NORTHROP

ECOLOGICALLY SUSTAINABLE DEVELOPMENT REPORT

SI NSW Kingscliff High School

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Ecologically Sustainable Development Report

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1. Executive Summary

This report is to inform the design of the Kingscliff High School project regarding its ESD requirements. High-level guidance is provided within this report to assist in informing the Design Assessment process. This report should be read in conjunction with the relevant design requirements as this note does not provide an exhaustive review of all requirements. This report intends to provide a guiding document that addresses the design requirements to meet the following project and planning objectives:

- Planning Secretary's environmental assessment requirements (SEARs)
- Mandatory ESD requirements from the EFSG and verification against these requirements.
- NSW Government Resource Efficiency Policy (GREP)
- The Government Architect NSW (GANSW) Environmental Design in Schools Manual (as required by the Planning Secretary's Environmental Assessment Requirements)
- Building Code of Australia 2019 – Section J Minimum Code Compliance
- Design Equivalence to a 4 Star Green Star rating (required by the SEARs, EFSG and GREP)

This report addresses the requirements outlined in the above governing guidelines and describes further sustainability to address how the project demonstrates its strong commitment to sustainability in its design, construction and operation.

The significant design initiatives to be implemented include:

- A strong commitment to energy efficiency with the project design to demonstrate a greenhouse gas emissions reduction compared to the code-compliant base case.
- A highly efficient façade wall-glazing system designed to minimise heat gains into the building while promoting the entry of daylight into the learning spaces.
- Low impact materials selections with the project maximising the reuse of onsite materials and the use of certified materials where applicable.
- The use of highly efficient water fixtures and fittings.
- An optimised air conditioning system to provide a good provision of outside air while maintaining thermal comfort in all school areas.

Overall, the integration of these initiatives demonstrates the strong commitment to a social, environmental and economic sustainability of the project in line with the aims of the Schools Infrastructure NSW development guidelines.

2. Project and Planning ESD requirements

2.1 Planning Secretary's Environmental Assessment Requirements (SEARs)

The Planning Secretary's Environmental Assessment Requirement defines that an Environmental Impact Statement (EIS) must be prepared following and meet the minimum requirements of clauses 6 and 7 of Schedule 2 the Environmental Planning and Assessment Regulation 2000 (the Regulation).

The EIS must address the following specific matters regarding Ecologically Sustainable Development (ESD):

- Incorporation of Ecologically Sustainable Development principles in the design and ongoing operation phases of the development (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000)
- Proposed measures to minimise consumption of resources such as energy and water (including water sensitive urban design) and how the future development would be designed to consider and reflect national best practice sustainable building principles to improve environmental performance and reduce ecological impact. This should be based on a materiality assessment and include waste reduction design measures, future-proofing, use of sustainable and low-carbon materials, energy and water-efficient design (including water sensitive urban design) and technology and use of renewable energy.
- How environmental design will be achieved following The Government Architect NSW (GANSW) Environmental Design in Schools Manual.

The Planning Secretary's Environmental Assessment Requirement also conditions the project to include:

- an assessment against an accredited ESD rating system or an equivalent program of ESD performance. This should include a minimum rating scheme target level.
- a statement regarding how the design of the development is responsive to the CSIRO projected impacts of climate change.
- an Integrated Water Management Plan detailing any proposed alternative water supplies, proposed end uses of potable and non-potable water, and water sensitive urban design

The principles of Ecologically Sustainable Development as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 have been incorporated into the design and on-going operation phases of the development as follow:

- **Inclusion of the precautionary principle** – through the implementation of environmental management and building maintainability, the project attempts to incorporate adaptability and resilience into the project design. The concept behind the precautionary principle is to create spaces that can both; accommodate for changes, which may eventuate in the future, and avoid the risk of serious or irreversible damage to the environment.
- **Inter-generational equity** to ensure that the health, diversity, and productivity of the environment are maintained or enhanced for the benefit of future generations – through the inclusion of, best practice PVC and low impact paints, sealants, and adhesives, alongside a focus on providing greater vegetation and support for the building's connection with nature, the project demonstrates a strong commitment to the preservation of environmental health, diversity, and productivity of the local area.

- **Conservation of biological diversity and ecological integrity** – through the planting of native vegetation, improvement of stormwater runoff from the site, and use of integrated landscaping, the project will act to improve, conserve, and support the local biological diversity and integrity. Improving water balance for the building to manage water and wastewater more efficiently. Integrating rainwater harvesting for garden irrigation.
- **Improved valuation, pricing, and incentive mechanisms** - the project has involved significant input from the Quantity Surveyor who will be involved throughout the entire design process to ensuring that the project both remains on budget and effectively considers environmental factors in the valuation of assets and services. Furthermore, the project has looked more broadly and considered the economic cost benefits that will stem from the project both short and long term, these are included within the economic analysis provided as part of the project submission.
- **Trajectory to reduce the carbon emission** of the proposed building by proposing active and passive design strategies, building service innovation, efficient building systems, and onsite energy generation. Building service innovation includes strategies for reducing the carbon footprint of the heating, ventilation, and air conditioning systems, efficient lighting, and providing controls around these systems
- **Providing learning and an engaging environment** by providing features like exposed services, building automation, operational waste reduction measures, etc. and providing measures to incorporate whole-building environmental comfort which includes acoustic, visual, and thermal comfort, and enhancing the students' collaboration by providing engaging enclosed and open spaces and amenities.

2.2 The Educational Facilities Standards & Guidelines Requirements

The Educational Facilities Standards and Guidelines (EFSG) have been developed by the NSW Department of Education (DoE) to assist the management, planning, design, construction, and maintenance of new and refurbished school facilities. The EFSG is to be treated as a reference guide that provides a starting point to allow for a consistent standard of delivery across various types of school developments.

The EFSG Design Guide considers a framework incorporating several aspects of design including extensive Ecologically Sustainable Development (DG02) requirements. The following categories are covered within the EFSG DG02 Design Guide:

- NSW Government Resource Efficiency Policy
- Environmental Design Policies
- Environmental Design Features of Educational Facilities
- Insulation
- Ventilation
- Pesticides
- Water Conservation

Within the EFSG there are mandatory requirements and optional requirements. All mandatory requirements are to be treated as minimum standards rather than a performance ceiling. Optional requirements are negotiable and to be considered in consultation with DOE stakeholders.

Independent verification against the mandatory provisions of the EFSG will be undertaken. The project must allow for the engagement of an ESD consultant to coordinate the ESD scope on their behalf and develop and collate the evidence required for verification against the ESD EFSG requirements.

The key ESD elements of the EFSG as follows:

2.2.1 Green Building Design and Sustainability Best Practice.

The EFSG requires that Ecologically Sustainable Development principles 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. Northrop provides an attached suggested Green Star pathway to achieve this standard including an assessment of how this aligns to the other EFSG requirements.

The design has currently made all relevant allowances to demonstrate compliance equivalent to a 4 Star Green Star rating under the Design & As Built v1.3 tool. It is noted that the project does not currently anticipate achieving a full Green Star Certification.

2.2.2 Energy conservation

The project must be constructed so that energy consumption is predicted to be at least 10% lower than if build to minimum compliance with National Construction Code requirements.

2.2.3 Environmental Management Plan

All new projects must prepare a site-specific Environmental Management Plan (EMP) before the commencement of the relevant site works. Tenderers will be required to prepare an EMP as a condition of the contract.

2.2.4 Timber

The project is to contain no rainforest timbers (unless plantation grown), no timbers from high conservation forests and uses only recycled timber, engineered and glued timber composite products, timber from plantations or sustainably managed re-growth forests.

2.2.5 Pesticides

No chemical pesticides and/or termiticides are to be used on the project. Physical measures must be taken to prevent and minimise risks posed by pests.

2.2.6 Low VOC materials

Following the Government Resource Efficiency Policy, all surface coatings, and other Volatile Organic Compound (VOC) emitting products including adhesives, sealants, carpets and carpet underlays, must be made from Low-VOC emission materials. In terms of surface coatings, the Australian Paint Approval Scheme's (APAS) VOC limits for Low VOC paints or lower are to be used.

Only low formaldehyde-emitting engineered wood products should be used, such as those that meet the Australian Standards for formaldehyde emission limit E1 (NICNAS classification) or lower. Engineered wood products include particleboard, plywood, Medium Density Fibreboard (MDF), Laminated Veneer Lumber (LVL), High-Pressure Laminate (HPL), Compact Laminate and decorative overlaid wood panels. This requirement excludes formwork.

2.2.7 Waste

The project must eliminate unnecessary waste by better planning and more efficient use of natural and manufactured sources. The contractor is to allow to produce an Operational Waste Management

Plan for the project in line with the requirements of the Green Star Design & As Built v1.3 submission guidelines Credit 8. Adequate spatial provision must be maintained in waste rooms for multiple waste stream separation, including general rubbish, co-mingled recycling, paper and cardboard, secure waste, and green waste

2.2.8 Natural Light

The project design has incorporated good daylighting to minimise energy consumption and ongoing running costs and ultimately provide natural light to the students and staff. The contractor must ensure that any alterations to the project design do not alter the following requirements.

- Natural daylight is to be provided to all teaching spaces unless otherwise identified by SINSW.
- Natural daylight is to be provided via windows, skylights and/or roof-lights. Where a room is required to have a brownout function, roof-lights and skylights will need to include a method to sufficiently adjust light levels.
- Include daylight sensors to rooms to reduce light output or turn off lights when sufficient daylight is provided within the space.
- When the space is large, it is recommended that perimeter lighting adjacent to windows be on a separate zone to make maximum use of daylight.

2.2.9 Appliances and Equipment

Minimum standards for new electrical appliances and equipment are to be compliant with the NSW Government Resource Efficiency Policy Part E3 and must have an energy star rating at least 0.5 stars above average.

2.2.10 Air Cooling and Heating Systems

Air cooling and heating systems for the project are to include the following:

- Timed or sensor operation functionality for all air-cooling systems.
- Centralised control of HVAC plant with programmable schedules for the school year.

Consideration must also be given to the use of central infrastructure for heating and cooling where it demonstrates the whole life cycle cost savings.

2.2.11 Electricity Meters

Electricity meters for the project are to be installed with the capacity for monitoring to lower electricity maintenance costs. Meters must be fit-for-purpose and allow access to energy consumption data at the school.

2.2.12 Renewable Energy Generation

A photovoltaic (PV) solar power grid-connect rooftop system must be provided to offset power consumption and costs. The provided system must be sized following EFSG Design Guide section 65.18.3.1. The designer and/or installer of the PV system must be fully accredited by the Clean Energy Council of Australia and adhere to the system design requirements given in section 65.28.3.2 of the EFSG Design Guideline.

A PV system commissioning checklist must be completed to ensure the system meets DG65 and SG933 requirements.

2.2.13 Insulation

Insulation is to be compliant with the Building Code of Australia under Section J, Part J1 – Building Fabrics of the National Construction Code, high-level advice relating to these requirements is provided within the later sections of this report. The current design also uses passive design to keep heat out of classrooms during summer and reduce heat loss during winter, this approach must be maintained as part of any alterations to the design.

2.2.14 Ventilation

Natural ventilation is to be used where possible to maintain good environmental air quality through all school areas. It is noted that due to the use of the school, mechanical ventilation and air-conditioning is being provided across most areas. It is required that it be demonstrated that this air-conditioning is of efficient design and does not preclude the use of natural ventilation when conditions allow.

2.2.15 Water Conservation

The EFSG requires that measures be taken to implement practical water conservation systems for new educational facilities. These include:

- All fixtures and fittings are to have a minimum WELS rating as given in the NSW Government Resource Efficiency Policy.
- Internal flow controllers that minimise water usage for staff amenities.
- Timed flow taps for student facilities.
- Dual flushing cisterns with a minimum WELS rating of 4 stars in all toilets.
- Manual flushing systems
- The inclusion of a rainwater harvesting and storage tank facilities for non-potable end uses.

2.2.16 Stormwater Management

Stormwater management should aim to minimise the transportation of toxicants to waterways and other offsite environments and maintain the existing hydrological regimes. Strategies to reduce stormwater pollution include, but are not limited to:

- Water sensitive urban design
- Reduction in area and connection of impervious surfaces.
- Use of road gutters, overflow pipes, verges, swales, living streams.
- Retention or detention of stormwater runoff from constructed impervious surfaces, including roof water tank, grass swales, end-of-line sand filter and irrigation reuse.
- Control of pollutants at their source.
- Improvement in water quality, via soil and vegetation filtration.
- Management of flow rates to prevent erosion.
- Refer to relevant local regulations for Stormwater Pollution Reduction Targets.

The tenderers should allow for verification that the design aligns to these requirements.

2.2.17 Modelling

The EFSG requires a variety of modelling to be completed. The project must allow for, as a minimum, Thermal Comfort Modelling in line with DG55, alongside energy simulation by major end-use and daylighting modelling to ensure natural light is optimised as per DG2.3.1 and DG12.

2.3 NSW Government Resource Efficiency Policy (GREP)

The GREP aims to both lead by example and reduces the Government's operating costs by increasing resource productivity. This policy drives resource efficiency by Government agencies in energy, water and waste and reducing harmful air emissions from associated operations.

The policy aims to:

- Meet the challenge of rising prices expected for energy, fuel, water and waste management.
- Use purchasing power to drive down the cost of resource-efficient technologies and services.
- Demonstrate leadership by incorporating resource efficiency in decision making.

GREP includes measures, targets, and minimum standards to drive efficiency in four key areas:

- Energy use
- Water use
- Waste management
- Air quality

It is expected that the project makes allowances to ensure that the project complies with the Government Resource Efficiency Policy.

2.3.1 Energy Use

The GREP requires that all government projects demonstrate energy savings within their design and operation. The following initiatives are required to be demonstrated within the design of the Kingscliff High School project.

- All new electrical equipment purchased must be at least 0.5 stars above the market average star rating or comply with high-efficiency standards
- The project has included design equivalency to a 4 Star Green Star Design & As-Built rating
- The design has allowed for the provision of onsite solar

2.3.2 Water Use

The GREP requires that all government projects demonstrate water efficiency within their design and operation. The following initiatives are to be demonstrated within the design of the Kingscliff High School project.

- All new water-using appliances must be at least 0.5 stars above the average Water Efficiency Labelling and Standards (WELS) star rating by product type, except toilets and urinals, which must be at least the average WELS star rating.

2.3.3 Waste Management

The GREP requires that all government projects report on their three key waste streams, as such the project must allow for the effective site separation and management of these waste streams.

2.3.4 Air Quality

The GREP requires that all government projects demonstrate consideration of air quality within their design and operation. The following initiatives are required to be demonstrated for the Kingscliff High School project.

- All surface coatings and other VOC emitting products will comply with the Property NSW Guidance Note on Low-VOC Emission Materials.
- to easily push your existing Ladybug models out to a Passive House Planning Package (PHPP)

2.4 The Government Architect NSW (GANSW) Environmental Design in Schools Manual

This manual gives greater advice to support the Education SEPP, including the Design Quality Principle 2: Sustainable, efficient and durable, and outlines how schools can apply environmentally conscious design to improve their learning spaces, buildings, and school grounds.

Below are the environmental strategies that have been incorporated into the design, elements to be considered in the detailed design, and the initiatives for the on-going operation of the development:

- Passive cooling and heating strategies:
    - Allowing for cross natural ventilation.
    - Addition of shading devices.
    - Use ceiling fans for ventilation comfort.
    - Use air conditioning efficiently setting temperatures 18 degrees in summer and 25 in winter (operation).
    - Use timers to ensure the air conditioning system is not left on after hours
- Design of learning spaces:
    - Creation of noisy and quiet spaces including soft furnishings or surfaces, like wall treatments or floor rugs.
    - Bring plants into the classroom for Biophilic Design to improve indoor air quality (operation).
    - Exposed building services such as colour coding exposed pipework to teach about resources
    - Outdoor teaching spaces to engage students with nature (operation).
- Communication of resources use:
    - Installation of simple signage to remind students and staff to reduce their water usage (operation).
    - Make sure lighting and other electrical equipment is used economically and switched off when it's not in use (operation).
    - Collate and display the school's data on energy and water usage and waste generation (operation).
    - Incorporate signage into the building, install sensors that monitor air quality, movement (to control lights), or daylight entering the building (through louvres).
- Control Heat Gains:

  - High performance glazing to allow daylight and block unwanted heat gains
  - Blinds to control direct sunlight
  - External shading devices

- Water Sensitive Design:
  - Adopt water sensitive strategies (operation).
  - Efficient fixtures and toilets.
  - Display through signage the potential water savings for the school (operation).

- Improve energy efficiency:
  - High levels of insulation according to JV3 assessment.
  - Solar Panels.

- Encourage Physical activity:
  - End-of-trip facilities for staff and bike racks for staff and students

- Activate school grounds:
  - Covered outdoor learning areas
  - Soft landscaping elements
  - Dry-weather resistant trees and plants that are locally native to the area to reduce the need for watering.

2.4.1 The Government Architect NSW (GANSW) Greener Places Policy

The Government Architect NSW (GANSW) also provides the Design Guide for Schools and the Greener Places Design Guide to inform the architectural, urban, and landscaping design.

Greener Places Policy is a design framework for urban green infrastructure. It seeks to capture our collective aspiration and expectations in planning, designing and delivering green infrastructure in urban areas across NSW.

Green infrastructure is the network of green spaces, natural systems and semi-natural systems that supports sustainable communities and includes waterways; bushland; tree canopy and green ground cover; parks, and open spaces that includes parks; and open spaces that are strategically planned, designed and managed to support a good quality of life in the urban environment.

It is the Architect's, Landscape Designer's and Planners' responsibility to make sure that the design follows the advices, strategies, performance criteria and recommendations to deliver a green infrastructure according to the Greener Places Design Guide.

2.5 Section J Fabric Performance Code Compliance Requirements

Northrop Consulting Engineers have prepared a preliminary NCC Section J Deemed-to-Satisfy (DTS) assessment according to the National Construction Code (NCC) 2019. This section outlines the minimum compliance requirements for the building envelope for the proposed new works at Kingscliff High School. However, the below specifications should be read in conjunction with the project's NCC 2019 Section J DTS Report.

Building fabric thermal insulation requirements apply to the building fabric enclosing habitable and conditioned spaces forming part of the thermal boundary of the site (building envelope).

The table below outlines the minimum compliance requirements for the building's current design.

Table 1 Building Fabric Performance Compliance Requirements

Building Fabrics	Minimum Performance
Roof and Ceiling	R3.7
External Walls (including thermal breaks)	R1.5
Insulated Partition Walls Forming Part of the Envelope	R1.5
Suspended Floors (exposed under)	R2.0
Floors (slab on ground)	R2.0
All External Windows	U_{total} = 5.7; $SHGC_{total}$ =0.49
All Internal Windows	No minimum requirement
Roof Light	U_{total} = 3.9; $SHGC_{total}$=0.29

It is noted that the above is a prescriptive pathway for the building's fabric performance. As described on the EFSG requirements the contractor is required to demonstrate that through the selected lighting mechanical systems and fabric performance a 10% improvement is achieved in comparison to a reference building through a JV3 Alternative Assessment.

Note, both building fabric and glazing requirements only apply to the building envelope, i.e., constructions enclosing habitable and conditioned spaces. Additionally, Section J JV3 assessments results are likely to alter as the detailed design of the development progresses.

The above values are inclusive of the effects of thermal bridging and as such, the contractor must allow for the provision of non-combustible thermal breaks within elements broaching the building thermal boundaries, along with sufficient insulation to achieve the targeted insulation values.

2.6 Summary of Project and Planning ESD requirements and respective Design and Compliance Responses

The table below summarises all the requirements and the design compliance response.

Table 2: Planning Secretary's Environmental Assessment Requirements and design compliance responses

Requirement	Objective	SEARs	EFSG	GREP	Fabric Performanc

ESD principles incorporated	Holistic Sustainability Objectives	x			
Measures to minimize consumption of resources, water and energy	Holistic Sustainability Objectives	x			
The environmental design will be achieved following the GANSW Environmental Design in Schools Manual	Holistic Sustainability Objectives	x			
Assessment against an accredited ESD rating system	Sustainability Benchmark	x	x	x	
A responsive development to the CSIRO projected impacts of climate change	Site Climate Risk Analysis	x			
Integrated Water Management Plan, Water Conservation, Stormwater Management	Water Use	x	x	x	
Energy Conservation and Green House Gas Emissions	Energy Use		x		x
Environmental Management Plan	Site-Specific Environmental Management Plan		x		
Pesticides, Low VOC materials, and Air Quality	Indoor Environment Quality		x	x	
Timber	Resources Management		x		
Waste	Indoor Environment Quality and Resources Management		x	x	
Natural Light, Appliances and Equipment, Air Cooling and Heating Systems, Electricity Meters, Renewable Energy Generation, Insulation, Ventilation	Energy Use		x	x	
Modelling	Performance Prediction		x		

3. Green Star Design & As-Built Rating Pathway

3.1 Overview

The Green Star rating tool is an internationally recognised system that provides independent verification of sustainable outcomes throughout the life cycle of the built environment. Green Star was developed by the Green Building Council of Australia (GBCA), which is the nation's leading authority on sustainable buildings and communities. The relevant Green Star rating tool for Kingscliff High School is Design & As-Built, which focuses on the design and construction of new buildings and major refurbishments.

This section will reference the Green Star – Design & As-Built v1.3 framework to provide Kingscliff High School with a strategy to meet a self-assessed rating equivalent to 4 Stars. This rating is required by the SEARs requirements, NSW Department of Education's EFSG and the GREP. The Green Star – Design & As-Built v1.3 framework incorporates ESD principals across nine major categories:

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

Points are awarded to a project based on the degree to which the project meets the various requirements within these nine categories.

3.2 Rating Tool Eligibility

The eligibility criteria for the Green Star – Design & As-Built v1.3 rating tool include:

- Building Type
- Spatial Differentiation
- Timing of submission for certification
- Conditional Requirements

Kingscliff High School meets these eligibility criteria given that:

- It is a school (BCA Class 9b)
- The building is distinct
- Green Star accredited assessors (Northrop) have been engaged during the project design phase
- The project is targeting credit pathways under Greenhouse Gas Emissions and Sustainable Sites

3.3 Rating Bands and Categories

Green Star awards achievement at 3 levels (4, 5 or 6 stars), depending on the points achieved after assessment by an independent panel. Since Kingscliff High School is undergoing a self-assessment, the accredited assessors will deem the number of points achieved by the project and the equivalent rating, without formal certification. The points corresponding to each award level (rating) are as follows:

- 4 Star – 45-49 points, recognising industry "Best Practice"
- 5 Star – 60-74 points, recognising "Australian Excellence"
- 6 Star – 75+ points, recognising the project as a "World Leader"

Points are assigned to the nine categories according to Table 1 below:

Table 3: Green Star Categories and Available Points

Category	Reference Code	Available Points
Management	Man	14
Indoor Environment Quality	IEQ	17
Energy	Ene	22
Transport	Tra	10
Water	Wat	12
Minerals	Mat	14
Land Use and Ecology	Eco	6
Emissions	Emi	5
Innovation	Inn	10
Total Available Points		110

The proceeding sections describe each of the targeted credits and provide an understanding of what is required to achieve compliance in the design review stage.

3.4 Green Star Targeted Credits

Kingscliff High School is targeting 51 points for a 4 Star Green Star rating. These points and their associated credits are displayed in Table 3 below.

Table 4: Targeted Green Star Credits

LIST OF CREDITS			
Index	Credit	Points Available	Points Targeted
MANAGEMENT			
1	Green Star Accredited Professional	1	1
2	Commissioning and Tuning	4	2
3	Adaptation and Resilience	2	2
4	Building Information	1	1
5	Commitment to Performance	2	2
6	Metering and Monitoring	1	1
7	Responsible Building Practices	2	2
8	Operational Waste	1	1
INDOOR ENVIRONMENT QUALITY			
9	Indoor Air Quality	4	2
10	Acoustic Comfort	3	2
11	Lighting Control	3	1
12	Visual Comfort	3	2
13	Indoor Pollutants	2	2
14	Thermal Comfort	2	1
ENERGY			
15	Greenhouse Gas Emissions	20	7
16	Peak Electricity Demand Reduction	2	1
TRANSPORT			
17	Sustainable Transport	10	3
WATER			
18	Potable Water	12	4
MATERIALS			
19	Life cycle Impacts	7	3
20	Responsible Building Materials	3	3
21	Sustainable Products	3	0
22	Construction and Demolition Waste	1	1
LAND USE AND ECOLOGY			
23	Ecological Value	3	0
24	Sustainable Sites	2	1
25	Heat Island Effect	1	1
EMISSIONS			
26	Stormwater	2	1
27	Light Pollution	1	1
28	Microbial Control	1	1
29	Refrigerant Impacts	1	0
INNOVATION			
30	Innovation	10	3
Total		**110**	**51**

3.5 Management

3.5.1 Accredited Professional

One point is available where a Green Star Accredited Professional – Design & As-Built (GSAP) has been contractually engaged to provide advice, support and information related to Green Star principles, structure, timing and processes, at all stages of the project, leading to certification.

This will be achieved via the engagement of Northrop Consulting Engineers.

3.5.2 Commissioning and Tuning

3.5.2.1 Environmental Performance Targets

For the minimum requirement to be met, documented targets for the environmental performance of the project must be set.

This will be demonstrated through the development (early in the design phase) of a design intent report or an owner's project requirements (OPR) document. This document must be prepared by the design team at the design phase stage and outline at least the following items:

- Description of the basic functions, operations, and maintenance of the nominated building systems including:
    - A description of its intended operation and maintenance requirements; and
    - A list of what the main components are (including controls), their operation and the importance of their efficient use.
- The targets for the project energy and water consumption and energy and water budgets for all nominated building systems.
- Description of how energy, water, and aspects of indoor environment quality are metered and monitored. This includes a meter diagram that illustrates how energy and water budgets are confirmed in operation.

3.5.2.2 Services Maintainability

One (1) point is awarded where a project team can demonstrate that a comprehensive services and maintainability review has been conducted, led by the head contractor or the owner's representative (or the ICA where applicable), during the design stage and before construction.

The services and maintainability review is to facilitate input from the design team, the facilities manager and operations staff (if known), and any relevant suppliers and subcontractors (if engaged).

The review must address the following aspects for all nominated building systems:

- Commissionability.
- Controllability.
- Maintainability.
- Operability, including 'Fitness for Purpose'; and
- Safety.

The services and maintainability review and its outcomes must be summarised in a 'Service and Maintainability Report'. This report must be agreed and signed off by the involved parties. Action items resulting from this review shall be incorporated in the design intent report or OPR as outlined in

2.0. Information on the requirements of this review is outlined in the approved standards and guidelines.

3.5.2.3 Building Commissioning

One (1) point is awarded when a project team can demonstrate that the pre-commissioning and commissioning activities have been performed based on the approved standards and guidelines. To demonstrate compliance, the following must be documented:

- Commissioning Specification: The contractual tender or construction documentation must list the commissioning requirements for each system. It is not sufficient to state that systems must be commissioned to the relevant standard. Instead, the documentation must:
    - List the design parameters for each system.
    - List the required commissioning activities.
    - Define how each system is intended to operate; and
    - List the acceptable tolerances during commissioning.

Contractual documentation must indicate divisions of responsibilities, pre-commissioning procedures, commissioning requirements, witnessing requirements, phased completion requirements (if needed), post-occupancy checks, and any training requirements for the operator.

- Commissioning Plan: A commissioning plan shall be developed and include at least the following, the:
    - Objectives, or basis, of the design.
    - Scope of the commissioning plan.
    - Commissioning team list, the individual responsibilities and interface matrix.
    - General sequence of commissioning.
    - Proposed commissioning procedures.
    - Witnessing requirements.
    - Commissioning program; and
    - Requirements for subcontractor commissioning manuals.

For a project to claim this criterion, the commissioning must have taken place following the requirements laid out in the contractual documentation and the commissioning plan. The commissioning report must certify that this is the case, and be signed by the designer, the head or main contractor, the commissioning manager (or ICA), and the project manager (or owner's representative).

The person responsible for the commissioning of the nominated services must have specific and demonstrable knowledge of the types of systems to be commissioned. As an example, a general sub-contractor is unlikely to be able to fill this role.

3.5.2.4 Building System Tuning

One (1) point is awarded where, following practical completion and before occupation, the owner/client has formally committed to a tuning process for all nominated building systems. 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. The scope of the tuning works will determine the relevant tuning period.

The building tuning process will require the analysis of data from the monitoring systems and assessment of feedback from occupants on building conditions. During the tuning period, the owner/client must commit to taking steps to adjust nominated building systems to account for all identified deficiencies.

The commitment from the building owner must confirm that there is a requirement for a building tuning process and responsibilities are assigned to have all nominated building systems tuned after practical completion. This commitment can be included in the Commissioning Plan or provided as a separate document from the building owner. The commitment must include at least the following:

- Operating and Maintenance Manuals have been developed following approved standards and guidelines (refer to Guidance).
- A building tuning manual, or a building tuning plan, has been developed following the approved standards and guidelines.
- A building tuning team has been created including the facilities manager, the owner's representative and the ICA (if applicable). The head contractor and the services design professionals are available to address specific tuning issues where required; and
- The owner has engaged parties to tune the nominated systems. This engagement includes requirements for:
    - Verification that nominated systems are performing to their design potential at full and part load conditions.
    - Reviews of environmental performance against the environmental targets.
    - Collection of user feedback to match the system performance with the occupant's needs.
    - Adjustment of all the systems to account for all deficiencies discovered; and
    - Management, communication, and assignment of responsibilities for the tuning process within the team.

3.5.3 Adaptation and Resilience

Two (2) points are awarded where the following Compliance Requirements are met:

3.5.3.1 Climate Adaption Plan

The Climate Adaptation Plan must contain as a minimum the following information:

- Summary of the project's characteristics (site, location, climatic characteristics).
- Assessment of climate change scenarios and impacts on the project using at least two-time scales (e.g., 2030, 2040, 2050 or 2070), relevant to the projects anticipated lifespan. This must include a summary of potential direct and indirect climate change impacts (environmental, social and economic) on the project.
- Identification of the potential risks (likelihood and consequence) for the project and the potential risks to people. This risk assessment is to be based on a recognised standard (section 4.5.3.3).
- A list of actions and responsibilities for all 'high' and 'extreme' risks identified; and

    Details of stakeholder consultation that was undertaken during plan preparation and how the issues raised have been incorporated.

3.5.3.2 Developing Climate Change Scenarios

Before undertaking the 'Initial Assessment', the Australian Greenhouse Office (AGO) Guide calls for climate change scenarios to be developed and reviewed. The scenarios used by the project team must be sourced from the Intergovernmental Panel on Climate Change (IPCC) endorsed Global Circulation Models (GCMs) and may include:

- CSIRO projections.
- State or Federal climate projections; or
- Projections determined by a more detailed climate model.

The project must justify the selection of the climate scenario and emissions scenario used.

3.5.3.3 Recognised Standards

For this credit, the recognised standards are listed below:

- AS 5334:2013 Climate Change Adaptation for Settlements and Infrastructure; or

The following two standards when combined:

- ISO 31000-2009 – Risk Management – Principles and Guidance; and
- The AGO's Climate Change Risks and Impacts: A Guide for Government and Business.

Should project teams wish to demonstrate compliance using an equivalent alternate standard or framework, a Technical Query may be submitted to the GBCA to confirm equivalency.

3.5.3.4 Risk Assessment

The project team is required to undertake the 'Initial Assessment' outlined in Sections 4-6 of the AGO Guide. The ISO 31000 Standard must be used for further guidance in undertaking the risk analysis process prescribed in Sections 5.1-5.6 of the AGO Guide.
The consequence/success criteria in the AGO Guide have been refined to be more applicable at the development scale and are provided in the Guidance section of this credit. Alternatively, organisations may use internal corporate success/criteria tables.
Alternatively, the project team may follow the approach within AS 5334:2013 for buildings. The analysis must include a discussion of all climate change elements described and follow the risk analysis and mitigation sections of the standard.

The assessment of climate change impacts must address a minimum of two-time scales (e.g., 2030, 2040, 2050 or 2070) relevant to the anticipated building lifespan for the primary effects of temperature, precipitation and sea-level rise. The plan must then consider the secondary effects of relative humidity, drought/flood, wind, cyclones and bushfire as a minimum.

3.5.4 Building Information

One (1) point is awarded where the project team can demonstrate that:

- Comprehensive operations and maintenance (O&M) information are available to the facilities management team. Compliance may be demonstrated with one document that includes operations and maintenance information (in accordance with 4.5.4.1) and the building logbook information (in accordance with 4.5.4.2), or a number of separate documents that contain the same information.
- Current building user information is available to all relevant stakeholders, in accordance with 4.5.4.3 and 4.5.4.4.

3.5.4.1 Operations and Maintenance Information

The project team must confirm that operations and maintenance information is provided for all nominated building systems and that the following criteria are achieved:

- Appropriate content for all nominated building systems is readily available.
- The appropriate user group has access to the information they require to deliver best practice environmental outcomes; and
- Guidance on keeping information up–to-date is provided to the facilities management team in these documents.

3.5.4.2 Building Logbook

The project team must develop a building logbook to present to the building owner before practical completion of the project. The building logbook must:

- Be developed in line with CIBSE TM31: Building Logbook Toolkit.
- Cover all nominated building systems; and
- Include links or references to all relevant operations and maintenance information.

3.5.4.3 Format of Building User Information

Building user information is a source of up-to-date, relevant information for the building user. The information must address the intended use of all nominated systems within the building.

The amount and details of building user information must be relevant to the project's audience.

For example, if the premises are owner-occupied, the information provided to users must be geared towards general staff that occupy the space. If the space is leased from a landlord, the information provided must also be geared towards the person responsible for the management of the tenanted space; this may be a tenant representative or an office manager.

Building user information must be able to be updated and edited by the facilities management team, or other appropriate stakeholder group, to ensure it remains current and relevant to users throughout the life of the building.

3.5.4.4 Delivery of Building User Information

All building user information must be available to the building owner and facilities management team at the time of practical completion. It is acknowledged that ongoing tuning may require updates to building user information and its content may extend beyond practical completion.

The method of delivery of the information provided may differ based on the target audience. However, due to the live nature of building user information it must be provided in a digital format and made available through any combination of digital signage or interactive information kiosks in high traffic public areas (e.g., building foyer, lift lobby or lift displays), induction or training material, website or intranet, or applications for mobile devices.

It must be made clear at the time of submission for certification how this information has been presented to the relevant audience or user group. It is the project team's responsibility to clearly identify the relevant user groups and deliver building user information tailored to their needs.

3.5.5 Commitment to Performance

3.5.5.1 End of Life Waste Performance

One (1) point is awarded where at least 80% of the project's GFA, excluding car parking areas, has a formal commitment in place to reduce demolition waste at the end of life of an interior fit out 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:

- Establish contractual agreements, in accordance with 4.5.5.1; or
- Achieve a certified operational performance rating for the building, addressing waste from refurbishments, in accordance with 4.5.5.2.

3.5.5.2 Contractual Agreements

For this option, contractual agreements must be in place to demonstrate the credit criteria. Projects may demonstrate this using one of the models outlined below that is most applicable to their context:

- Formal agreement.
- Internal requirement.
- Strata management for multi-unit residential.

If the project is not adequately described by one of these options, project teams are invited to submit a CIR.

3.5.5.3 Certified Operational Performance Rating

For this option, the project must commit to achieving the 'Waste from Refurbishments' credit (23) from the Green Star – Performance rating tool. This credit must be used to report on the measured results of the end-of-life waste commitments set by the parties involved.

3.5.6 Metering and Monitoring

3.5.6.1 Metering

It is a conditional requirement of this credit that 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 base building as follows.

Metering distinct uses or floors:

- Metering shall be provided to allow for monitoring of the relevant areas or functions of the project. In most cases floor by floor metering will suffice if the entire floor has a single use.
- Where a load for a single item exceeds 5% of the total energy use for the building, or 100kW, it must be independently metered.
- Where a common water use consumes 10% of the project's water use, these must be independently metered.

3.5.6.2 Monitoring Systems

One 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 the following requirements.

The monitoring strategy must be developed in accordance with a recognised standard, such as CIBSE TM39 Building Energy Metering. The same principles described in the standard shall be used for developing water metering and monitoring strategies.

The monitoring strategy must include a metering schedule. This schedule shall address the estimated loads for energy and water and must list:

- The incoming input (electricity, gas, water, etc.).
- The end use (lighting, HVAC, fans).
- The estimated energy consumption for the end use.
- Which meter(s) provide the required information; and
- The individual estimated end consumption.

The project team must provide automatic monitoring systems that record both consumption and demand of energy or water, and are capable of producing reports on quarter hourly, hourly, daily, monthly, and annual energy use for all meters.
The installed meters must be capable of producing an output that can be transmitted to a central location (either onsite or offsite). This central location must provide data retrieval and reporting mechanisms.

3.5.7 Responsible Construction Practices

3.5.7.1 Environmental Management Plan

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.

The EMP must be compliant with best practice guidelines and must be implemented from the beginning of construction works, including any excavation and demolition. The requirements for EMPs, as outlined within the NSW Environmental Management Systems Guidelines, are considered best practice. The edition of the guidelines current at the time of construction must be used.

3.5.7.2 Formalised Environmental Management System

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.

There are two compliance pathways for this criterion. Project teams must demonstrate compliance with the pathway specified for the project's contract value, below:

- For projects with a contract value less than $10 million, the environmental management system (EMS) must comply with either NSW Environmental Management Systems Guidelines or a recognised standard.

- For all other projects, 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.

In all cases, an auditor report confirming evidence of effective use of the formalised EMS must be provided to demonstrate compliance. An auditor report for the organisation, rather than the site, will suffice. Where nonconformities with the EMS have been recorded, corrective and preventive actions must also be demonstrated to have been applied, in order for credit compliance to be achieved.

3.5.8 Operational Waste

3.5.8.1 Performance Pathway: Specialist Plan

One (1) point is awarded where a qualified waste auditor prepares an Operational Waste Management Plan (OWMP) for the building in accordance with best practice approaches. The requirements or recommendations made in the Operational Waste Management Plan must then be reflected in the design of the building's facilities.

For information on what qualifications are required to be deemed a qualified waste auditor, please see the Guidance section. OWMPs can influence the amount of waste recycled and generated by occupants, tenants and visitors. For the purposes of this credit, the OWMP must be developed for implementation at the site and building level and be applicable to the Green Star project boundary. OWMPs are usually implemented by building owners or operators.

The OWMP must be developed by a qualified waste auditor. As a minimum, the OWMP must:

- Identify the site boundary, the waste streams relevant to the project, and the individual roles responsible for delivering and reviewing the OWMP.
- Set diversion from landfill targets and/or targets for reducing total materials generation (general waste materials and recyclable/reusable materials), as well as monitoring and measurement procedures for waste and recycling streams by weight.
- Outline methods for encouraging the separation of waste streams, such as bins, storage areas, or recycling facilities in public areas as required.
- Identify storage areas for all waste streams and outline best practice safety and access requirements for their collection.
- Identify safe methods for vehicle access and transfer of waste; and
- Incorporate a review process to assess the success of the OWMP and make improvements, based on operational experience.

3.6 Indoor Environment Quality

3.6.1 Indoor Air Quality

3.6.1.1 Ventilation System Attributes

One (1) point is awarded where project teams demonstrate that the ventilation system meets all of the following conditions:

- The entry of outdoor air pollutants is mitigated - The building services must be designed to comply with ASHRAE Standard 62.1:2013 in regard to minimum separation distances between pollution sources and outdoor air intakes.

- The system is designed for ease of maintenance and cleaning; and
- The system has been cleaned prior to occupation and use.

3.6.1.2 Provision of Outdoor Air

Up to two (2) points are awarded where at least 95% of the nominated area is provided with sufficient outdoor air to ensure that levels of indoor air pollutants are maintained below acceptable levels.

For mechanically ventilated or mixed-mode spaces:

- 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.

3.6.1.3 Exhaust or Elimination of Pollutants

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:

- Removing the source of pollutants; or
- Exhausting the pollutants directly to the outside.

A combination of methods can be used to demonstrate compliance.

3.6.2 Acoustic Comfort

3.6.2.1 Internal Noise Levels

One point is awarded where project teams demonstrate that internal ambient noise levels, in the nominated area, are no more than 5dB (A) above the “satisfactory” sound levels provided in Table 1 of AS/NZS 2107:2016.

The noise measurement and documentation must be provided by a qualified acoustic consultant in accordance with AS/NZS 2107:2016.

3.6.2.2 Reverberation

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.

3.6.2.3 Acoustic Separation

One (1) point is awarded where the project addresses noise transmission in enclosed spaces within the nominated area. Enclosed space is defined as meeting rooms, private offices, classrooms, and any other similar space where it is expected that noise should not carry over from one space to the next. There are two methods for demonstrating compliance with this criterion:

- The partition between the spaces should be constructed to achieve a weighted sound reduction index (Rw) of:

- At least 45; for all partitions which are fixed without a door and/or glazed partitions without a door.
- At least 35; for all partition types that contain a door.

- The sound insulation between enclosed spaces complies with $D_w + LA_{eq}T > 75$ where D_w is the weighted sound level difference measured between the two spaces and $LA_{eq}T$ is the indoor ambient noise level in the space adjacent to the enclosed space.

3.6.3 Lighting Comfort

3.6.3.1 Minimum Lighting Comfort

To qualify for points in this credit project teams must demonstrate that all lights in the nominated area are flicker free and accurately address the perception of colour in the space.

- Flicker-free lighting refers to luminaires that have either:
- A minimum Class A1 & A2 ballast.
- High frequency ballasts for all fluorescent lamps, or
- Electronic ballasts in High Intensity Discharge (HID) lighting.

3.6.3.2 General Illuminance and Glare Reduction

One point is awarded where project teams can demonstrate that, for 95% of the nominated area, lighting levels comply with best practice guidelines for Office Spaces; corresponding to Table 3.1 of AS 1680.2.

In addition, glare is to be eliminated in accordance with Prescriptive Method 1 where; all bare light sources must be fitted with baffles, louvers, translucent diffusers, ceiling design, or other means that obscures the direct light source from all viewing angles of occupants, including looking directly upwards.

3.6.4 Visual Comfort

3.6.4.1 Glare Reduction

To qualify for points in this credit project teams must demonstrate that glare from sunlight through all viewing façades in the nominated area is reduced through a combination of blinds, screens, fixed devices, or other means.

3.6.4.2 Daylight

Two points are awarded where project teams can demonstrate that 80% of the nominated area receives high levels of daylight during 80% of the nominated occupied hours. Compliance with EFSG Design Guidelines (section 3.4.1) also requires natural light be the primary lighting source in all teaching spaces.

3.6.4.3 Views

One point is available where project teams can demonstrate that 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 window, atrium, or view can be considered to meet this credit criterion.

3.6.5 Indoor Pollutants

3.6.5.1 Paints, Adhesives, Sealants and Carpets

One point is available where at least 95% of all internally applied paints, adhesives, sealants and carpets meet stipulated 'Total VOC Limits' (TVOC), or, where no paints, adhesives, sealants or carpets are used in the building.

Maximum TVOC limits for paints, adhesives and sealants are detailed in the Table 3 below:

Table 5: Maximum TVOC Limits for Paints, Adhesives and Sealants

Product Category	Max TVOC content in grams per litre (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

The product is certified under a recognised Product Certification Scheme (listed on the GBCA website http://new.gbca.org.au/product-certification-schemes/) or other recognised standards. The certificate must be current at the time of project registration or submission and list the relevant product name and model.

3.6.5.2 Engineered Wood Products

One point is available where at least 95% of all engineered wood products including: particleboard, plywood, Medium Density Fibreboard (MDF), Laminated Veneer Lumber (LVL), High-Pressure Laminate (HPL), Compact Laminate and decorative overlaid wood panels meet stipulated formaldehyde limits or no new engineered wood products are used in the building.

All engineered wood products used in the building will meet the relevant limits specified in Table 4 as per the specified test protocol or have product specific evidence that it contains no formaldehyde.

Table 6 Formaldehyde Emission Limit Values for Engineered Wood Products

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.

3.7 Energy

Through the 'Energy' category, Green Star Design & As-Built v1.3 aims to facilitate reductions in greenhouse gas emissions by facilitating efficient energy usage and encouraging the utilisation of energy generated by low-emission sources.

3.7.1 Greenhouse Gas Emissions – Conditional Requirement

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.

3.7.2 Greenhouse Gas Emissions – Comparison to a Reference Building Pathway

Up to 20 points are available where it is demonstrated that there is a specified reduction in the predicted energy consumption and GHG emissions of the Proposed Building from the Benchmark Building.

Points are awarded based both on improvements to the building's façade, and on the project's predicted ability to reduce its energy consumption and emissions towards 'net zero'.

Prediction of the building performance against this benchmark is assessed using building performance modelling that assesses potential energy use for building services systems including:

- Mechanical Services

- Electrical Services
- Communications, AV and security systems
- Hydraulic Services
- Vertical Transportation Systems

The project will be targeting 10 points which correlates to a 20% reduction in energy consumption and 40% reduction in greenhouse gas emissions from the Benchmark Building.

3.7.3 Peak Electricity Demand Reduction – On-site Energy Generation

One (1) point is awarded where it is demonstrated that the use of on-site renewable energy or on-site generation sources reduces the peak electricity demand by at least 15%. The EFSG Design Guide requires a solar PV system of 40kW capacity for Kingscliff High School (section 2.4.7 – 21 Core Primary School), however we recommend installing the maximum capacity able to be accommodated on the roof.

Peak electricity demand must be calculated in line with the below requirements:

- In accordance with AS/NZS 3000:2007 (or as subsequently amended).
- As the absolute design capacity of the system, after the application of diversity factors, but prior to the application of contingency factors as required for utility agreements (the value is likely to be about 30% less than that for the utility agreement); and
- To include all building end-use loads, except process loads, in the peak demand assessment.

For mixed-mode ventilated buildings, peak demand must be calculated in the mechanically ventilated mode. Refer to the Building Energy Consumption and Greenhouse Gas Emissions Calculation Guidelines for the applicable assessment scope.

3.8 Transport

Sustainable transport criteria aim to provide design and operational measures that reduce the carbon emissions arising from occupant travel to and from the project, when compared to a benchmark building. In addition, it also promotes the health and fitness of commuters, and the increased liveability of the location.

3.8.1 Sustainable Transport – Prescriptive Pathway

3.8.1.1 Access by Public Transport

Up to three (3) points are awarded based on the accessibility of the site by public transport. The points score is determined by the GBCA's *Access by Public Transport Calculator*. Points are awarded based on the percentage of people within the Greater Capital City Statistical Area (GCCSA) that can access the site by public transport within 45 minutes during peak hour. Based on this calculation method, Kingscliff High School qualifies for all three points.

3.8.1.2 Reduced Car Parking Provision

Up to one (1) point is awarded where there is a reduction of car parking spaces for the proposed building, when compared to the maximum local planning allowance. For Kingscliff High School, this correlates to a minimum of 30 individuals at peak building occupancy per car parking space.

Where no carparks are provided, 1 point is awarded unless this has been enforced by planning requirements, where it becomes Not Applicable.

3.8.1.3 Bicycle Facilities

One (1) point is awarded where bicycle parking and associated facilities are provided to a proportion of the building's regular occupants and visitors. For Kingscliff High School, this equates to secure bicycle parking facilities for 7.5% of regular school staff and 40% of students over grade 4. In addition, end-of-trip facilities including showers and lockers are required based on the total number of regular occupants.

3.8.1.4 Walkable Neighbourhoods

One (1) point is awarded where the project achieves a Walk Score of least 80, as determined by the website www.walkscore.com, using the 'street smart' method of calculation. Based on its location, Kingscliff High School achieves a walk score of 85 and hence qualifies for this point.

3.9 Water

3.9.1 Potable Water – Prescriptive Pathway

Up to 6 points out of 12 are available where it is demonstrated that the building's potable water consumption has been reduced through best practice water saving design features.

3.9.1.1 Sanitary Fixture Efficiency

One point is awarded where all fixtures are within one star of the WELS rating stated in Table 5.

Table 7: Nominated Fixture WELS Rating

Fixture / Equipment Type	WELS Rating
Taps	6 Star
Urinals	6 Star
Toilet	5 Star
Showers	3 Star (> 4.5 but <= 6.0)
Clothes Washing Machines	5 Star
Dishwashers	6 Star

3.9.1.2 Heat Rejection

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. Kingscliff High School will qualify for both points based on the DoE Design Guidelines which promote natural ventilation and restrict the use of water cooled HVAC systems.

3.9.1.3 Landscape Irrigation

One (1) point is awarded where either drip irrigation with moisture sensor override is installed, or where no potable water is used for irrigation.

The landscaping and associated systems must be designed to reduce the consumption of potable water required for irrigation through the installation of subsoil drip irrigation and moisture sensor controls.

3.9.1.4 Fire System Test Water

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.

Kingscliff High School will have access to the wider precinct's central fire hydrant system. To qualify for this point, the central system should comply with the above requirements.

3.10 Materials

The aim of the materials credits is to reward projects that include building materials that are responsibly sourced or have a sustainable supply chain.

3.10.1 Life Cycle Impacts – Prescriptive Pathway

3.10.1.1 Concrete

One (1) point is awarded where project teams can demonstrate that the Portland cement content is reduced by 30%, measured by mass across all concrete used in the project compared to the reference case.
Half a point (0.5) is awarded where project teams can demonstrate that 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).

Or.

Half a point (0.5) is awarded where project teams can demonstrate that either:

- At least 40% of coarse aggregate in the concrete is crushed slag aggregate or another alternative material (measured by mass across all concrete mixes in the project), provided that the use of such materials does not increase the use of Portland cement by over five kilograms per cubic metre 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 materials does not increase the use of Portland cement by over five kilograms per cubic metre of concrete.

3.10.1.2 Steel

Up to one (1) point is awarded where project teams can demonstrate that there is a reduction in the mass of steel framing used when compared to standard practice. The reduced mass of steel framing can be demonstrated by one of the following design initiatives:

- High strength steel; or
- Reduction in mass of steel framing by 5% when compared to a suitable reference building

3.10.2 Responsible Building Materials

To reward projects that include building materials that are responsibly sourced or have a sustainable supply chain.

3.10.2.1 Structural and Reinforcing Steel

One (1) point is awarded where project teams can demonstrate that 95% (by mass) of the building's steel 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 processes in its manufacture.

Steel manufacturers can be considered a sustainable source when they currently have a valid ISO 14001 Environmental Management System in place, and they are a member of the World Steel Association's Climate Action Programme.
Steel Fabricators are considered sustainable if they can prove they are a current member of the ASI's Environmental Sustainability Charter Group.

3.10.2.2 Timber

One (1) point is awarded where project teams can demonstrate that, at least 95% (by cost) of all timber used in the building and construction works is either:

- Certified by a forest certification scheme that is deemed to satisfy the minimum requirements of the GBCA's 'Essential Criteria'; or
- From a reused source.

A combination of both initiatives may be used to achieve 95% compliance. This must be clearly demonstrated within the timber schedule in the Submission Template.

3.10.2.3 Permanent Formwork, Pipes, Flooring, Blinds and Cables

One point is available where 90% (by cost) of all cables, pipes, flooring and blinds in a project either:

- Do not contain PVC and have an Environmental Product Declaration (EPD); or
- Meet the GBCA's 'Best Practice Guidelines' for PVC.

3.10.3 Construction and Demolition Waste

To reward projects that reduce construction waste going to landfill by reusing or recycling building materials.

3.10.3.1 Percentage Benchmark

One (1) point is awarded where the project team can demonstrate that at least 90% of the waste generated during construction and demolition has been diverted from landfill. Waste shall be reported in kilograms.

3.11 Land Use and Ecology

The Green Star - Design & As Built 'Land Use & Ecology' category aims to reduce the negative impacts on sites' ecological value as a result of urban development and reward projects that minimise harm and enhance the quality of local ecology.

3.11.1 Ecological Value

To reward projects that improve the ecological value of their site.

3.11.1.1 Endangered, Threatened or Vulnerable Species and Communities

It is a minimum requirement of this credit that a check is carried out to ensure that the site does not contain 'critically endangered, endangered, or vulnerable species or ecological communities' as defined in the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

3.11.2 Sustainable Sites

To reward projects that choose to develop sites that have limited ecological value, that reuse previously developed land, and that remediate contaminated land.

3.11.2.1 Conditional Requirement

The Conditional Requirement is met when all of the following conditions are satisfied:

- The project is not on land containing old-growth forest.
- The project is not on prime agricultural land.
- The project does not impact on any wetland listed as being of 'High National Importance', unless specified Wetland Protection Measures are in place.
- The project does not have a significant impact on 'Matters of National Significance' listed under the Environmental Protection and Biodiversity Conservation Act (1999).

3.11.2.2 Reuse of Land

One (1) point is awarded where either of the following conditions is met:

- 75% of the site was 'previously developed land' at the date of site purchase; or
- The project is a building extension, and 75% of the extension (including landscaping) falls within an area of the site that was 'previously developed land' at the project's Green Star registration date.

3.11.3 Heat Island Effect

One (1) point is awarded where, when assessed in plan view, at least 75% of the whole site area comprises of one or a combination of the following:

- Vegetation.
- Green roofs.
- Roofing materials, including shading structures, having the following:
    - For roof pitched <15°– a three year SRI of minimum 64; or
    - For roof pitched >15°– a three year SRI of minimum 34.
- Only where the three year Solar Reflectance Index (SRI) for products is not available, use the following:
    - For roof pitched <15° – an initial SRI of minimum 82; or
    - For roof pitched >15° – an initial SRI of minimum 39.
- Unshaded hard-scaping elements with a three year SRI of minimum 34 or an initial SRI of minimum 39.

- Hardscaping elements shaded by overhanging vegetation or roof structures, including solar hot water panels and photovoltaic panels.
- Water bodies and/or water courses; or
- Areas directly to the south of vertical building elements, including green walls and areas shaded by these elements at the summer solstice.

3.12 Emissions

The Green Star - Design & As Built 'Emissions' category aims to assess the environmental impacts of 'point source' pollution generated by projects. Negative impacts commonly associated with buildings include damage to the environment through refrigerant leaks or disturbances to native animals and their migratory patterns as a result of light pollution.

3.12.1 Stormwater

To reward projects that minimise peak storm water outflows from the site and reduce pollutants entering the public sewer infrastructure or other water bodies.

3.12.1.1 Stormwater Peak Discharge

One (1) point is available where the post-development peak event discharge from the site does not exceed the pre-development peak event discharge using the design Average Recurrence Interval (ARI) that corresponds to the associated flooding risk identified in the Climate Change and Adaption Assessment undertaken as part of the Adaption and Resilience credit.

3.12.2 Light Pollution

This credit rewards projects that minimise light pollution.

3.12.2.1 Light Pollution to Neighbouring Bodies

To qualify for points under this credit project teams must demonstrate that all outdoor lighting on the project complies with AS 4282:1997. The conditions shall be applied to all inhabited boundaries, apart from boundaries with roads.

3.12.2.2 Light Pollution to Night Sky

One point is awarded where it can be demonstrated that one of the following specified reductions in light pollution has been achieved by the project:

- Control of upward light output ratio (ULOR) by demonstrating that no external luminaire on the project has a ULOR that exceeds 5%, relative to its actual mounted orientation; or
- Control of direct luminance- demonstrate that direct illuminance from external luminaries on the project produces a maximum initial point illuminance value no greater than:
    - 0.5 Lux to the site boundary, and
    - 0.1 Lux to 4.5 meters beyond the site into the night sky.

3.12.3 Microbial Control

This credit aims to recognise projects that implement systems to minimise the impacts associated with harmful microbes in building cooling systems.

3.12.3.1 Legionella Impacts from Cooling Systems

One (1) point is awarded where it can be demonstrated that impacts associated with harmful microbes in building cooling systems are minimised through one of the following:

- Naturally ventilated buildings; or
- Waterless heat-rejection systems.

The DoE EFSG Design Guidelines prevent the use of water cooled systems in educational facilities, hence, Kingscliff High School will qualify for this point.

3.13 Innovation

3.13.1 Market Transformation

This credit recognises projects that have undertaken sustainability initiatives that substantially contribute to the broader market transformation towards sustainable development in Australia or in the world. Points will be awarded for projects that:

- Increase the knowledge and capacity of the building industry.
- Increase the knowledge of sustainable practices in regional areas.
- Change the regulatory environment.
- Use technologies or strategies which, if adopted widely, would lead to a significant reduction of impacts in the built environment.

Kingscliff High School's implementation of hub based learning and multi-use spaces is an initiative that will qualify for one (1) point in the Market Transformation credit.

3.13.2 Improving on Green Star Benchmarks

Points for this Innovation credit are awarded where the project can demonstrate a substantial improvement to a specific benchmark addressed by Green Star – Design & As-Built v1.3 which the project is already targeting.

3.13.2.1 Sustainable Transport

One (1) point will be awarded where there is no new car-parking provided on the site, even if this parking is operated by a third party.

3.13.3 Innovation Challenge

For this credit, projects must address an issue that is not included within the Green Star – Design & As-Built v1.3 rating tool. A range of Innovation Challenges have been developed by the GBCA to challenge owners, developers, tenants and project teams to create even more sustainable projects.

3.13.3.1 Community Benefits

One (1) point is awarded where the project team can demonstrate the provision of spaces that promote engagement between the wider community and the building. Kingscliff High School will qualify for this innovation point with the inclusion of mixed-use and multi-functional spaces on the ground floor of the development. To qualify, the project team must:

- Perform a 'needs analysis' of the surrounding community.
- Develop a strategy for how the project will provide social/community benefits and consult with the broader community on the proposed plan; and
- Implement the plan and deliver outcomes as defined by the community benefits strategy.

3.13.3.2 Financial Transparency

One (1) point is awarded where owners, developers and operators disclose the costs of sustainable building practices in order to promote uptake by future projects. The project team must:

- Agree to complete the 'Financial Transparency Disclosure Template' that comprehensively itemises design, construction, documentation and project costs.
- Provide this information in Excel format at the time of the projects Green Star submission.

- Agree to participate in the yearly GBCA report, using autotomized data provided by project teams.

4. Sustainability Initiatives

The project is aiming to demonstrate a strong commitment to sustainability in its design, construction and operation. The design has been assessed to determine its ability to minimise resource consumption and cost of operation.

This process has resulted in a number of effective sustainability solutions to be considered throughout the design, construction and operational stages of the building. These initiatives and actions help to minimise the use of natural resources, improve waste minimisation and recycling rates, reduce adverse environmental impacts of the project and allow for the development of a resilient building.

The following section outlines the initiatives proposed for implementation and consideration, separated by their sustainability objectives apart from the all the requirements listed on the sections above:

- Reduced Operational Energy:
- Health and Wellbeing:
- Water Management:
- Resource Management:
- Ecological Footprint:
- Climate Adaptation

The following section details the initiatives proposed for implementation and consideration:

4.1 Reduced Operational Energy Strategy

4.1.1 Heat Avoidance - Reduced Window-to-wall ratios

The design has been optimized to reduce the project's window-to-wall ratio across all orientations in order to help to manage the heat transfers through the window systems. A low window-to-wall ratio enables more highly insulated building and therefore a reduction in the peak cooling loads from direct solar radiation.

4.1.2 Heat Avoidance - Optimised Shading

Direct solar radiation entering a building can act as a beneficial heat source in winter, but then in summer can drastically increase air-conditioning loads. As such optimised shading, with the deep reveals of the school windows, also the building to use the position of the sun in the sky across the year to allow the entry of solar radiation in winter and block this in summer.

4.1.3 Heat Avoidance - High performance fabric

Exceeding the minimum compliance requirements of section J fabric performance will also assist in improving performance. The project is planning to incorporate high insulation values on the solid parts of the building fabric, performance glazing, and fabric designed to reduce thermal bridging. This will allow minimal heat transfer through the building envelope reducing both heating and cooling loads throughout the year.

4.1.4 Enhanced Daylight - High VLT Glazing

The glazing selected balances the transfer of heat energy and that of visual light, this will allow a greater level of daylight into the building, reducing lighting loads and improving the user's visual comfort within the space.

4.1.5 Enhanced Daylight - Internal finishes

The use of pale internal finishes will help to maximize light propagation through the space and minimize the energy used for lighting spaces throughout daylight hours.

The cost implications of doing this should be minimal given colour of materials is generally non determinant of price.

4.1.6 Enhanced Daylight - Shading and Blinds

Shading and internal blinds allow the control of direct solar radiation on the space to mitigate glare issues. This both allows building occupant to reduce glare and control the indoor environment allowing for comfortable flexible use of all spaces.

4.1.7 Artificial light & controls - Lighting design and efficacy

The installation of efficient lighting systems includes both lighting technology and design approach. Benefits of a considered approach result in cost neutral or cost positive lighting design and efficacy opportunities.

Strategies to achieve reduction in lighting energy intensity include:

1. The use of surface mounted down-lighting in preference to recessed lighting and up-lighting.

   This design approach significantly reduces the number of fittings installed and the energy intensity of lighting. A secondary benefit of the use of surface mounted lighting is a reduced number of penetrations through the building fabric which reduces heat loss and gains through the penetrations.

2. The provision of more GPOs throughout habitable spaces.

   In our experience adding GPOs beyond the standard guideline can also promote the use of task lighting in areas where localised light levels and control are required. This can also reduce the number and power of general lighting required in a space for comfort and task purposes. Overall, the provision additional GPO's would be nominal during the design stage and provides residents with a greater level of amenity within their space.

4.1.8 Artificial light & controls - Lighting controls

The implementation of motion sensors and lighting controls within communal spaces would be recommended alongside a room master switch to ensure that lighting is not left on when spaces are not occupied. Considering lighting control should include the application of motion sensors and dimmers in the dwelling spaces, which would provide a higher standard of lighting control for the occupants, and results in greater energy efficiency for the development.

The design team should specify zoned switching coupled with daylight sensors, as well as motion sensors for communal spaces.

4.1.9 Renewable Energy Onsite Generation - Rooftop Solar Photovoltaics

Rooftop solar power within the development should have the potential to provide a portion of the building's energy use across the year. Using a system connected to the base building systems will offset energy used by the central services. Using solar power will significantly reduce ongoing costs.

4.1.10 Energy Efficiency – Ventilation Efficiency Measures

A Building Management System coupled with Efficient ventilation measures should be recommended for the development to reduce the amount time and the need of ventilation energy use. Carbon monoxide monitors should be specified for areas with high volume of carbon monoxide emissions.

4.1.11 Energy Efficiency – HVAC Systems

The mechanical systems should include a mixed mode system to account for opportunities to use the operable windows, cross-ventilation, and adaptive thermal comfort approach to the site. This system's design will be to minimize its use when external conditions can meet the occupant's comfort needs.

4.1.12 Energy Efficiency – Appliances

Highest energy efficient ratings under the energy star system to be installed in all dwellings.

4.2 Health and Wellbeing

4.2.1 Indoor Environment Quality - Low VOC's and low formaldehyde

The idea of improving indoor environment quality helps to ensure that building occupants are comfortable within a space and reduce exposure to internal pollutants. Through the provision of sufficient outside air, sufficient lighting levels and good visual access to outside the project will help to promote good indoor environment quality.

To assist with improved indoor environmental quality of the building occupants, 50% of materials (by cost) used on site are proposed to contain low Volatile Organic Compounds (VOCs) including paints, flooring, sealants and adhesives and all engineered wood products used in the development are to be low formaldehyde or formaldehyde free.

Paints are required to have a VOC of less than 5g/L. All other paints, adhesives, sealants and carpets used in the building shall meet the requirements within each of the following criterion. Emissions for each application must be acquired through recognised testing methods and reported through a recognised datasheet. In the case of paints and adhesives and sealants, theoretical TVOC calculations are also acceptable.

The following items are excluded:

- Glazing film, tapes, and plumbing pipe cements.
- Products used in car parks.
- Paints, adhesives and sealants used off-site, for example applied to furniture items in a manufacturing site and later installed in the fitout; and
- Adhesives and mastics used for temporary formwork and other temporary installations

At least 95% (by volume) of all internally applied paints and adhesives, sealants shall meet stipulated 'Total VOC Limits' as per table below:

Table 8: VOC content limits - interior finishes

Product Category	Max TVOC content in grams per litre (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

At least 95% of all internally applied carpets shall meet stipulated 'Total VOC Limits' as per table below, Carpet Test Standards and TVOC Emissions Limits:

Table 9: VOC content limits - carpets

Test protocol	Limit
ASTM D5116 - Total VOC limit	0.5mg/m2 per hour
ASTM D5116 - 4‑PC (4‑Phenylcyclohexene)	0.05mg/m2 per hour
ISO 16000 / EN 13419 - TVOC at three days	0.5mg/m2 per hour
ISO 10580 / ISO/TC 219 (Document N238) - TVOC at 24 hours	0.5mg/m2 per hour

4.2.2 Indoor Environment Quality - Trickle Ventilation

A trickle vent is a very small opening within a buildings fabric that allows a small amount of ventilation into spaces when major elements of the ventilation systems, such as windows and doors, are closed. Trickle ventilators can also provide a greater level of control over the provision of outside air to inside spaces. A number of products are available that control ventilation flow based on temperature and pressure, allowing outside air into spaces when it would be beneficial to the internal conditions and automatically shutting this off when it would result in increased heating or cooling costs.

A well-controlled trickle vent will also reduce condensation risk, avoid over ventilation (reducing air-conditioning energy and improve comfort through minimising drafts. The provision of trickle ventilators would not remove the requirements for openable windows but could assist with acoustic and ventilation controls while providing a continuous source of fresh outside air.

4.3 Water Management

A strong focus has been put on the effective management of water and design for water balance to reduce potable water use. The building with the following initiatives being included in the design in all areas throughout the project:

4.3.1 Fire hydrant test water reuse

Similar to sprinkler test water reuse, the maintenance of fire protection systems and equipment requires the checking of the water supplies. This is carried out in a number of tests aimed at proving water supplies, ensuring the required flows and pressures are achieved, and to ensure that equipment such as pump sets operate as intended. It is proposed that cooling water used in the fire hydrant system is captured, which would otherwise be discharged to the sewer or stormwater system, by redirecting it to the rainwater tank.

4.3.2 Use of low maintenance landscaping

The site's landscaping will incorporate native and low maintenance vegetation where possible which will significantly reduce the potable water consumption of the site. This use of native vegetation will also help support local flora and fauna, create a strong connection to space, and incorporate learning opportunities for the students.

4.3.3 Water Sensitive Urban Design

In line with the aim of the SEARs, the project is incorporating a strong focus on water sensitive urban design with the external landscape design assisting to minimize water use for irrigation. The inclusion of vegetation assists in the reduction of site stormwater discharge and the management of the project's broader impact on urban stormwater flows.

4.3.4 Water reuse

A stormwater control tank (OSD) and rainwater storage (RWT) should be provided to assist in managing water flows onsite. The water from RWT will be reused for toilet flushing and landscape irrigation. In general, Greywater makes up about 30 to 50%of wastewater discharged into the sewers. Hence greywater from the showers and basins will be recycled on-site and used for irrigation.

4.3.5 Appliances

The appliances specified for development should have a higher WELS performance rating than the typical.

4.4 Resource Management

4.4.1 Construction and demolition waste

Building materials account for approximately half of all materials used and about half the solid waste generated worldwide incurring significant environmental impacts at each process interval. It is proposed that at least 90% of construction and demolition waste is to be recycled, to reduce the carbon footprint of the site. This commitment could be incorporated into the head contractors' Environmental Management Plan for the site. Reclamation of high value building materials should be considered first preference. Where reclamation is not viable, materials such as asphalt, bricks, timber, plastics (including PVC) and concrete should be recycled accordingly.

4.4.2 Locally sourced products and services

Locally sourcing products and services for use in the design and construction of the development would help to keep transport and distribution impacts to a minimum. It will also help to support local employment and improve economic resilience of the north coast of NSW manufacturing industry. Manufacturer location for materials and services should adhered to the following restrictions:

- 20% of more of the materials construction budget should come from within 500km of the construction site
- An additional 30% of the materials construction budget should come from within 1000km of the construction site or closer.
- An additional 25% of the materials construction budget should come from within 5000km of the construction site.
- 25% of materials may be sourced from any location.
- Consultants should come from within 2500km of the project location.

Utilising local manufacturing and suppliers should also help to minimise lead time for products, build positive relationships and make supply chain auditing easier. Overall, the sourcing of locally sourced products should be explored and implemented where economically feasible.

4.4.3 Dual waste segregation

Providing isolated chutes located centrally within the building to dispose of general waste and comingled recycling will improve the waste outcomes for the development. The use of source separation of waste will drastically improve environmental outcomes as post collections segregation takes longer, costs more and increases cross contamination. Overall, the separation of general waste and comingled recycling will reduce waste disposal costs for the development and therefore help to minimise waste levies payable by residents. Furthermore, and for example, source separation for Paper and Cardboard with an on-site compactor to process both residents and retailers paper based recycling, will likely result in a notable operational cost savings because this resource stream attracts either low cost, nil charge or pay-back for its collection.

4.4.4 Waste compactors

Waste compaction is being considered for the development to reduce the number of traffic movements on site, reduce vermin and rodents and improve cleanliness and sanitation on site.

A compaction system offers several options which have the potential to reduce waste services costs up to 75 percent. This would allow the reduction in size of waste rooms, help to minimise the number of collections that are required by the waste contractor and should reduce the waste disposal costs and therefore help to minimise costs to the residents and operators.

4.4.5 Unified bin design and source separation

Unified bin design and source separation throughout the development can form part of a waste management strategy to create a waste sortation culture in the building. Not only should each be a different colour e.g., Red for general waste, yellow for co-mingled recycling, blue for paper and green for organics but should be consistent throughout the site. This is to assist with clarity and develop effective waste sortation prior to disposal. The waste strategy should be as part of the Waste Management Plan and considered during the early stages of e development to ensure appropriate design integration across all building uses.

Providing integrated bins into the project's kitchen would both improve the aesthetic of kitchens and help to promote the effective use of the onsite sortation facilities.

4.5 Ecological Footprint

4.5.1 Native vegetation - from local species

Native vegetation will be considered as an option for the detail design by the landscape architects. This type of vegetation plays a key part in the biodiversity and ecological stability of the local area.

A planting mix of at least 90% endemic native vegetation plantings have the benefit of:

- Controls erosion through protecting soils and riverbanks
- Reduces land degradation and salinity
- Improves water quality and availability
- Provides habitat for a wealth of unique biodiversity including threatened species.

In addition, native vegetation stores a significant amount of carbon, mitigating the effects of climate change.

The planting of native vegetation throughout the development will reduce the water needed for irrigations, reduce vegetation maintenance requirements and promote biodiversity.

4.5.2 Nonobtrusive outdoor lighting

Light pollution revealing up into the night sky (sky glow) or spilling on to neighbouring properties can harm the environment in many ways including effects on:

- Migratory birds – nocturnal birds use the moon and stars for navigation and can become disoriented by lights shining upwards into the sky.
- The disruption of biological rhythms and other effects on the behaviour of nocturnal animals and insects.
- Greenhouse gas emissions are emitted to unnecessarily light the night sky.

Ensuring that nil outdoor lights are up-facing into the night sky would not attract any additional costs and would provide ongoing operational and maintenance savings and reduce the sites impact on the natural environment.

4.5.3 Urban heat island mitigation - Rooftop or Terrace Gardens

Plants have the ability to reduce the overall heat absorption of the building which in-turn reduces the energy used by the developments active cooling systems, if proposed. The primary cause of the urban heat island effect in urbanised areas is absorbed direct solar radiation by roads and building materials. These construction materials store the suns radiation and later release with changed wavelength that cannot penetrate back through the lower atmosphere. This phenomenon creates a heat bubble over urbanised areas.

Installing roof or terrace gardens may create a passive cooling solution to this heat bubble issue by planting native vegetation and tree canopy. Plants in effect cool the ambient environment by direct shading and by the process of transpiration, which is the evaporation of water from plant leaves. Rooftop and terrace gardens have the potential to minimise temperature in the immediate atmosphere by approximately 3-4°C, improving the ambient temperature conditions within the building and minimising the buildings effect on urban heat islands.

4.6 Climate Adaption

Climate adaption planning has been considered as part of the detailed design processes with measures to consider the likely climate change impacts for the north coast of NSW. These impacts include the following.

- Increased frequency of extreme heat days
- Extended heatwave events
- More extreme (intense) rainfall events and associated flood risks.

These key elements are addressed through the following measures.

4.6.1 Increased Frequency of Extreme Heat Days

The design of the building allows the site to adapt to increased extreme heat is addressed through the improve façade performance, increased thermal mass and inclusion of façade shading. Furthermore, the mechanical design has incorporated additional peak capacity to accommodate for increased summer design day temperatures, the architectural fabric selections for roof material and site

landscaping has considered the contribution of these elements on the urban heat island for the site and the opportunities for vegetation to provide transpiration cooling.

4.6.2 Extended Heatwave Events

The project has actively included landscaping within the design to address heatwave considerations and has included capacity within the air-conditioning systems to ensure that temperature conditions are able to be maintained within the facility.

4.6.3 More Extreme Rainfall Events

Rainfall frequency and intensity has been considered as part of the management of both rainwater and stormwater on the site. Onsite detention systems have been designed to ensure that the peak discharge from the site is not increased because of the project and a rainwater system included to offset water consumption irrigation. Furthermore, site guttering and downpipes have been designed to manage an increase in rainfall intensity based on the climate change projections.

4.7 Climate Change Effects

The following list provides a summary of the primary climate effects and the risks associated due to secondary climate effects applicable to the development. The climate change projection data relevant to the climate and site conditions of the project identified within the CSIRO projected impacts of climate change were utilized to establish the below scenarios for the development and how they have been addressed within the design of the project.

4.7.1 Changing Surface Temperature

- An increase in the average surface temperature could lead to reduced thermal comfort for the building occupants over time – reflective and vegetated surfaces have been included throughout the site to minimize urban heat island effects; the building has been designed to capture multidirectional breezes and promote movement of air across the site; mixed-mode ventilation and conditioning strategy allows the building to ramp up space

- An increase in extreme heat could lead to an increase in energy and water demand and associated utility and maintenance costs – the incorporation of native low water use vegetation and not water-based heat rejection systems will minimize water demand for key systems; the use of a flexible mixed-mode system supported by onsite solar power generation will work to balance increased energy costs for space conditioning.

- An increase in extreme heat could place additional stress on building services including air conditioning equipment – an increased average outside design temperature will be used to size the air conditioning systems to ensure that they are sufficiently sized for the potential temperature increases; adaptability of these systems will also be considered with the potential to add additional cooling capacity if required in the future.

4.7.2 Changing Precipitation

- An increase in rainfall intensity could increase local flood events limiting access to the building for vehicles, building occupants, and pedestrians – the onsite stormwater management systems will be designed for the forecast increases in rainfall intensity; the landscape design incorporates significant vegetation to assist in the management of stormwater runoff and the project will improve the permeability of the site.

- Increased severe thunderstorms and intensity could result in blockages in roof drainage systems from the build-up of hail and debris, causing stormwater to overflow and damage the building asset,

goods, and equipment owned by the school – the projects hydraulic design will consider this risk and increase the capacity of roof drainage to accommodate.

- Power outages during major storm events could lead to a potential disturbance to building systems including security, lighting, etc, posing a safety issue to occupants on-site – the flexible mixed-mode ventilation systems and project focus on good daylight penetration will enable the building to continue operating across most of the year in the occasion of power outages; emergency lighting and safety systems will have redundancy to minimize safety risks posed to building occupants.

4.7.3 Changing Wind Speed

- An increase in wind speed intensity could lead to damaged building assets including windows and roof elements – this is considered within the structural and landscaping design of the site.
- Increased wind speed intensity could result in damaged vegetation, creating a disturbance to the local ecosystems and increased maintenance costs for the property – this risk is considered within the landscaping design with the use of endemic native species well suited to the site, and these future risks
- An increase in wind speed intensity could potentially damage power lines, resulting in a power outage for the building - the flexible mixed-mode ventilation systems and project focus on good daylight penetration will enable the building to continue operating across most of the year in the occasion of power outages

4.7.4 Changing Humidity

- A decrease in humidity could relate to higher risks of fires – the inclusion of rainwater supplied a drip irrigation system for landscaping and the general location of the site should minimize this risk.
- A decrease in humidity could lead to changes in the micro-climate, impacting the local ecology (flora and fauna) of the site – the use of endemic native vegetation will act as a buffer to this impact as will the provision of the rainwater supplied irrigation systems.

4.7.5 Statement on Design

The project design has included specific measures detailed within section 3 of this report to respond to the CSIRO and projected impacts of climate change. These measures include simple alterations such as building orientation and site layout to promote airflow through the building and site, colour selection and the use of vegetation, through to more complex solution such as the proposed HVAC controls and mixed mode ventilation strategy. Overall, these measures alongside the adaptability of the building and its systems shows a strong consideration within the design of potential future climate change adaptation needs.

5. Conclusion

Northrop Consulting Engineers have assessed and assisted the design of the building and its ability to minimise resource consumption and cost of operation.

Based on the above, the development has the potential to meet all the planning requirements. Effective sustainability solutions are to be considered throughout the design, construction and operational stages of the building.

Northrop notes that the documentation provided the for the tender package is, generally, in compliance with the information provided within this report, however, it is the contractor's responsibility to ensure that the final constructed building complies with the applicable standards.

The table below summarises all the requirements and the design compliance response

Requirement	Objective	SEARs	EFSG	GREP	Fabric Performance	Design and Compliance Response
ESD principles incorporated	Holistic Sustainability Objectives	x				Sustainability Initiatives in Section 4 of the Report
Measures to minimize consumption of resources, water and energy	Holistic Sustainability Objectives	x				Reduced Operational Energy and Water Management in the Sustainability Initiatives in Section 4 of the Report, the Water efficiencies requirements from Green Star in section 3.9, the Water Sensitive Design from the Government Architect NSW Environmental Design in Schools Manual in section 2.4, and the Water Conservation initiatives from the EFSG in Section 2.2.
The environmental design will be achieved following the GANSW Environmental Design in Schools Manual	Holistic Sustainability Objectives	x				The Government Architect NSW Environmental Design in Schools Manual initiatives in Section 2.4 and, Sustainability Initiatives in Section 4 of the Report
Assessment against an accredited ESD rating system	Sustainability Benchmark	x	x	x		Design Equivalence to a 4 Star Green Star rating. Green Star Pathway in Section 3, Table 3 of the report.
A responsive development to the CSIRO projected	Site Climate Risk Analysis	x				Climate Adaption in the Sustainability Initiatives in Section 4 of the Report

Requirement	Objective	SEARs	EFSG	GREP	Fabric Performance	Design and Compliance Response
impacts of climate change						
Integrated Water Management Plan, Water Conservation, Stormwater Management	Water Use	x	x	x		Water Management in the Sustainability Initiatives in Section 4 of the Report
Energy Conservation and Green House Gas Emissions	Energy Use		x		x	A 10% improvement above the NCC Section J requirements in Section 2.5 of the Report
Environmental Management Plan	Site-Specific Environmental Management Plan		x			Tenderers will be required to prepare an Environmental Management Plan
Pesticides, Low VOC materials, and Air Quality	Indoor Environment Quality		x	x		Indoor Environment Quality in the Sustainability Initiatives in Section 4 of the Report
Timber	Resources Management		x			The project is to contain no rainforest timbers (unless plantation grown), no timbers from high conservation forests
Waste	Indoor Environment Quality and Resources Management		x	x		Indoor Environment Quality and Resources Management in the Sustainability Initiatives on Section 4 of the Report
Natural Light, Appliances and Equipment, Air Cooling and Heating Systems, Electricity Meters, Renewable Energy Generation, Insulation, Ventilation	Energy Use		x	x		Reduced Operational Energy in the Sustainability Initiatives in Section 4 of the Report
Modelling	Performance Prediction		x			The project must allow for modelling of thermal comfort, daylight access and energy consumption