered wood products are used in the building.
Thermal Comfort	To encourage and recognise projects that achieve high levels of thermal comfort.	14.1	Thermal Comfort	1	1	Architecture	One (1) point is awarded where project teams demonstrate that, for 95% of the nominated area and 98% of the year, a high degree of thermal comfort is provided. - Naturally ventilated spaces must be within 80% of limits provided (ASHRAE 55-2013)
		14.2	Advanced Thermal Comfort	1	0	Architecture	The internal temperatures in each space are within 90% of Acceptability Limit 1 of ASHRAE Standard 55-2013, in accordance with 14.1.1
Total				17	11		

Energy	Performance Pathway 15E			22			
		15A.0	Conditional Requirement: Prescriptive Pathway	-	Complies	Building Services	For each pathway a Conditional Requirement must be met in order for the project to be eligible for Green Star – Design & As Built rating
		15A.1	Building Envelope	1			
		15A.2	Glazing	1			
		15A.3	Lighting	1			
		15A.4	Ventilation and Air-conditioning	1			
		15A.5	Domestic Hot Water Systems	1			

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED	Discipline	Compliance Requirements
Greenhouse Gas Emissions	E. Modelled Performance Pathway	15A.6	Accredited GreenPower	5			
		15B.0	Conditional Requirement: NatHERS Pathway	-			
		15B.1	NatHERS Pathway	-			
		15C.0	Conditional Requirement: BASIX Pathway	-			
		15C.1	BASIX Pathway	-			
		15D.0	Conditional Requirement: NABERS Pathway	-			
		15D.1	NABERS Energy Commitment Agreement Pathway	-			
		15E.0	Conditional Requirement: Reference Building Pathway	-	complies	Building Services	Project teams must demonstrate that the operational greenhouse gas (GHG) emissions from the Proposed Building are less than those of the equivalent Benchmark Building. The Benchmark Building represents a 10% improvement on the Reference Building. The Reference Building is a building which achieves minimal compliance with the NCC Section J DTS provisions.
		15E.1	Comparison to a Benchmark Building Pathway	-	3.6	Building Services	Up to 20 points are available for this credit. Points are awarded independently for improving on the building's fabric against a Reference Building (4 points), and for reducing emissions against the Benchmark Building (16 points).
Peak Electricity Demand Reduction	Prescriptive Pathway	16A	Prescriptive Pathway - On-site Energy Generation	1	0	Building Services	It must be demonstrated that the use of on-site electricity generation systems reduces the total peak electricity demand by at least 15%
		16B	Performance Pathway - Reference Building	-	1		Up to 2 points are available where it is demonstrated that the project's predicted peak electricity demand has been reduced below that of a Reference Building: - 20% : 1 point - 30%: 2 points
Total				11	4.6		

Transport				10			
Sustainable Transport	Prescriptive Pathway	17A.1	Performance Pathway	0			
		17B.1	Access by Public Transport	3	0	Traffic	Up to 10 points are awarded under this pathway. Points are awarded based on a holistic approach to reducing the impacts from transport, where the proposed building performance is improved when compared to a reference building across four indicators: - Emissions reduction; - Active mode encouragement; - Vehicle kilometres travelled reduction; and - Walkable location.
		17B.2	Reduced Car Parking Provision	1	1	Traffic	1 point is available where there is a reduction in the number of car parking spaces in the proposed building when compared to a standard-practice building, as per Green Star guidelines. - Disabled parking and loading zones (parking not used to transport people to the site) may be excluded from the count.
		17B.3	Low Emission Vehicle Infrastructure	1	0	Traffic	1 point is available where parking spaces and/or dedicated infrastructure is provided to support the uptake of low-emission vehicles.
		17B.4	Active Transport Facilities	1	1	Traffic	One (1) point is awarded where bicycle parking and associated facilities are provided to a proportion of the building's regular occupants and visitors. Numbers of bicycle parking facilities to be staged to match development equivalent to secure bicycle parking is provided for 40% of students over grade 4, in addition to permanent building occupants (staff) as per Green Star guidelines.

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED	Discipline	Compliance Requirements
		17B.5	Walkable Neighbourhoods	1	0	Traffic	One (1) point is awarded where the project complies with one of the following options: - The project is located so that at least four (4) amenities for industrial buildings, or at least eight (8) amenities for all other types of buildings, are within 400m of the project. The distance is to be measured from the centre of the project's site; or - The project achieves a Walk Score of at least 70 for industrial buildings, or at least 80 for all other types of buildings, as determined by the website www.walkscore.com, using the 'street smart' method of calculation.
Total				7	2		
Water				12			
Potable Water	Prescriptive Pathway	18A.1	Potable Water - Performance Pathway	0			
		18B.1	Sanitary Fixture Efficiency	1	1	Architecture	One (1) point is awarded where all fixtures are within one star of the WELS rating listed in the Green Star Guidelined.
		18B.2	Rainwater Reuse	1	1	Hydraulic	One (1) point is awarded when a rainwater tank is installed to collect and reuse rainwater, within the project's site boundary as deemed appropriate by the project team. The rainwater tank size must meet the criteria set out in the Green Star Guidelines
		18B.3	Heat Rejection	2	2	Mechanical	Two (2) points are awarded where no water is used for heat rejection. To comply, the project must be either naturally ventilated (allowing for the use of ceiling fans or similar) or the HVAC system must not use water for heat rejection.
		18B.4	Landscape Irrigation	1	0	Landscape	One (1) point is awarded where either drip irrigation with moisture sensor override is installed, or where no potable water is used for irrigation. Moisture sensor override installation required
		18B.5	Fire System Test Water	1	1	Fire	One (1) point is awarded when one of the following conditions is met: - The fire protection system does not expel water for testing; or - The fire protection system includes temporary storage for 80% of the routine fire protection system test water and maintenance drain-downs for reuse on-site calculated on the basis that any single zone is drained down annually. - If sprinkler systems are installed, each floor must be fitted with isolation valves or shut-off points for floor-by-floor testing.
Total				6	5		
Materials				14			
Life Cycle Impacts	Prescriptive Pathway - Life Cycle Impacts	19A.1	Comparative Life Cycle Assessment	0			
		19A.2	Additional Life Cycle Impact Reporting	4			
		19B.1	Concrete	3	1	Structural	Up to 2 points are available where the Portland cement content in all concrete used in the project has been 2 points are available where the Portland cement content is reduced by 40%, measured by mass across all concrete used in the project compared to the reference case. 0.5 point is available where the mix water for all concrete used in the project contains at least 50% captured or reclaimed water (measured across all concrete mixes in the project). 0.5 point is available where either: At least 40% of coarse aggregate in the concrete is crushed slag aggregate or another alternative materials (measured by mass across all concrete mixes in the project), provided that use of such materials does not increase the use of Portland cement by over five kilograms per cubic meter of concrete; OR At least 25% of fine aggregate (sand) inputs in the concrete are manufactured sand or other alternative materials (measured by mass across all concrete mixes in the project), provided that use of such

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED	Discipline	Compliance Requirements
		19B.2	Steel	1	1	Structural	Either - Up to 1 point is available when there is a reduction in the mass of steel framing used when compared to standard practice, OR Up to 1 point is available when there is a reduction in the mass of steel reinforcement used when compared to standard practice. Dependant on the primary structure of the building.
		19B.3	Building Reuse	4	0	Architecture	Where the site contained no buildings at the time of purchase, or the total GFA of the original building(s) is less than 20% of the GFA of the new building that replaces it, the 'Life Cycle Impacts – Building Reuse' pathway cannot be targeted.
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	1	1	Structural	1 point is available where 95% of the building's steel (by mass) is sourced from a Responsible Steel Maker; and - For steel framed buildings, at least 60% of the fabricated structural steelwork is supplied by a steel fabricator/steel contractor accredited to the Environmental Sustainability Charter of the Australian Steel Institute (ASI); or - For concrete framed buildings, at least 60% (by mass) of all reinforcing bar and mesh is produced using energy-reducing processed in its manufacture (measured by average mass by steel maker annually). Where the cost of structural and reinforcing steels is less than 1% of the Project Contract Value, or there are no new structural or reinforcing steels used in the project, this criterion is made 'Not Applicable'.
		20.2	Timber Products	1	1	Architecture	1 point is available where at least 95% (by cost) of all timber used in the building and construction works is either: - Certified by a forest certification scheme that meets the GBCA's 'Essential' criteria for forest certification; or - Is from a reused source. Where the cost of timber is less than 0.1% of the Project Contract Value, this criterion is made 'Not Applicable'.
		20.3	Permanent Formwork, Pipes, Flooring, Blinds and Cables	1	1	Architecture	1 point is available where 90% (by cost) of all permanent formwork, pipes, flooring, blinds and cables in a project either: - Do not contain PVC and have a recognised product declaration; or - Meet the GBCA's Best Practice Guidelines for PVC. Interdisciplinary coordination needed, i.e Civil, architecture, mechanical, structural
Sustainable Products	To encourage sustainability and transparency in product specification.	21.1	Product Transparency and Sustainability	3	1	Architecture	Up to 3 points are available when a proportion of all materials used in the project meet transparency and sustainability requirements under one of the following initiatives: A. Reused Products; B. Recycled Content Products; C. Environmental Product Declarations; D. Third-Party Certification; or E. Stewardship Programs. Points are calculated based on specified benchmarks for the percentage of compliant products used in the project
Construction and Demolition Waste	Fixed Benchmark	22A	Fixed Benchmark	1	1	Waste	Up to one (1) point is awarded based on the reduction of construction and demolition waste going to landfill. There are two options for demonstrating compliance with this credit: A. Minimising the total amount of waste sent to landfill when compared against a fixed benchmark, in accordance with 22A (Fixed Benchmark - comparison to a typical building); or B. Minimising the total amount of waste sent to landfill as a proportion of total waste generated, in accordance with 22B (% Benchmark).
		22B	Percentage Benchmark	-			
Total				12	7		

Land Use & Ecology				6			
Ecological Value	To reward projects that improve the ecological value of their site.	23.0	Endangered, Threatened or Vulnerable Species	-	Complies	Planning	The minimum requirement is met where the project can demonstrate that at the date of site purchase or option contract, no critically endangered, endangered or vulnerable species, or ecological communities were present on the site.
		23.1	Ecological Value	3	0	Landscape	Up to 3 points are awarded where the ecological value of the site is improved by the project. The number of points awarded is determined by the Ecological Value Calculator based on a comparison of the condition of the site before and after design/construction.
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	Planning	The Conditional Requirement is met where, at the date of site purchase or option contract, the project site did not: - Include old growth forest; - Include prime agricultural land; - Include a wetland of 'High National Importance'; or - Impact on 'Matters of National Significance'.
		24.1	Reuse of Land	1	0		
		24.2	Contamination and Hazardous Materials	1	0	Contamination	1 point is available where the site, or an existing building, was previously contaminated and the site has been remediated in accordance with a best practice remediation strategy.

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED	Discipline	Compliance Requirements
Heat Island Effect	To encourage and recognise projects that reduce the contribution of the	25.0	Heat Island Effect Reduction	1	0	Electrical	1 point is available when at least 75% of the WHOLE SITE AREA comprises of one or a combination of vegetation, green roofs or a prescribed solar reflectance index
Total				6	0		

Emissions				5			
Stormwater	To reward projects that minimise peak stormwater flows and reduce pollutants entering public sewer	26.1	Stormwater Peak Discharge	1	0	Civil	One (1) point is awarded where project teams demonstrate that the post-development peak event stormwater discharge from the site does not exceed the pre-development peak event stormwater discharge, using the Average Recurrence Interval (ARI)
		26.2	Stormwater Pollution Targets	1	0	Civil	Additional point for all stormwater discharged from the site meeting required pollution reduction targets - need to measure against untreated runoff. Testing is required.
Light Pollution	To reward projects that minimise light pollution.	27.0	Light Pollution to Neighbouring Bodies	-	Complies	Planning	All outdoor lighting on the project complies with AS 4282:1997 Control of the obtrusive effects of outdoor lighting
		27.1	Light Pollution to Night Sky	1	1	Electrical	One (1) point is awarded where it can be demonstrated that one of the following specified reductions in light pollution has been achieved by the project. A. Control of upward light output ratio (ULOR), in accordance with 27.1A; or B. Control of direct illuminance, in accordance with 27.1B.
Microbial Control	To recognise projects that implement systems to minimise the impacts associated with harmful microbes in building systems.	28.0	Legionella Impacts from Cooling Systems	1	1	Mechanical	1 point is available where the building: - Is naturally ventilated; or - Has waterless heat-rejection systems; or - Has water-based heat rejection systems that includes measures for Legionella control and Risk Management
Refrigerant Impacts	To encourage operational practices that minimise the environmental impacts of refrigeration equipment.	29.0	Refrigerants Impacts	1	1	Mechanical	1 point is awarded where one of the following criteria is achieved: - The calculated Total System Direct Environmental Impact (TSDEI) of the refrigerant systems in the building is less than 15; or - The calculated TSDEI of the refrigerant systems is between 15 and 35, AND a leak detection system ‖with automated refrigerant recovery is in place ‖R1.29.01; or - All refrigerants in the project have an ozone depletion potential of zero, and a global warming potential of 10 or less; or - Where there are no refrigerants employed within the building systems, this point is awarded
Total				5	3		

Innovation				10			
Innovative Technology or Process	The project meets the aims of an existing credit using	30A	Innovative Technology or Process				
Market Transformation	The project has undertaken a sustainability initiative that substantially contributes to the broader market transformation towards sustainable development in Australia or in the world.	30B	Market Transformation		1	Management	
				10			

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED	Discipline	Compliance Requirements
Improving on Green Star Benchmarks	The project has achieved full points in a Green Star credit and demonstrates a substantial improvement on the benchmark required to achieve full points.	30C	Improving on Green Star Benchmarks	10	1	Building Services	
Innovation Challenge	Where the project addresses an sustainability issue	30D	Innovation Challenge		1	Cultural and Heritage	
Global Sustainability	Project teams may adopt an approved credit from a Global	30E	Global Sustainability		1	Architecture	
Total				10	4		

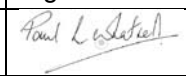
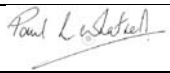
TOTALS	AVAILABLE	SELF-ASSESSMENT
CORE POINTS	100	46.6
CATEGORY PERCENTAGE SCORE		46.6
INNOVATION POINTS	10	4.0
TOTAL SCORE TARGETED		50.6

GHD

Level 15
133 Castlereagh Street, Sydney NSW 2000
T: +61 2 9239 7100 W: www.ghd.com

\ESD Report - Marsden Park New Primary School.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	JS, AA, MS	Paul Whatnell		Paul Whatnell		17/07/19

www.ghd.com