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SUSTAINABILITY

STEENSEN VARMING

Gledswood Hills High School (GHHS) – Sustainability Report

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1.0 Introduction and declaration

This report has been prepared by Steensen Varming on behalf of the Department of Education NSW to assess the potential environmental impacts that could arise from the proposed activity of the new Gledswood Hills High School (the **activity**) at 9 Gregory Hills Drive, Gledswood Hills (the **site**). The works are proposed by the Department of Education to meet the growth in educational demand in Gregory Hills and Gledswood Hills, and the broader South-West Growth Area.

This document has been prepared in accordance with the Guidelines for Division 5.1 assessments – Consideration of environmental factors for health services facilities and schools, October 2024 (the Guidelines) by the Department of Planning, Housing and Infrastructure.

The ESD design strategies for this activity have been developed in accordance with the following guidelines and standards:

- Government Resource Efficiency Policy (GREP)
- State Environmental Planning Policy (Sustainable Buildings) 2022
- SINSW Educational Facilities Standards & Guidelines (EFGS v2.0)
- National Construction Code of Australia (NCC) 2022
  Green Star Buildings V1
- Environmental Planning and Assessment Regulations 2021

This document also includes a Net-Zero Energy Statement provided in Appendix A, a Green Star scorecard in Appendix B, and a Climate Change Risk Assessment in Appendix C.

1.1 Documentation Review

The following plans/ reports identified in Table 1 have been reviewed to inform the assessment contained within this report:

Table 1: Documents reviewed

Discipline	Document Name	Revision	Date
Architecture	SD issued for tender	01	29/11/24
Mechanical	SD issued for tender	A	15/11/24
Electrical & Lighting	SD issued for tender	A	15/11/24
Biodiversity Report	Gledswood Hills High School – Biodiversity Report	-	17/12/24

1.2 Proposed Activity Description

The Proposal will involve the construction and operation of a new high school at the site, which involves the following works:

- A series of school buildings along the northern, eastern and southern site boundaries.
- A school hall.
- An assembly area, sports field and multi sports courts.
- Car parking and a Kiss and Drop zone.
- Associated on and off-site infrastructure to support the school, including a new pedestrian crossing and relocation of the existing bus stop on Gregory Hills Drive to the site frontage.

Figure 1 shows the proposed site plan for Gledswood Hills High School (GHHS).

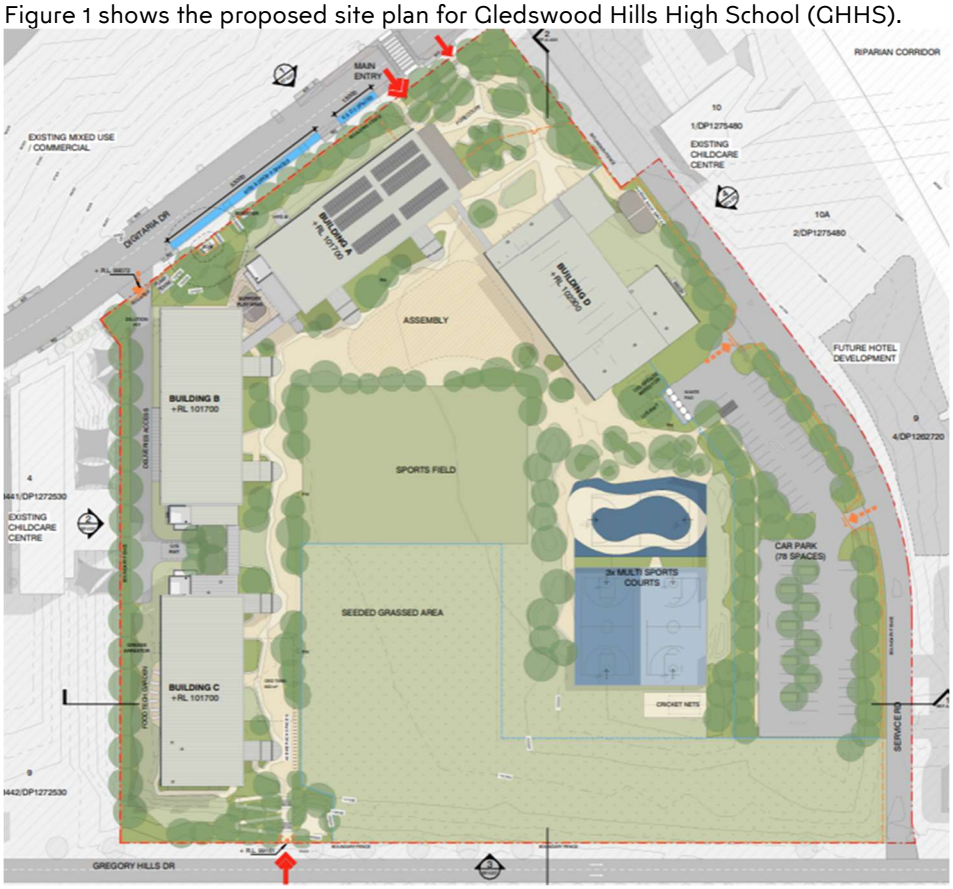

Figure 1: Proposed Site Plan for GHHS. Source: djrd Architects, December 2024.

The Review of Environmental Factors prepared by Ethos Urban provides a full description of the proposed works.

2.0 Site Description

The site is located at 9 Gregory Hills Drive, Gledswood Hills, within the Camden Local Government Area, approximately 60km southwest of the Sydney CBD and approximately 3.5km from Narellan Town Centre. It comprises one lot, legally described as Lot 2 in DP 1262720, that measures approximately 4.15ha in area. The site is bound by Digitaria Drive to the north and Gregory Hills Drive to the south. To the east lies two vacant lots, a childcare centre, and a fast-food outlet. To the west lies another childcare centre and a vacant lot (which also has approval for a childcare centre).

An aerial image of the site is shown at the figure below.

Figure 2: Aerial Photograph

2.1 Need for Activity

As part of the NSW Government's plan to rebuild public education, the 2024-25 budget is delivering record education funding, for new and upgraded schools in Western Sydney. This targeted investment will ensure growing communities get access to a world class public education.

This project will deliver a new high school for the growing communities in Gledswood Hills and Gregory Hills. The Gledswood Hills High School is scheduled in two stages. Stage 1 is planned to cater for 1000 students with approximately 36 teaching spaces.

2.2 Significance of Environmental Impacts

Based on the identification of potential issues, and an assessment of the nature and extent of the impacts of the proposed activity, the report includes details reflecting that:

- The extent and nature of potential impacts are low and will not have significant impact on the locality, community and/or the environment.
- Potential impacts can be appropriately mitigated or managed to ensure that there is minimal impact on the locality, community and/or the environment.

3.0 REF Reporting Requirements & Responses

This section addresses the REF requirements issued for the project as well as the requirements of the Sustainable Buildings SEPP 2022. Furthermore, it presents the EFSG Requirements and the targeted Green Star Credits. The requirements and the associated responses are outlined along with corresponding references to sections both within this report and in relevant reports. The requirements under the Turner Road Precinct DCP have also been reviewed and it has been identified that they are applicable only to residential development.

3.1 Response to Section 171 of the EP&A Regulation 2021

The following environmental factors have been specified in review of Section 171 of the EP &A Regulation 2021 under the EP & A Act 179:

- the environmental impact on the community,
- the transformation of the locality,
- the environmental impact on the ecosystems of the locality,
- reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality,
- the effects on any locality, place or building that has—
    - aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance, or
    - other special value for present or future generations,
- the impact on the habitat of protected animals, within the meaning of the *Biodiversity Conservation Act 2016*,
- the endangering of a species of animal, plant or other form of life, whether living on land, in water or in the air,
- long-term effects on the environment,
- degradation of the quality of the environment,
- risk to the safety of the environment,
- reduction in the range of beneficial uses of the environment,
- pollution of the environment,
- environmental problems associated with the disposal of waste,
- increased demands on natural or other resources that are, or are likely to become, in short supply,
- the cumulative environmental effect with other existing or likely future activities,
- the impact on coastal processes and coastal hazards, including those under projected climate change conditions,
- applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1,
- other relevant environmental factors.

Of the above REF environmental factors, the factors that are applicable to the proposed activity are outlined in the following table, with a corresponding response.

Table 2: REF Requirements and Relevant Responses and References

Item	REF Requirement	Report Reference	Response
1.0	Any environmental impact on a community	**Section 2.1**	To provide world class education for growing communities.
2.0	Any environmental impact on the ecosystems of the locality	**Section 4.2**	The site is located on the biodiversity certified land and the project team has provided a Biodiversity report with relevant information.
3.0	Any risk to the safety of the environment	**Section 4.3**	Climate Change Adaptation and Risk Assessment has been conducted to incorporate design measures for resilience.
4.0	Any reduction in the range of beneficial uses of the environment	**Section 5**	Mitigation measures
5.0	Any pollution of the environment	**Section 4.9** Minimization of waste **Section 4.10** Embodied Carbon emissions reduction	90% of the construction and demolition waste is to be diverted from landfill. Environmental management plan to cover the scope of construction activities.
6.0	Any environmental problems associated with the disposal of waste	**Section 4.9**	Construction and Operational waste management strategies
7.0	Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply	**Section 4.4** Passive Design **Section 4.5** Reduction in demand for electricity **Section 4.6**Energy Efficiency	Optimization of façade to promote day-light and natural ventilation to reduce cooling load demand. M&E design strategies and equipment efficiency to reduce energy demand. Net-zero by 2050 Goal Provision of PV panels to generate green power for the activity.

3.2 Project response to Section 3.2 (1) of the SEPP (Sustainable Buildings) 2022

This section has been prepared to address the relevant activity requirements outlined in Chapter 3.2 (non-residential development) of the State Environmental Planning Policy (Sustainable Buildings) 2022. The following table summarises the requirements:

Table 3: Project response to SEPP Sustainable buildings 2022

Clause No.	SEPP SB (2022) Chapter 3.2 Requirement	Report Reference
3.2 (1)	(a) the minimisation of waste from associated demolition and construction, including by the choice and reuse of building materials	Refer to **Section 4.9** (Minimisation of waste)
3.2 (1)	(b) a reduction in peak demand for electricity, including through the use of energy efficient technology	Refer to **Section 4.5** (Reduction in peak demand for electricity)

3.2 (1)	(c) a reduction in the reliance on artificial lighting and mechanical heating and cooling through passive design	Refer to **Section 4.4** (Passive design)
3.2 (1)	(d) the generation and storage of renewable energy	Refer to **Section 4.6** (Energy efficiency)
3.2 (1)	(e) the metering and monitoring of energy consumption	Refer to **Section 4.7** (Metering and monitoring)
3.2 (1)	(f) the minimisation of the consumption of potable water	Refer to **Section 4.8** (potable water consumption)
3.2 (2)	The embodied emissions attributable to the development have been quantified	Refer to **Section 4.10** (Embodied emissions)

3.3 Green Star Scorecard

The project will be targeting a formal Green Star Certification, under the Green Star – Buildings v1. In alignment with NSW GREP, the project will aim for a 5-Star Rating.

To achieve the targeted rating the project must achieve a total of 35 points plus at least 5 buffer points within the rating tool. The table below provides a summary of the Green Star points currently targeted per category as listed in the table below. In addition to the targeted 40 points, further stretch points have been identified to serve as an alternative consideration, should any of the targeted points not be achievable:

Table 4: Summary of GS points

Category	Points Available	Minimum Requirements	Points Targeted	Stretch points	Required Points for 5 Star
Total	**116**	**15**	**40**	**17**	**35 (+ 5 buffer)**
Responsible	**17**	**3**	**8**	**1**	
Healthy	**14**	**4**	**11**	**1**	
Resilient	**8**	**1**	**4**	**1**	
Positive	**30**	**4**	**6**	**0**	
Places	**8**	**1**	**4**	**4**	
People	**9**	**1**	**5**	**3**	
Nature	**14**	**1**	**2**	**4**	
Leadership	**16**	**0**	**0**	**3**	

Refer to the **SINSW Group-1 Schools – Green Star Master Specification** by Steensen Varming further details on the targeted Green Star Credits. For a full Green Star Register Scorecard, please refer to **Appendix B**.

3.4 Project response to EFSG Requirements

The latest Educational Facilities Standards and Guidelines (EFSG) 2.0 standards and guidelines do not provide an updated ESD schedule. The project commitments have been checked for compliance using EFSG ESD Schedule V9. An overlap with has been observed between EFSG and the Green Star Buildings Rating requirements. Hence, if and any requirements not covered in Green Star shall be addressed separately.

Within the EFSG there are some mandatory requirements and some recommended ones, the project will meet all mandatory ones and will aim to comply with as many as possible from the recommended ones.

The following table identifies and addresses the sustainability strategy and requirements under EFSG which do not overlap with Green Star Buildings V1 system.

Table 5: EFSG ESD Schedule V9

Sustainable Strategy	Requirements	Response
Build Resilience	**Weather Protection** Circulation areas provided between administrative, staff and all student spaces (except Agriculture), should be protected from sun, rain and unfavourable winds.	The proposed site layout plans show well-lit, and weather protected building access provided between building blocks.
Consume Responsibly	**Building Flexibility** Position structural members considering the future flexibility of the structure. Avoid ad hoc placing of columns internally, giving preference to uniformity in layout. Design all internal walls as non-load bearing to enable future flexibility.	The project follows Hub Layout design strategy to allow for future flexibility. & uniformity. The future expansion plan provided complies with the layout requirement.
Consume Responsibly	**Trade waste** Arrestors for acid, grease, plaster and clay of adequate capacity must be installed to treat wastewater from science laboratories, kitchens, art rooms and canteens as required in DG52.	Design details such as drawings or letter from Hydraulic Engineer confirming the trade waste arrestors shall be installed to treat wastewater from cafes, kitchens art rooms and laboratories.
Foster Connections	**Open play space** Open play space must be provided for students to access during recess, lunch breaks and for outdoor learning. Open play space can be comprised of: - Paved and grassed areas - Rooftops and terraces - Covered outdoor areas The designated open play space must be easily monitored and managed by school staff. Where a joint use agreement can be negotiated with a local council or landowner, the required play space can be located off-site, providing the facilities are: - In close proximity to the school - Easily accessible - Safe and secure Designs must aim to achieve a minimum of 10m^2 per student. Where this figure is not achievable the proposed m^2 per student of the completed project must not be less than the existing m^2 per student currently on the site.	The proposed stage 01 drawings show the provision of open play spaces including multi-sports courts, sports field, and grassed area within the project boundary. The requirement to achieve a minimum of 10m^2 per student has been confirmed in proposed open play space calculations drawing dated 14 August 2024.

Sustainable Strategy	Requirements	Response
Unlock Human Potential	**Noise emission (to the environment)** Generally, noise emission to the environment from mechanical services noise sources (such as air conditioners) are the subject of a development consent conditions. In NSW the development consent conditions will refer to the Industrial Noise Policy (INP) or Local Council requirement. Where no condition regarding noise sources exists for a school development, noise emission from such sources should be designed, in-principle, to satisfy the requirements of the Industrial Noise Policy.	The acoustic consultant has issued the relevant acoustic design consideration for external noise intrusion and noise emission from M&E equipment to demonstrate compliance.
Unlock Human Potential	**Fly free indoors** Fly screening must be provided in all schools to the doors, windows and other openings in food preparation, biology, and non-water-closet toilet spaces or where specifically nominated in the EFSG. Schools in localities where fly incidence constitutes a health hazard (especially trachoma or other nuisance) will require fly screens to all opening sashes.	To be incorporated in the architectural design at the discretion of SINSW.
Unlock Human Potential	**Pesticide free environments** Schools must be designed, constructed and maintained, without using chemicals for termite and other pest control. No chemical pesticides and termicide to be used. Preventive treatments to be by physical means and careful design to minimise risk	Declaration and documentation to be provided by head contractor that no pesticides or termites shall be used in the construction stage. For maintenance scope, which is on-going operational requirement, the implementation shall be followed by SINSW Asset Maintenance Unit (AMU).

4.0 Sustainability Approach

The sustainability requirements for the Gledswood Hills High School, including the EP &A Regulation 2021, SEPP (Sustainable Buildings), EFSG, and Green Star Buildings v1, are reviewed to compile a sustainability approach in consultation with the SINSW Sustainability team. Relevant design documentation and reports to support these strategies have been developed and shared with the design team to inform the requirements for the following Detailed Design stage and subsequent Construction stage, where it will be the responsibility of the contractor to implement the targeted strategies.

4.1 Overview of key ESD strategies

- **Optimised Indoor Environmental Quality (IEQ)**
  Design high quality spaces to promote comfortable and productive learning environments, while supporting the functional demand of the building, i.e., a learning / teaching environment. Key design emphasis is on providing optimised Indoor Environmental Quality (IEQ) and occupant comfort, including optimised indoor air quality, thermal, acoustic, and visual comfort. This is achieved through a high level of internal natural daylight and ventilation within the proposed buildings.

- **High-performance building envelope**
  Incorporate a high-performance building envelope, to ensure energy efficiency as well as occupant comfort (including thermal, visual, and acoustic comfort). This is demonstrated by adopting a 20% improvement of the DTS requirement of Section J as a project requirement.

- **Incorporate passive design**
  Incorporate appropriate passive design strategies, such as improved fabric thermal performance and active design strategies that include low energy active systems (mechanical and lighting systems) to ensure a low-energy and low-maintenance design outcome.

- **Water Sensitive Urban Design**
  Adopt Water Sensitive Urban Design (WSUD) principles that include rainwater reuse for landscape irrigation, planting of low water species and stormwater management.

- **Minimise construction and operational waste**
  Adopt practices to minimise construction and operational waste including recycling of construction and operational waste. This includes consideration for use of modular and prefabricated components in design, selection of recycled and reprocessed materials, returning package to the supplier, purchasing policies and auditing/ monitoring for the same.

- **Sustainable material selection and waste handling**
  Utilise environmentally preferable materials, such as low carbon concrete and steel, selection of sustainable materials with low VOC's and formaldehyde content and have their Environmental Product Declaration (EPD) certificates.

The following diagram shows the key ESD strategies and a site analysis for GHHS:

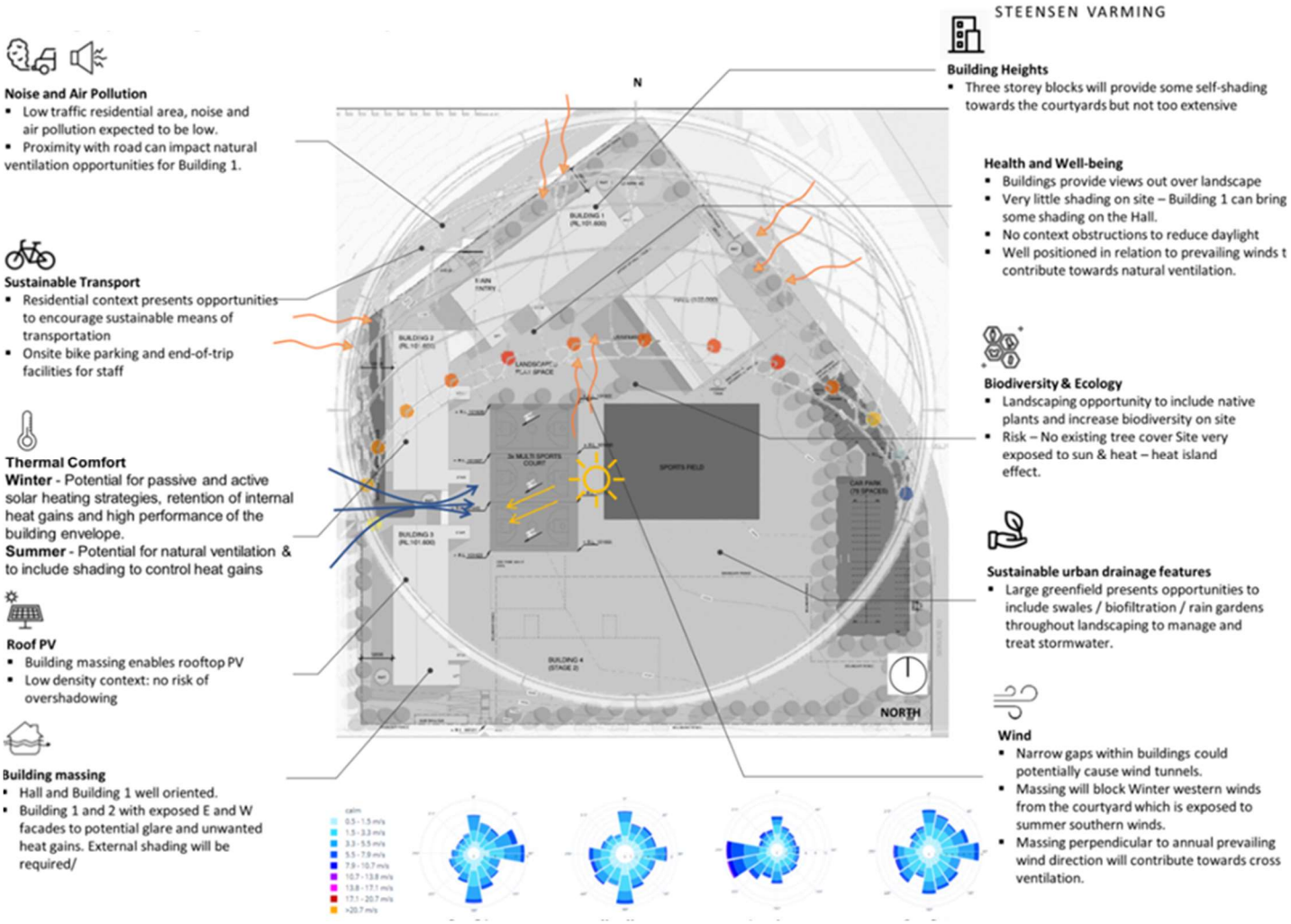

Figure 3: Key ESD considerations and site analysis

4.2 Impact on Biodiversity

In accordance with **Green Star Credit 35 (Impact on Nature)** a Biodiversity Report has been provided by Travers Bushfire & Ecology (TBE) on behalf of the NSW Department of Education (DoE) to assess the potential environmental impacts that may arise from the proposed new Gledswood Hills High School.

Figure 4: Site location within Certified Lands for South West Growth Centres

The project stakeholders have also conducted soil contamination test for the existing site to implement mitigation measures in the event of unexpected finds. The Detailed Site Investigation (DSI) indicates no contamination. It is confirmed that the activity complies with Credit 35 Minimum Expectation.

A landscape strategy has been developed to enhance the environmental performance of the land to meet or improve beyond its existing condition, including integration of native plant species and incorporation of water sensitive urban design features to passively manage storm water across the site and enhance biodiversity. Also, the arrangement of plantation and selection of hardscape materials with high Solar Reflective Index (SRI) is done to assist with the reduction of urban heat island effect. Refer to Figure 5 below.

Figure 5: Landscape Masterplan (Issue 01 by Site Image, 29/11/24)

4.3 Resilience

In accordance **with Green Star Credit 16 (Climate Change Resilience), Credit 17 (Operations Resilience) and Credit 18 (Community Resilience)**, the project has identified and developed strategies to increase the resilience of the proposed activity in response to potential risks arising from climate change.

The latest available global climate models show that in the coming decades, NSW is projected to experience the following:

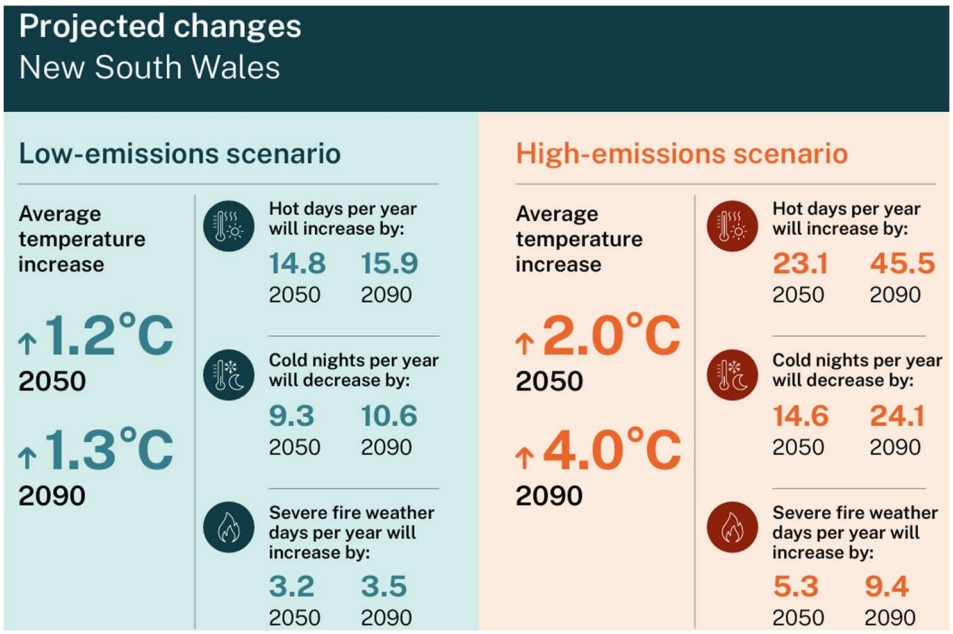

Figure 6: Summary diagram of climate projections for NSW. Source: NARCLiM 2 Climate Change Snapshot / NARCliM2-Snapshot-NSW.pdf

The below climatic variables have been considered to develop a resilience strategy for the school:

- Temperature
- Precipitation
- Fire weather/Bushfires
- Drought
- Flood
- Solar Radiation
- Relative Humidity
- Evapotranspiration
- Soil Moisture
- Wind
- Sea-level rise
- Cyclone

A Climate change workshop was conducted during the early design stage to discuss the Climate Change impacts/ risks on the design and to assess how the design and services strategy will respond to future expected climate conditions or develop risk mitigation strategies.

The **following key climate change risk mitigation strategies** are considered for the proposed new high school:

- Passive Design Optimisation: (Increased thermal performance of the building envelope/ Shading / Air tightness / Heat recovery / etc.)
- Designed for natural ventilation and good air flow in indoor and outdoor areas (all classrooms and staff spaces) to allow for some increase in temperatures during peak times while maintaining comfortable conditions.
- Active design systems: Increase in plant capacity in buildings to accommodate higher ambient temperatures.
- Reduced stormwater runoff through rainwater harvesting from roofs and selection native species with low irrigation (potable water) demands.
- As part of the community resilience initiative, under the 'Share Our Space' program launched by SINSW, if needed, the schools could serve as a place of refuge in case of a natural calamity.

Refer to the **GHHHS Climate Change Adaptation Plan** by Steensen Varming for further detail on the climate change adaptation analysis and risk assessment. For a

list of extreme and high climate change risks and design responses, please refer to **Appendix C**.

4.4 Passive design

Following the compliance criteria for **Green Star Credit 11 (Light Quality), Credit 15 (Connection to Nature), and Credit 10 (Clean Air)** the following passive design initiatives have been considered:

- Providing shaded outdoor areas such as canopies, sheltered walkways connecting all the blocks, shaded outdoor learning area and covered bike canopy to assist with thermal comfort for outdoor activities.

Figure 7: Canopy and shading details (djrd Architects, Revision 01, 29/11/24)

- Considering this is a new school development, glazing has been strategically placed in spaces which can allow for more relaxed environmental conditions and that can benefit from access to daylight, views and natural ventilation.
- Where required the windows are designed to have appropriate shading or be of high performance to control heat gains and glare.
- The building fabric is designed to achieve 20% improvement over the minimum deemed to satisfy (DTS) façade performance requirements under NCC 2022 Section-J. A Section-J assessment report has been prepared by Steensen Varming and shared with the design team.
- In accordance with the **Green Star Credit 3 (Verification and Handover),** the building will be tested for airtightness. This will ensure a well-constructed façade and will prevent unwanted heat transfer to the exterior.
- Occupancy sensors are considered for all non-critical spaces, to ensure the artificial lighting system is only activated when the space is occupied and remain turned off at all other times.

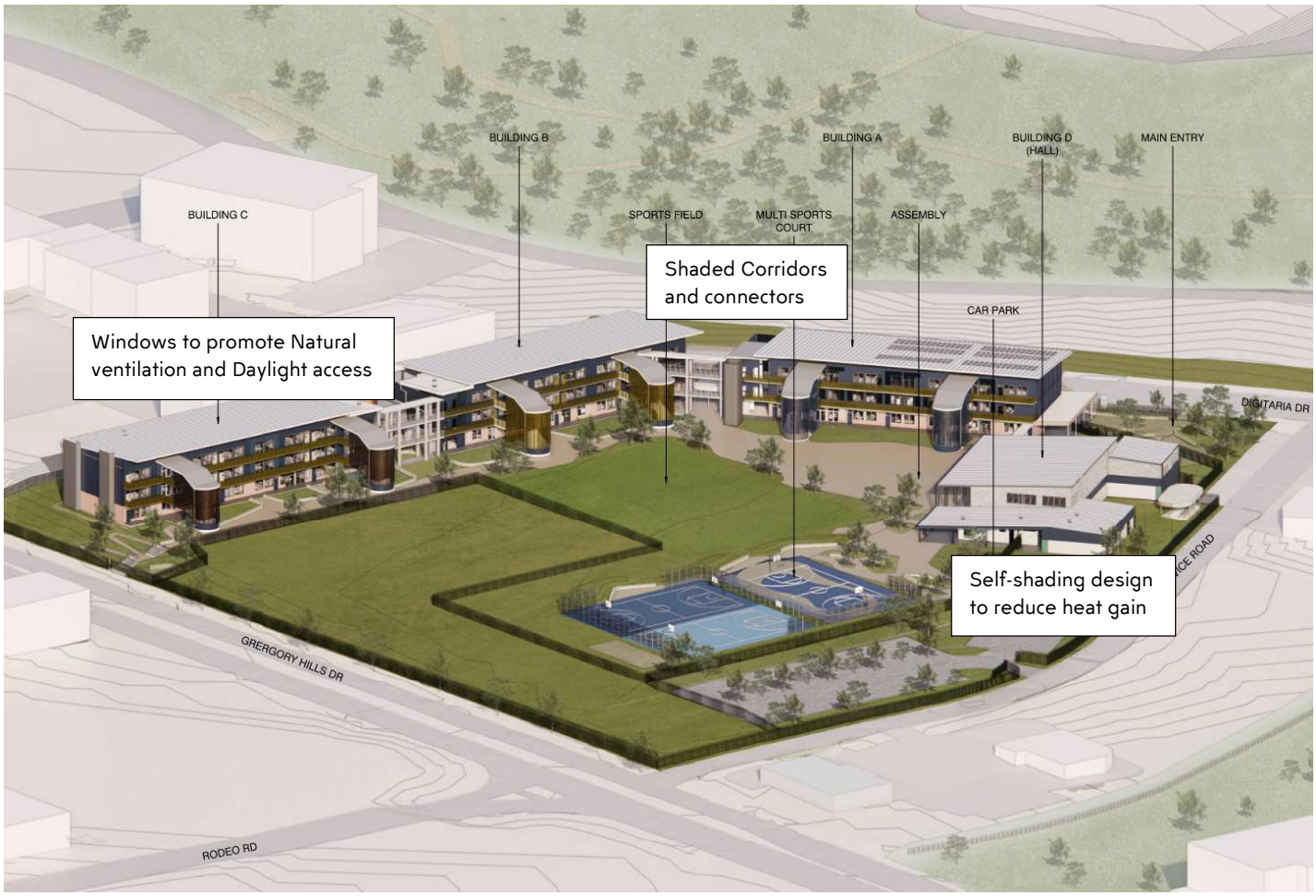

Figure 8: Passive design strategies for the Gledswood Hills High School

4.5 Reduction in peak demand for electricity

The following energy efficient design features have been provided in the design, to reduce peak demand for electricity as according to **Green Star Credit 20 (Grid Resilience) and Green Star Credit 22 (Energy Use),** detailed as follows:

- The mechanical ventilation system applies CO2 monitoring in all spaces to activate the fans upon exceedance of the CO2 threshold. This approach works in conjunction with the natural ventilation strategy in providing an elevated level of indoor air quality and a smooth transition between natural and mechanical ventilation, leading to reduced energy consumption.
- All the air-conditioning systems utilise push-buttons with a run-on timer for activation and de-activation of the air-conditioning in all spaces. This ensures that the air-conditioning is only activated when desired by the users and the run-on timer ensures the system deactivates after a set period (typically 2 hours).
- In addition to the Passive Infrared (PIR) Occupancy sensors, the lighting system applies daylight sensors to adjust the artificial lighting to the required levels. Electric lighting is designed to be comprised of high efficiency LED (Light Emitting Diode) technology and to include occupancy sensors where possible.
- An Energy Monitoring System (EMS) will be applied to monitor the energy usage across the project. The energy and water usage data are available to staff and can be used to inform the students thereby assisting in them understanding of their consumption patterns, leading to improved, more resource-conscious user behaviour.
- Provision for a 99kW Photovoltaic on Building-A for on-site renewable energy generation has been included in the project. Refer to Figure 9.

Furthermore, the following strategies already included in the project design contribute towards reducing the peak demand:

- Passive strategies contribute to lowering of cooling loads.
- The project is complying with a minimum 20% improvement over NCC 2022 Section-J energy efficiency requirements, with the first 10% to be achieved with design improvement and better equipment efficiency; the next 10% to be assisted with the PV panels, in addition to savings from the aforementioned.

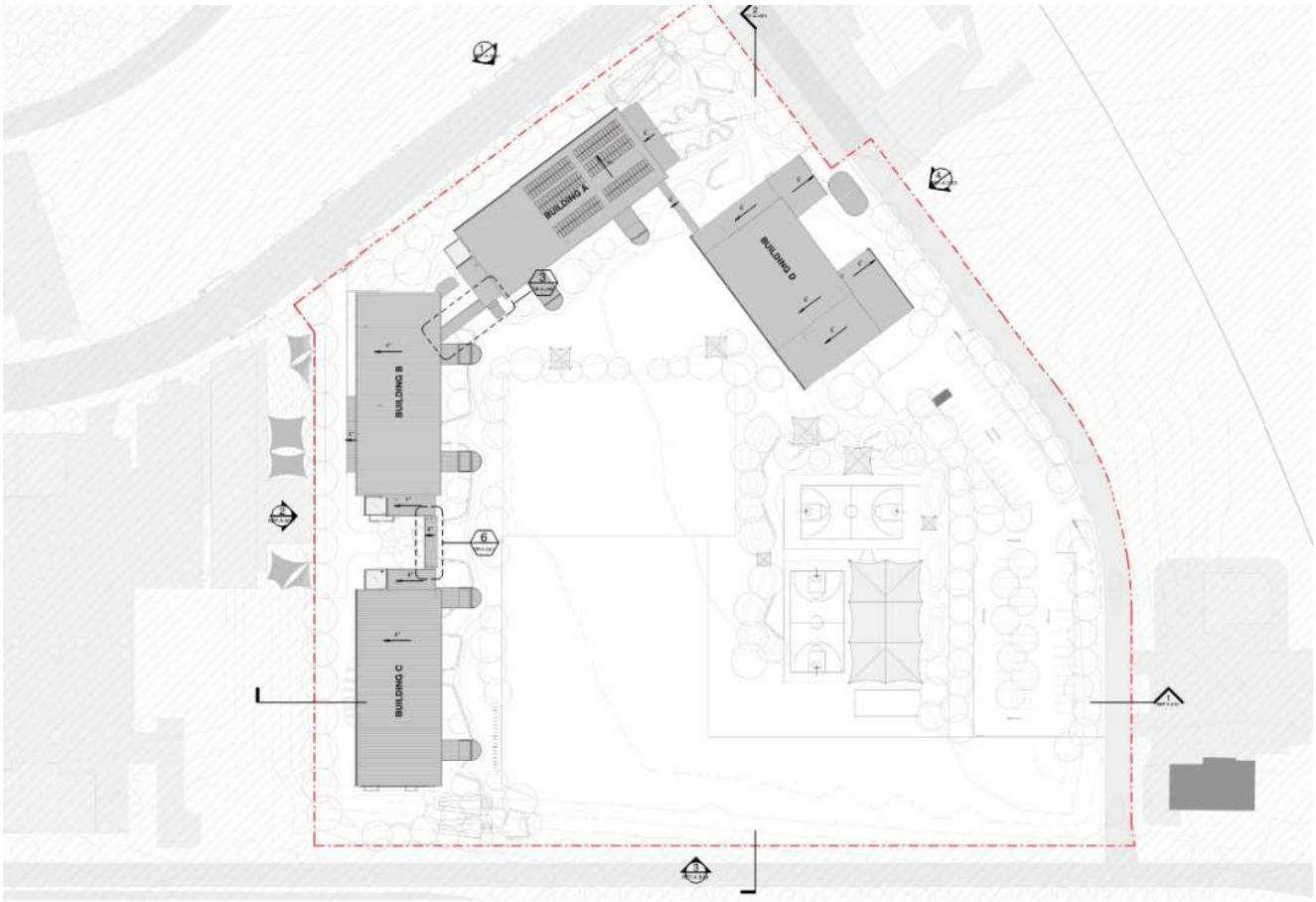

Figure 9: Provision of Solar Panels to provide renewable energy for GHHS

4.6 Energy efficiency

Aligning with the NSW Government commitment to achieving net-zero emissions by 2050 and halving emissions by 2030, the activity is designed to endeavour for optimized energy efficiency and reduction in GHG emissions. Refer to the Net-Zero Energy Statement in Appendix A for further information.

The proposed approach to sustainability and energy related systems is based on applying an "energy hierarchy" methodology.

This methodology has the reduction of energy use as its priority, and then seeks to meet the remaining energy demand by the most efficient means available, before the inclusion of on-site generation and procurement of green power.

Figure 10 Energy Hierarchy

The following initiatives have been incorporated for the project's energy generation and storage capabilities and is presented in a combined energy assessment for the Group 1 Schools (SINSW Group 1 Schools SD Energy Report):

- Currently, a 99kW PV system has been incorporated into the design. Further, a spatial allowance will be made in the architectural design of each building, to ensure an area of at least 20% of the roof space is available for PV installation. This is in accordance with the minimum deemed-to-satisfy (DTS) requirements of NCC Section-J.
- The main switchboard will be designed in accordance with NCC 2022 Section-J requirements, to allow for PV and future battery installation as per project requirement.

4.7 Metering and Monitoring of Energy Consumption

The following initiatives have been provided in the design to enable metering and monitoring of energy consumption of the project, as according to **Green Star Credit 3 (Verification and Handover**)

- A BMS system as per NCC requirements has been included in the project design.
- Project significant energy uses will be monitored via the proposed sub metering BMS to understand energy usage and distribution, such as air-conditioning, artificial lighting, appliance power, lifts, on-site renewables, etc. These energy meters are to be capable of recording time of use/consumption and be interlinked by a communications system which collates data to be stored, analysed and reviewed in accordance with NCC Section J requirements. This will also assist in target-based approach to reduce operational energy consumption in the future by capturing the main guzzlers.

Documentation will be provided by Head Contractor at a later stage.

4.8 Minimise Potable Water Consumption

The following hierarchy alongside the Green Star Buildings and Educational Facilities Standards & Guidelines (EFSG) has been considered as the basis of water strategies implemented in the design of Gledswood Hills High School:

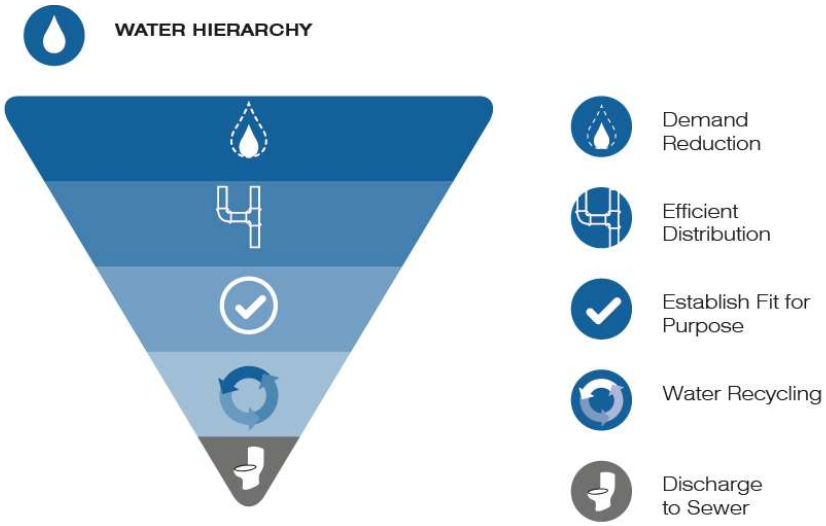

Figure 11 Water Hierarchy

The following initiatives have been provided in the design to minimise the project's potable water consumption as according to **Green Star Credit 25 (Water Use)**:

- Water efficient fixtures and fittings, such as taps, showerheads, toilets, zip taps, dishwashers etc certified under the WELS rating scheme will be specified for the project, to be implemented by Head Contractor.
- Rainwater harvesting, 2 tanks of 20kL each have been incorporated in the current design and the rainwater collected will be reused for landscape irrigation.
- Efficient water management through an automatic water meter monitoring system will be installed.

4.9 Minimisation of waste

Addressing **Green Star Credit 2 (Responsible Construction)** the activity is targeting the following waste-related ESD strategies for the contractor to implement during construction:

- The builder or head contractor will be contractually required to have an environmental management system in place to manage impacts of construction activities on the site.
- The builder or head contractor will develop and implement an environmental management plan to cover the scope of construction activities.
- The builder diverts at least 90% of construction and demolition waste from landfill.

For operational waste management, the activity shall endeavour to implement guidelines provided in the SINSW Waste Handbook. The project will be designed for the collection of separate waste streams and the design will ensure safe and efficient access to waste and storage areas for both occupants and waste collection contractors.

4.10 Embodied Emissions Reporting

As part of the Sustainable Buildings SEPP, a NABERS Embodied Emissions Material form is required to be prepared by the quantity surveyor for the project and will be

submitted as a stand-alone document, post-approval as a part of the mitigation measures.

The embodied emissions material form would disclose the quantities and types of materials proposed for the project to inform on the amount of embodied emissions attributable to the proposed activity. This is to contribute towards developing a benchmarking tool for the industry.

To support a reduction in the embodied emissions for the project under **Green Star Credit 21 (Upfront Carbon Emissions)**, a minimum of 20% reduction in the upfront carbon emissions must be achieved compared to a reference building as defined under the Green Star guidelines and ensure that all the demolition works are offset. The following strategies are to be considered for the GHHS at Detailed Design Stage by the design team and final procurement process by the Head Contractor:

- Material reduction through efficient design layouts, structure and façade.
- Prioritising prefabricated and modular components
- Reviewing materials and substituting with lower carbon alternatives where possible
- Sourcing of local products and implementing 'Responsible Procurement' policies as guided by Green Star
- Substitution of raw materials with recycled or reclaimed alternatives
- Design for disassembly & repurposing of demolition waste

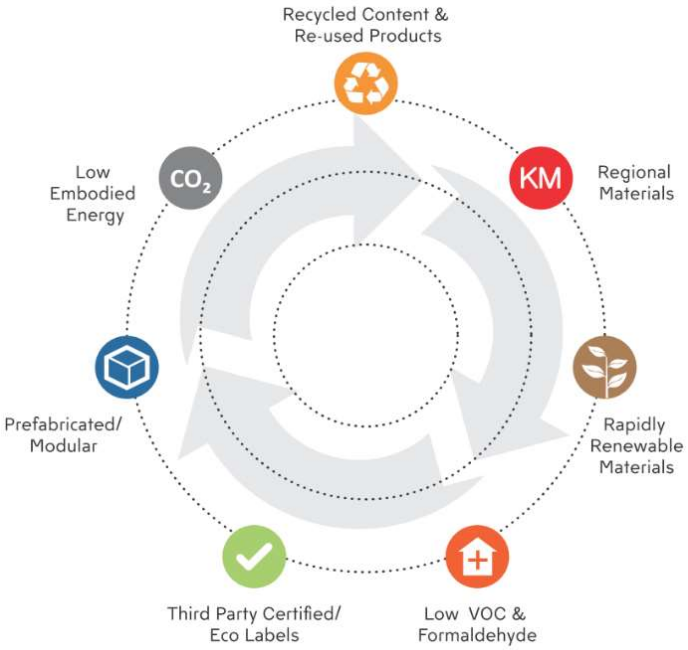

Figure 12 Material selection strategies

5.0 Mitigation Measures

The table below shows the key mitigation measures for the sustainability requirements of the activity and at what stage the measure is to be resolved:

Table 6: Key Mitigation Measures for the activity

PRE-CONSTRUCTION		
Mitigation Number/ Name	**Mitigation Measure**	**Reason for Mitigation Measure**
Formal Green Star Certification / Green Star Buildings v1 / 5 Star	A holistic approach to sustainability must be implemented, by addressing the requirements from Green Star Buildings framework, which is representative of an Industry Best-practice outcome.	To ensure the environmental performance and Indoor Environmental Quality of the building performs beyond the minimum regulatory compliance standard and achieves a high-performance outcome.
Passive design	The final building design must achieve high levels of daylight and natural ventilation.	To reduce operational energy consumption, and also contribute towards reduction of Greenhouse Gas Emissions.
Reduction in energy demand	The following strategies must be incorporated: Air Conditioning systems must utilise push-buttons with a run-on timer for activation and de-activation of the air-conditioning in all spaces. LED lighting fixtures must be provided with Passive Infrared Occupancy sensors. Sub-meters must be provided for monitoring and preparing targeted approach for future optimization.	To reduce the energy demand and move towards the Department of Education's Net-Zero Energy target.

CONSTRUCTION		
Mitigation Number/ Name	**Mitigation Measure**	**Reason for Mitigation Measure**
Minimise potable water consumption	Certified WELS rated water fixtures to reduce wastage of water. Rainwater tanks (2x20kL each) must be installed for enabling rainwater harvesting, to reduce the load on potable water demand.	To reduce the stress on natural resources and water demand.
Embodied Reporting	Must implement environmentally friendly materials and responsible procurement to reduce the stress on virgin materials. Must divert 90% of the construction waste from landfill	To align with Sustainable Buildings SEPP and Green Star guidelines to drive a sustainable design and operational building.
OPERATION		
Mitigation Number/ Name	**Mitigation Measure**	**Reason for Mitigation Measure**
On-site renewable energy generation	A 99kW Photovoltaic system must be incorporated in the design.	To enable the project to contribute towards the Department of Education's Net-Zero Energy target.
Formal Green Star Certification / Green Star Buildings v1 / 5 Star	For operations, meter, measure and monitor the building performance to address the requirements from Green Star Buildings framework, which is representative of an Industry Best-practice outcome.	Energy consumption data collection and analysis to reflect on the design initiatives and energy savings achieved because of them. Conduct post-occupancy audits as part of facilities management to monitor building performance. Help to aid with target-based approach for future improvement strategies.
Embodied Reporting	Potential waste streams that would occur during the operational stage must be identified, and a 'reduce-reuse-recycle' strategy must be implemented.	To align with Sustainable Buildings SEPP and Green Star guidelines to drive sustainable operation of the building.

6.0 Evaluation of Environmental Impacts

To support the sustainability targets for the project, a Green Star Pre-Assessment has been carried out. At this stage, a rating of 5 Stars is targeted through the Green Star Buildings tool. The associated requirements are addressed in the current design and expected to be implemented during the construction phase. The outcome of this process will ensure that the environmental impacts associated with the proposed activity are mitigated.

Refer to **Appendix B: Green Star Scorecard** (15/11/2024).

In conclusion, based on the identification of potential issues, and an assessment of the nature and extent of the impacts of the proposed activity, it is determined that:

- The extent and nature of potential impacts are low and will not have significant impact on the locality, community and/or the environment.
- Potential impacts can be appropriately mitigated or managed to ensure that there is minimal impact on the locality, community and/or the environment.

7.0 Appendixes

7.1 Appendix A: Net-Zero Energy Statement

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STEENSEN VARMING

Mechanical and Electrical Services Schematic Design - Net Zero Energy Statement

Gledswood Hills High School, NSW

Sydney, 07th January, 2025
Ref. No. 237220 CER S00 [00]

Chris Arkins
Director

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This Net Zero Energy Statement accompanies an Environmental Impact Statement (EIS) pursuant to Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act), in support of a Review of Environmental Factors (REF) Application for the proposed new high school located at 9 Gledswood Hills Drive, Gledswood Hills, NSW, 2557.

This Net Zero Energy Statement has been prepared to address the relevant requirements under the NSW Sustainable Buildings State Environmental Planning Policies (SB SEPP) Section 3.4, and as defined under Section 35C of the Environmental Planning and Assessment Regulation 2021 (EP&A).

This statement addresses the Environmental Assessment Requirements for the project, notably:

Ref. No.	SB SEPP Requirement	Section of Statement where response is provided
3.4	If Chapter 3 of SEPP (Sustainable Buildings) 2022 applies:	
	- provide a net zero statement (as defined in section 35C of the EP&A Regulation) that includes:	- This Net Zero Energy Statement addresses this item
	- evidence of how the development will either be fossil fuel-free after the occupation of the development commences or transition to be fossil fuel-free by 1 January 2035.	- This Net Zero Energy Statement addresses this item
	- details of any renewable energy generation and storage infrastructure implemented and any passive and technical design features that minimise energy consumption.	- This Net Zero Energy Statement does not address this item.
	- estimations of annual energy consumption for the building (if available)	- A preliminary energy modelling was conducted, and Energy Modelling Report was prepared by Steensen Varming at Schematic Design stage. As the design progresses into Detailed Design phase, another iteration of energy modelling will need to be conducted to analyse system performance and energy efficiency achieved.

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We note that Steensen Varming are only engaged up to the completion of the Schematic design phase.

The following initiatives have included in the design; however, it remains the responsibility of the appointed design and construct contractor to ensure these initiatives are designed in detail and implemented during the construction phase.

While the mechanical and electrical services have been designed to be fossil fuel-free by way of being all-electric systems, it remains the responsibility of Schools Infrastructure to procure 100% renewable electricity in enabling a net zero emissions operation. This is in accordance to the NSW Department of Education's commitment to sustainability and net zero emissions in operation as per goal-5 of their "Our 9 goals to 2030" initiative.

On-site Fossil Fuel Usage

The mechanical and electrical services strategy for the proposed activity has been designed to be all-electric from day 1 of its operation.

The electrical services design incorporates electric power outlets to serve the following equipment (provided by others) - domestic hot water heaters, kitchen equipment and science Bunsen burners.

Although the current directive is to move all schools to electric, there is ongoing review on the Bunsen burners and VET stovetops. The current direction under consideration with SINSW is to provide electric Bunsen burners with a backup of bottled gas in case the school is unable to procure electric burners. It is noted that the SINSW will have to purchase offsets equivalent to the usage of gas on site to be able to attain 100% net zero emissions in operation.

This allows the project to be capable of operating at net zero emissions once 100% renewable electricity is procured by Schools Infrastructure NSW, in line with the 1 January 2035 target, set out in Section 35C(2)(b) of the EP&A Regulation 2021.

Passive Design Features

The following passive design features have been integrated in order to minimise energy consumption.

- The buildings' orientation is considerate of the site's constraints, solar pathway, and overall functionality requirements.
- The shading strategy has been developed in respect to the buildings' orientation and to minimise energy consumption and glare risk, while maximising daylight ingress and as a result reducing the use of artificial lighting, use of cooling, and these systems' energy consumption.
- The façade has been designed in considerations of;
    - Abundant daylight to all spaces to improve visual comfort and in minimising the use of artificial lighting. Detailed daylight simulations have been undertaken as part of the Environmental Sustainability Design (ESD) scope of works, to document daylight compliance with regulations and Green Star certification.
    - Efficient natural ventilation for all teaching spaces to improve thermal comfort, indoor air quality, and to reduce the use of mechanical ventilation and cooling systems, thereby reducing energy consumption.
    - The natural ventilation to the teaching spaces is provided through the use of louvres, windows, and doors, with an effective opening area of minimum 6.25% of the floor area.

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- Compliance with the Section J requirements of the National Construction Code (NCC) 2022.

Technical Design Features

The following technical design features have been integrated into the design in order to minimise energy consumption.

- The air-conditioning system is a variable refrigerant type of system which is considered the most suitable solution for a school building, and which delivers good efficiencies, particularly at lower thermal loads.
- The mechanical ventilation system applies CO_2 monitoring in all spaces to activate the fans upon exceedance of the CO_2 threshold. This approach works in conjunction with the natural ventilation strategy in providing a high level of indoor air quality and a smooth transition between natural and mechanical ventilation, leading to reduced energy consumption.
- All the air-conditioning systems utilise push-buttons with a run-on timer for activation and de-activation of the air-conditioning in all spaces. This ensures that the air-conditioning is only activated when desired by the users and the run-on timer ensures the system deactivates after a set period (typically 2 hours).
- The lighting fixtures are highly efficient LED (Light Emitting Diode) technology.
- The lighting system applies passive infrared (PIR) sensors for all spaces to ensure the artificial lighting system is only activated once the space is occupied, and to ensure that the system is deactivated shortly after de-occupation of the space.
- In addition to the above, the lighting system applies daylight sensors to adjust the artificial lighting to the required levels.
- An Energy Monitoring System (EMS) will be applied to monitor the energy usage across the project. The energy and water usage data are available to staff and can be used to inform the students thereby assisting in their understanding of their consumption patterns, leading to improved, more resource-conscious user behaviour.

Renewable Energy Generation and Storage

The following initiatives have been implemented for the project's energy generation and storage capabilities.

- A 99-kW rated rooftop photovoltaic (PV) system has been designed to provide a portion of the project's electricity usage. The PV system is located on the roof of Building A.
- Furthermore, a spatial allowance has been made to ensure a total of 20% of the roof space (including the above) is available for future PV installation, on each building.
- The main switchboard has been designed to allow for future battery installation.

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Estimated Energy Consumption & GHG Emissions

Estimated energy consumption is not yet available for the project. Detailed energy modelling shall be undertaken by responsible parties as the design progresses, to help inform the design and its targeted Green Star requirements, as well as verify the design for regulatory compliance. This will include an estimation of PV-solar electrical contribution to the site and an estimation of grid-purchased electricity and associated direct and indirect emissions.

Chris Arkins
Director
BEng Mechanical, Accredited Green Star Professional, FIEAust, EngExec, CPEng, NER, APEC Engineer, IntPE(Aus), FCIBSE

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Evidence

The following evidence has been provided to demonstrate electricity as the fuel source for mechanical services.

Document Reference Number	Description
GSHS-ME-SD-SPC-Part B - Schematic Design Report & Mechanical System Descriptions -A-	Excerpt from Mechanical Design Report outlining the HVAC system description, as being all-electric. Domestic hot water usage. No gas usage.

Excerpt from the Mechanical System Descriptions report.
Reference: 'GSHS-ME-SD-SPC-Part B - Schematic Design Report & Mechanical System Descriptions -A-'
Date: 15/11/2024
Revision: A
Author: Alan Sharkey, Senior Associate, Steensen Varming

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4.3 Proposed Mechanical Systems

A summary of the mechanical systems serving are as follows:

Systems	System selection Description
Air conditioning systems	**Admin office areas**: Ducted type VRF or Cassette type VRF reverse cycle heat recovery air conditioners providing simultaneous heating and cooling. Subject to compliance with acoustics. **General Learning spaces and library:** Ducted type VRF reverse cycle heat recovery air conditioners providing simultaneous heating and cooling. **High heat Load rooms/ Communications rooms:** Dedicated DX air conditioning split systems
Heating only systems	**Gym, Hall, OSCH and Canteen:** Electric radiant panel heaters. **Disabled Toilet**: Electric heaters.
Mechanical Ventilation systems	**Admin, learning spaces** Outside air will be generally ducted locally from the façade to internal fan coil units. A dedicated outside air supply grilles will be provided adjacent to indoor cassette type units when the flow rate is above 20 l/s due to the limitations of the direct duct connected size. **The gymnasium** will be provided a mechanical ventilation to comply with acoustic boundary conditions during amplified music operation (to be confirmed with site acoustic services consultant). This can be omitted if found not to be required. **Main switch rooms, Toilets, Changing areas, Stores, First aid, Communications rooms, Kitchen hoods, Fume cupboards, and the like:** Mechanical ventilation systems will be provided in accordance with AS1668.2.
Natural ventilation	Natural ventilation must be provided in addition to mechanical ventilation to all learnings spaces, admin areas and the hall. The windows/louvres will be manually operated except for any high-level openings in the hall or other applciations. Opening must be based on the effective opening areas and not the structural openings, as per DG55 requirements.
Smoke management systems	Smoke extract systems will be provided to stage where applicable.
BMS/Controls	The BMS will consist, of a virtual network on the SINSW LAN, LED traffic light digital controllers, 2 X weather and VOC stations, CO2 monitoring sensors, VOC sensors in selected areas, faults and alarms from all major plant and equipment. A laptop shall be required to enable early commissioning of the system should the network not be unavailable at the time. Any MCC's and VSD's mounted externally must be suitably protected from rain ingress. (The Energy metering and monitoring system forms part of the electrical package).

7.2 Appendix B: Green Star Scorecard

Gledswood Hills High School

16/12/2024

	Summary			Categories	Points Available	Minimum Expectations (No Points)	Points Targeted	Stretch Points (TBC)
	Registering from	2023		Responsible	17	3	8	1
	Net zero carbon in operations targeted	Yes		Healthy	14	4	11	1
ME	Minimum Expectations (ME) - Met	Yes		Resilient	8	1	4	1
CA	Credit Achievement (CA) - Total Ppoints	50		Positive	30	4	6	0
EP	Exceptional Performance (EP) - Total Points	7		Places	8	1	4	4
	Core points targeted	40		People	9	1	5	3
	Leadership points targeted	0		Nature	14	1	2	4
	Total points targeted	40		Leadership	16	0	0	3
	Green Star rating targeted	5 Star		Total	**116**	**15**	**40**	**17**

Category	Credit	Credit No.	ME / CA / EP	Points Available	Points Targeted (5 Star + Buffer)	Stretch Points TBC	Total Points	Risk (L/M/H)
Responsible	**Industry Development**	**1**	CA	1	**1**	**0**	1	L
Responsible	**Responsible Construction**	**2.1**	ME	-	0	0	Nil	M
Responsible	**Responsible Construction**	**2.2**	CA	1	**1**	**0**	1	M
Responsible	**Verification and Handover**	**3.1**	ME	-	0	0	Nil	M
Responsible	**Verification and Handover**	**3.2**	CA	1	**1**	**0**	1	M
Responsible	**Responsible Resource Management**	**4**	ME	-	0	0	Nil	L
Responsible	**Responsible Procurement**	**5**	CA	1	**1**	**0**	1	L
Responsible	**Responsible Structure**	**6.1**	CA	3	**3**	**0**	3	H
Responsible	**Responsible Structure**	**6.2**	EP	2	**0**	**0**	0	H

Category	Credit	Credit No.	ME / CA / EP	Points Available	Points Targeted (5 Star + Buffer)	Stretch Points TBC	Total Points	Risk (L/M/H)
Responsible	**Responsible Envelope**	**7.1**	CA	2	**0**	**0**	0	H
Responsible	**Responsible Envelope**	**7.2**	EP	2	**0**	**0**	0	H
Responsible	**Responsible Systems**	**8.1**	CA	1	**0**	**0**	0	H
Responsible	**Responsible Systems**	**8.2**	EP	1	**0**	**0**	0	H
Responsible	**Responsible Finishes**	**9.1**	CA	1	**1**	**0**	1	H
Responsible	**Responsible Finishes**	**9.2**	EP	1	**0**	**1**	1	H
Healthy	**Clean Air**	**10.1**	ME	-	0	0	Nil	L
Healthy	**Clean Air**	**10.2**	CA	2	0	0	0	H
Healthy	**Light Quality**	**11.1**	ME	-	0	0	Nil	M
Healthy	**Light Quality**	**11.2**	CA	2	**2**	**0**	2	L
Healthy	**Light Quality**	**11.3**	EP	2	**2**	**0**	2	H
Healthy	**Acoustic Comfort**	**12.1**	ME	-	0	0	Nil	L
Healthy	**Acoustic Comfort**	**12.2**	CA	2	**2**	**0**	2	L
Healthy	**Exposure to Toxins**	**13.1**	ME	-	0	0	Nil	L

Category	Credit	Credit No.	ME / CA / EP	Points Available	Points Targeted (5 Star + Buffer)	Stretch Points TBC	Total Points	Risk (L/M/H)
Healthy	**Exposure to Toxins**	**13.2**	CA	2	**2**	**0**	2	H
Healthy	**Amenity and Comfort**	**14**	CA	2	**2**	**0**	2	H
Healthy	**Connection to Nature**	**15.1**	CA	1	**1**	**0**	1	M
Healthy	**Connection to Nature**	**15.2**	EP	1	**0**	**1**	1	H
Resilient	**Climate Change Resilience**	**16.1**	ME	-	0	0	Nil	L
Resilient	**Climate Change Resilience**	**16.2**	CA	1	**1**	**0**	1	L
Resilient	**Operations Resilience**	**17**	CA	2	**2**	**0**	2	M
Resilient	**Community Resilience**	**18**	CA	1	**0**	**1**	1	H
Resilient	**Heat Resilience**	**19**	CA	1	**1**	**0**	1	M
Resilient	**Grid Resilience**	**20**	CA	3	**0**	**0**	0	H
Positive	**Upfront Carbon Emissions**	**21.1**	ME	-	0	0	Nil	L
Positive	**Upfront Carbon Emissions**	**21.2**	CA	3	**3**	**0**	3	L
Positive	**Upfront Carbon Emissions**	**21.3**	EP	3	**0**	**0**	0	H
Positive	**Energy Use**	**22.1**	ME	-	0	0	Nil	L

Category	Credit	Credit No.	ME / CA / EP	Points Available	Points Targeted (5 Star + Buffer)	Stretch Points TBC	Total Points	Risk (L/M/H)
Positive	**Energy Use**	**22.2**	CA	3	**3**	**0**	3	M
Positive	**Energy Use**	**22.3**	EP	3	**0**	**0**	0	H
Positive	**Energy Source**	**23.1**	ME	-	0	0	Nil	L
Positive	**Energy Source**	**23.2**	CA	3	**0**	**0**	0	L
Positive	**Energy Source**	**23.3**	EP	3	**0**	**0**	0	M
Positive	**Other Carbon Emissions**	**24.1**	CA	2	**0**	**0**	0	L
Positive	**Other Carbon Emissions**	**24.2**	EP	2	**0**	**0**	0	m
Positive	**Water Use**	**25.1**	ME	-	0	0	Nil	L
Positive	**Water Use**	**25.2**	CA	3	**0**	**0**	0	m
Positive	**Water Use**	**25.3**	EP	3	**0**	**0**	0	H
Positive	**Life Cycle Impacts**	**26**	CA	2	**0**	**0**	0	H
Places	**Movement and Place**	**27.1**	ME	-	0	0	Nil	L
Places	**Movement and Place**	**27.2**	CA	3	**0**	**3**	3	m
Places	**Enjoyable Places**	**28**	CA	2	**2**	**0**	2	L

Category	Credit	Credit No.	ME / CA / EP	Points Available	Points Targeted (5 Star + Buffer)	Stretch Points TBC	Total Points	Risk (L/M/H)
Places	**Contribution to Place**	**29**	CA	2	**2**	**0**	2	L
Places	**Culture, Heritage and Identity**	**30**	CA	1	**0**	**1**	1	H
People	**Inclusive Construction Practices**	**31.1**	ME	-	0	0	Nil	L
People	**Inclusive Construction Practices**	**31.2**	CA	1	**1**	**0**	1	L
People	**Indigenous Inclusion**	**32**	CA	2	**2**	**0**	2	H
People	**Procurement and Workforce Inclusion**	**33.1**	CA	2	**0**	**2**	2	M
People	**Procurement and Workforce Inclusion**	**33.2**	EP	1	**0**	**0**	0	H
People	**Design for Inclusion**	**34.1**	CA	2	**2**	**0**	2	L
People	**Design for Inclusion**	**34.2**	EP	1	**0**	**1**	1	H
Nature	**Impacts to Nature**	**35.1**	ME	-	0	0	Nil	L
Nature	**Impacts to Nature**	**35.2**	CA	2	**0**	**0**	0	H
Nature	**Biodiversity Enhancement**	**36.1**	CA	2	**2**	**0**	2	H
Nature	**Biodiversity Enhancement**	**36.2**	EP	2	**0**	**2**	2	H
Nature	**Nature Connectivity**	**37**	CA	2	**0**	**0**	0	H

Category	Credit	Credit No.	ME / CA / EP	Points Available	Points Targeted (5 Star + Buffer)	Stretch Points TBC	Total Points	Risk (L/M/H)
Nature	**Nature Stewardship**	**38**	CA	2	**0**	**0**	0	L
Nature	**Waterway Protection**	**39.1**	CA	2	**0**	**2**	2	M
Nature	**Waterway Protection**	**39.2**	EP	2	**0**	**0**	0	H

7.3 Appendix C: List of climate change risks and design responses

Refer to the table below with information on list of potential climate change risks and corresponding design considerations.

Note: The risks highlighted below in blue are to be considered by SINSW Asset Maintenance Unit (AMU) during the operations stage.

Group 1 NSW Schools - Gledswood Hills High School Building

237220 Group 1 Schools - ESD / Green Star Follow Up

Date **7 Jan 2025**

STEENSEN VARMING

			Unmitigated Scenario							
			Medium-term (2040-2050)			Long-term (2070-2090)				
S\Z	Climate Projection	Potential impact on the project (environmental, social and economic)	Likelihood	Consequences	Risk	Likelihood	Consequences	Risk	Responsible	Response/Design Consideration
Increased Temperatures / Number of Hot Days										
1	**Increased average temperatures / Number of Hot Days**	Higher on-going cost for space and outdoor air conditioning. Higher cooling capacity of mechanical plant.	Almost Certain	Moderate	High	Almost Certain	Moderate	High	Mech	- Passive Design Optimisation - Façade and building fabric to a minimum NCC 2022 Section-J requirements (improving insulation R-values / Glazing ratios and performance / Shading / Heat recovery / etc.) - Adaptive comfort and ceiling fans - will allow for some decrease in temperatures during peak times. Design Flexibility to switch between natural ventilation and air-conditioning as and when needed. - School is closed during some of the peak summer months which reduces the risk. - Shaded walkways. extensive landscaping and light shade surfaces for hardscape and roof system to reduce urban heat island (UHI) effect.
2	**Increased average temperatures**	Increase in hot days leading to increased outdoor temperatures and reduced thermal comfort. Likely worst for hardscaping areas through urban heat island effect.	Likely	Moderate	High	Almost Certain	Moderate	High	Landscape / Arch / Civil	To meet the Green Star (GS) certification commitments, credit-19 Heat resilience has been targeted. **GS Credit 19** Heat Resilience addresses the need for incorporating outdoor surface finishes with a high Solar Reflectance Index (SRI) value. Strategies include: - Application of cool paint or light coloured concrete for hardscape pavements and roof systems. - Use of soft landscape to reduce heat island and improve outdoor thermal comfort. - Additional planting around outdoor areas adjacent to hardscaped areas to improve shading and reduce urban heat island (UHI) effect.
3	**Increased average temperatures**	Thermal expansion of the cladding, framing and building structure, and other building elements leading to possible damage of buildings.	Unlikely	Moderate	Medium	Unlikely	Moderate	Medium	Façade	There is likely to be minimal impact on building structures. - Facade Design details to address thermal shock mitigation strategy. Thermal bridging and insulation are documented and specified to perform better than minimum NCC 2022 Section-J specification, especially for single glazed units. - No major impacts on the structural steel likely based on likely increased temperature range. - Head Contractor/Façade team to confirm maximum temperatures from manufacturers specifications during procurement process.
4	**Increased average temperatures**	Blackout / Power interruptions impact to power and services, leading to loss of comfort and productivity, and causing potential damage to elements within the building, further leading to loss of productivity and comfort and possibly impact on health of students.	Possible	Major	High	Likely	Major	High	Elec	- The school will not function in its entirety in a blackout scenario, as there is no power backup to the school from inverters. **- Potential for space to be provided for battery storage or a future generator to be stored more permanently.**

S\Z	Climate Projection	Potential impact on the project (environmental, social and economic)	Likelihood	Consequences	Risk	Likelihood	Consequences	Risk	Responsible	Response/Design Consideration
5	**Increased maximum temperatures**	Reduced thermal comfort within the buildings and reduced cooling plant efficiency.	Almost Certain	Moderate	High	Almost Certain	Moderate	High	Mech / Client	- Relaxed set points for conditioned spaces. - Passive Design measures (daylighting, natural ventilation, thermal insulation) to reduce impact. - Mixed-mode ventilation to deliver optimum thermal comfort and indoor air quality conditions **- Operational management of air-conditioning to prioritise conditioning specific areas in peak hot days.**
6	**Increased maximum temperatures**	Passive cooling for the substations may not be sufficient, resulting in lower electrical loads and impacting equipment lifespan.	Possible	Minor	Medium	Possible	Minor	Medium	Elec	- Document the need to consider a larger substation to address the temperature derating. **- Likely high cost to include active cooling for the sub-station. Hence, the maintenance team to confirm if and when it is necessary.**
7	**Increased maximum temperatures**	Sustained heat stress to vegetation and landscaping leading to wiltering/death and reducing greenery and comfort to outdoor areas, views to landscape and contributes to urban heat island effect.	Likely	Moderate	High	Likely	Moderate	High	Landscape / Client	- Selection of climate responsive native species with low water demands - Management to identify periods when heat stress occur and adjust the watering needs to supplement existing irrigation.
8	**Increased maximum temperatures**	Additional maintenance of sports fields / ovals due to extreme heat.	Likely	Minor	Medium	Likely	Minor	Medium	Landscape	- Management to identify periods when heat stress occur and adjust the watering needs to supplement existing irrigation.
9	**Increased maximum temperatures**	PV Panels and Inverters can only operate in a certain temperature ranges. Other mechanical plant will also be impacted.	Likely	Minor	Medium	Likely	Minor	Medium	Elec	- PV panel efficiency decreases with increase in temperature. The project team to factor in during product selection. - Cool paint Application for roof surface hosting PV Panels could help reduce ambient temperatures. - Avoid direct solar radiation to inverters and mech equipment. Locate in sufficiently shaded and/or well ventilated areas.
10	**Increased maximum temperatures**	Heat stress on building occupants due to extreme heat days could lead to dehydration and associated health impacts.	Likely	Moderate	High	Likely	Moderate	High	Arch / Landscape	Easy access to drinking water & shaded areas for outdoor assembly and activities.
11	**Increase in extreme heat days**	Increase in extreme heat days resulting in higher energy bills.	Almost Certain	Minor	Medium	Almost Certain	Minor	Medium	Mech	- Passive Design Optimisation - Façade and building fabric to a minimum NCC 2022 Section-J requirements (improving insulation R-values / Glazing ratios and performance / Shading / Heat recovery / etc.) - PV to reduce peak demand (this is Sustainable Buildings SEPP 2022 requirement). A 99 kW roof mounted PV array is incorporated in the current design.

S\Z	Climate Projection	Potential impact on the project (environmental, social and economic)	Likelihood	Consequences	Risk	Likelihood	Consequences	Risk	Responsible	Response/Design Consideration
12	**Increase in extreme heat days**	Loss of planting through irrigation failure.	Possible	Moderate	Medium	Likely	Moderate	High	Landscape /Civil	- Selection of planting of climate appropriate species. - Rainwater harvesting and reuse for irrigation to reduce load on potable water. - Weather responsive automated irrigation systems or drip irrigation system could be considered where applicable.
Decrease in soil moisture and relative humidity, increase in evapotranspiration										
13	**Decrease on humidity**	Possible need for humidification for thermal comfort.	Unlikely	Minor	Low	Possible	Minor	Medium	Mech	Change in Relative Humidity (RH) in the near future is considered low. Potentially no action required.
14	**Decrease in soil moisture, increase in evapotranspiration**	Loss of planting through irrigation failure. Increased irrigation demand/costs.	Possible	Moderate	Medium	Likely	Moderate	High	Landscape /Civil	- Selection of planting of climate appropriate species. - Rainwater harvesting and reuse for irrigation to reduce load on potable water. - Weather responsive automated irrigation systems or drip irrigation system could be considered where applicable.
Increased Rainfall & Storm Events										
15	**Increase in rainfall intensity and storm events**	Increased surface water flood risk due to increased flows from surrounding areas causing damage to assets from water ingress and possible health risks. Other flood risks to be identified?	Possible	Major	High	Possible	Major	High	Civil	- Civil team confirmed that the site is located at a crest, hence no on-site flooding risk. - The internal stormwater network is designed to convey the 1% AEP storm to an OSD tank which will detain stormwater thereby reducing the risk of flooding on downstream catchments. - Overland flow paths will be designed to within the school to minimise ponding and prevent stormwater from entering buildings.
16	**Increase in rainfall intensity and storm events**	Roof flooding causing water ingress into the building causing damage to internal linings, furniture, equipment etc.	Possible	Major	High	Possible	Major	High	Hydr / Arch	- Roofs are designed to direct water away from the buildings. - Consider increased intensity events in the design stage for sizing of gutter and downpipes. - For high risk scenario analysis, the pre-development storm event/design rainfall intensities is 5 Years ARI (Refer to AS/NZS 3500.3 for AEP to ARI conversion) to comply with GS Credit 26.1 Stormwater discharge.
17	**Increase in rainfall intensity and storm events**	Roof drainage flooding into the drainage design to 1:200 year storm - damage to equipment and risk to health.	Possible	Major	High	Possible	Major	High	Hydr / Arch	Assess surface water movements, possible waterproofing or egress requirements.

S\Z	Climate Projection	Potential impact on the project (environmental, social and economic)	Likelihood	Consequences	Risk	Likelihood	Consequences	Risk	Responsible	Response/Design Consideration
18	**Increase in rainfall intensity and storm events**	Impact of flooding and damage to internal ground level finishes / furniture / equipment.	Unlikely	Major	Medium	Possible	Major	High	Civil / Arch	- The site is not impacted by any on-site flooding risk as a result of external catchments. - Overland flow paths will be designed to within the school to minimise ponding and prevent stormwater from entering buildings.
19	**Increase in rainfall intensity and storm events - Increased Flood Risk**	Impact of flooding limiting access to and from the buildings	Possible	Major	High	Possible	Major	High	Client / Civil	**- Access to the site shall be limited during a flood event, The flood response strategy for the school involves:** **- pre-emptive closure** **- shelter-in-place and self-evacuation dependent on the flood warnings received and time of day.**
20	**Increase in rainfall intensity and storm events**	Increase rainfall intensity and frequency leading to a greater size rainwater tank and Stormwater infrastructure	Possible	Minor	Medium	Possible	Minor	Medium	Hydr / Civil	Consider large storm events/design rainfall intensities, such as 5 Years ARI (Refer to AS/NZS 3500.3 for AEP to ARI conversion) in MUSIC and DRAIN modelling. This is required to comply with **GS Credit 26.1 requirement.**
21	**Increase in rainfall intensity and storm events - Hail storms**	Damage to façade materials, glass roofs, skylights, during hail storm events, leading to maintenance costs. May have some impact to Stage 2 works and carpark location consideration.	Possible	Minor	Medium	Possible	Minor	Medium	Façade / Arch	- Reinforced cladding panels to resist hail and wind impacts. - Selection of façade materials with greater impact resistance.
22	**Increase in rainfall intensity and storm events - Hail storms**	Damage to buildings, vehicles, people and animals during hail storm events, leading to injury	Possible	Moderate	Medium	Possible	Moderate	Medium	Client / Arch	- Consider provision of Management plan in place for where to shelter in event of hail storm. - Certain areas designed to provide necessary protection in case of extreme event.
23	**Increase in rainfall intensity and storm events - Hail storms**	Hail damage to Solar PV panels resulting in maintenance cost	Possible	Major	High	Possible	Major	High	Elec	- Hail loading - roof pitches over 2.5deg so hail should fall off. - Project to include specifications for Solar panels to be impact ratings.
24	**Increase in rainfall intensity and storm events - Hail storms**	Hail damage to Solar PV panels resulting in reduced energy production	Possible	Minor	Medium	Possible	Minor	Medium	Elec	As above

S\Z	Climate Projection	Potential impact on the project (environmental, social and economic)	Likelihood	Consequences	Risk	Likelihood	Consequences	Risk	Responsible	Response/Design Consideration
25	**Increase in rainfall intensity and storm events - Hail storms**	Hail events leading to blocking roof downpipes resulting in roof flooding, internal water ingress and damage to internal building / furniture / carpets / etc.	Unlikely	Moderate	Medium	Possible	Moderate	Medium	Arch / Hydr / Client	**- Management plan for these extreme scenarios by SINSW Asset Maintenance Unit (AMU).**
Increased Drought Events										
26	**Increase in drought events**	Drought conditions leading to damage to garden areas leading to reduced amenity and plants that potentially die off to water restrictions / limited watering.	Possible	Moderate	Medium	Likely	Moderate	High	Landscape / Client	- Selection of drought tolerant/climate appropriate species. - Effective and efficient irrigation method implemented. **- Management plan to provide additional watering to supplement existing irrigation when absolutely necessary.**
27	**Increase in drought events**	Cracking of pipes due to drought conditions	Unlikely	Moderate	Medium	Unlikely	Moderate	Medium	Hydr / Civil	- Pipe material to be specified to limit the risk. - Plastic pipes with flexible joints are proposed which are less susceptible to cracking or shrinkage and swell cycles.
28	**Increase in drought events**	Cracking of paved surfaces due to drought conditions	Unlikely	Moderate	Medium	Unlikely	Moderate	Medium	Landscape / Civil	- Pavements will be designed with expansion joints to allow thermal variation however no specific impact to Pavements as a result of drought conditions. Hence, very low possibility of occurrence.
Increased Bushfire Conditions										
29	**Increase in bushfire conditions**	Bushfire smoke causing poor indoor air quality, and impact to staff, student and visitor health. While the school is not within a bushfire zone, elevated air quality ($PM_{2.5}$ and PM_{10}) are significantly higher than typical conditions.	Possible	Major	High	Possible	Major	High	Facade / Arch / Mech	- CO2, PM and VOC sensors to monitor the indoor air quality and to take immediate action. **- Operational policy to close windows in times of poor air quality.** - Building to be designed so it can be sealed and air is filtered as it enters the building. - Ability to increase filtration media when air quality is very poor - require operational policy. - Design for better air tightness to be included in the design - air tightness testing to be considered.
30	**Increase in bushfire conditions**	Bush fires causing fire damage to the school	Rare	Major	Low	Rare	Major	Low	Facade / Arch / Mech	N/A; school is not in the bushfire zone.
31	**Increase in bushfire conditions**	More regular filter changes, higher filter maintenance and cost.	Almost Certain	Minor	Medium	Almost Certain	Minor	Medium	Client	**Consider provision of Management plan to ensure filters are regularly monitored and replaced when necessary.**
32	**Increase in bushfire conditions**	Increased façade maintenance due to smoke and ash buildup.	Almost Certain	Minor	Medium	Almost Certain	Minor	Medium	Arch / Façade / Client	**Façade maintenance provisions in such scenario to be provided by SINSW Asset Maintenance Unit (AMU) under the Management Plan.**

S\Z	Climate Projection	Potential impact on the project (environmental, social and economic)	Likelihood	Consequences	Risk	Likelihood	Consequences	Risk	Responsible	Response/Design Consideration
33	**Increase in bushfire conditions**	Ash buildup will impact efficiency of the PV panels.	Possible	Minor	Medium	Possible	Minor	Medium	Client	**Cleaning and maintenance provisions to be provided in the Management Plan by SINSW Asset Maintenance Unit (AMU).**
34	**Increase in bushfire conditions**	Plant maintenance due to ashes	Possible	Minor	Medium	Possible	Minor	Medium	Client	**Cleaning and maintenance provisions to be provided in the Management Plan by SINSW Asset Maintenance Unit (AMU).**
Increase in Air Pollution										
35	**Increase in air pollution**	Increase in air pollution causing poor indoor air quality, and impact to student health.	Possible	Minor	Medium	Possible	Moderate	Medium	Mech	- Better than normal air tightness to be included in the design. - Higher level of outdoor air filtration for key spaces. - Air quality monitoring through CO2 sensors, PM and VOC sensors.
36	**Increase in air pollution**	Increased air pollution resulting in increased filter costs and replacement to meet NCC acceptable air quality requirements.	Possible	Moderate	Medium	Possible	Minor	Medium	Mech / Client	**SINSW Asset Maintenance Unit (AMU) team to replace filters as and when needed.**
Increase in Wind Velocity										
37	**Impact of wind**	Intense wind causing trees or other elements close to the façade to collapse and damage the building and potentially people.	Possible	Moderate	Medium	Possible	Moderate	Medium	Landscape / Arch	- Consideration of trees located close to the buildings for strength and support to be provided, if needed. - Soil condition to be reviewed to ensure strong root systems. - Selection of species types will also be considered.
38	**Impact of wind**	Intense winds causing damage to roof structures, of shading elements leading to potential damage to people and increased maintenance and replacement costs.	Rare	Major	Low	Unlikely	Major	Medium	Structure	Review any gaps between current codes and climate change scenarios. Account for increased wind speed - wind load codes.
Extreme cold conditions										
39	**Extreme cold conditions**	Slip fall consideration for external areas.	Unlikely	Minor	Low	Unlikely	Minor	Low	Arch	Design to avoid risk of slipping due to dew condensation on external floors during peak winter periods.
40	**Extreme cold conditions**	Roof structures over entrances, can cause water freezing and ice become a hazard.	Unlikely	Moderate	Medium	Unlikely	Moderate	Medium	Arch	Possibility during the peak winter period. SINSW Asset Maintenance Unit (AMU) team to consider in the Management Plan