



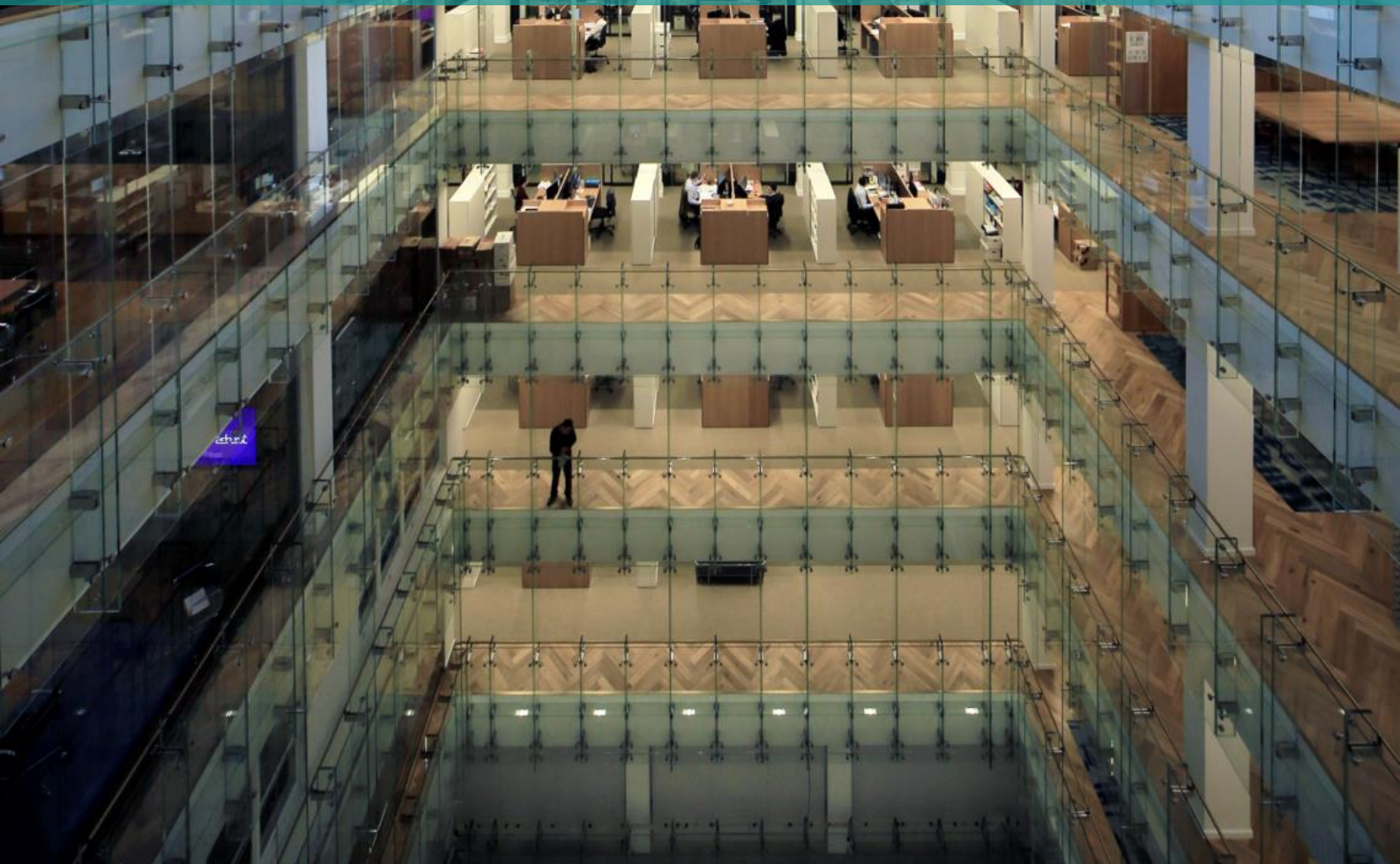
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A TETRA TECH COMPANY

BVN

Green Square Integrated Community Facility and School – SSD-10381

Ecologically Sustainable Development Statement
26 July 2021

CONFIDENTIAL | Revision: 0.5 – FOR SSDA SUBMISSION | Issued: 26 July 2021



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1 EXECUTIVE SUMMARY

Norman Disney & Young (NDY) has been engaged by BVN Architects (on behalf of Schools Infrastructure NSW, 'SINSW') to provide an Ecologically Sustainable Development (ESD) Statement for the proposed Green Square Integrated Community Facility and School development located at Joynton Avenue, Zetland.

The principal objective of this report is to address the following: The minimum requirements set out in the Schools Infrastructure NSW Educational Facilities Standards and Guidelines document; The City of Sydney Sustainable Design Technical Guidelines document; and to outline how the project will address the following six Key Issues of the Planning Secretary's Environmental Assessment Requirements (SEARs) – SSD 10381, Key Issue: 9, *Ecologically Sustainable Development*:

- ▶ ESD principles incorporated in the design and operation of the development – Section 6
- ▶ A framework for best practice sustainable building principles – Section 4 and Section 6
- ▶ Preliminary consideration of building performance and mitigation of climate change, including consideration of Green Star Performance – Section 3, Section 4, Section 6, Appendix A, Appendix D and Appendix E.
- ▶ Assessment against an accredited ESD rating system – Section 3, Section 4, Section 6 and Appendix A
- ▶ Demonstration on how the proposed design is in line with initiatives contained within the Government Architect NSW (GANSW) Environmental Design in Schools Manual and Section 5.15 of the Architectural Design Competition Brief for the GSICFS – Section 6.10 and 6.11
- ▶ Climate Change Resilience Statement addressing how the design is responsive to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) projected impacts of climate change (e.g. hotter days, extended drought, extreme rainfall, wind conditions etc.) – Section 3, Section 7, Appendix D and Appendix E.

The proposed Green Square Integrated Community Facility and School development goes beyond the minimum code requirements and provides a progressive sustainability outcome for the community. Through early design input from sustainability professionals, sustainability initiatives incorporated in the proposed development include:

- ▶ Passive design elements to reduce the energy demand of the building in operation and improve indoor environment quality and thermal comfort for students and staff
- ▶ High performance façade and glazing, efficient lighting and lighting zoning, solar PV, selection of appliances with high energy efficiency ratings
- ▶ Preliminary consideration of the building design's resilience to climate change impacts
- ▶ Good daylight, visual comfort and acoustic design in both buildings to support their functions as training and teaching spaces and private staff areas
- ▶ Best practice waste management principles in operation and for the demolition works to avoid waste to landfill and,
- ▶ Enhanced greening to improve air quality and reduce the urban heat island effect, water efficient fixtures and fittings (high WELS ratings), and rainwater collected from the roof and stored for use on-site.
- ▶ Verification of the above initiatives through Green Star Design & As Built v1.3 formal certification. The development's targeted 5 star rating is deemed to represent Australian *Excellence*. This sustainability outcome goes above and beyond typical Australian *Best Practice* outcomes for a school development of this nature.

These ESD principles adopted for the project will contribute to the conservation of resources and future resilience, across the whole life cycle of the project; from construction, through to the operation phase. Refer to Table 1 for the project's specific sustainability SEARs and how they have been satisfied.



2 PROJECT SUMMARY

2.1 Purpose

This Ecologically Sustainable Design (ESD) Statement has been prepared in accordance with SEARs requirements – SSD 10381 – to detail the sustainability features of the proposed development.

2.2 Development Description

The proposed development is located at 3 Joyton Avenue Zetland. The development is known as the Green Square Integrated Community Facility and School. This is a joint project between School Infrastructure NSW and the City of Sydney Council.

The development will comprise a four storey building made up of various indoor and outdoor functional spaces including:

- ▶ Primary education facilities for up to 600 kindergarten to year 6 students
 - Indoor and outdoor learning spaces
 - Administration and staff rooms
 - Library and School community hall
- ▶ shared multi function spaces within for school and community use
 - 2 x multipurpose community facilities rooms to be operated solely by City of Sydney
 - 2 x multipurpose rooms to be shared by the City of Sydney and the primary school
- ▶ At ground level there is:
 - play spaces which will be a shared use between school and community.
 - multipurpose games court

2.3 Information Sources

The following information sources have been used in the preparation of this report:

- ▶ Section 4.12(8) of the *Environmental Planning and Assessment Act 1979*;
- ▶ Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*;
- ▶ Planning Secretary’s Environmental Assessment Requirements – SSD 10381, Key issues, Part 9, “Ecologically Sustainable Development (ESD), including:
 - Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Regulation) will be incorporated in the design and ongoing operation phases of the development.
 - Include a framework for how the future development will be designed to consider and reflect national best practice sustainable building principles to improve environmental performance and reduce ecological impact. This should be based on a materiality assessment and include waste reduction design measures, future proofing, use of sustainable and low-carbon materials, energy and water efficient design (including water sensitive urban design) and technology and use of renewable energy.
 - Include preliminary consideration of building performance and mitigation of climate change, including consideration of Green Star Performance.
 - 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.
 - Demonstrate how environmental design will be achieved in accordance with GANSW Environmental Design in Schools Manual Section 5.15 of the Architectural Design Competition Brief for the GSICFS dated October 2019 and presented by Urbis.
 - Provide a statement regarding how the design of the future development is responsive to the CSIRO projected impacts of climate change, specifically:
 - › hotter days and more frequent heatwave events.
 - › extended drought periods.



- › more extreme rainfall events.
- › gustier wind conditions.
- › how these will inform landscape design, material selection and social equity aspects (respite/shelter areas).
- ▶ SINSW Educational Facility Standards and Guidelines (EFSG);
 - GANSW Design Guide for Schools;
 - GANSW Environmental Design in Schools Manual
- ▶ Architectural Design Competition Brief for the GSICFS (Section 5.15, dated October 2019);
- ▶ City of Sydney’s Sustainable Design Technical Guidelines;
- ▶ SINSW Sustainable School Infrastructure Strategy & Action Plan;
- ▶ NSW Government Resource Efficiency Policy (GREP);
- ▶ NSW School Asset Strategic Plan;
- ▶ City of Sydney’s Adapting for Climate Change Strategy;
- ▶ NSW and ACT Government Regional Climate Modelling (NARClIM) climate change projections;
- ▶ NCC Section J 2019;
- ▶ Green Star Design & As Built v1.3 Submission Guidelines;
- ▶ Architectural drawings prepared by BVN Architects – 21/04/2021, 75% Design Development Issue; and,
- ▶ Discussions and workshops with the design team.

2.4 Revision History

Revision	Date	Reason for Issue
0.1	2/10/2020	Draft for Review and Comment
0.2	12/03/2021	For Information
0.3	29/04/2021	For SSDA Submission
0.4	11/05/2021	For SSDA Submission
0.5	26/07/2021	For SSDA Submission

2.5 City of Sydney Design for Environmental Performance Template

It is noted that the City of Sydney Design for Environmental Performance template was created after the initial revision of this SSD report being prepared. The City of Sydney Design for Environmental Performance template has been reviewed against the content of this report and it has been determined that this report addresses all sections and requirements outlined in the template, albeit, in a different more detailed format. To avoid unnecessary re-work, this SSD report will be used in lieu of the City of Sydney Design for Environmental Performance template.



3 SEARS COMPLIANCE SUMMARY

Sustainability principles are embedded in the proposed design for Green Square Integrated Facility & School (GSICFS). Outcomes of the sustainability principles will include energy and water efficiency, resilience to future climate impacts, high indoor environment quality, planning and spatial organization, materials selection, and comfort and wellbeing for staff and students using the spaces within.

Table 1 addresses how the project’s specific sustainability initiatives satisfy the relevant SEARs for ESD, the GANSW Environmental Design in Schools requirements, the Educational Facilities Standard Guidelines (EFSG) requirements, and City of Sydney’s Sustainable Design Technical Guidelines.

A copy of the completed SDTG v1.1 tool is included in Appendix B.

Table 1: GSICFS SEARS and EFSG compliance summary

ESD Requirement	Proposed Compliance Strategy	Compliance
<p>SEARS</p> <p>1 Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Regulation) will be incorporated in the design and ongoing operation phases of the development.</p>	<p>Through targeting and designing to recognised sustainability rating tools and frameworks, the project ensures that the general principles of ESD as defined in clause 7(4) of Schedule 2 of the Regulation are incorporated into the design. Refer to Section 5 and 6 for a detailed breakdown of how the principles of ESD have been addressed.</p> <p>General ESD principles have been adopted for the project, with a focus on conservation of resources and future resilience. The proposed design includes sustainability initiatives relating to:</p> <ul style="list-style-type: none"> ▶ Management: preliminary consideration of the building design and its resilience to climate change impacts, commissioning and tuning, metering and monitoring to capture consumption trends, building information to facilitate operator understanding, and separation of waste streams to facilitate reuse, recycling, compositing and overall waste reduction. ▶ Indoor Environment Quality: passive design analysis in early design phase, preliminary daylight and glare analysis for natural lighting, energy-efficient lighting, high efficiency heating and cooling, acoustic design, and responsible material selection. ▶ Energy: the building will comply with NCC 2019 Section J minimum requirements, passive design analysis undertaken in early design phase to reduce mechanical energy consumption, climate projections analysed to support an adaptable and climate responsive design, solar PV on roof spaces to reduce the urban heat island effect, integrated shading, high performance building fabric (façade and glazing), high performance building sealing, and minimum energy efficiency targets for appliances. ▶ Transport: GSICFS is highly connected to public transport – less than a 10 minute walk to Green Square Station and well-connected to central public transport hubs. Bicycle parking is provided for staff and students, as well as change facilities for staff. ▶ Water: selection of water efficient sanitary fixtures, fittings (high WELS ratings), and appliances, water meters installed for monitoring, waterwise landscaping principles, and rainwater collected from the roof and stored for use on-site. 	<p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p>



ESD Requirement	Proposed Compliance Strategy	Compliance
	<ul style="list-style-type: none"> ▶ Materials: a significant portion of construction waste generated from the demolition works will be reused or recycled, to limit the amount of waste going to landfill. Strategies to reduce natural resource consumption (e.g. exposed services or prefabricated components) will also be considered in developed design. Low emission products and materials will be specified as well as targets to reduce impacts from concrete. ▶ Land Use & Ecology: the building will be built on previously developed land and the proposed design will include integrated shading and overhangs, landscaping, and the minimization of hardscaping where possible. ▶ Emissions: landscaping and rainwater harvesting will be implemented to support Water Sensitive Urban Design and limit stormwater pollutants leaving the site; and high-efficiency lighting and appropriate lighting zoning will reduce light pollution. <p>These initiatives relate to ESD benefits over the entire lifecycle of the project; from construction through to ongoing operation of the GSICFS building.</p>	<p>Y</p> <p>Y</p> <p>Y</p>
<p>2 Include a framework for how the future development will be designed to consider and reflect national best practice sustainable building principles to improve environmental performance and reduce ecological impact. This should be based on a materiality assessment and include waste reduction design measures, future proofing, use of sustainable and low-carbon materials, energy and water efficient design (including water sensitive urban design) and technology and use of renewable energy.</p>	<p>The proposed development is targeting 5-star Green Star Design & As Built v1.3 formal certification. Environmental impact categories covered by Green Star include; Management, Indoor Environment Quality, Energy, Water, Transport, Land Use & Ecology, Emissions and Materials.</p> <p>This was based on materiality assessment completed during early concept design stages of the project, whereby a Green Star kick of meeting was held with project stakeholders. A green Star gap analysis was completed to identify the shortfall between standard practice and the project achieving the targeted 5 Star Green Star Design & As-Built rating, categorised as achieving Australian Excellence. This gap analysis was completed in the form of the Green Star pathway, which is an evolving document that has changed and developed throughout the design lifecycle of the project. Refer to Appendix A for current Green Star pathway for the project.</p> <p>In conjunction with the Green Star Design & As-Built rating, the project will be developed in line with the sustainability frameworks set out by Schools Infrastructure NSW's and City of Sydney, nominally: the Educational Facilities Standards and Guidelines; and the Sustainable Design Technical Guidelines.</p>	<p>Y</p>
<p>3 Include preliminary consideration of building performance and mitigation of climate change, including consideration of Green Star Performance.</p>	<p>The proposed design addresses building performance through numerous ESD initiatives including a selection and specification of high-performance building envelope (façade and glazing), selection of energy efficient fittings, fixtures and appliances (high WELS ratings) and water capture and storage. Building performance validated through energy and water modelling in line with the Green Star Design & As-Built requirements. Refer to Section 6 for detail of the sustainability initiatives implemented on the GSICFS project. Mitigation of climate change impacts are addressed in the Climate Change Resilience Statement, refer to Section 7 and Appendix D and E.</p>	<p>Y</p>



ESD Requirement	Proposed Compliance Strategy	Compliance
	<p>In addition, the design includes ESD elements relating to energy and water efficiency, good management practices for building systems during the operational phase, and adaptable design elements.</p> <p>The targeted Green Star Design & As Built rating tool provides benefits which are recognized through the Green Star Performance tool. While Green Star Performance will not formally be targeted, the proposed development does support high-efficiency building performance and mitigation of climate change, thus satisfying this Key Issue of SEARs for ESD.</p>	
<p>4 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.</p>	<p>The proposed development is targeting 5-star Green Star Design & As Built v1.3 formal certification. Environmental impact categories covered by Green Star include; Management, Indoor Environment Quality, Energy, Water, Transport, Land Use & Ecology, Emissions and Materials. Refer to Section 6 and Appendix A for details on the Green Star credits incorporated into the design.</p> <p>In conjunction with the Green Star Design & As-Built rating, the project will be developed in line with the sustainability frameworks set out by Schools Infrastructure NSW's and City of Sydney, nominally: the Educational Facilities Standards and Guidelines; and the Sustainable Design Technical Guidelines. Refer to Appendix B and C.</p>	
<p>5 Provide a statement regarding how the design of the future development is responsive to the CSIRO projected impacts of climate change, specifically:</p> <ul style="list-style-type: none"> ▶ hotter days and more frequent heatwave events ▶ extended drought periods ▶ more extreme rainfall events ▶ gustier wind conditions ▶ how these will inform landscape design, material selection and ▶ social equity aspects (respite/shelter areas). 	<p>NDY has been engaged to assess the projected impacts of climate change on the proposed GSICFS development, based on predicted climate change models. This engagement has included a Climate Adaptation Workshop and assessment of climate change projection data sourced from CCIA (a joint BOM and CSIRO initiative), as per AS 5334-2013, Green Star Design & As Built v1.3 requirements, and in response to SEARs conditions.</p> <p>The analysis of projected climate change risks can be found in Appendix D, and the project's Climate Change and Adaptation Risk Register is provided in Appendix D. Refer to Section 7.</p>	Y
<p>6 Demonstrate how environmental design will be achieved in accordance with the GANSW Environmental Design in Schools Manual and Section 5.15 of the Architectural Design Competition Brief for the GSICFS dated October 2019 and prepared by Urbis.</p>	<p>The project has adopted environmentally conscious design initiatives including air quality, ventilation, natural lighting, thermal comfort, and acoustic performance to benefit teacher wellbeing and student attentiveness, attendance, and overall performance. The ESD principles embedded in the proposed design satisfy the environmental and passive design elements in the GANSW Environmental Design in Schools Manual and the GANSW Design Guide for Schools.</p> <p>The project will incorporate passive design elements, systems with high energy and water efficiency, and technology to ensure that the development is both sustainable and durable. Likewise, the spaces are designed with inclusivity and accessibility in mind through good indoor environment</p>	Y



ESD Requirement	Proposed Compliance Strategy	Compliance
	<p>quality, lighting design, acoustic design and thermal comfort initiatives; this will, in turn, provide healthy environments with high levels of amenity for students and staff. Furthermore, renewable energy technologies, high performance building facades, and sustainable product selection on the project support the development's aims to reduce impact on natural resources, whilst maintaining a flexible and adaptive design. Refer to Section 6.10 and 6.11. Refer to Section 6 for a detailed breakdown of ESD initiatives in the proposed development.</p>	



4 SUSTAINABILITY FRAMEWORKS

Relevant sustainability frameworks applicable to the proposed development are detailed in the following sub-sections.

4.1 NCC 2019 – Section J

The National Construction Code (NCC) is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Australian Government with the aim of achieving nationally consistent, minimum necessary standards of relevant health and safety, amenity and sustainability objectives efficiently. Section J of the NCC Volume 1 2019 sets out the minimum energy efficiency requirements for all commercial buildings in Australia.

GSICFS development, has achieved compliance with Section J of the NCC Volume 1 2019 through a JV3 Performance Solution. Results of the assessment have been outlined in the appended JV3 report (refer to Appendix G), including minimum performance requirements for the development as well as design opportunities that would allow these requirements to be exceeded.

4.2 Green Star

Green Star is a voluntary sustainability rating tool for buildings, tenancies and communities in Australia. It was launched in 2003 by the Green Building Council of Australia (GBCA), a not-for-profit organisation with the key objective of driving the transition of the Australian property industry towards the design and construction of a more sustainable built environment.

Although initially developed specifically for the design and construction of office buildings, the Green Star suite of rating tools has now expanded to cover all habitable buildings and communities across a design, as built and operational performance life cycle.



Figure 1: Green Star rating tool suite

The proposed development is targeting 5 star Green Star Design & As Built v1.3 formal certification, representing Australian *Excellence* in developments.

4.3 Educational Facilities Standards and Guidelines

The Educational Facilities Standards and Guidelines (EFSG) are a set of guidelines prepared by Schools Infrastructure NSW to assist those responsible for the management, planning, design, construction and maintenance of new and refurbished school facilities.

The EFSG is a suite of information to aid in the planning, design and use of NSW Department of Education school facilities. The information includes:



- ▶ NSW Department of Education school types with content on educational principles, accommodation recommendations, design intent on rooms and spaces, relationships between accommodation components and associated technical data.
- ▶ Technical Design Guide
- ▶ Technical Specification Guide
- ▶ Links to relevant industry design and specification information

4.4 Sustainable Design Technical Guidelines

The City's Sustainable Design Technical Guidelines (SDTG) highlight relevant sustainable practices and design principles for a broad range of projects at their various development stages. The tool is designed to be easily integrated into the City's Project Management framework, allowing users to quickly assess various sustainability options, from early project stage all the way to final hand over. The SDTG are to be read in conjunction with the City's Public Domain Codes when capital works involve public domain improvements.



5 THE PRINCIPLES OF ESD

The principles of sustainable development as identified in Clause 7(4) of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* EPS are nominated below:

(4) The principles of ecologically sustainable development are as follows—

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

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

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

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

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

(d) ***improved valuation, pricing and incentive mechanisms***, namely, that environmental factors should be included in the valuation of assets and services, such as—

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

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

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

The principles of ESD as defined above will be incorporated into the design through adherence to the Green Star Design & As-Built v1.3 guidelines, the City of Sydney Sustainable Design Technical Guidelines and the Schools Infrastructure NSW Educational Facilities Standards and Guidelines. Within each of these guidelines requirements that have been incorporated into the Green Square Integrated Community Centre and School project that directly address the principles of ESD as defined above. These are as follows:

Precautionary Principle:

- ▶ A climate change risk assessment has been completed for the site, identifying potential risks as a result of a changing climate and nominating design measures to mitigate these risks. This assessment was completed with stakeholders and design team members.
- ▶ A large solar array has been included on the roof of the project, as well as generating enough electricity to power the site for a significant proportion of the year, this array will reduce the peak electrical demand of the site on extremely hot days and will reduce stress on the electrical grid.
- ▶ The site is connected to the City of Sydney district recycled water plant, to use recycled stormwater for toilet flushing and irrigation when the on-site rainwater tank does not have capacity. This is in response to the likelihood of increased periods of drought in the future. Reducing the sites potable water consumption.

Intergenerational Equity:

- ▶ Per above a climate change risk assessment was completed for the site identifying potential risks as a result of a changing climate and nominating design measures to mitigate these risks. This is an effort to ensure that future generations receive the same amenity and resources as current generations.



- ▶ A large solar PV array and connection to 100% green power for the site means that the site is not powered by burning fossil fuels, providing future generations the same access to available resources as current generations.
- ▶ Sourcing of responsible materials with low embodied carbon to minimise to provide future generations the same access to the resources as current generations.

Conservation of biological diversity and ecological integrity

- ▶ Landscape design for the site using xeriscaping principles and use of Australian natives demonstrates that the ecological value of the site will improve from the current site to the proposed site upon practical completion.

Improved valuation, pricing and incentive mechanisms

- ▶ Whilst the project is not directly in a position to influence how these evaluation, pricing and incentive mechanisms are implemented, initiatives have been incorporated throughout the design to reduce pollution (through large PV array and connection to 100% Green Power), reduce embodied carbon (through selection of low embodied carbon materials and materials with recognised environmental certifications) and pursued environmental goals through smart design decisions, that ensure the project meets the budget requirements as well as sustainability goals.

Further detail on sustainability initiatives incorporated into the design that address the principles of ESD are detailed in Section 6 below.



6 SUSTAINABILITY INITIATIVES

The proposed GSICFS development aims to go beyond minimum building code requirements and provide a progressive sustainability outcome for the community.

The ESD principles adopted on the project will contribute to the conservation of resources and future resilience, across the whole life cycle of the project; from construction, through to the operation phase.

As discussed, to address the SEARs and EFSG requirement for ESD, the proposed development is targeting a 5 star rating under the GBCA's Green Star Design & As Built rating tool. The 5 Star Green Star rating is deemed to represent Australian Excellence in development. This sustainability outcome goes above and beyond typical Australian Best Practice outcomes for a school development of this nature.

The following sub-sections (6.1 to 6.9) outline the initiatives incorporated into the proposed development in line with the Green Star categories and credits. The project will be registered against the current version of Green Star Design & As Built v1.3.

Refer to Appendix A for the full pathway of targeted points proposed for the Green Star rating, and Appendix B for the City of Sydney Sustainable Design Technical Guidelines v1.1 tool.

6.1 Management

6.1.1 General Principles

Good management - adopted from design phase, construction and through to building operation - should be used to support best practice sustainability outcomes. These practices and processes include:

- ▶ Guidance from sustainability professionals
- ▶ Pre-commissioning, commissioning and tuning
- ▶ Adaptation and resilience
- ▶ Building information to facilitate operator and user understanding
- ▶ Metering and monitoring
- ▶ Responsible construction practices
- ▶ Commitments to performance (e.g. reducing building and operational waste).

6.1.2 Best Practice Initiatives

The following initiatives have been incorporated into the proposed design to ensure that the project minimises its environmental impact through construction and operational management, including but not limited to:

- ▶ Pre-commissioning, commissioning, and tuning of building systems to ensure systems are operating as intended – Reviews of the architectural and services design having been completed throughout all stages of the design process by the SINSW Commissioning team to ensure that commission ability of the building at completion.
- ▶ Preliminary consideration of the proposed GSICFS development to assess how the proposed design is responsive to future climate impacts by undertaking a climate change risk assessment – Including sizing mechanical equipment for future weather files, increasing solar PV array on-site and locating plant and equipment away from flood prone areas, refer to Appendix D for Climate change risk register.
- ▶ A Climate Adaptation Plan developed for the building to address specific climate risks of the design and how they might be mitigated to reduce risk – climate change risk register contained in Appendix D.
- ▶ Provision of building information to facilitate operator and user understanding of all building systems, and their specific operation and maintenance requirements and/or environmental targets (e.g. EMS monitoring).
- ▶ Environmental targets for the GSICFS and a system in place to measure results, for reduction of energy and water consumption.



- ▶ Metering and monitoring to capture data consumption trends in support of building environmental targets, including separate metering of lighting and power, floor by floor, separate metering of school and community hub spaces, separate water metering for school, community hub and potable and non-potable water sources.
- ▶ Separation of waste streams (e.g. paper, cardboard, glass, plastics, toner cartridges, batteries, organics etc.) to facilitate reuse, recycling, composting, and overall waste reduction, as nominated in the site-specific waste report prepared for the project
- ▶ Essential building services equipment such as electrical and mechanical infrastructure to be protected from the inundation of up to a 1 in 100-year flood level through the location of these services above required height levels.
- ▶ Waste management plans for demolition, construction and operation of the site, with requirements to divert at least 80% of demolition and construction waste from landfill.
- ▶ Adopting Green Star 'management' credits across the development.

6.2 Indoor Environmental Quality

6.2.1 General Principles

Healthy, comfortable learning environments are vital for students and staff, particularly when they may require spaces that facilitate focus and engagement for a considerable amount of time. General principles of indoor environmental quality (IEQ) include:

- ▶ High indoor air quality (e.g. increased fresh air levels that is free from pollutants).
- ▶ Acoustic comfort with noise levels suitable to the activities within each space.
- ▶ Good lighting design and control that is suitable to the space and free from glare.
- ▶ High levels of daylight amenity and views for visual interest.
- ▶ Reduced internal air pollutant levels (e.g. product and material selection).
- ▶ Thermal comfort.

6.2.2 Best Practice Initiatives

The following initiatives have been incorporated into the proposed design, including but not limited to:

- ▶ Passive Design Analysis to assess the performance of the passive design elements of the building, including advice on potential impacts to natural daylight, ventilation, and to further support comfortable and low-energy indoor environment quality (refer to Appendix E).
- ▶ Daylight modelling has been completed to assess the level of natural lighting received in internal spaces, demonstrating that the project achieves good levels of daylight throughout the year (refer to Appendix F).
- ▶ External shading structures and operable blinds are provided throughout to mitigate occurrence of glare.
- ▶ Energy-efficient lighting (typically LED) will be provided throughout, lighting has been designed with, occupant, daylight and time switch controls, to achieve a more energy efficient lighting solution than required by the NCC 2019.
- ▶ High efficiency heating and cooling will be provided to the building, including: An energy efficient VRV solution with heat recovery; all spaces throughout the project have been fitted with indicator lights that nominate when outdoor conditions are suitable to provide free cooling, occupants can open windows which are fitted with reed switches that shut down mechanical systems and enable spaces to be naturally ventilated; Community hub FCU's have been fitted fan mode only operation so that when external conditions are suitable condensers are switched off and spaces is treated with outside air only.
- ▶ Acoustic design to support the building's function as training, teaching and multi-purpose spaces for students, staff and community use. All three of the Green Star acoustic credits have been incorporated into the design to reduce reverberation times and provide acoustic separation between spaces.
- ▶ Responsible structural and finishing materials for reduced environmental impact and improved indoor environment quality, including specification of low VOC paints, adhesives and sealants and low formaldehyde composite timber products.



- ▶ Adopting Green Star 'IEQ' credits across the development.

6.3 Energy

6.3.1 General Principles

Ineffective energy management can lead to unnecessary growth in greenhouse gas emissions and consumption of natural resources. An effective energy plan should aim to:

- ▶ Minimise energy consumption through good passive design.
- ▶ Maximise energy efficiency of systems.
- ▶ Consider green energy technologies.

1.1.1 Best Practice Initiatives

The following initiatives have been incorporated into the proposed design to enhance the energy efficiency of the building. It is worth highlighting that many initiatives are currently being explored that go over and above the minimum requirements stated in the SEARs, EFSG and Section J.

- ▶ Exceeding NCC 2019 Section J minimum requirements (refer Section 4.1).
- ▶ Passive Design Analysis to assess the performance of the passive design elements of the building, including advice on building form, orientation, shading, natural daylight and ventilation, insulation and thermal mass (refer to Appendix E).
- ▶ Adaptable building design that is climate responsive, including mechanical equipment sized for days of extreme heat, large on-site solar PV, on-site rainwater tank and stormwater re-use tank connected to City of Sydney district recycled water network (for toilet flushing and irrigation), locating plant away from flood prone areas.
- ▶ Integrated shading devices which reduce solar heat gains to conditioned spaces.
- ▶ High performance building sealing for conditioned spaces (e.g. practice rooms, teaching spaces, staff areas).
- ▶ High performance building fabric, including thermally broken double glazed low SHGC glazing.
- ▶ Higher levels of thermal insulation for the roof than required under the National Construction Code (NCC).
- ▶ Energy-efficient lighting (typically LED) will be provided throughout, and high efficiency heating and cooling.
- ▶ Maximise the roof mounted solar photovoltaic (PV) system to the available roof space.
- ▶ Adoption of minimum targets energy efficiency of appliances (air conditioners, TVs, fridges) to make energy efficiency one of the selection requirements. Major appliances to be within one star of the highest available at the time of purchase.
- ▶ Roofs with solar absorptance values of <0.45.
- ▶ Minimising up-lighting from external light fittings unless for a specific purpose.
- ▶ Lighting controlled by motion and/or daylight sensors, period bell linked controls and occupancy sensors to reduce the operation of artificial lighting when it is not required.
- ▶ Lighting power densities reduced to below the NCC maximum values.
- ▶ Adopting Green Star 'energy' credits across the development.

6.4 Transport

6.4.1 General Principles

Sustainable transport has a role in encouraging healthier active transport options while also decreasing greenhouse gas emissions from transport.

6.4.2 Best Practice Initiatives



The following initiatives have been incorporated into the proposed design to improve sustainable transport options:

- ▶ GSICFS is highly connected to public transport – less than a 10 minute walk to Green Square train and bus station.
- ▶ The school is well-located, being in close-proximity to amenities (e.g. gyms, pools, retail centres, ATMs etc) at Green Square, Zetland and surrounds.
- ▶ The school site is the meeting point of several pedestrian corridors with a flow of public vs secure use patterns expected across the day. As such, the design supports a highly-circulatory and transient environment with entry and gathering spaces for students during the day, and an open ground plane for public use outside of school hours.
- ▶ To encourage active and public transport, bicycle parking for staff and students as well as change facilities for staff are provided to the development, a site specific travel plan has been prepared for the project.

6.5 Water

6.5.1 General Principles

Ineffective management of water use can lead to unnecessary potable water consumption. An effective water management plan should aim to:

- ▶ Reduce consumption by focusing on efficiency of major uses (hydraulic fittings and fixtures, landscape irrigation, and HVAC).
- ▶ Incorporate appropriate building management systems to reduce leakage.
- ▶ Reduce consumption by encouraging a change in user behaviour.

6.5.2 Best Practice Initiatives

The following initiatives have been incorporated into the proposed design to enhance the water efficiency of the proposed development and reduce potable water consumption associated with the above major uses:

- ▶ Selection of water efficient sanitary fittings and fixtures, within one star of the highest rated equivalent product at the time of specification, refer to Section 6.5.2.1.
- ▶ Minimum water efficiency targets adopted for dishwashers, within one star of the highest rated equivalent product at the time of specification.
- ▶ Water meters installed to assist with monitoring and identify excessive consumption, including separate metering for the school and community hub spaces and separate metering of the potable and non-potable water supplies.
- ▶ Water wise landscaping principles incorporated, including using xeriscape (draught tolerant species) landscaping, and/or irrigation with non-potable water.
- ▶ Rainwater harvesting and water reuse system and connection to City of Sydney district recycled water network, for flushing and irrigation, refer to Section 6.5.2.2.
- ▶ Adopting Green Star ‘water’ credits across the development.

6.5.2.1 FIXTURES & FITTINGS

Water sanitary fittings and fixtures account for a large portion of water use for the GSICFS development as determined through water modelling for the project. By selecting water efficient sanitary fittings and fixtures, potable water demand can be significantly reduced. In line with Green Star water efficiency benchmarks, all fittings and fixtures installed by the project will aim to be within one star of the proposed WELS ratings in Table 2 below.



Table 2: WELS rated fittings and fixtures as per the Green Star (Design & As Built v1.3) Potable Water credit

Fittings and Fixtures	Standard Practice Benchmark	Proposed WELS Rating
Taps	4 Star (7.5 L/min)	6 Star (4.5 L/min)
WC	3 Star (4 L/flush)	5 Star (3 L/flush)
Urinals	3 Star (2 L/min)	6 Star (1 L/min)
Showers	3 Star (9 L/min)	3 Star (<=6 L/min)

6.5.2.2 RAINWATER HARVESTING AND RECYCLED WATER

A rainwater reuse system will reduce potable water consumption from the mains water supply. A 40kL recycled water tank is included in the design and used throughout the School development for use in landscaping irrigation.

In addition, a 15kL tank is included in the design which will be connected to the City of Sydney district recycled water network. This tank will be used for toilet flushing and irrigation throughout the project, providing redundancy for the on-site tank when empty.



Figure 2: Rainwater harvesting system for landscape irrigation

6.6 Materials

6.6.1 General Principles

The construction sector is a significant contributor to greenhouse gas emissions and climate change. Building construction should aim to reduce the natural resources consumption and environmental impacts resulting from the manufacture and procurement of materials, and waste impacts from demolition and construction.

6.6.2 Best Practice Initiatives

To raise the level of sustainability for the project regarding material use, the following initiatives have been incorporated into the proposed design:

- ▶ A significant portion of construction waste generated from demolition will be reused or recycled, to limit the amount of waste going to landfill.
- ▶ Low-VOC and low- or no-formaldehyde products specified where possible to improve the indoor environment quality for users.
- ▶ Specifying timber products with recognised best practice certificates (FSC and PEFC certified)

- ▶ Targets to reduce:
 - The Portland Cement content of concrete;
 - The use of potable water used in concrete mix water; and,
 - The use of aggregate in concrete mixes, substituted with alternative materials.
- ▶ Selection of equipment and furniture demonstrating that products are either: reused products, contain recycled content, contain environmental product declarations / third party certifications, or are part of a stewardship program.
- ▶ Reduced materials strategies such as exposed services or prefabricated components to reduce material consumption.
- ▶ Adopting Green Star ‘materials’ credits across the development.

6.7 Land Use & Ecology

6.7.1 General Principles

Building developments can lead to loss of ecology and biodiversity. The proposed development will limit its impact on the ecology and biodiversity by reusing land.

6.7.2 Best Practice Initiatives

To raise the level of sustainability for the project regarding ecology and biodiversity, the following initiatives have been incorporated into the proposed design:

- ▶ Incorporate water wise landscaping principles, including using xeriscape (draught tolerant species) landscaping for improved ecology and biodiversity at the site.
- ▶ Adopting Green Star ‘land use & ecology’ credits across the development, demonstrating that the ecological value of the site has increased from pre to post development. Demonstrated through the ecological value calculator for the project.

6.8 Emissions

6.8.1 General Principles

In any new development there is a risk that the project will generate negative impacts including:

- ▶ Light pollution
- ▶ Pollutants in stormwater runoff
- ▶ Environmental damage from refrigerant leaks
- ▶ Harmful microbes in cooling systems.

6.8.2 Best Practice Initiatives

The following initiatives have been incorporated into the proposed design to reduce harmful emissions from the site, including but not limited to:

- ▶ Landscaping and rainwater harvesting to support Water Sensitive Urban Design and limit stormwater pollutants leaving the site.
- ▶ High-efficiency lighting and appropriate external lighting zoning to reduce light pollution.
- ▶ All heat-rejection systems to be waterless to eliminate risk of Legionella.
- ▶ Use of awnings to block light pollution to neighbours and the night sky.
- ▶ Adopting Green Star ‘emissions’ credits across the development.

6.9 Innovations

The proposed development has incorporated innovative technologies, exceeding Green Star benchmarks. Such as the extensive, use of Ultra Low VOC paints throughout the project and a number of innovation challenges



that SINSW have approved with the GBCA, such as healthy canteen policy, community benefits and universal design.

6.10 GANSW Design Guide for Schools and GANSW Design in Schools Manual

The GANSW Design Guide for Schools and Design in Schools Manual are documents prepared by the office of the Government Architect NSW and set out guidelines for ensuring high quality, well designed schools throughout NSW. The guide and manual act as a best practice manual to support the delivery of good school design, by highlighting the importance design plays in creating high quality education environments; Outlining good design principles, design considerations and key steps for effective design processes and key activities for good design outcomes.

The following highlights the key design principles as nominated in the GANSW guide and manual: Context, built Form and Landscape; Sustainable Efficient and Durable; Accessible and Inclusive; Health and Safety; Amenity; Whole of life, flexible and adaptive; Aesthetics.

The following summarises how these will be addressed by the project:

- ▶ High indoor air quality (e.g. increased fresh air levels that is free from pollutants).
- ▶ Acoustic comfort with noise levels suitable to the activities within each space.
- ▶ Good lighting design and control that is suitable to the space and free from glare.
- ▶ Reduced internal air pollutant levels (e.g. product and material selection).
- ▶ High quality levels of thermal comfort.
- ▶ Passive design principles including consideration for building orientation and massing, and optimisation of window to wall ratios to reduce energy consumption.
- ▶ Maximise energy efficiency of systems.

The design elements nominated above have been incorporated into the project in accordance with the GANSW Design in Schools Manual through using the manual as a guide to influence design. Part 2 of the manual identifies some passive design strategies that have been used on other schools projects that were subsequently incorporated in the GSICFS project including: natural cross ventilation, external shading, internal blinds, fan cycle operation, glazing sizing and performance and considerations for building orientation and thermal massing.

Part three of the guide provides strategies that can be implemented within the school learning spaces, buildings and school grounds and was used as guide for influencing design in GSICFS project such as: internal blinds to learning spaces, interactive learning throughout through visual identification of building features, external landscaping, rainwater tanks and the solar PV array.

In using the manual as a guiding tool for the design, the project team has ensured that the design processes implemented, were in accordance with the GANSW Design in Schools Manual.

6.11 Architectural Design Competition Brief GSICFS

Section 5.15 of the Architectural Design Competition Brief for the Green Square Integrated Community Facility and School dated 29th October 2019 nominates sustainability initiatives that are to be integrated into the facility as a whole.

The primary objective of the brief is to ensure that the facility is designed to operate with minimal resource use (gas, electricity and water) and minimise operational emissions. In addition to the primary objective the Architectural Design Competition Brief, nominates that the facility must at a minimum incorporate good passive design, incorporate on-site renewables, be designed to the SINSW EFSG and the City of Sydney SDTG,



achieve a Green Star rating of 5 Star, connect to the Green Square recycled water network and the Green Square private wire.

This has been achieved in design through the following initiatives:

- ▶ No gas or any other fossil fuels burned on site.
- ▶ Good passive design elements incorporated into the building design, including, shading devices, optimised orientation and massing, optimised façade design and mixed mode ventilation strategies to minimise reliance on heating and cooling energy.
- ▶ Active solutions such as: large solar PV array on the roof, high efficiency VRV system with heat recovery, integration to energy monitoring system, fan mode operation of community spaces when external conditions are suitable, high efficiency LED lighting, equipment and appliance selections within one star of highest rated equivalent.
- ▶ 15kL rainwater tank on site for ground floor irrigation.
- ▶ Construction and operational waste targets and strategies to reduce waste.
- ▶ Project has been designed in line with the EFSG and SDTG, refer to Appendix B and C
- ▶ Project is targeting a 5 Star Green Star certification, Refer to Appendix A
- ▶ Project is connected to the Green Square recycled water network and the Green Square private wire.

Per the above, the project addresses the sustainability requirements outlined in Section 5.15 of the Architectural Design Competition Brief for the Green Square Integrated Community Facility and School dated 29th October 2019.



7 CLIMATE CHANGE RESILIENCE STATEMENT

In response to the SEARs requirement to Include preliminary consideration of building performance and mitigation of climate change, the projected impacts of climate change on the proposed GSICFS development were assessed in conjunction with the project's early-phase design and longevity, based on predicted climate change models. A Climate Adaptation Workshop was held with all project stakeholders to:

- ▶ Identify and describe risks posed by climate change to the development and rate the consequences and likelihood of each.
- ▶ Identify and evaluate potential adaptation actions and/or design strategies to mitigate those risks which are deemed unacceptable.

To facilitate this process, pre-workshop notes were provided to all stakeholders attending the workshop which consisted of the following parts:

- ▶ Climate change projections
- ▶ Consequence scale for the risk assessment
- ▶ Likelihood scale for the risk assessment.

Climate change projection data was sourced from CCIA (a joint BOM and CSIRO initiative, in line with NARClIM climate change projections), and baseline data was sourced from BOM. The results showed the following:

- ▶ More hot days and warm spells are projected with very high confidence.
- ▶ Extreme temperatures are projected to increase with very high confidence and substantial increases in temperatures reached on hot days, as well as the frequency of hot days, and the duration of warm spells.
- ▶ Average temperatures will continue to increase in all seasons (very high confidence).
- ▶ Generally, less rainfall is expected in winter (medium confidence) but the intensity of extreme rainfall events is projected to increase (high confidence)
- ▶ Time spent in drought is projected to increase (low confidence) over the course of the century.
- ▶ There is high confidence that climate change will result in a harsher fire-weather climate.

The climate change risk assessment was undertaken during the workshop as per AS 5334-2013, Green Star Design & As Built v1.3 requirements, and in response to SEARs conditions for the project. A risk profile and mitigation approach for the following climate change projected impacts was conducted:

- ▶ Hotter days
- ▶ More frequent heatwave events
- ▶ Extended drought periods
- ▶ More extreme rainfall events
- ▶ Gustier wind conditions.

The design's responsivity to the above impacts was then assessed, which included consideration of landscape design, material selection and social equity aspects (e.g. respite/shelter areas).

This climate change risk assessment considered prescribed design features and current controls to mitigate future climate risks for the project. Outcomes of the assessment have shown that there are no major risks remaining in the design at this early stage of development. Key design elements have been highlighted for



consideration in design development, and appropriate maintenance after project completion should ensure that the project remains resilient to future climate change impacts. This information will also be summarized in a Climate Adaptation Plan.

Refer to Appendix D for the complete Climate Change Adaptation Workshop: Pre-Workshop Notes, and Appendix D for the Climate Change and Adaptation Risk Register.

7.1.1 Opportunities

In addition to the management initiatives outlined above, the following initiatives are currently being explored:

- ▶ Engagement of an Independent Commissioning Agent to lead the commissioning and tuning process from design through to project completion.

As design development progresses, the feasibility of implementing the above opportunities will be investigated further.



8 CONCLUSION

This report identifies the sustainability measures being pursued or investigated by the project team, demonstrating how the project-specific SEARs for Ecologically Sustainable Development, GANSW Environmental Design in Schools, the Educational Facilities Standard Guidelines, and City of Sydney's Sustainable Design Technical Guidelines requirements have been addressed. The project is being certified to a recognised sustainability framework, i.e. Green Star Design & As-Built v1.3 and a detailed Climate Change risk assessment has been completed for the project.

The proposed design for the GSICFS development incorporates sustainability measures that have far reaching benefits from the perspective of energy, water and waste reduction; as well as providing good indoor environment quality, thermal comfort and visual comfort. These are expected to have a positive impact on the health and wellbeing of the students and staff occupying the building.



APPENDIX A. GREEN STAR DESIGN & AS BUILT V1.3 – 5 STAR PATHWAY



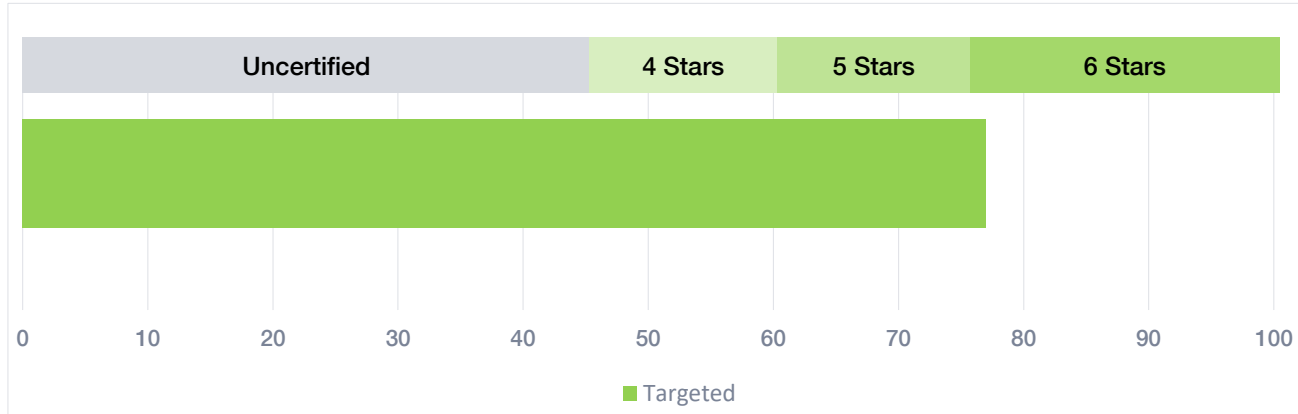
Design & As Built v1.3 Scorecard

Project:	Green Square Integrated Community Facility and School
Targeted Rating:	5 Star - Australian Excellence

Date:	28/04/2021	Rev4.0
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Core Points Available	Targeted
100	77.0



CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	Targeted
Management				14	
Green Star Accredited Professional	To recognise the appointment and active involvement of a Green Star Accredited Professional in order to ensure that the rating tool is applied effectively and as intended.	1.0	Accredited Professional	1	1
Commissioning and Tuning	To encourage and recognise commissioning, handover and tuning initiatives that ensure all building services operate to their full potential.	2.0	Environmental Performance Targets	-	Complies
		2.1	Services and Maintainability Review	1	1
		2.2	Building Commissioning	1	1
		2.3	Building Systems Tuning	1	1
		2.4	Independent Commissioning Agent	1	1
Adaptation and Resilience	To encourage and recognise projects that are resilient to the impacts of a changing climate and natural disasters.	3.1	Implementation of a Climate Adaptation Plan	2	2
Building Information	To recognise the development and provision of building information that facilitates understanding of a building's systems, operation and maintenance requirements, and environmental targets to enable the optimised performance.	4.1	Building Information	1	1
Commitment to Performance	To recognise practices that encourage building owners, building occupants and facilities management teams to set targets and monitor environmental performance in a collaborative way.	5.1	Environmental Building Performance	1	1
		5.2	End of Life Waste Performance	1	1
Metering and Monitoring	To recognise the implementation of effective energy and water metering and monitoring systems.	6.0	Metering	-	Complies
		6.1	Monitoring Systems	1	1
Responsible Building Practices	To reward projects that use best practice formal environmental management procedures during construction.	7.0	Environmental Management Plan	-	Complies
		7.1	Formalised Environmental Management System	1	1

		7.2	High Quality Staff Support	1	1
Operational Waste	Prescriptive Pathway	8A	Performance Pathway - Specialist Plan	1	1
		8B	Prescriptive Pathway - Facilities	1	
Total				15	14

Indoor Environment Quality				17	
Indoor Air Quality	To recognise projects that provide high air quality to occupants.	9.1	Ventilation System Attributes	1	1
		9.2	Provision of Outdoor Air	2	1
		9.3	Exhaust or Elimination of Pollutants	1	1
Acoustic Comfort	To reward projects that provide appropriate and comfortable acoustic conditions for occupants.	10.1	Internal Noise Levels	1	1
		10.2	Reverberation	1	1
		10.3	Acoustic Separation	1	1
Lighting Comfort	To encourage and recognise well-lit spaces that provide a high degree of comfort to users.	11.0	Minimum Lighting Comfort	-	Complies
		11.1	General Illuminance and Glare Reduction	1	1
		11.2	Surface Illuminance	1	
		11.3	Localised Lighting Control	1	
Visual Comfort	To recognise the delivery of well-lit spaces that provide high levels of visual comfort to building occupants.	12.0	Glare Reduction	-	Complies
		12.1	Daylight	2	2
		12.2	Views	1	1
Indoor Pollutants	To recognise projects that safeguard occupant health through the reduction in internal air pollutant levels.	13.1	Paints, Adhesives, Sealants and Carpets	1	1
		13.2	Engineered Wood Products	1	1
Thermal Comfort	To encourage and recognise projects that achieve high levels of thermal comfort.	14.1	Thermal Comfort	1	1
		14.2	Advanced Thermal Comfort	1	
Total				17	13

Energy		22		
Greenhouse Gas Emissions	E. Modelled Performance Pathway	15A.0 Conditional Requirement: Prescriptive Pathway	-	
		15A.1 Building Envelope	-	
		15A.2 Wall-Glazing Construction and Retail Display Glazing	-	
		15A.3 Lighting	-	
		15A.4 Ventilation and Air-conditioning	-	
		15A.5 Domestic Hot Water Systems	-	
		15A.6 Transition Plan	1	
		15A.7 Fuel Switching	1	
		15A.8 On-Site Storage	1	
		15A.9 Vertical Transportation	1	
		15A.10 Off-Site Renewables	5	
		15B.0 Conditional Requirement: NatHERS Pathway	-	
		15B.1 NatHERS Pathway	-	
		15C.0 Conditional Requirement: BASIX Pathway	-	
		15C.1 BASIX Pathway	-	
		15D.0 Conditional Requirement: NABERS Pathway	-	
		15D.1 NABERS Energy Commitment Agreement Pathway	-	
		15E.0 Conditional Requirement: Reference Building Pathway	-	Complies
		15E.1 Comparison to a Reference Building Pathway	20	15
		Peak Electricity Demand Reduction	Performance Pathway	16A Prescriptive Pathway - On-site Energy Generation
16B Performance Pathway - Reference Building	2			2
Total		21	17	

Transport		10		
Sustainable Transport	Performance Pathway	17A.1 Performance Pathway	10	5
		17B.1 Access by Public Transport	0	
		17B.2 Reduced Car Parking Provision	0	
		17B.3 Low Emission Vehicle Infrastructure	1	
		17B.4 Active Transport Facilities	0	

		17B.5 Walkable Neighbourhoods	0	
Total			11	5

Water			12	
Potable Water	Performance Pathway	18A.1 Potable Water - Performance Pathway	12	9
		18B.1 Sanitary Fixture Efficiency	0	
		18B.2 Rainwater Reuse	0	
		18B.3 Heat Rejection	0	
		18B.4 Landscape Irrigation	0	
		18B.5 Fire System Test Water	0	
Total			12	9

Materials			14	
Life Cycle Impacts	Performance Pathway - Life Cycle Assessment	19A.1 Comparative Life Cycle Assessment	6	
		19A.2 Additional Life Cycle Impact Reporting	4	
		19B.1 Concrete	3	3
		19B.2 Steel	1	1
		19B.3 Building Reuse	1	
		19B.4 Structural Timber	0	
Responsible Building Materials	To reward projects that include materials that are responsibly sourced or have a sustainable supply chain.	20.1 Structural and Reinforcing Steel	1	1
		20.2 Timber Products	1	1
		20.3 Permanent Formwork, Pipes, Flooring, Blinds and Cables	1	1
Sustainable Products	To encourage sustainability and transparency in product specification.	21.1 Product Transparency and Sustainability	3	1
Construction and Demolition Waste	Percentage Benchmark	22A Fixed Benchmark	-	
		22B Percentage Benchmark	1	1
Total			14	9

Land Use & Ecology			6	
Ecological Value	To reward projects that improve the ecological value of their site.	23.0 Endangered, Threatened or Vulnerable Species	-	Complies
		23.1 Ecological Value	3	1
Sustainable Sites	To reward projects that choose to develop sites that have limited ecological value, re-use previously developed land and remediate contaminate land.	24.0 Conditional Requirement	-	Complies
		24.1 Reuse of Land	1	1
		24.2 Contamination and Hazardous Materials	1	1
Heat Island Effect	To encourage and recognise projects that reduce the contribution of the project site to the heat island effect.	25.0 Heat Island Effect Reduction	1	1
Total			6	4

Emissions				5	
Stormwater	To reward projects that minimise peak stormwater flows and reduce pollutants entering public sewer infrastructure.	26.1	Stormwater Peak Discharge	1	1
		26.2	Stormwater Pollution Targets	1	1
Light Pollution	To reward projects that minimise light pollution.	27.0	Light Pollution to Neighbouring Bodies	-	
		27.1	Light Pollution to Night Sky	1	
Microbial Control	To recognise projects that implement systems to minimise the impacts associated with harmful microbes in building systems.	28.0	Legionella Impacts from Cooling Systems	1	
Refrigerant Impacts	To encourage operational practices that minimise the environmental impacts of refrigeration equipment.	29.0	Refrigerants Impacts	1	
Total				5	2

Innovation			10		
Innovative Technology or Process	The project meets the aims of an existing credit using a technology or process that is considered innovative in Australia or the world.	30A	Innovative Technology or Process		
Market Transformation	The project has undertaken a sustainability initiative that substantially contributes to the broader market transformation towards sustainable development in	30B	Market Transformation - Soft Landings		
Improving on Green Star Benchmarks	The project has achieved full points in a Green Star credit and demonstrates a substantial improvement on the benchmark required to achieve full points.	30C	Improving on Green Star Benchmarks - Stormwater		
			Improving on Green Star Benchmarks - Sustainable Products		
			Improving on Green Star Benchmarks - Supplementary or Tenancy Fitout Systems Review		
			Improving on Green Star Benchmarks - Ultra Low VOCs	1	
Innovation Challenge	Where the project addresses an sustainability issue not included within any of the Credits in the existing Green Star rating tools.	30D	Innovation Challenge - Integrating Healthy Environments	10	
			Innovation Challenge - High Performance Site Offices		
			Innovation Challenge - Principle's Dashboard		
			Innovation Challenge - Community Benefit		
			Innovation Challenge - Reconciliation Action Plan (RAP)		
			Innovation Challenge - Universal Design		
			Innovation Challenge - Financial Transparency		1
			Innovation Challenge - PV Generation		2
Global Sustainability	Project teams may adopt an approved credit from a Global Green Building Rating tool that addresses a sustainability issue that is currently outside the scope of this Green Star rating tools.	30E	Global Sustainability		
Total			10	4	

TOTALS	AVAILABLE	Targeted
CORE POINTS	100	73.0
CATEGORY PERCENTAGE SCORE		73.0
INNOVATION POINTS	10	4.0
TOTAL SCORE TARGETED		77.0

APPENDIX B. CITY OF SYDNEY SUSTAINABLE DESIGN GUIDELINES TOOL V1.1



Project Plan	Project Stage:	Asset Type:
		Other
Delivery Manager Sign Off: Date: _____ Sustainability Advisor Sign Off: Date: _____		

Project Name	Green Square Integrated Community Facility and School
Project Number	Enter Project Number

Energy and Emissions	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	ENE1.1	Heating and Cooling - Passive Design • Does the building design incorporate passive heating and cooling features, such as measures to reduce solar gain (e.g. facade shading), insulation to increase thermal performance, allow for cross ventilation and pre-conditioning elements (e.g. basement labyrinth)?	Yes	The project incorporates good passive design to reduce energy consumption from heating and cooling systems, such as: Thermally broken double glazed units, extensive shading to the northern and western facades; high performance glazing in line with the Deemed Satisfy (DTS) requirements of Section J NCC 2019; Thermal insulation to all external walls in line with the DTS requirements; External roof thermal performance 15% improvement on the DTS requirements; building orientation to provide passive cooling through shading to the southern and eastern play areas. In addition, a passive design modelling assessment was completed by NDY at the concept design stage to assess the passive design elements of the building and provide recommendations for further improvements. The key finding of the assessment was that the original window to wall ratio (percentage of glazed area throughout the project) was high, leading to increased heating and cooling loads. As a result of the passive design assessment, window to wall ratios (WWR) were reduced throughout the project: North WWR reduced from ~80% to ~40%, East reduced from ~45% to ~40%, South reduced from ~70% to ~40% and West reduced from ~85% to ~40%.	<ul style="list-style-type: none"> NCC 2019 - Section J Credit 15A, 12.1 Green Star D&AB Guidelines v1.3 Section 3.6 Sydney DCP 2012 AS1688.4:2012
	ENE1.2	Heating and Cooling - Mechanical Systems • Does the mechanical component of the HVAC design include energy efficiency measures such as economy cycle, mixed mode operation, heat recovery, multiple zoning and occupancy sensors etc.3	Yes	All conditioned areas are designed based on EFSG DG.55 which incorporates temperature sensor, CO2 sensor, as well as control panel (with light indication) to allow occupants to open windows when outdoor temperature is suitable for natural ventilation. Operable windows are connected with reed switches that shut off mechanical systems when windows are opened. Community Hub spaces FCU's have been integrated with fan mode operation so that when external conditions are suitable, condensing units are disengaged and free cooling is provided by outside air only.	As Above
	ENE1.3	Heating and Cooling - Chillers • Where the building AC load is high (> 200 kW) and cooling towers are practical, install high efficiency water cooled chiller(s); • Choose chiller(s) technology (e.g. digital scroll) that allows low loads as well as high loads to be served efficiently; • For moderate building loads (12.5-200kW), or where cooling towers are impractical to install high efficiency, packaged units or Variable Refrigerant Volume type systems. Avoid the use of multiple split DX systems where HVAC is required for two or more spaces and the total building load is greater than 12.5 kW.	No	A Whole of life analysis was conducted to compare VRV option vs Air Cooled Chiller option and the decision was to use a VRV system for this project. Note that EFSG DG55.08 stipulates that cooling towers should be avoided. It is noted that this item was discussed in detail with SINSW and CoS prior to the decision being made. Energy modelling has been completed in line with the Green Star v1.3 credit 1.5E guidelines and demonstrates that the VRV solution adopted for the project achieves good energy efficiency and with the 125kW solar array and 100% Green Power the project achieves the required 75% of the Green Star Energy.	As Above
	ENE2.1	Lighting: Passive Design • Does the lighting design incorporate maximum use of natural daylight considering building orientation and facade, window design, sky lights and architectural features conducive to natural light utilisation been considered?	Yes	Spatial Daylight Autonomy modelling in line with Green Star D&AB v1.3 guidelines has been completed for the project and demonstrates that 89% of the regularly occupied spaces achieve good levels of daylight for more than 80% of the occupied hours, achieve 2 of the 2 points available for this credit.	<ul style="list-style-type: none"> NCC 2016 - Section J Credit 15A Green Star D&AB Guidelines Section 3.6 Sydney DCP 2012 AS1680 Series
	ENE2.2	Lighting: Energy Efficiency • Does the lighting design include LED lighting technology design for all lighting - internal and external and energy efficiency measures such as perimeter zones and photo-electric sensors (to maximise the use of natural light), multiple zones with addressable controls (including occupancy sensors) and a choice of luminaires and lighting levels appropriate to the planned activities?	Yes	All luminaires on the job are to be LED. Room lighting levels are to be calculated to comply with the EFSG and AS1680. Lighting power density will comply with the NCC Section J. Interior lighting shall be controlled via a DALI network and a smart lighting control system with motion sensors and period bell linked control. Lighting energy calculations have been included in the Energy modelling completed for the project.	As Above
	ENE3	Has a solar PV system been incorporated into the project and does it comply with the City's guidelines?	Yes	Yes, a 125kWp solar PV system has been included in the project, in accordance with the CoS guideline.	The City's Guideline for Solar PV Systems
	ENE4	Has a low carbon energy supply (cogeneration or trigeneration) opportunity been investigated in consultation with the Sustainability Adviser. This applies to projects with significant electrical demand, space heating/cooling and/or water heating/cooling demands e.g. pools, libraries, large offices.	Yes	Power supply to be provided by separate private wire network. Analysis of co/tri-generation opportunities to be assessed at the power source (by others, not part of this project).	<ul style="list-style-type: none"> NCC 2016 - Section J Credit 6 Green Star D&AB Guidelines v1.3 Section 3.6 Sydney DCP 2012 City of Sydney's Energy and Water Metering Guidelines
	ENE5	Has an energy (electricity and gas) metering and monitoring system been incorporated into the electricity, gas and water systems and can it be integrated into the City's SMART metering system? Does it comply with the City's energy and water metering guideline?	Yes	Electrical meters and an energy monitoring system will be installed to comply with the NCC section J8 and green star credit 4. Electrical meters have been included for all sub uses (lighting and power per floor). No gas meters required for mechanical services. Cold water meters have been included for all sub uses (community spaces and school spaces). No gas meters as there is no gas on site. All community hub and school spaces are separately metered for both lighting, power and water.	<ul style="list-style-type: none"> NCC 2016 - Section J Credit 6 Green Star D&AB Guidelines v1.3 Section 3.6 Sydney DCP 2012 City of Sydney's Energy and Water Metering Guidelines
	ENE6.1	Hot Water System - Domestic • Does the building design make use of solar hot water systems or energy efficient methods such as high coefficient of performance (COP > 3.5) heat pumps, or the use of heat recovery to produce domestic hot water?	Yes	Point of use hot water systems (electric) have been designed for this site, to eliminate constant hot water circulation through the building. The heaters are demand hot water, they only consume energy when used, these are technically more efficient than the heat pumps as we will have 23% loss of energy in recirculation etc. To confirm these heaters are not storage heaters.	<ul style="list-style-type: none"> NCC 2016 - Section J Credit 15A Green Star D&AB Guidelines
	ENE6.2	Hot Water System - Facility Heating • Does the hydraulic design make use of energy recovery, co/trigeneration or high COP heat pumps to produce hot water for HVAC (thermal) and pool heating? Does the design comply with National Construction Code 2016, Minimum Energy Performance Standards, and any Australian Standards relevant to various aspects of energy efficiency (eg AS1688, AS1680)?	Yes	No central hot water used for heating.	As Above
	ENE7	Does the project comply with the minimum energy performance standard as nominated in Section J of the NCC 2019.	Yes	The project complies with the minimum energy performance standard as nominated in Section J of the NCC 2019.	<ul style="list-style-type: none"> NCC 2016 - Section J AS1680 Series AS1688 Series Greenhouse and Energy Minimum Standards Act 2012 (MEPS)
	ENE8	Has NCC Section J JV3 Energy Efficiency modelling been completed in accordance with the methodology and reporting requirements set by the City?	Yes	Yes, JV3 verification modelling has been completed.	<ul style="list-style-type: none"> NCC 2016 - Section J City of Sydney 8BP Section J, JV3 Repro Requirements
	ENE9	Has predictive energy modelling been completed in accordance with the City's Guidelines on Energy Modelling?	Yes	Predictive Energy modelling has been completed for the project in line with the City's Guidelines on Energy Modelling and the Green Star Design & As-Built v1.3 credit 1.5E energy modelling guidelines. Modelling demonstrates that with 100% Green Power and the 125kWp PV array on-site, the project achieves 75% of the points available under this credit.	<ul style="list-style-type: none"> City's Guidelines on Energy Modelling Green Star Design and As Built Credit 1.5 GHG Emissions Reduction - Modelled Performance NABERS Guide to Building Energy Estimation NABERS Guide to Tenancy Energy Estimation ASHRAE Standard 90.1-2016 - Energy Standard for Buildings Except Low-Rise Residential Buildings CoS Sustainable Sydney 2030 Target
	ENE10	Have high efficiency water pumps and motors and, where the load can be varied, variable speed drives, been installed on all potable, recycled, firefighting, chilled water and hot water systems	Yes	Hydraulic - Cold water pumps for potable and re-use water have been designed and specified as variable speed pumps. Mechanical - No water pumps will be used for this project. Fire - The fire pump is diesel driven and is at a constant load. No	
Reference Code	Additional Aspects	Relevant to Project?	Comments/Assurance	Guidelines and Standard	

	ENE11	Does the design include: • building envelope, pipework and ductwork insulation with a 15% improvement in insulation performance on NCC Section J requirements? • glazing performance no greater than 85% of the allowable performance level under the NCC Section J Glazing Calculator? • heating and cooling water pumps and fans with an efficiency improvement of 15% over minimum NCC Section J requirements? • heating hot water generators with at least an efficiency improvement of 15% over minimum NCC Section J requirements? • cooling systems with a COP improvement of 15% over minimum NCC Section J or MEPS requirement?	Yes	Glazing performance is no greater than 85% of the allowable under NCC Section J glazing Calculator. Roof insulation demonstrates a 15% improvement on NCC Section J requirements. Mechanical - ductwork insulation, pipework insulation, fan and cooling system COP demonstrate an increase of 15% above NCC Section J requirement. Performance requirements for walls have increased significantly from NCC 2016 to NCC 2019. Demonstrating a 15% improvement on the DTS requirements will prove difficult (particularly for internal walls). The project team instead have demonstrated an improvement on overall building energy efficiency as demonstrated through energy modelling. Thereby meeting the intent of the requirement - noting that the project as a minimum will meet the DTS requirements. In addition, the project team has incorporated considerable other energy efficiency measures into the project such as extensive shading devices, mixed mode ventilation, fan mode operation for community spaces and sizeable 125kWp solar PV array on-site.	• NCC 2016 - Section J • Credit 15A Green Star D&AB Guidelines v1.1
	ENE12	The design must stipulate the minimum efficiency of the appliances used. • 4 Star GEMS rated refrigerators (or "high efficiency" where commercial)? • 3 Star GEMS rated clothes dryers? • 4 Star GEMS rated washing machines? • 4 Star GEMS rated dishwashers? • 4 Star GEMS rated fridge / freezers? • 4 Star GEMS rated freezers?	Yes	This has been captured in both the architectural and the sustainability Green Star specifications. All equipment selections are to be within one star of the highest available at the time of purchase. Note, that the requirements refer to Energy Star Rating in line with the current standards, not GEMS.	• Greenhouse and Energy Minimum Standards Act 2012 • Credit 15A Green Star D&AB Guidelines v1.1
	Reference Code	Aquatic Centres	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	ENE13	Does the design include mechanical design to minimise evaporation rates?	N/A	N/A	N/A
	ENE14	Has the pool temperature set point been reduced for energy saving purposes?	N/A	N/A	N/A
ENE15	Does the design include a pool cover for reduced evaporation and heat loss?	N/A	N/A	N/A	
ENE16	Does the design include a solar heating system for pool heating?	N/A	N/A	N/A	
Water	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	WAT1	Has a metering and monitoring system been installed for all major water sources and uses (potable, recycled, rainwater etc) which can be integrated into the City's SMART utility monitoring system? The Sustainability Advisor must be consulted on metering and monitoring. Separate metering should apply to (but not limited to) cooling towers, irrigation systems, wash down systems, kitchens, bathrooms/toilets. If non-potable water is used on site, meters shall be installed to understand water use from each non-potable source.	Yes	All major water uses will be metered separately and connected to the Building Monitoring System in line with the Green Star metering and monitoring requirements. Major water uses include the school spaces and the community hub spaces. Refer to Green Star Specification section 6.	• Credit 6 Green Star D&AB Guidelines v1.1 • City of Sydney, Decentralised Water Master Plan 2012 - 2030
	WAT2	Has the project connected to a recycled water network where a scheme is available in the immediate vicinity, or has provision been made by providing dual plumbing to non-potable end uses such as toilet flushing?	Yes	Yes, the building is connected to the Green Square precinct Rain water re-use system. The design has incorporated this feed through to toilets and irrigation.	• Credit 18A Green Star D&AB Guidelines v1.1 • City of Sydney, Decentralised Water Master Plan 2012 - 2030 • Sustainable Sydney 2030: Zero increase potable water use by 2030, based on 20C levels • Section 3.1 Sydney DCP 2012 • Sydney Street Technical Specifications
	WAT3.1	Stormwater - Compliance • Does the design include stormwater management compliant with or exceeding the requirements of Section 3.7 of the Sydney DCP 2012, Part 4A Sydney Street Technical Specifications, the City's WSUD & Stormwater Infrastructure Report, and the City's Parks Management and Maintenance Plan?	Yes	A stormwater management plan has been prepared showing compliance to the requirements in the listed guidelines and standards.	As Above
	WAT3.2	Stormwater - Volume • Does the design comply with the management of volume of stormwater run-off as per section 3.7.2 of the Sydney DCP 2012 and Part 4A Sydney Street Technical Specifications?	Yes	Stormwater flows up to 1 in 20 year ARI's is captured and conveyed through underground drainage systems. Stormwater flows up to 1 in 100 ARI's is conveyed through an overflow flow path that's matching the existing condition. Stormwater flow rate has been limited to the existing condition prior to discharge to public drainage system by providing an on-site	As Above
	WAT3.3	Stormwater - Pollution Does the design reduce the baseline annual pollutant load: • for litter and vegetation larger than 5mm by 90%? • for total suspended solids by 85%? • for total phosphorous by 65%?	Yes	Water quality treatment device such as storm filter cartridges, emipipods, rainwater tank are proposed in the stormwater quality treatment train to meet Council's water pollution removal targets.	As Above
	Reference Code	Additional Aspects	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	WAT4	Does the design include efficient fixtures and fittings such as: • minimum 5 Star WELS rated taps with motion sensor based timers • waterless urinals • minimum 4 Star WELS rated toilets (4.5L/full flush, 3.0L/half flush) (if appliance is specified) • minimum 3 Star WELS rated showers (7.5 - 6.0L/min) (if appliance is specified) and if appliance is specified with individual piezo-switch timers (or similar) • minimum 4 Star WELS rated washing machine? (if appliance is specified) • minimum 5 Star WELS rated dishwasher? (if appliance is specified)	Yes	This has been captured in both the architectural and the sustainability Green Star specifications. All selections for the fittings and fixtures nominated are within one star of the highest available at the time of selection. Refer to Section 22 of Green Star Specification.	• Credit 18A, 18B1 Green Star D&AB Guidelines v1.1 • City of Sydney, Decentralised Water Master Plan 2012 - 2030
	WAT5	Regardless of whether or not there is a connection to a recycled water network, the project should include an onsite alternative water source including rainwater or bore water: • Rainwater collection, storage and reuse for non-potable water demands is an effective and inexpensive method to reduce potable water consumption. • Bore water use for non-potable water demands is an effective and inexpensive method to reduce potable water consumption and should be considered if groundwater quality at the site is suitable with minimal treatment.	Yes	A 40,000 rainwater tank is provided to the site which collects roof water. It is topped up from the recycled water scheme. This feeds ground floor irrigation and wash down only. A separate 15,000 litre buffer tank is provided for recycled water scheme, this serves all WC's and washdown above ground floor for building.	• Credit 18A Green Star D&AB Guidelines v1.1 • City of Sydney, Decentralised Water Master Plan 2012 - 2030 • Sustainable Sydney 2030: Zero increase potable water use by 2030, based on 20C levels
	WAT6	Is the landscape design based on xeriscaping principles or, if it requires irrigation, does the design incorporate moisture sensing to schedule watering and use of efficient drip or micro jet emitters?	Yes	The landscaping design has adopted Xeriscaping principles through the selection of low water use plants, predominately the eastern suburbs banksia scrub/health, with the potential to incorporate a WSUD/twale system treating stormwater runoff prior to entering the OSD tank system. The water stored in the OSD tank has the ability to be recycled for irrigation of planted areas. Dip irrigation will be specified with a smart irrigation system to schedule watering as required.	• Credit 18A, 18B4 Green Star D&AB Guidelines v1.1 • City of Sydney, Decentralised Water Master Plan 2012 - 2030 • Sustainable Sydney 2030: Zero increase potable water use by 2030, based on 20C levels
	Reference Code	Aquatic Centres	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	WAT7	Does the design include a water sensitive mechanical design to minimise evaporation rates (orientation of fans away from pool surface)?	N/A	N/A	N/A
	WAT8	Does the design minimise the pool's exposure to direct sun to reduce evaporation?	N/A	N/A	N/A
	WAT9	Does the design provide wind breaks for outdoor pools?	N/A	N/A	N/A
	Climate Resilience	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance
CR1		All assets within the City's portfolio should consider Climate change as a future impact on the asset. Our city is expected to be three times more prone to heatwaves and extreme storms or flash flooding events will be twice as likely by 2070. Climate change is a key risk item to assets with long design lives which have been designed based on historical climate data. The first step for any project is understanding what the climate risks are to the project, and secondly developing mitigation strategies to address climate risks. The design should consider the impacts and mitigation of the key climate risks identified in	Yes	Climate Adaptation Workshop was held during concept design stage whereby the risks to the project associated with climate change were identified and measures to mitigate and eliminate risks were identified and implemented by the team. The Climate Adaptation register has been open throughout design development with measures included in design to reduce medium risks to low risks. Refer to Climate Adaptation Risk Register contained as an appendix in	• Credit 3, Green Star D&AB Guidelines v1.1 • City of Sydney Climate Change Adaptation Strategy • ASS334:2013 Climate Change Adaptation For Settlements and Infrastructure • City's Floodplain Management Policy
Reference Code		Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard
Waste	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	WAS1	Does the development comply with City of Sydney Policy for Waste Minimisation in New Developments, City's Draft Waste Strategy and Waste Approvals Policy?	Yes	The Council's relevant waste management documents and policies have been taken into account in the process of designing the operational waste management strategy for the site.	• Credit 8 Green Star D&AB Guidelines v1.1 • The City's Draft Waste Strategy • The City's Policy for Waste Minimisation in New Developments • The City's Waste Approvals Policy • Sustainable Sydney 2030: 70% resource recovery of waste from City-managed as by end June 2021 • Sustainable Sydney 2030: 95% resource recovery of organic waste from parks by June 2021 As Above
	WAS2	Does the development include waste stream separation of the relevant waste streams including: • General waste; • Paper and cardboard; • Glass; • Plastic; • Organics; • Clinical and Hygiene; • E-Waste;	Yes	The site will have bins or a strategy for the separation and management of general waste, co-mingled recycling (glass and plastic), paper/cardboard recycling, e waste, bulk waste items, hygiene waste and green waste	As Above
	WAS3	Does the development consider dimensions of required waste bins with appropriate design of bin storage and collection areas.	Yes	The number of bins in the site have been calculated based on City of Sydney's information, from there the equipment is drawn into the waste rooms to ensure that there is adequate space to accommodate the bins while allowing for acceptable access for all	As Above
	WAS4	Is the waste collection area designed for the dimensions of waste collection vehicles, including minimum height clearance and turning circles for access to the building.	Yes	Yes	As Above
Materials	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard

	MAT1	<ul style="list-style-type: none"> Does the design include at least 95% by cost of all timber sourced sustainably? Does the design include at least 95% by cost of all timber certified by a forest certification scheme (FSC or PEFC)? Does the design include at least 95% by cost of all timber from a reused source? Does the design include at least 95% by cost of a combination of the sources above? (COMBINED) 	Yes	<p>This has been captured in the architectural, services and sustainability Green Star specifications. All timber selections made by contractor shall meet the sustainable timber requirements.</p> <p>Requirements for contractor issuance of sustainability certifications to demonstrate compliance with these requirements is included in the Green Star Specification.</p> <p>Refer to Section 26 of the Green Star Specification - Sustainable Timber</p>	Credit 20.2 Green Star D&AB Guidelines v1.1
	MAT2	Does the project require steel to be sourced from manufacturers who are accredited to the Environmental Sustainability Charter of the Australian Steel Institute (ASI) or to be produced using energy-reducing process in its manufacture (e.g. Polymer Injection Technology)?	Yes	<p>This has been captured in the structural and sustainability Green Star specifications. All steel selections made by contractor shall meet the responsible steel requirements.</p> <p>Refer to Section 25 of the Green Star Specification - Steel Procurement</p>	Credit 20.1 Green Star D&AB Guidelines v1.1
	Reference Code	Additional Aspects	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	MAT3	Does the project avoid the use of virgin sub-grade/sub-base materials through the use of crushed recycled materials?	Yes	This has been captured in the civil and sustainability Green Star specifications.	Credit 19B.1.3 Green Star D&AB Guidelines v1.1
	MAT4	Does the design include a minimum 30% reduction in portland cement measured by mass across the project compared to a reference case?	Yes	Refer to Section 29 of the Green Star Specification - Concrete	Credit 19B.1.1 Green Star D&AB Guidelines v1.1
MAT5	Does the project source sustainable asphalt through the following: <ul style="list-style-type: none"> "warm mix" or "cool mix" asphalts to be used in place of "hot mix"? use of reclaimed or recycled aggregates within asphalt mixes? recycled aggregate asphalt mixtures (TerraGreen or GreenBase)? 	Yes	<p>Refer to Section 29 of the Green Star Specification - Concrete</p> <p>This has been captured in the structural and sustainability Green Star specifications.</p>	Credit 19B.1.2 Green Star D&AB Guidelines v1.1	
Indoor Environmental Quality	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	IEQ1	Does the design include all engineered wood product, paints, adhesives, sealants and carpets which are low VOC or low Formaldehyde as appropriate to the product?	Yes	<p>This has been captured in the architectural, services, civil & structural and sustainability Green Star specifications. All paints adhesives and sealants and engineered wood product selections made by contractor shall meet the VOC and formaldehyde limit criteria.</p> <p>Requirements for contractor issuance of sustainability certifications to demonstrate compliance with these requirements is included in the Green Star Specification.</p> <p>Refer to Section 17 and 18 of the Green Star Specification - Volatile Organic Compounds and Engineered Wood Products.</p>	Credit 13.1 Green Star D&AB Guidelines v1.1
	Reference Code	Additional Aspects	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	IEQ2	Has the ventilation system been designed for minimised pollution?	Yes	Yes, all outside air ductwork will be fitted with filters to minimise air pollution within the space.	Credit 9.1 Green Star D&AB Guidelines v1.1
	IEQ3	Does the design allow for effective (high flow rate) morning fresh air flushes, either via the HVAC system or passive ventilation, during the first few months of occupancy to remove any residual VOC outgassing?	Yes	All FCU are fitted with outside air system which allow the outside air enter the air conditioning zone which can be programmed into the control strategy during first few months of occupancy for morning air flushes to remove residual VOC outgassing. To be coordinated with morning air flushes.	<ul style="list-style-type: none"> Credit 9.2 Green Star D&AB Guidelines AS1668.2 - 2012 Mechanical Ventilation
	IEQ4	Does the design incorporate a natural or mixed mode ventilation system?	Yes	<p>Light indication panels are proposed for all air conditioning system to enable occupants to open the windows for natural ventilation, when outdoor temperature is suitable to natural ventilation. Window opening areas have been sized to enable adequate cooling and cross ventilation when opened.</p> <p>In addition, Community hub FCU's have been fitted with fan mode operation, to use free cooling when outside conditions are suitable.</p>	<ul style="list-style-type: none"> AS1668.4 - 2012 Natural Ventilation AS1668.2 - 2012 Mechanical Ventilation Credit 9.2 Green Star D&AB Guidelines
	IEQ5	Has the mechanical system incorporated exhaust systems for kitchens, print rooms or other high polluting areas?	Yes	All print rooms and the canteen kitchen will be enclosed and will be provided with dedicated exhaust to exhaust pollutants from these spaces and stop the spread throughout other areas of the project.	<ul style="list-style-type: none"> ASHRAE Standard 62.1-2016 AS1668.2 - 2012 Mechanical Ventilation Credit 9.3 Green Star D&AB Guidelines
	IEQ6	Does the design incorporate humidity control for improved thermal comfort and reduced risk of condensation?	Yes	40-60% relative humidity anticipated by virtue of cooling coil performance for all air conditioned space. Mechanical exhaust systems are used to serve wet area such as toilet, kitchen to reduce risk of condensation.	Credit 14.1 Green Star D&AB Guidelines v1.1
	IEQ7	Does the design have suitable internal noise levels and reverberation levels in accordance with AS2107:2000?	Yes	Project has been designed to maintain internal noise levels and reverberation times in accordance with AS2107:2000.	<ul style="list-style-type: none"> AS2107:2000 - Acoustics-Recommend design sound levels Credit 10 Green Star D&AB Guidelines
	IEQ8	Do all lighting levels comply with AS1680 and do all fittings include baffles, louvers, diffusers or a ceiling design to eliminate glare?	Yes	Yes. All lighting to be in compliance with Green Star criteria.	<ul style="list-style-type: none"> AS21680 - Interior and Workplace Lighting Credit 11 Green Star D&AB Guidelines
	IEQ9	Does the design include awnings, blinds, screens or other devices which eliminate glare from the sun?	Yes	Yes, extensive shading fabric/shading structures have been provided the north and western facades. Internal blackout blinds have been included for all spaces for manual control by occupants if required.	Credit 12 Green Star D&AB Guidelines v1.1
	IEQ10	Does the design allow for 60% of the floor plate to be located within 5 meters of a window or view?	Yes	Yes, 60% of primary regularly occupied spaces within 5m of windows.	As Above
IEQ11	Does the design achieve a high level of thermal comfort (Adaptive Thermal Comfort assessment or PMV)?	Yes	Yes, adaptive thermal comfort modelling has been completed in line with the Green Star Design & As-Built v1.3 guidelines. It has been demonstrated that 95% of the nominated area for 98% of the occupied hours demonstrates a high level of thermal comfort PMV+/-1.	Credit 14 Green Star D&AB Guidelines v1.1	
Ecology	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	ECO1	Does the project comply with the City's Urban Forest Strategy?	Yes	<p>The selection of endemic plant species (eastern banksia scrub/health and native trees) will increase biodiversity within the site maximising the opportunity to align with the CoS Urban Forest Strategy principles and encourage native fauna to once again populate this area. The species selected are a combination of tall shady trees that have been positioned in locations that maximise shade within the outdoor play spaces. Combining these tall shade trees with the shade provided by other endemic species selected within the design, a total canopy coverage of 15.12% is achieved.</p>	<ul style="list-style-type: none"> City of Sydney's Urban Forest Strategy City of Sydney Parks Code
	Reference Code	Additional Aspects	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	ECO2	Has the project completed and implemented recommendations from a Ecological Assessment?	Yes	Yes	<ul style="list-style-type: none"> Section 3.5 Sydney DCP 2012 City of Sydney's Urban Forest Strategy City of Sydney Parks Code
	ECO3	Does the project require an arboriculture assessment of the trees on site to protect trees and enhance canopy cover?	Yes	This was done by previous DA. However new canopy is considered by landscape designers to ensure sufficient shading for children	SCA v1.2- 2016
ECO4	Does the project incorporate a green roof or wall?	No		<ul style="list-style-type: none"> Section 3.5 Sydney DCP 2012 Green Roofs and Walls Guidelines http://www.rics.org/Global/Green_roofs_walls_1st_edition_PGguidance_2016.pdf 	
Transport	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	TRA1	Has the project provided cyclist parking in accordance with section 3.11.3 of Sydney DCP 2012?	Yes	Cyclist parking, showering facilities and lockers provided in line with Sydney DCP.	<ul style="list-style-type: none"> DCP Sydney 2012 General provisions 3. Credit 17B Green Star D&AB Guidelines
	TRA2	Has the project provided car share scheme parking in accordance with section 3.11.2 of Sydney DCP 2012?	N/A	N/A only 3 car spots provided as part of the project.	<ul style="list-style-type: none"> DCP Sydney 2012 General provisions 3. Credit 17B Green Star D&AB Guidelines
	Reference Code	Additional Aspects	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	TRA3	Has the project developed a Green Travel Plan in accordance with the City's guidelines?	Yes	Green Travel Plan to be completed during next stage of works by Traffic or contractor. Requirement for Green Travel Plan included as part of EFSG requirements as well, to meet the Green Star Design & As-Built v1.3 requirements.	City of Sydney's Green Travel Plan http://www.cityofsydney.nsw.gov.au/development/planning-controls/travel-plans/how-develop-implement-and-review-a-travel-plan/
	TRA4	Does the design included safe and accessible infrastructure for active transportation options?	Yes	Yes site is situated close to regular bus routes.	<ul style="list-style-type: none"> DCP Sydney 2012 General provisions 3. 17B Green Star D&AB Guidelines v1.1
TRA5	Does the site location achieve a walkscore of minimum 80?	Yes	ESD - Yes walk score of 83 achieved for the project	17B Green Star D&AB Guidelines v1.1	
Management	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	N/A	N/A	N/A	N/A	N/A
	Reference Code	Additional Aspects	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	MAN1	Is the Contractor required to have an Environmental Management System (eg. ISO 14001)?	Yes	Contractor requirement for an EMS included in the Green Star Specification.	<ul style="list-style-type: none"> Credit 7 Green Star D&AB Guidelines v1.1 ISO 14001: Environmental Management
	MAN2	Is the Contractor required to have an Environmental Compliance history?	Yes	Contractor requirement for an Environmental compliance history included in the Green Star Specification.	<ul style="list-style-type: none"> NSW Environmental Compliance Policy ISO 14001: Environmental Management

	MAN3	The Contractor shall develop equipment operation and maintenance manuals specific to the project. The contractor shall ensure that all information developed is issued to the City, and that the manuals cover all equipment within the asset. As a minimum the manual should cover the following systems where present: <ul style="list-style-type: none"> • HVAC system; • Building management and control systems (BMS); • Electrical, communications, security, alarms and lighting systems; • Onsite electrical generation systems; • Fire protection and fire detection systems; • Hydraulic system, including gas and any recycled water systems; • Vertical transportation systems; 	Yes	Yes contractor requirement included in the Green Star Specification. Refer to Section 5 of Green Star Specification.	Credit 4.1, 4.2 Green Star D&AB Guidelines v1.1
	MAN4	The Contractor shall develop building user information and facilitate a building user training sessions. The information and training session should cover the following as a minimum: <ul style="list-style-type: none"> • Description of initiatives designed to enhance energy efficiency and minimise greenhouse gas emissions and measures that must be taken by users during day-to-day operation to maximise their effectiveness; • Description of initiatives intended to enhance and minimise water use and the measures that must be taken by users during day-to-day operation to maximise their effectiveness; • Description of basic function and operation of any nominated building systems that building users may come in direct contact with including any occupant activated controls; • List of relevant contacts for maintenance information, operational issues, complaints or other feedback (e.g. relevant facilities management contact details and/or online request/feedback form); • Description of alternative transport initiatives promoted within premises (such as bicycle facilities, end of trip facilities, carpooling or car-share), location of a transport plan (if available); • Local public transport information, maps and timetables; • Description of the operational waste requirements for the building users, including what waste streams can or cannot be collected for recycling at the premises 	Yes	Yes contractor requirement included in the Green Star Specification. Refer to Section 5 of Green Star Specification.	Credit 4.1, 4.2 Green Star D&AB Guidelines v1.1
Construction Environment Management	Reference Code	Mandatory Requirements	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	CEM1	Has a Construction Environmental Management Plan been prepared and implemented for the project?	Yes	Contractor requirement for EMP included in the Green Star Specification.	
	CEM2	Does the project contractually require the Head Contractor to achieve a diversion from landfill (recycling) rate of minimum 80%?	Yes	Refer to section 7 of the Green Star Specification Contractor requirement for 90% by mass diversion from landfill. Refer to section 29 of the Green Star Specification	Credit 22 Green Star D&AB Guidelines v1.1
	Reference Code	Additional Aspects	Relevant to Project?	Comments/Assurance	Guidelines and Standard
	CEM3	Has an Erosion and Sediment Control Plan been prepared and implemented for the project?	Yes	Yes	
	CEM4	Has a Vegetation Management Plan been prepared and implemented for the project?	No		

APPENDIX C. SCHOOLS INFRASTRUCTURE NSW EDUCATIONAL FACILITIES STANDARDS AND GUIDELINES ESD SCHEDULE



PROJECT		Green Square Integrated Community Facility and School			It is the consultant's responsibility to check the level of compliance in the EPGS of each DG. If there is a conflict between the ESD Ca...		To be complete for all projects			
Name	Indicator	This is an extract only from the relevant EPGS. For full requirements refer to	EPGS	Compared with Green Star	Standard evidence to demonstrate compliance	Has this been implemented in the project? Y or N	Contractor's L1SD consultant	This evidence needs to show that the requirement from column 2 has been met	Actual evidence provided	Responsibility: (Identify party responsible to provide evidence)
Energy & Carbon	ECL: Energy efficiency	Improvement over NCC All new facilities must be designed and built so that energy consumption is predicted to be at least 10% lower than that required to meet minimum compliance with National Construction Code requirements. The energy consumption reduction must be achieved without including renewable energy generation in the calculation.	DG02.03	DAB C15E D.O GHG Emissions Reduction Conditional Requirement	1. Energy modelling report / Predictive energy modelling and thermal comfort assessment. Report needs to show at least 10% improvement of building over minimum NCC requirements; and 2. As built evidence that model is an accurate representation of the building, e.g. drawings; and 3. Specifications / calculations supporting modelling inputs, e.g. window energy rating scheme certificates, calculated R-values of walls, roofs, etc. 4. As an alternative to 2 and 3 above, a Statement by energy modeller confirming that the model accurately represents the building.	Y	Green Star Energy Modelling completed demonstrating a 30% reduction in GHG Emissions compared to a reference building	Green Star Energy Modelling Report	ESD	
Energy & Carbon	ECL: Energy efficiency	Energy conservation Design and construct all school buildings within the parameters specified in the: NCC Public Works Energy Manual for Buildings Building Code of Australia (BCA) Section 9 for Energy Efficiency The NSW Public Energy Manual for Buildings provides an energy-saving strategy by identifying aspects of the building and services where reductions in operating and maintenance costs can be made through proper selection of: Building fabric Insulation materials Shading and ventilation Services and control It also requires the formulation of an energy impact statement.	DG05.02	DAB C15 GHG Emissions Reduction	1) Section 9 report 2) Energy impact statement	Y		Green Star Energy Modelling Report NCC Section 9 DTS Report	ESD	
Energy & Carbon	ECL: Energy efficiency	Daylighting Designers must seek to maximise natural daylight in all learning and administration spaces to reduce energy usage through windows and skylights. Including daylight sensors in rooms to reduce light output or turn off light when sufficient daylight is provided within the space When the space is large and perimeter lighting is adjacent to windows, perimeter lighting is to be a separate zone to make maximum use of daylight	DG13.1 DG12	DAB C15 GHG Emissions Reduction	1. Daylight modelling report demonstrating how natural daylight has been maximised in all habitable spaces; and 2. As built drawings demonstrating that the model accurately represents the building (i.e. window size and location, skylights installed, etc.) and 3. Specifications supporting inputs used in modelling (e.g. skylights and glass panels).	Y	Spatial Daylight Autonomy modelling completed for the project demonstrating that the project achieves good levels of daylight amenity throughout the space. Equivalent to two Green Star Daylight points.	Green Star Daylight Modelling Report	Architect ESD	
Energy & Carbon	ECL: Energy efficiency	On exposed facades subject to direct sunlight, external window shading has been incorporated as part of the building design	DG23.1	DAB C15 GHG Emissions Reduction	1. As built drawings	Y	External fixed brick shading structure provided to building	75% architectural package Passive design report	Architect	
Energy & Carbon	ECL: Energy efficiency	Lighting energy conservation Lighting system must have timed or sensor feedback functionality for energy conservation	DG12.3	DAB C15 GHG Emissions Reduction	1. As built mechanical drawings / statement from head contractor	Y	Included in electrical design	75% electrical drawings and specification	Electrical	
Energy & Carbon	ECL: Energy efficiency	Energy efficient lighting LED lighting must be installed The design of the lighting systems and the selection of fittings is to be undertaken based on a Whole of Life approach System must support sustainable design principles including reducing energy consumption Use light sources lamps and control gear with a long life	DG23.1 DG08.01	DAB C15 GHG Emissions Reduction	1. As built electrical drawings	Y	Included in electrical design	75% electrical drawings and specification	Electrical	
Energy & Carbon	ECL: Energy efficiency	Maximum illumination power densities Section 9 part 6 of the National Construction Code provides tables that define the maximum illumination level that is acceptable in various locations. This, and all other elements of Section 9 part 6 should be applied appropriately.	DG05.01	DAB C15 GHG Emissions Reduction	1) Lighting drawings 2) Lighting specifications / schedules 3) Lighting modelling report showing compliant power densities	Y	Included in electrical design	75% electrical drawings and specification	Electrical	
Energy & Carbon	ECL: Energy efficiency	Lighting control The required communication protocol for the luminaires is DALI. The following systems for the control of luminaires fitted with DALI control gear are considered acceptable: Digital Rapid suite of products. Clapal C bus suite of products Philips Dynalite suite of products KNX based systems Systems must be designed to be as simple as possible. This simplicity must extend from the topography to ease of use. It is a specific requirement that programming of any control system must be relatively simple and not limited to costly specialist consultants. Allowances should be made in system design specification for user group training of control systems and for the programming of the system as part of the commissioning and hand over process. All equipment and manuals necessary to operate and maintain the system must be provided to the school and Asset Management	DG03.06.01	DAB C15 GHG Emissions Reduction DAB C4 Building Information	1) Commissioning report 2) Confirmation from AEM that all relevant manuals have been handed over	Y	Included in electrical design	75% electrical drawings and specification	Electrical	
Energy & Carbon	ECL: Energy efficiency	Constant light output / Daylighting Constant Light Output (CLO) systems consisting of dimming luminaires and light level sensors are highly recommended as they are effective in maintaining the required illuminance values. CLO systems ensure that the illuminance remains compliant at the lowest possible Watts per square metre for the reasonable operating life of the luminaires. Maintained illuminance values required for design compliance will result in areas being over-lit for a large proportion of their operating life without a CLO system. Sensors can be fitted to each luminaire or by utilising sensors that control groups of luminaires. Once in operation a CLO system delivers compliant light levels over the life of a system by reducing the light through dimming and ramping the levels up over the lifespan of the luminaire. These systems should be seamless and invisible in operation to users of the locations. Daylight harvesting can be delivered as a component of a CLO system and requires no additional hardware above and beyond that required for a CLO to operate. Daylight harvesting is recommended in areas where there is a rapid transition from natural day light to a dark environment, such as when entering a multi deck or underground car park from a street in full daylight, or in a classroom where daylight from windows is within the field of vision. Light switching should be provided where it is identified that the users can benefit from manual operation of the lighting and other lighting automation technology is considered cost prohibitive. The switching should be clearly marked and robust. Achieve energy efficient switching in Schools by: The use of multiple switching group Automatic control of these groups to operate as follows: Controlled luminaires are to automatically turn off nominally 5 minutes after the bell sounds. Turn off is to be in two steps other than small rooms, one step after 3 minutes and the second group 2 minutes later (5 min). If the lighting is required for the next period, occupants of that room can prevent the lights turning off by pressing the ON switch(es) after the bell sounds. The luminaires in each room can be turned off at any time by pressing the OFF switch(es). The off signal is to be capable of transmission at the end of normal school hours or at other selected times without the bells sounding, with the lighting turning off in two steps (other than small rooms).	DG03.06.02 DG03.06.03	DAB C15 GHG Emissions Reduction	1) Lighting drawings 2) Lighting modelling report showing compliant power densities	Y	Included in electrical design	75% electrical drawings and specification	Electrical	
Energy & Carbon	ECL: Energy efficiency	Energy efficient HVAC system HVAC system must have timed or sensor feedback functionality for energy conservation systems should be designed to minimise energy consumption. System design / equipment selection is to be based on whole of life cost analysis. Specify air conditioning equipment should: support sustainable design principles including reducing energy consumption; and be easily accessible and serviceable - easy to maintain with minimal impact on school operations / activities when maintenance is being performed. All new school buildings are to be designed to meet or exceed the requirements of building regulations for conditioned spaces.	DG12.3 DG55 DG16.09	DAB C15 GHG Emissions Reduction	1. As built mechanical drawings / statement from head contractor; 2. Whole of life cost analysis demonstrating systems were selected based on WOL performance.	Y	VRF Heavy recovery solution with integrated mixed mode ventilation. Connected to EMS. System controlled by temperature, CO2 and occupancy sensors and time clock.	75% mechanical drawings and specification	Mechanical	
Energy & Carbon	ECL: Energy efficiency	Energy efficient appliances & equipment Electrical equipment must be at least 0.5 stars above the market average star rating or comply with high efficiency standards specified in the GREP	DG13.3	DAB C15 GHG Emissions Reduction	1. Schedule of appliances and equipment with their star ratings or performance standards, signed by head contractor or architect. All appliances and equipment required in the GREP must be listed, not air conditioning equipment, electric motors, transformers, etc.	Y	All equipment within one star of highest rated equipment product.	Green Star Specification Architectural schedules	Architect	
Energy & Carbon	ECL: Energy efficiency	Heat loss/gain Building/HVAC design must consider: Climate/ micro climate: This data must come from the current AIRAH handbook and where a specific area is not referenced in the handbook, the Bureau of Meteorology statistics must be utilised. Orientation: exposure to sun(wind) and wind Natural Ventilation and cross ventilation Insulation, thermal capacity and time lag of building fabric. Energy and Resources Cost: Initial and on-going, of heating and cooling. Reduced energy consumption provides future cost savings and reduced carbon footprint. Activities / Equipment that may produce excess heat. Energy modelling software must be used to determine heating and cooling loads as part of the Whole of Life analysis that must be undertaken. (i.e. Carpal or Carrier).	DG04.01	DAB C15 GHG Emissions Reduction	1. Thermal modelling report 2. As built evidence demonstrating that model is an accurate representation of the building 3. Specifications / calculations supporting modelling inputs	Y	Green Star Energy Modelling and passive design modelling completed for the project based on project location, weather, orientation, fabric and services design	Green Star Energy Modelling Report Passive design modelling report	ESD Mechanical	
Energy & Carbon	ECL: Energy efficiency	Passive design The need for active cooling and heating shall be minimised by employing passive / sustainable design principles. Windows: The size and proportions of windows need to be carefully considered in the design to provide maximum efficiency and a balance between the ESD factors such as; maximising daylight in rooms but avoiding unnecessary solar heat gain and thermal mass etc. Roofing: The colour selected will have an impact on the thermal performance. Light colours will reflect more of the sun's heat and darker colours absorb more of the sun's heat, which will be transferred into the roof structure. Unless prevented by glare issues to surrounding development, light colours must be selected to reduce the thermal load from solar heating and contribute to heat island effect mitigation. Orientation (as close to True North as possible). With appropriate shading, this will provide a balanced approach to reducing summer heat ingress and encouraging solar warmth during winter. Appropriate glazing / shading strategy (related to orientation and local environment), depending on the climate, windows would be minimised on southern, eastern & western elevations with external shading on western and eastern facades). Use of thermal mass to stabilise internal temperatures. Insulation: maximise insulation	DG05 DG08.02 DG27.12	DAB C15 GHG Emissions Reduction	1. Thermal modelling report 2. As built evidence demonstrating measures implemented to reduce need for active cooling / heating 3. Passive design report by Architect listing all passive design initiatives implemented	Y	Detailed passive design modelling assessment completed during concept design with recommendations to improve glazing and insulation performance and reduce glazing area. These recommendations have been incorporated into the design. Fixed brick shading structure provided to the facade and external corridors provide shading from direct solar gains.	Green Star Energy Modelling Report Passive design modelling report	ESD Mechanical	
Energy & Carbon	ECL: Energy efficiency	Natural ventilation A ventilation strategy must be developed to ensure that sufficient ventilation is provided to all spaces to meet the requirements of the BCA/NCC and associated standards. Specifically ventilation equipment must be designed from a whole of life perspective and: Enable healthy learning environments with indoor air quality (IAQ) that supports learning and teaching (i.e. IAQ that is fit for purpose for schools). Support sustainable design principles including reducing energy consumption Be accessible and serviceable - easy to maintain with minimal impact on school use	DG17.01	DAB C15 GHG Emissions Reduction	1) Cooling system strategy including WOL analysis 2) Concept plans 3) Construction drawings 4) Trade based specification 5) As built drawings	Y	Included in mechanical design	75% mechanical drawings and specification	Mechanical	
Energy & Carbon	ECL: Energy efficiency	Natural ventilation It is required for all classrooms for comfort in summer and to maintain a healthy indoor environment. Where cross ventilation may be restricted (i.e. where rooms are located on each side of a corridor, at least one whole wall of operable windows plus ceiling fans are required, to provide air movement. Some windows need to be operable in driving rain and so must be protected with appropriately designed weather hoods, awnings overhangs or other method of protection.	DG05.01	DAB C15 GHG Emissions Reduction	As built drawings demonstrating windows have been installed as required.	Y	solution incorporated into all classrooms. Indicator light panel in classrooms nominates when external conditions are suitable and windows can be opened. Windows	75% mechanical drawings and specification	Mechanical	
Energy & Carbon	ECL: Energy efficiency	Mechanically assisted cross-ventilation In two storey blocks where cross flow ventilation is not possible to the lower floor, mechanically assisted cross ventilation is to be provided to the lower floor learning spaces nominated in the EPGS. The ventilation system is to be used to provide at least 7 air changes per hour. The system is to be thermostatically controlled to activate when room temperature exceeds 25 deg C and is to run continuously until the room temperature drops below 27 deg C. Additionally the system is not to be activated unless the outdoor temperature is lower than the indoor temperature and is to be immediately de-activated as soon as the outdoor temperature exceeds indoor air temperature. Some programmable sensor gear must be used to be adjustable after-hour timer to control each mechanically assisted exhaust ventilation system.	DG17.18	DAB C15 GHG Emissions Reduction	As built mechanical drawings and specifications Extracts from commissioning report	Y	solution incorporated into all classrooms. Indicator light panel in classrooms nominates when external conditions are suitable and windows can be opened. Windows connected to a reef sensor, once opened, mechanical systems will vent off and the space is naturally ventilated.	75% mechanical drawings and specification	Mechanical	
Energy & Carbon	ECL: Energy efficiency	Ceiling void ventilation Provide ventilation so as to remove hot air built-up in large enclosed roof spaces. Roof mounted turbo ventilators are an approved method. The size and number of ventilators to be included will depend upon the volume and use of the individual rooms and the local climatic conditions to provide suitable air changes and room cross ventilation. Provide a minimum of two roof ventilators to each Secondary General Learning Space or a Primary Home Base unless otherwise directed, or other number recommended by the manufacturer for the size of the space (whichever is the greater).	DG05.02 DG17	DAB C15 GHG Emissions Reduction	As built mechanical drawings demonstrating ventilation has been installed as required.	N/A	N/A	N/A	N/A	
Energy & Carbon	ECL: Energy efficiency	Roof ventilator control Provide controls for the operation of the motorised dampers on the roof ventilators. Generally one switch is required for each space within the school where roof ventilators are installed.	DG05.16	DAB C15 GHG Emissions Reduction	Mechanical / electrical drawings showing controls	N/A	N/A	N/A	N/A	

Energy & carbon	ECL: Energy efficiency	School buildings can use wind powered roof ventilators with dampers to provide effective natural ventilation. Design to suit ambient conditions to ensure correct sizes, locations and numbers are provided for each particular application. Co-ordinate the locations of ventilators with the ceiling fans to achieve effective air movement. In assisted ventilators should also be considered on days of low wind Provide a wall mounted switch to open /close the damper.	DG17.14	DAB C15 GHG Emissions Reduction	As built mechanical drawing showing location of roof ventilators if installed	N/A	N/A	N/A	N/A	
Energy & carbon	ECL: Energy efficiency	Greater air circulation than that required by building regulations is required, with sufficient natural ventilation or mechanical ventilation, to disperse odours and /or humidity. Cross ventilation is to be used where possible. Provide mechanical ventilation to all disabled Toilets. Operate the system by time control equipment (time switches or run on timers as appropriate).	DG65.D4 DG17.16	DAB C15 GHG Emissions Reduction DAB C15 GHG Emissions Reduction	As built mechanical drawings demonstrating ventilation has been installed as required.	Y		Dedicated toilet exhaust supplied to all bathrooms	75% mechanical drawings and specification	Mechanical
Energy & carbon	ECL: Energy efficiency	Ventilation in storage spaces Permanent air ventilation openings are to be provided (without compromising structural integrity) to ensure adequate air circulation. Ventilation in permanent learning spaces and libraries Where feasible / practical: Ceiling fans shall be installed where ceiling height is equal to or greater than 2,700mm. Wall fans shall be installed where ceiling heights are less than 2,700mm.	DG65.D5	DAB C15 GHG Emissions Reduction	As built mechanical drawings demonstrating ventilation has been installed as required.	Y		ventilation supplied to all storage spaces	75% mechanical drawings and specification	Mechanical
Energy & carbon	ECL: Energy efficiency	Indoor environment controls: Both the thermal comfort and indoor air quality shall be controlled automatically within specified parameters. Controls shall be simple and intuitive to use. A prominent green light shall highlight to occupants when conditions are suited to opening windows and doors to utilise natural ventilation. A prominent blue light shall highlight to occupants when the air conditioning is operating. The lights shall be clearly labelled with traffic light labels as follows: + Green light – "External conditions are suited to opening windows and doors" + Blue light – "Air conditioning is operating. Windows and doors should be closed" Temperature and CO2 sensors are to be installed within the space and be readily accessible for maintenance. Sensors must be located so as to accurately record the actual room temperature and indoor air quality (CO2). Controls shall be designed to minimise energy consumption – e.g., by minimising over cooling and heating and automatically switching off when the space is unoccupied. Controls shall be designed so that the system's will shut down automatically if a room is unoccupied for greater than 10 minutes (except in specific cases such as designated computer rooms). Controls shall be properly labelled and suitably located in the space (preferably near the light switches) and incorporate: + A key operated auto / manual / off switch, and + A push on / push off adjustable hour run timer. The run timer shall be adjustable from 1 to 4 hours and initially be set at 2 hours.	DG65	DAB C15 GHG Emissions Reduction	As built drawings demonstrating ceiling/wall fans have been installed as required.	Y		Ceiling fans supplied to all classrooms, libraries and learning spaces	75% mechanical drawings and specification	Mechanical
Energy & carbon	ECL: Energy efficiency	Access for maintenance All systems and equipment that is installed within a school is to be provided with suitable access to ensure that this equipment is safe and efficiently maintainable. In order to ensure that maintenance is available, on the completion of all buildings, drawings are to be provided showing the completed (As built) building including all equipment and equipment access arrangements. Communication services DfE requires a 4 hour on-site training session for up to four persons on the use of the PCS. Training is to be accompanied by appropriate documentation and a video that demonstrates operation of the system and its components, including patching, cable management for voice, video and data of the SCS installed on site. Include explanation of detailed drawings left on site. The video / CD ROM may be generated from the on-site training for future use by DfE school staff. The Project Manager will, in consultation with the School Principal, nominate the timing of this session together with the number of attendees. Manuals are to be handed to the school during the training session. Include in copies of all cabling test reports and the (minimum) 20 year warranty certificate the manual. As built documentation and manufacturers warranty and test results are required. Building user's guide Produce a Building User's Guide to enable the client to understand the building systems and operate systems to maximise efficiency. This must: + Clearly and concisely describe the operation of building and its services. + Detail a reasonable maintenance program + Advise the user of the most suitable replacements for consumables	DG55	DAB C15 GHG Emissions Reduction	1) As built evidence demonstrating controls have been installed as required. 2) Commissioning report / statement by head contractor confirming controls have been set as required	Y		Mechanical control strategy compliant with EPSC. System controlled by temperature, CO2 and occupancy sensors and time clock.	75% mechanical drawings and specification	Mechanical
Energy & carbon	ECL: Energy efficiency	Renewable energy A grid connected solar PV system must be installed in line with DG66 requirements and, where feasible, PV systems shall be installed to offset as much of the electricity consumption by the school as is practicable	DG14.10 DG64.10 DG65.D2	DAB C4 Building Information DAB C15 GHG Emissions Reduction DAB C16 Peak Electricity Demand Reduction	1) As built drawings including all equipment access arrangements for maintenance 2) Training records 3) Operation manuals 4) Manufacturers warranties and cabling test reports 5) Building user's guide	Y		All systems designed for access and maintenance in line with the Green Star credits 1.1 requirements, including access to all filters and coils.	75% mechanical drawings and specification	Mechanical
Energy & carbon	EC2: Scope 1 & 2 emissions	Renewable energy A grid connected solar PV system must be installed in line with DG66 requirements and, where feasible, PV systems shall be installed to offset as much of the electricity consumption by the school as is practicable	DG13.4 DG65	DAB C15 GHG Emissions Reduction	1) As installed drawings of PV system 2) Energy modelling report showing renewable energy generation	Y	125kW PV on-site	75% Architectural drawings Green Star Energy Modelling Report		Architect ESD
Energy & carbon	EC2: Scope 1 & 2 emissions	Battery Energy Storage System A battery energy storage system shall only be designed in consultation with SINSW Sustainability. sustainability.enquiries@det.nsw.edu.au	DG66.B.3	DAB C15 GHG Emissions Reduction	1) As installed drawings of battery storage system	N/A	N/A	N/A	N/A	N/A
Energy & carbon	EC2: Scope 1 & 2 emissions	Heaters Electric heating must be preferred over gas heating. Where gas heating is considered, it must be approved by SINSW Sustainability. Heating equipment must be designed from a whole of life perspective and: + Support sustainable design principles including reducing energy consumption and carbon emissions. + Be accessible and serviceable - easy to maintain with minimal impact on school use when maintenance is being performed	DG66	DAB C15 GHG Emissions Reduction	1) If reverse cycle air conditioning is installed, confirmation that gas heaters are not installed, OR 2) Evidence that the gas heaters installed are energy efficient	Y		No gas on-site. VEV heat recovery system operates in both heating and cooling mode.	75% mechanical drawings and specification	Mechanical
Energy & carbon	EC2: Scope 1 & 2 emissions	Hot water heaters Hot water and thermal water generation for schools must be carefully considered to ensure that a Whole of Life assessment is undertaken to minimise life cycle costs and carbon emissions. Environmentally friendly options such as solar heating (if viable) and heat pumps are preferred energy options to minimise energy consumption.	DG53.09	DAB C15 GHG Emissions Reduction	1. WOL cost assessment for hot water systems 2. Hydraulic drawings/chematics showing installed DHW systems	Y		Proof of use water heaters used on-site, limited hot water consumption and thus reduced energy consumption through	75% Hydraulic drawings and specification	Hydraulic
Energy & carbon	EC3: Scope 3 emissions	Transport plan	N/A	DAB C17 Sustainable Transport		Y		Transport plan prepared by Traffic.	Traffic Transport plan	Transport Consultant
Energy & carbon	EC3: Scope 3 emissions	Recycle storage Provide 1 space for every 20 students to AS2980 3 standard	DG52.4.36	DAB C17 Sustainable Transport		Y			75% Architectural drawings	Architect
Water	W1: Water use efficiency	Public water conservation WATER CONSERVATION STRATEGIES must be implemented on school sites, including: Manual Flush Urinal Systems - New and replacement urinals must use manual in lieu of automatic flushing mechanisms. A microwave-activated urinal flushing system may be used as an alternative. Water Conservation Taps - Use metal flow control valves and /or push down taps with pre set flow limits. 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 purchased at the average WELS star rating. Refer to DG53.02 for specific rating requirements. Harvest Rainwater - Where practical, harvest roof water and connect to a pumped rainwater supply system to authorise requirements for landscaped areas toilet flushing.	DG53	DAB C18 Potable Water	1. Schedule of fixtures and fittings showing type of urinals and taps installed as required	Y		Low flow fittings and fixtures, within one star of highest rated equivalent product at time of specification. Rainwater harvesting on-site (40L) tank for irrigation + 150L tank connect to CoS district recycled water network for toilet flushing and irrigation	75% Architectural drawings 75% hydraulic drawings	Hydraulic
Water	W1: Water use efficiency	Fixture efficiency All products must be rated to AS 6400 to the following minimum WELS ratings: + Tapware to 5 star flow rating requirements + Showers to have 3 star flow rating requirements + Water Closet Pans to 4 star flow rating requirements Flow restrictors can be used to minimise water usage and wastage for staff amenities + Taps with timed flow can be used to minimise water usage and wastage in student amenities. In any case, all new water-using appliances must be at least 0.5 stars above the average WELS star rating by product type, except toilets and urinals, which must be purchased at the average WELS star rating. Where WELS rating is not available, use the hydraulic services	DG53.02 DG14.4	DAB C18B.1 Potable Water-Sanitary Fixture Efficiency	1. Schedules of materials, fixtures, fittings and equipment with WELS/WaterMark ratings, demonstrating compliance and identifying those with flow restrictors and timed flow.	Y		Low flow fittings and fixtures, within one star of highest rated equivalent product at time of specification.	75% Architectural specification	Architect
Water	W1: Water use efficiency	Hydraulic services Hydraulic services should: + Support sustainable design principles including reducing water consumption and waste production. + Appropriately treat any trade waste to ensure minimal environmental impact. + Be accessible and serviceable - easy to maintain with minimal impact on school use when maintenance is being performed Use products with a long life span - many hydraulic services are concealed so durability is essential	DG51.01	DAB C18 Potable Water	1) Hydraulic report showing sustainability initiatives implemented to reduce potable water consumption 2) As built drawings showing trade waste arrestors	Y			75% Hydraulic report	Hydraulic
Water	W1: Water use efficiency	Water sub-metering In addition to the main water meter for the site provide sub meters for the following: + Mixed irrigation systems + Laboratory buildings + Amenity blocks + Canteens + Any other major water use on the site	DG53.04		1) As built hydraulic drawings	Y		Metering provided to all major uses including separate metering to the school and community hub and separate potable and non-potable metering	75% hydraulic drawings - metering tree diagram	Hydraulic
Water	W2 - Proportion of potable vs non-potable water	Rainwater collection It is DfE policy to include roof water harvesting and tank storage in new schools and to encourage it where practical in existing schools, to reduce the demand on drinking water supplies. Tank water can connect to drip irrigation systems for adjacent landscape/gardens with the major preference being for gravity feed supply to minimise ongoing maintenance.	DG53.14 DG14.2 DG53.01	DAB C18B.2 Rainwater Reuse	1) As built hydraulic drawings showing tank connection to end users and capacity	Y		40L cistern tank included on site	75% hydraulic drawings	Hydraulic
Water	W2 - Proportion of potable vs non-potable water	Fire system water reuse Where schools are required to install a sprinkler system for fire safety, it is recommended to install a closed loop system must be installed to capture and reuse fire systems testing and maintenance water, or by using an alternative non-potable water source.	DG14.2	DAB C18B.5 Fire System Test Water	Fire engineering report	N/A		No sprinkler system	N/A	Fire
Water	W2 - Proportion of potable vs non-potable water	Ground water Where ground water is available for use for irrigation purposes in drought affected locations, enquiries must be undertaken with the Department of Planning, Industry and Environment to determine the suitability of a ground water system.	DG53.03	DAB C18 Potable Water	1. Relevant due diligence report / investigation	N/A		Site connected to City of Sydney district recycled water system	N/A	N/A
Water	W3 - Responsible water discharge	Stormwater management Must aim to minimise the transportation of toxicants to waterways and other off-site environments, and maintain the existing hydrological regimes. Due diligence for flooding must be done up to and including landscape design.	DG14.3	DAB C26 Stormwater	Stormwater modelling report showing stormwater pollution and flows. DWI / Hydraulic drawings showing management measures.	Y		MUSIC modelling report demonstrating compliance with EPSC requirements.	MUSIC Modelling report	Civil
Water	W3 - Responsible water discharge	Trade waste Arrestors for acid, grease, plaster and clay of adequate capacity must be installed to treat wastewater from science laboratories, kitchens, art rooms and canteens as required in DGS2	DG52	Not covered in Green Star	1) As built drawings showing trade waste arrestors or 2) Letter by Hydraulic Engineer confirming arrestors have been installed as required	Y			75% hydraulic drawings	Hydraulic
Waste & materials	W4: Materials selection and use	Life cycle assessment (environmental) Environmental impacts of products and materials has been assessed and inform material selection	DG11.03	DAB C15A - Life Cycle Assessment	Life cycle assessment report	N/A	N/A	N/A	N/A	N/A

	<p>Whole of life costing (WOL) Total cost of ownership (TCO) assessment / Analysis of direct and indirect costs and benefits / Life cycle costing analysis</p> <p>When calculating the whole of life cost for the different materials / building elements or systems, the following must be considered: - The total initial capital cost of the system(s) – including design, project management, builder and building services works in connection etc. - resources (energy and where applicable water) consumption. - Maintenance: - the replacement of component parts. - disposal costs - ecological sustainable options. - durability - vandalism - safety</p> <p>The whole of life cost shall be calculated over the estimated life of the asset/s.</p>	DG51 A4 design guide for selection of materials and building systems	ISC C20 - Return on Investment	Life cycle costing report for relevant system	N/A	N/A	N/A	N/A	
Waste & materials	<p>Waste & materials selection and use</p> <p>Construction materials must be selected based on the following: - Adequately and economically perform their intended functions; and also have lower adverse environmental impacts throughout their life cycle (refer to DG 3) - Contain reduced or no hazardous substances (e.g. low VOC) to ensure effective indoor environmental quality. Reduce the demand for rare or non-renewable resources. - Have low embodied energy and water. - Are made from or contain recycled materials or can be reused or recycled at the end of their useful life.</p>	DG52.06	DAB C21 Sustainable Products	Environmental Product Declarations of products / materials used; Product certificates (like GGBA, FSC, etc.) Supplier's declarations confirming recycled contents in products Bill of quantities	Y		Materials selection in line with Green Star credits for VOC, formaldehyde, PVC, timber, Concrete and Sustainable Products	Green Star Specification Services Specifications Architectural Specifications	ESD All services Architect
Waste & materials	<p>Waste & materials selection and use</p> <p>Sustainable timber - No rainforest timbers, or timbers from high conservation forests, are to be used unless plantation grown. Use only recycled timber, engineered and glued timber composite products, or timber from plantations or from sustainably managed growth forests that is FSC, AF5 or PEFC certified. - All timber used is to be termite (white ant) resistant or treated to be termite resistant to the appropriate hazard level.</p>	DG21.05.01	DAB C02 Responsible Building Materials - Timber	1. Evidence of chain of custody 2. Bill of quantities	Y		Materials selection in line with Green Star credits for VOC, formaldehyde, PVC, timber, Concrete and Sustainable Products	Green Star Specification Services Specifications Architectural Specifications	ESD All services Architect
Waste & materials	<p>Waste & materials selection and use</p> <p>Built for disassembly Consider the use of building materials which are able to be disassembled for re-use, in conjunction with considerations for the addition and removal of accommodation over time.</p>	DG52.07			N/A	N/A	N/A	N/A	
Waste & materials	<p>Waste & materials selection and use</p> <p>Concrete 1. Use materials complying with AS based on the Whole of Life approach to materials selection. 2. Do not use breccia or dolerite in concrete mixes. Fly ash is a manufacturing by-product that can be used as a cement replacement but should be limited to a maximum of 20% by weight of cement content.</p>	DG52.02	DAB C19B.1	Structural specifications and drawings Structural Engineer's report showing %cement replacement	Y		Materials selection in line with Green Star credits for VOC, formaldehyde, PVC, timber, Concrete and Sustainable Products	Green Star Specification Services Specifications Architectural Specifications	ESD All services Architect
Waste & materials	<p>Operational waste A waste storage area must be included in all new school sites. The provision of space must include source separation including bin stations and appropriate signage of waste and receptacles for multiple waste streams, including: - Organics - Commingled containers - Paper & cardboard - Container deposit scheme - Soft plastic - General waste Designers must refer to AS 4122.3 Mobile waste containers. Colour, marking, and designation requirements for further guidance on bin colour, waste stream and waste type. Safe methods for vehicle access and the transfer of waste must also be considered. For new and refurbished schools, an operational waste management plan (OWMP) must be developed to establish operational waste targets, identify opportunities for reuse and recycling in the operation of the facilities and make adequate provision for the facilities to accommodate the OWMP. The OWMP must address all requirements from DG 2.7.2.</p>	DG52.07	DAB C8 Operational Waste	Operational waste management plan Operational waste reports showing diversion rates	Y		Captured in design as nominated in Elephant's foot OWMP report	Elephant's Foot OWMP	Waste Consultant
Waste & materials	<p>Waste & materials selection and use</p> <p>Building flexibility Position structural members considering the future flexibility of the structure. Avoid ad hoc glazing of columns internally, giving preference to uniformity in layout. Design all internal walls as non-load bearing to enable future flexibility.</p>	DG21.1.16	Not covered in Green Star	As built drawings or statement by relevant professional	Y			75% Architectural drawings 75% Structural drawings	Architect Structural
Waste & materials	<p>Waste & materials selection and use</p> <p>Construction waste Consider opportunities for re-use and recycling of materials in the construction phase</p> <p>Operational waste A waste storage area must be included in all new school sites, with the provision of space for the storage of waste and receptacles for multiple waste streams, including: - general rubbish, - co-mingled recycling, - paper and cardboard, - secure waste, and - green waste. Safe methods for vehicle access and the transfer of waste must also be considered.</p>	DG52.07	DAB C22 Construction and Demolition Waste	Construction waste reports showing percentage of waste re-used and recycled (derived from landfill)	Y		Targets for diverting 90% of construction and demolition waste	Green Star Specification	
Waste & materials	<p>Waste & materials selection and use</p> <p>Operational waste A waste storage area must be included in all new school sites, with the provision of space for the storage of waste and receptacles for multiple waste streams, including: - general rubbish, - co-mingled recycling, - paper and cardboard, - secure waste, and - green waste. Safe methods for vehicle access and the transfer of waste must also be considered.</p>	DG52.07	DAB C8 Operational Waste	As built drawings showing location of waste storage area	Y		Captured in design as nominated in Elephant's foot OWMP report	Elephant's Foot OWMP	Waste Consultant
Place	<p>Waste & materials selection and use</p> <p>Environmental conservation education The design of the facilities provide unique and valuable environmental conservation learning opportunities and effective environmental modelling to the wider community.</p>	DG52.06		Statement / Report by qualified ecologist	Y				Architect Mechanical Landscape architect
Place	<p>Productive landscape Consider/identify opportunities for development of community garden within the site and relationships with community groups for this to occur.</p>	DG52.06	ISC C14.2 Local Food Production	Site plan demonstrating location and size of community garden	Y		Landscape included and accessible to community space	75% Landscape drawings	Landscape architect
Place	<p>Drinking water catchment protection For developments within drinking water catchment areas, a water cycle management study is to be included with the Development Application for Education Facility developments involving: - Agricultural facilities - Biosolids and effluent re-use schemes - Sewerage systems or works (including package sewerage treatment plants) - Stormwater or works involving the disposal of untreated runoff</p>	DG51.07	ISC C24 Integrated Water Cycle	1. Water cycle management study 2. Evidence that recommendations in the study have been followed / implemented	N/A	N/A	N/A	N/A	N/A
Place	<p>Site investigations for place making / community connections The following detailed reports/ surveys/ information should be considered in developing the business case: - Local environment/ character - Climate and microclimate - Heritage significance / impact - Appraisal of physical and visual factors affecting site development - Available transport/ road infrastructure servicing the site - Geo-technical and Soil reports will be required for each site to investigate the suitability of the topsoil and anticipated soil-grade materials for horticultural purposes. - Testing for toxic residues must be undertaken in all areas identified as being a possible risk, i.e. filled or dumped ground.</p>	DG52.02	DAB 24.2 Contamination and Hazardous Materials	1) Relevant reports/surveys developed (these ideally include recommendations for further development stages) 2) Evidence demonstrating recommendations / best practice solutions have been implemented/addressed	Y		Project is shared public school and community facility	75% Architectural drawings	Architect
Place	<p>Sense of place The following design principles to every landscape zone of the school. - A healthy and safe landscape - A sense of place - A sustainable landscape - A low maintenance landscape</p>	DG50.04	Not covered in Green Star	1) Landscape design report 2) Landscape drawings	Y			75% Landscape drawings	Landscape architect
Place	<p>Community use of facilities Some school facilities are used out of hours for activities such as weekend church groups, sport events and public meetings. Liaise with the Project Director to gain an understanding of any shared use, or community use arrangements that are being considered for the site.</p>	DG16.08	DAB C30B Community Benefit	1) Confirmation by the Architect that direct access has been provided to open spaces and any other facilities that could be shared with the community. 2) A list of community engagement activities undertaken to develop a community benefits strategy. 3) Plans clearly outlining how the outcomes from the community benefits strategy have been implemented in the project 4) Joint-use or lease agreements where directly in place	Y		Project is shared public school and community facility	75% Architectural drawings	Architect
Place	<p>Reconciliation action plan</p>	N/A	DAB C30D Reconciliation Action Plan	1) DoE's Reconciliation Action Plan 2) Evidence of the project's relationship with the RAP, e.g. actions implemented in line with RAP, etc.	Y		SNSW Reconciliation Action Plan, initiatives implemented on project	Reconciliation Action Plan	SNSW
Place	<p>Daylighting Maximise natural daylight in all habitable spaces to improve indoor amenity and create a pleasant environment.</p>	DG2.3.1	DAB C12 Visual Comfort	1. Daylight modelling report demonstrating how natural daylight has been maximised in all habitable spaces; and 2. As built drawings demonstrating that the model accurately represents the building (i.e. window size and location; skylights installed, etc.); and 3. Specifications supporting inputs used in modelling (e.g. skylights and glass specs)	Y		Daylight Modelling Report	Daylight Modelling Report	ESD
Place	<p>Daylight glare control Discomforting glare and brightness contrasts must be avoided. Designers must seek to: - Exclude direct sunlight from all learning spaces, libraries, administrative offices and staff studies for the period of 9:00am to 3:30pm including Eastern Daylight Saving Time between 21st September to 21st March (inclusive). - Exclude direct sunlight from desk level in all learning spaces between 9am and 3:30pm. Sun exclusion and glare control can be achieved by the use of elements such as: Sun shades, external overhangs, vertical blinds and the like. Glare must only be controlled by blinds as a last resort.</p>	DG12.01	DAB C12.02 Glare Reduction	1. Daylight glare modelling report / sun diagrams showing direct sunlight has been excluded as required. 2. Drawings supporting inputs of model, showing location of blinds and any other glare control device	Y		External fixed brick shading structure provided to building. Internal blackout blinds applied to all spaces (in line with Green Star requirements)	75% Architectural drawings	Architect
Place	<p>Lighting comfort Consider the furniture layouts to determine the orientation of luminaires. Especially when positioning luminaires in Materials Technology spaces to ensure adequate illumination on machines and work surfaces; - avoid potential ergonomic effects and avoid shadows from ductwork - Mount luminaires as high as possible, but generally no higher than 4000mm AFL (including Gymnasiums and Halls); improve luminance uniformity and reduce direct glare in the direction of normal view. The standard lamp colour temperature is 4000K, except in certain toilet areas where the Design Guide requires the use of blue colours. Compliance with the uniformity requirements of the applicable standard should be demonstrated by the presentation of the output from lighting design software. Unified Glare Rating (UGR) must be calculated using design software and compliant with the maximum recommended in AS/NZS 1680.1:2006</p>	DG63.03 DG63.05	DAB C11 Lighting Comfort	1) Lighting drawings 2) Architectural drawings 3) Lighting specifications / schedules 4) Product data sheets 5) Isolux plot drawings 6) Lighting modelling report showing compliant uniformity and UGRs	Y				
Place	<p>Lighting modelling Lighting designs should be carried out utilising industry standard lighting design software such as AG13D, Dialux or Relux. Modelling must provide output that clearly demonstrates that the proposed design is compliant with the standards including but not limited to the following parameters: - Maintained illuminance values (average, maximum and minimum) on horizontal surfaces such as floors or working planes as required, broken down to identify the parameters defined in AS/NZS 1680.4 or AS/NZS 1158 as applicable - Maintained illuminance values (average, maximum and minimum) on vertical surfaces such as walls, shelves or racks as required, broken down to identify the parameters defined in AS/NZS 1680.4 or AS/NZS 1158 as applicable - Unified Glare Rating (UGR) as defined in AS/NZS 1680.1 - Uniformity as defined by the applicable standard for indoor or outdoor illumination, Lighting power density in System Watts/m2</p>	DG63.02	DAB C11.1 General Illuminance and Glare Reduction	Lighting modelling report confirming compliance with required standards and parameters	Y		Lighting modelling report		Electrical
Place	<p>External access lighting External Access Lighting shall be provided to illuminate building entrances, footpaths, sheltered walkways, roadways and car park. External Access Lighting must: - Be minimal and designed to prevent glare to pedestrians, nearby residents and to motorists. Evidence of compliance with AS4282, AS/NZS 1158 and other applicable Australian Standards must be provided by the designer. - Be located so as to link various sources of illumination such as street lighting (for carpark and roadways) and internal security lighting (for footpaths, walkways and entrances). - Illuminate building entry doors. - Highlight 'accident prone' areas such as changes in level, stairs and ramps. - Provide vertical illumination.</p>	DG63.08.01	DAB C27.0 Light Pollution to Neighbouring Bodies	1) As built drawings indicating the location of all external luminaires 2) Letter by lighting designer describing glare prevention measures	Y			75% Lighting drawings	Electrical

	Thermal comfort The inclusion of active cooling within school facilities is directed by the Department's Air Cooling policy. 1.1 Schools with a long term average mean maximum January temperature of 33 °C and above. Generally, air conditioning is to be provided to all school buildings. 1.2 Schools with a long term average mean maximum January temperature of below 33°C. Air conditioning is to be installed in all permanent learning spaces and libraries forming part of each projects scope. Thermal modelling is undertaken to demonstrate that learning spaces and libraries have been designed to achieve a predicted mean vote (PMV) of +/- 0.5 for 95% of occupied hours	DG65.03 DG65.01 DG65.02	DAB c14 Thermal Comfort	1) Mechanical drawings showing HVAC systems installed, or 2) Confirmation from sub-contractors that services have been installed and commissioned as required; and 3) Modelling report showing required PMV is achieved. Modelling report to be done in line with methodology described in Draft thermal comfort and indoor air quality interim performance brief for DG65		Thermal comfort modelling report completed in line with the Green Star DAB v1.3 requirements. Modelling demonstrates that high level of thermal comfort will be achieved throughout the project	Thermal Comfort modelling report	ESD Mechanical
P3 - Welcoming learning spaces	Acoustic Performance HVAC systems shall be designed in accordance with the recommended internal noise levels noted in table 1 of DG65.02. The noise levels are the result from the cumulative contribution of traffic noise (via the facade) PLUS the building air conditioning ventilation systems. The noise measurement and documentation must be provided by a qualified acoustic consultant and in accordance with AS/NZS 2107. Noise measurement must account for all internal and external noise including noise arising from building services equipment, noise emission from outdoor sources such as traffic, and (where known) noise from industrial process. Occupancy noise is excluded. Compliance shall be demonstrated through measurement, and the measurements shall be conducted in at least 10% of the spaces in the nominated area. The selection of representative spaces must be justified and must consider how the spaces are considered to be the most conservative with respect to both internal, and external noise sources. The range of measurement locations shall be representative of all spaces available within the nominated area. All relevant building systems must be in operation at the time of measurement. Projects less than 500m ² Gross Floor Area (GFA) must account for noise from toilets	DG65.02 DG68.06	DAB c10.1 Internal Noise Levels	1. Road, rail, aircraft, industrial and rain noise assessment as per DG11.02 2. Report by qualified acoustic consultant demonstrating noise measurements are compliant		Acoustics report	Acoustics report	Acoustics
P3 - Welcoming learning spaces	The following elements have prescriptive acoustic performance or construction requirements: Operable walls (between general learning areas, all schools): Rw 45 Entry doors to occupied teaching, music, drama and sports spaces: Solid core, minimum 55 mm thick with acoustic weather (where external seals or all related flooring faces. Gap at floor to be minimised. Internal glazed sections in walls and vision panels in or adjacent to internal doors: minimum 50.38 mm laminated glass. In some situations acoustic windows may be needed for satisfactory noise separation. Construction separating wastewater pipework from occupied spaces: Rw 40 Where adjacent to an occupied space (and not serving that space), hydraulic supply pipework and wastewater pipework shall be separated from the adjacent occupied space. Construction between the adjacent spaces in this instance shall be a staggered stud arrangement or otherwise discontinuous.	DG11.05	DAB c0.3 Acoustic Separation	1. Detailed drawings including the acoustic design specification of operable walls, entry doors, internal glazed sections, etc. OR 2. Statement by a qualified acoustic consultant confirming compliance		Acoustics report	Acoustics report	Acoustics
P3 - Welcoming learning spaces	Noise emission to the environment Generally noise emission to the environment from mechanical services noise sources (such as air conditioners) are the subject of a development consent conditions. In NSW the development consent conditions will refer to the Industrial Noise Policy (INP) or Local Council requirement.	DG11.04	Not covered in Green Star			Acoustics report	Acoustics report	Acoustics
P3 - Welcoming learning spaces	Where no condition regarding noise sources exists for a school development, noise emission from such sources should be designed, in principle, to satisfy the requirements of the Industrial Noise Policy	DG11.04	Not covered in Green Star			Acoustics report	Acoustics report	Acoustics
P3 - Welcoming learning spaces	Acoustic post-occupancy evaluation Post-Occupancy Evaluation is often undertaken to assess the performance of recently completed or existing facilities. Where a Post Occupancy Evaluation is to be undertaken it should be conducted by the project team or acoustic engineer and should be undertaken of selected acoustic parameters only. Evaluation may include: Internal noise levels. Room acoustics. Noise emission. Room to room acoustic performance	DG11.07	EGP c13 Internal Noise Levels	1. Commitment by SI to conduct acoustic post-occupancy evaluation	N/A	Not applicable until PC		
P3 - Welcoming learning spaces	Low VOC-emitting materials All surface coatings, and other volatile organic compound (VOC) emitting products including adhesives, sealants, carpets, carpet tiles, and carpet underlays, must be made from low VOC emission materials. Paints must meet the limits stipulated in the Australian Paint Approval Scheme's (APAS) VOC limits for low VOC paints. Adhesives and sealants must not exceed the maximum VOC limits stipulated in Table 13.1.2B of the Green Star - Design & As-Built v1.3 tool. Carpets must not exceed the total VOC limits stipulated in Table 13.1.2B of the Green Star - Design & As-Built v1.3 tool.	DG2.5.2	DAB c13 Indoor Pollutants	Product specifications, certificates, safety datasheets that demonstrate low-VOC contents Bill of quantities		Paint adhesives and sealants must meet Green Star VOC limits as specified in Green Star DAB v1.3 guidelines	Green Star Specification	ESD Architect Builder
P3 - Welcoming learning spaces	Low formaldehyde-emitting materials Only low formaldehyde-emitting engineered wood products should be used, such as those that meet the Australian Standards for formaldehyde emission limit E1 (NCNAS classification or lower).	DG2.5.2	DAB c13 Indoor Pollutants	Product specifications, certificates, safety datasheets that demonstrate low-formaldehyde contents Bill of quantities		Engineered wood products must meet Green Star formaldehyde limits as specified in Green Star DAB v1.3 guidelines.	Green Star Specification	ESD Architect Builder
P3 - Welcoming learning spaces	Ventilation in printing rooms The ventilation system is to be designed to serve the whole room and is not intended to provide localised exhaust at equipment. Discharge air from the ventilation unit to the outside of the building via a vermin proofed louvre. Draw make-up air from inside the building through wall or door grilles. Locate the inlets and exhaust to achieve good airflow across the room in plan and elevation to pick up all machine emissions. Ensure the airflow doesn't draw equipment emissions across operator's face. Note that the room door in many schools may be left open in normal daily operation. Allow for this when locating the exhaust so that cross ventilation is achieved with make-up air drawn through door opening. Required speed range: minimum of 6 air changes per hour and maximum of 15 air changes per hour.	DG57.07	DAB c9.3 Exhaust or Elimination of Pollutants	1. Mechanical drawings and specifications showing compliant printing room ventilation		Print rooms are enclosed fitted with dedicated exhaust system	75% mechanical drawing and specification	Mechanical
P3 - Welcoming learning spaces	Chemical store ventilation Provide mechanical exhaust system with high and low level exhaust points to all chemical stores, with a minimum of 15 air changes per hour flow rate. Discharge air according to the requirements of BCA. The discharge outlet is to be fitted with bird safe mesh. Provide make up air to all chemical stores, (to replace exhausted air) through openings in an external wall, fitted with weatherproof louvers. All grilles and louvers are to be fitted with vandal proof bars and be fitted with vermin mesh. For security and fire rating reasons do not use windows/doors or door grilles for air intake. The chemical stores ventilation systems are to run continuously.	DG57.09	Not covered in Green Star		N/A	N/A	N/A	N/A
P3 - Welcoming learning spaces	Pesticide free environments Schools must be designed, constructed and maintained, without using chemicals for termite and other pest control. No chemical pesticides and termiticide to be used. Preventive treatments to be by physical means and careful design to minimise risk	DG2.5.3	Not covered in Green Star	Statement by head contractor that no pesticides or termiticides have been used.		Operations policy	N/A	SINW
P3 - Welcoming learning spaces	Green cleaning	N/A	ESP c5 Green Cleaning	1) WBS Clean School User Guide 2) Green Cleaning specifications		Operations policy	N/A	SINW
P3 - Welcoming learning spaces	Fly free indoors Fly screening must be provided in all schools to the doors, windows and other openings in food preparation, biology, and non-water closet toilet spaces or where specifically nominated in the ESG. Schools in localities where fly incidence constitutes a health hazard (especially brachina or other nuisance) will require fly screens to all opening cashes.	DG11.01	Not covered in Green Star	As-built drawings showing fly screening has been provided as required			75% Architectural drawing	Architect
P3 - Welcoming learning spaces	Indoor CO2 levels For mechanically ventilated spaces: 1. Outdoor air ventilation rates are in accordance with requirements of AS 1668.2 2. Mechanical ventilation systems shall be linked to CO2 sensors to provide demand-controlled ventilation within each space to ensure that CO2 levels are maintained below the required CO2 threshold 3. Mechanical ventilation systems shall be designed to provide adequate access for maintenance and cleaning 4. Ventilation systems are designed to maintain an average daily CO2 concentration as per the latest NCC code, and so that the maximum concentration does not exceed 1,500ppm for more than 20 consecutive minutes in each day. 5. The required outdoor air ventilation rates and CO2 concentrations shall be maintained without the need for any human intervention e.g. the opening of windows or external louvers. 6. Ventilation systems shall be designed to minimise the entry of outdoor pollutants through ensuring that the ventilation system design is in accordance with the relevant parts of AS 1668.2 and AS/NZS Standard 622.1. 7. Where local sources of pollutants are present e.g. photocopiers, minimum exhaust ventilation flow rates shall be provided in accordance with AS1668.2: Table S1.	DG65.02	DAB c9 Indoor Air Quality	Mechanical drawings and specifications Extracts from commissioning report		CO2 sensors are included throughout the design. CO2 levels will be controlled to below 800ppm in all spaces in line with Green Star requirements.	75% Mechanical drawing and specification	Mechanical
P3 - Welcoming learning spaces	Biological conservation Schools sites must conserve for future generations, the biological diversity of genetic materials, species and ecosystems so that site and its wider surrounding natural environment. The design of the facilities must provide unique and valuable environmental conservation learning opportunities and effective environmental modelling to the wider community. Schools must model best practice design, material use, systems and operational methodology, demonstrating human connections to nature and the operation of natural cycles of sea, wind, rain and the four seasons. Schools must connect with nature and incorporate biophilic design principles. Open space must allow for exploration, and biodiversity and earth education to enhance the site's outdoor learning potential. New and refurbished schools must preserve or re-establish native flora (unless it poses a safety risk or cannot be planted). Consider opportunities for development of community gardens within the site and relationships with community groups for this to occur. Adequate due diligence must be conducted where biodiversity or high ecological value is identified on the site. For more details see D900 Landscape Design	DG02.06	DAB c23 Ecological Value (incl Biodiversity Enhancement)	1) Biodiversity or ecological assessment / local flora and fauna survey 2) Biodiversity management plan describing measures for the conservation and protection of threatened species or communities, biodiversity enhancement, tree protection, etc. 3) Evidence demonstrating measures have been implemented to protect and enhance endangered species / ecological communities identified to preserve or re-establish native flora; etc.		Ecological calculator completed demonstrating the ecological value of the design is a greater than the existing site	Green Star Specification	ESD Landscape Architect
P3 - Welcoming learning spaces	All new facilities must meet current DTS provisions of the NCC and the associated standards. Generally AS 1428.1 is the minimum design standard for access and mobility. However, it is DTS's policy that any enhanced requirements noted in AS 1428.2 be incorporated in any new design. Additionally, DAE have enhanced circulation requirements as noted in DG / CIRCULATION Provide hearing augmentation system for areas that have amplification, generally within Gymnasium, library, movement studios and Community Halls, provide a system to assist the aurally challenged to hear music and speech within the main auditorium and on the stage Provide the International Symbol for Deafness to indicate that an assistive hearing device is installed.	DG19.01 DG65.14	DAB S90 Universal Design	1) Accessibility plan 2) As-built drawings or other evidence demonstrating that minimum and enhanced accessibility requirements have been provided for walkways, corridors, ramps, etc. 3) Photographic or other evidence of signage installed		Flexbrick shading structure and corridor coverings	75% Architectural Package	Architect
P3 - Welcoming learning spaces	Weather protection Circulation areas provided between administrative, staff and all student spaces (except playgrounds), should be protected from sun, rain and unfavourable winds.	DG06.05	Not covered in Green Star	As built drawings showing circulation areas are protected as required			75% Architectural Package	Architect
P3 - Welcoming learning spaces	Open play space Open play space must be provided for students to access during recess, lunch breaks and for outdoor learning. Open play space can be comprised of: Paved and grassed areas Recliffs and terraces Covered outdoor areas The designated open play space must be easily monitored and managed by school staff. Where a joint use agreement can be negotiated with a local council or land owner, the required play space can be located off-site, providing the facilities are: In close proximity to the school Easily accessible Safe and secure Designs must aim to achieve a minimum of 10m ² per student. Where this figure is not achievable the proposed m ² per student of the completed project must not be less than the existing m ² per student currently on the site.	DG10.03	Not covered in Green Star	Plan view drawings showing provision of open space			75% Architectural Package	Architect
P3 - Welcoming learning spaces	Staff room	N/A	ES1 c Amenities Space	1) Extracts from the ESG required for staff rooms 2) Evidence of staff room delivered accordingly			75% Architectural Package	Architect

	P3 - Welcoming learning spaces	Health and safety policy	N/A	DAB C300 Integrating Health Environments	1) Research report behind Healthy Canteen Policy 2) Evidence that policy initiative has been incorporated into the school under assessment.	Y	SNSW policy in operation	ESNDW	
	P3 - Welcoming learning spaces	Safety by design The Work Health and Safety Act and the Department of Education principles of student safety and welfare mandate the avoidance of accidents through careful design of facilities. The designer must ensure, so far as is reasonably practicable, that the plant, substance or structure is designed to minimise risks to the health and safety of all parties who will work on a site connected with its design as well as the end users of the facility. An important part of the Safety by Design principle is recording the risk assessments that are conducted during the design and providing to the client, owners, any users/occupiers of the facilities and those who will be building or maintaining the facilities, details of risks and hazards identified. The design of facilities should not only be inherently safe but visually and pragmatically safe and not tempt students or the general public into unsafe practice. Examples: Sliding - The safety of occupants is paramount where glass is being used, especially in areas subject to human impact. All glazing types and thickness are to comply with the relevant AS a minimum. Hot water - To minimise scalding risk all hand basins, showers and the kitchen sink in practical activities areas serving Q2/Q3 classes, require "heated" rather than "hot" water provided at a specified temperature, by mixing hot and cold water through a Thermostatic Mixing Valve. (Note: Tempering Valves are not permitted in schools) Drinking water tanks - Ensure rainwater is not collected from areas containing lead materials. All coating materials used inside the reservoir must be suitable for drinking water and guaranteed against liner leakage for a period of 20 years. A filtering and UV system to be provided where drinking water tanks are present.	DG14.02 DG13.09 DG13.11 DG13.16 DG13.17	Not covered in Green Star	1. Safety risk assessments 2. Short report identifying safety-by-design principles incorporated / Sign off by head contractor confirming all mandatory requirements in DG14 have been addressed. 3. Manufacturer's certificate to AS/NZS 4020 for tanks	Y	Safety in design completed throughout design process with risks mitigated/eliminated	Safety in design register	Architect
	P3 - Welcoming learning spaces	Microbial control As a measure to prevent legionella, heated water to hand basins, showers etc. shall be stored at temperature above 65 C. Thermostatic mixing valves are to be used for tempered water generation at each point of use. Valves need to comply with microbe disinfection requirements. "Code of Practice for Thermostatic Mixing Valves" as approved by the NSW Health Department.	DG13.09 DG13.11	DAB C28 Microbial Control	1. Letter by hydraulic engineer confirming hot water is stored above 65 deg and that valves comply with code of practice.	Y	Waterless heat rejection equipment used throughout project	75% mechanical drawings and specification	Mechanical
	P3 - Welcoming learning spaces	Security Safety in Design and Crime Prevention Through Environmental Design (CPTED) principles are to be implemented in project planning stage. Advice on the electronic surveillance systems can be sought early in the design phase. CCTV systems are required in several locations where indicated in the Rooms and Spaces Technical Data table, including: - Secondary clinic - Primary sick bay - Library	DG14.10 DG16.08 DG16.09	ISC c15 Safe Places	1) Crime risk assessment or equivalent 2) Evidence of designing out crime principles implemented 3) Security services plans, schedules and forms by School Security Unit (SSU) 4) SSU specification and evidence of funding on project identification	Y			Architect Security consultant
	P3 - Welcoming learning spaces	Hazardous materials Where a new school is to be developed a Hazardous materials study is to be conducted, including: - Asbestos Containing Materials (ACM) - Synthetic Mineral Fibres (SMF) - Polychlorinated Biphenyls (PCB) - Lead Paint - Ozone Depleting Substances Any existing structures and all parts of the site should be examined in order to determine the presence of hazardous materials before commencement of any renovation or demolition. Inspection should be conducted by organisations with the National Association of Testing Authorities (NATA) accreditation complying with the requirements of AS/NZS 4362.1:2020 for the inspection of hazardous materials (HazMat) including asbestos. Hazardous Materials inspection reports should be produced in accordance with the requirements of the various Safe Work Australia "Codes of Practice" for the management and control of hazardous substances. Where hazardous materials are found a Hazardous Materials Management Plan should be prepared.	DG48.01	DAB 24.2 Customisation and Hazardous Materials	1. Hazardous materials study / site inspection report / survey 2. Management plans for hazardous materials identified 3. Remediation strategies implemented 4. Environmental auditor certificates / clearance certificates	Y	Hazmat survey completed for site		
	P3 - Welcoming learning spaces	WiFi infrastructure New buildings and refurbishments are required to provide a common wireless solution compatible across the school, providing a consistent user experience and support mechanism. This involves the replacement of existing legacy wireless equipment such as wireless access points and site switches.	DG64.12.02	ISC C2.2 Digital Infrastructure	1) Contracts describing the network infrastructure specification and operational requirements	Y			
	P3 - Welcoming learning spaces	Sustainability benchmarking Ecologically Sustainable Development principles must be included in any new school buildings to a level that the building could be benchmarked to achieve a 5 Star Green Star rating if located in Sydney, Newcastle, or Wollongong metropolitan areas or a 4 star Green Star rating if located elsewhere in NSW. Benchmarking must be undertaken against the Green Star credits with the edition of the Green Star scorecard current at the time of the assessment. The filled out scorecard must demonstrate the project can achieve enough points for the required rating. Formal Green Star certification is not mandatory.	DG02.09	All credits	1) Green Star scorecard demonstrated the final design is benchmarked to the required rating (by a Green Star Accredited Professional)	Y		Project registered and targeting 5 Star Green Star Design & As-Built v1.3 certification GS-SS550A	ESD
	R1 - Preparation for shocks	Site investigations for resilience The following detailed reports/surveys/information should be considered in developing the business case: - Slope, drainage and erosion issues including flood risks (if any) - Geotechnical and soil conditions - Airborne pollutants - Bushfire risks - Appraisal of available services infrastructure Climate change risk assessment must be undertaken considering at least two different climate change scenarios An environmental risk report will be required for developments proposed within sensitive natural environments or sites subject to natural risks (i.e. flood prone sites, bush fire areas)	DG03.02	DAB c3 Adaptation and Resilience	1) Detailed reports or surveys developed 2) Environmental risk report 3) Evidence demonstrating recommendations have been implemented and risks addressed through design responses.	Y			
	R1 - Preparation for shocks	Bushfire protection Development applications on bush fire prone land must be accompanied by a Bush Fire Assessment Report demonstrating compliance with the aim and objectives of Planning for Bush Fire Protection and the specific objectives and performance criteria for the land use proposed. Local Authorities and the Rural Fire Service can provide advice on the design of buildings in bush fire prone areas. The Building Code of Australia and AS3959 "Construction of buildings in bushfire-prone areas" set out the requirements for buildings which are within close proximity to a defined bush fire zone. Mandatory landscape management strategies: - Keep the amount of fuel (leaves, twigs, logs, dead grass) in the vicinity of buildings to a minimum - Ensure trees are located at away from buildings to avoid branches overhanging and leaves collecting on roof. - Do not plant shrubs against buildings. - The crowns of trees planted on the hazard side of the development should not be coniferous. - Plant fire resistant trees and shrubs on the hazard side of the development to reduce the potential impact of wind, fire intensity, radiant heat, and rain of spent as well as intercepting burning embers. - Avoid combustible fencing materials. - Provide irrigation and garden sprinklers to water areas near the buildings (subject to water authority approval).	DG13.01	DAB c3 Adaptation and Resilience	1) Bush fire assessment report 2) Statement by Architect / fire consultant outlining building strategies implemented in line with BCA and AS3959 3) Bush fire management plan outlining management strategies implemented 4) Landscape plans detailing bush fire management measures implemented	N/A	N/A	N/A	N/A
	R1 - Preparation for stresses	Climate change adaptation Sites and school communities must be able to withstand natural and urban hazards and adaptively respond to climate change over time, especially for projects involving vulnerable communities e.g. climate generating exacerbated flood, storm surge, inundation, heatwaves, bush fires, extreme storm and other weather events. School facilities must be able to withstand natural hazards and adapt to shocks and stresses to avoid social and economic costs of interrupted operation and repairing or replacing damaged assets. To achieve this, increasing resilience to natural hazards must be considered in the business case development so that associated costs are budgeted. An initial assessment of natural hazards and project vulnerability must be carried out, in consultation with resilience experts, to inform the business case and identify hazards where further analysis is required.	DG07.08	DAB c3 Adaptation and Resilience	1) Climate risk assessment, and 2) Climate adaptation plan 3) Emergency management plan	Y	Climate Change Risk Assessment completed with the design team identifying risks associated with the design. Risks have been closed out as design has progressed, risks are now considered low due to measures implemented in design.	Climate Change and Adaptation Risk Register	ESD

APPENDIX D. CLIMATE CHANGE AND ADAPTATION PRE-READING





MEMORANDUM

Project: Green Square Public School Redevelopment
Date: 1 July 2020

Name	
To:	All workshop attendees

SUSTAINABILITY- CLIMATE CHANGE ADAPTATION WORKSHOP: PRE-WORKSHOP NOTES

The purpose of this memorandum is to provide information to all stakeholders that will attend NDY's climate change adaptation workshop to facilitate the consultation process for establishing the Climate Adaptation Plan for BVN's Green Square Public School Redevelopment project. Please familiarise yourself with this information before the workshop scheduled for Tuesday 7th July.

Climate change adaptation is something quite distinct from climate change mitigation:

- ▶ Mitigation is about making climate change less severe - this is where our focus to date on this project has been (energy efficiency, renewable energy, low-carbon materials).
- ▶ Adaptation accepts that there will be some degree of climate change no matter how successful our combined mitigation efforts are - and looks to design buildings that are resilient to it. This will be the focus of our workshop.

This advice note consists of the following parts:

- ▶ Climate Change Projections
- ▶ Consequence Scale for Risk Assessment
- ▶ Likelihood Scale for Risk Assessment

The two 'time slices' that will be referenced throughout the risk assessment and adaptation planning process are 2030 (Practical Completion + 10 years) and 2070 (+ 50 years).

Climate change projection data has been sourced from CCIA (a joint BoM and CSIRO initiative), and baseline data has been sourced from BoM. Full references will be included in the final report.

The priorities for the workshop will be two-fold:

- ▶ Identify and describe risks posed by climate change to the development and rate the consequence and likelihood of each.
- ▶ Identify and evaluate potential adaptation actions and/or design strategies to mitigate those risks which are deemed unacceptable.

CLIMATE CHANGE PROJECTIONS – SYDNEY AIRPORT, NSW (STATION NO. 066037) SYDNEY EAST COAST (SOUTH) SUB CLUSTER

Climate Variable		Baseline	2030 @ RCP8.5	2070 @ RCP8.5	Commentary
Average 3pm Temperature	Summer	24.5° C	26° C (+1.5° C)	27.5° C (+3° C)	There is <i>very high confidence</i> in continued <u>substantial increases</u> in projected mean, maximum and minimum temperatures. By late in the century (2090), there is a large difference between scenarios. The projected range of warming is 1.3 to 2.5°C above the climate of 1986-2005 for RCP4.5 and 2.7 to 4.7°C for RCP8.5.
	Autumn	21.5° C	23° C (+1.5° C)	24.5° C (+3° C)	
	Winter	16.6° C	18.1° C (+1.5° C)	19.6° C (+3° C)	
	Spring	20.6° C	22.1° C (+1.5° C)	23.6° C (+3° C)	
Maximum Recorded Temperature		46.4° C (18 th Jan 2013)	47.9° C (+1.5° C)	49.4° C (+3° C)	More hot days and warm spells are projected with <i>very high confidence</i> . Extreme temperatures are projected to increase at a similar rate to mean temperature, with a <u>substantial increase</u> in the temperature reached on hot days, the frequency of hot days, and the duration of warm spells (<i>very high confidence</i>). https://www.tai.org.au/sites/default/files/Western%20Sydney%20Heatwatch%20%5BWEB%5D.pdf
Number of Hot Days (over 35°C) <i>Coogee</i>		4 days	7 days	16 days	
Number of Hot Days (over 40°C) <i>Central Sydney</i>		0.3 day	2.1 days	7.5 days	
Average Rainfall	Summer	93.7 mm	84.3 mm (-10%)	79.6 mm (-15%)	Annual rainfall shows no long-term trend, however there has been prolonged periods of extensive drying throughout the 20 th Century to the present, particularly in winter and spring. Decreasing winter rainfall is projected with medium confidence based on good understanding of the contributing underlying physical mechanisms driving this change (relating to a southward shift of winter storm systems).
	Autumn	106.4 mm	little change	95.8 mm (-10%)	
	Winter	89.9 mm	76.4 mm (-15%)	76.4 mm (-15%)	
	Spring	70.0 mm	63.0 mm (-10%)	63.0 mm (-10%)	
1-in-20 Year Rainfall Event (24 Hour)		216.2 mm (3 rd Feb 1990)	259.4mm (+20%)	259.4mm (+20%)	Increased intensity of extreme rainfall events is projected, with high confidence. Even though annual mean rainfall is projected to decrease in the region, projections indicate increases in extreme rainfall.
Time in Drought (%)		40%	50%	55%	Time spent in drought is projected to increase (low confidence) over the course of the century.
Fire Weather (Severe Fire Danger Days FFDI >50)		-	45% increase	130% increase *2090 RCP8.5	There is high confidence that climate change will result in a harsher fire-weather climate in the future. However, there is low confidence in the magnitude of the change, though predicted to be extreme, as this is strongly dependent on rainfall projections, which as we have seen are declining in almost all seasons.
Sea Level Rise <i>Change relative to 1986-2005</i>		-	14cm above baseline	66cm above baseline *2090 RCP8.5	There is very high confidence in future sea-level rise. Mean sea level will continue to rise and height of extreme sea-level events will also increase (very high confidence).
Yearly Average Daily Solar Radiation		16.5 MJ/m ²	little change	16.7 MJ/m ² (+1%)	Little change is projected for solar radiation (high confidence), except for winter and spring increases.
Yearly Average 3pm Humidity		57% RH	little change	little change	A tendency for a decline in relative humidity away from coasts although changes in the near term will be small (high confidence).
Yearly Average 3pm Wind Speed		21.6 km/h	little change	little change	There is high confidence in little change.



CONSEQUENCE SCALE FOR RISK ASSESSMENT

Descriptor	Service Quality	Compliance	Infrastructure	Financial
Insignificant	Minor deficiencies in principle that would pass without comment	Concerns about compliance would be resolved without special attention	No infrastructure damage, little change to infrastructure service	Little financial loss or increase in operating expenses
Minor	Services would be regarded as satisfactory but personnel would be aware of deficiencies	Minor perceived or actual breaches of compliance would be resolved	Localised infrastructure service disruption, no permanent damage. Some minor restoration work required. Early renewal of infrastructure by 10-20%. Need for new/modified equipment	Additional operational costs. Financial loss is small <10%.
Moderate	Services would be regarded as barely satisfactory by the general public and the organisation's personnel	Formal action would be required to answer perceived breaches or charges of compliance failure	Limited infrastructure damage and loss of service. Damage recoverable by maintenance and minor repair. Early renewal of infrastructure by 20-50%	Moderate financial loss 10-50%
Major	The general public would regard the organisation's services as unsatisfactory	Significant amounts of management and advisers' effort would be required to answer charges of compliance failures	Extensive infrastructure damage requiring major repair. Major loss of infrastructure service. Early renewal of infrastructure by 50-90%	Major financial loss 50-90%
Catastrophic	Services would fall well below acceptable standards and this would be clear to all	Obvious and proven breaches of legal and regulatory requirements with the prospect of corporate or individual penalties	Significant permanent damage and/or complete loss of the infrastructure and infrastructure service. Loss of infrastructure support and translocation of service to other sites. Early renewal of infrastructure by >90%	Extreme financial loss >90%



LIKELIHOOD SCALE FOR RISK ASSESSMENT

Rating	Descriptor	Recurrent or event risks	Long term risks
Almost Certain	Could occur several times per year	Has happened several times in the past year and in each of the previous 5 years <i>or</i> Could occur several times per year	Has a greater than 90% chance of occurring in the identified time period if the risk is not mitigated
Likely	May arise about once per year	Has happened at least once in the past year and in each of the previous 5 years <i>or</i> May arise about once per year	Has a 60-90% chance of occurring in the identified time period if the risk is not mitigated
Possible	Maybe a couple of times in a generation	Has happened during the past 5 years but not in every year <i>or</i> May arise once in 25 years	Has a 40-60% chance of occurring in the identified time period if the risk is not mitigated
Unlikely	Maybe once in a generation	May have occurred once in the last 5 years <i>or</i> May arise once in 25 to 50 years	Has a 10-30% chance of occurring in the future if the risk is not mitigated
Rare	Maybe once in a lifetime	Has not occurred in the past 5 years <i>or</i> Unlikely during the next 50 years	May occur in exceptional circumstances, i.e. less than 10% chance of occurring in the identified time period if the risk is not mitigated

Should you have any queries or would like further information prior to the workshop please do not hesitate to contact me.

Regards,

NORMAN DISNEY & YOUNG

Claudia Burbidge | Sustainability Consultant
C.Burbidge@ndy.com

APPENDIX E. CLIMATE CHANGE AND ADAPTATION RISK REGISTER



Climate Change Adaptation Risk Register

Project: Green Square Public School Redevelopment
Project No: 00120.0038578.0001

Item No.	Description of Hazard (Cause & Effect)	Aspect	Discipline	Existing Controls	BAU 2040 @ RCP8.5			BAU 2090 @ RCP8.5			Residual						
					Conseq.	Likel.	Risk	Conseq.	Likel.	Risk	Conseq.	Likel.	Risk				
1	Accelerated material deterioration (colour fading or failure) due to higher temperatures.	Average Temperature	Architecture	Clay-based screening, timber structure (natural shading), aluminium frame, glazing. Clay maintains properties over time.	Insignificant	Possible	Low	Insignificant	Possible	Low							
2	Cracking/failure of seals due to higher temperatures	Average Temperature	Façade	Cladding system screened, increase life expectancy	Insignificant	Possible	Low	Insignificant	Possible	Low							
3	Increase in electricity consumption due to higher temperatures	Average Temperature	Mechanical	PV on roof, r-value glazing. Thermal performance of CLT. Winter/summer may balance out consumption.	Minor	Possible	Medium	Minor	Possible	Medium							
4	HVAC not maintaining internal conditions during heat waves.	Extreme Temperature	Mechanical	Designing to 32 Design day, well-insulated building will minimise impact of extreme temperatures and resulting impact on HVAC electrical loads.	Minor	Possible	Medium	Minor	Possible	Medium							
5	Changes in occupant travel behaviour during heat waves (increased demand for carparking).	Extreme Temperature	Architecture	Allocated drop off, entry sheltered, external circulation spaces covered and sheltered. N-facing multipurpose spaces have sheltered entrance areas. Mostly hard-structure shading, some trees. Playground well-shaded, covered bb court. Building mass on N-W of site, play areas to the south.	Minor	Likely	Medium	Minor	Likely	Medium							
6	Sediment/debris may build up in surrounding drainage infrastructure due to less frequent washout in drought. Build up of internal pressure.	Droughts	Civil	Maintenance to address ground plane - sweeping etc, landscaping. 6 monthly cycle	Minor	Likely	Medium	Minor	Likely	Medium							
7	Structural cracking due to soil moisture changes	Droughts	Structural	Sand. Screw piles and slab-on-ground, external incorporates slab + paving, soft-fall, landscaping.	Minor	Unlikely	Low	Minor	Unlikely	Low							
8	Stormwater system blockages as a result of higher flows	Extreme Rainfall	Civil	Floor levels set 1% (0.5m) above current flood-modelling design (1 in 100years). City of Sydney have just upgraded civil infrastructure in the area. New building raised. Sight falls away	Major	Possible	Medium	Major	Possible	Medium							
9	Water entering ground floor due to overland flow / localised flooding - may affect access to the building for occupants and emergency services.	Extreme Rainfall	Civil	Comment on fall of main entries and provision of drainage slots.	Insignificant	Possible	Low	Insignificant	Possible	Low							
10	Prolonged periods of no rainfall	Extreme Rainfall	Hydraulics	Resilient entry materials used. Materials selected for easy cleaning or replacement if necessary.	Insignificant	Possible	Low	Insignificant	Possible	Low							
11	Surrounding sewer / stormwater infrastructure impacted by storm surge.	Sea Level Rise	Civil	School connecting to recycled water. Non-potable water supply back-up to rainwater storage.	Insignificant	Possible	Low	Insignificant	Possible	Low							
12	Extended blackouts due to transmission infrastructure failure or capacity being exceeded.	Extreme Rainfall Extreme Wind Extreme Temperature	Electrical & Comms	Any existing controls? Expectation may be that Council will adapt an adequate strategy over time - particularly given gradual rate of sea level rise - laying additional drains etc. Shared elec load between aquatic centre + green infrastructure and school community centre. Potential for group to run in island mode (not possible, no generators). No existing controls - school would be shut down and students and staff sent home.	Major	Possible	Medium	Major	Possible	Medium							
13	Blocked downpipes/guttering as a result of hail	Hail / Snow / Lightning	Hydraulics	100mm trench grate around perimeter should prevent build-up. Building envelope well-placed to deal with damage. System is designed for 1 in 100 year storm.	Insignificant	Possible	Low	Insignificant	Possible	Low							
14	Façade / solar PV / mechanical kit damage by hail / lightning / wind	Hail / Snow / Lightning	Mechanical	Securing plant and equipment to roof. Specify hail damage protection on chiller.	Moderate	Unlikely	Low	Moderate	Unlikely	Low							
15	Soft landscaping damage due to scouring or hail.	Extreme Wind	Electrical Architecture	Wind bracket, cables wire tied. Separate framing system for wind loads.	Insignificant	Possible	Low	Insignificant	Possible	Low							
16	Spilt-brick façade screen	Hail / Snow / Lightning	Architecture	Native landscaping to be incorporated.	Insignificant	Possible	Low	Insignificant	Possible	Low							
17	Smoke / dust impacting upon air quality, or accidentally shutting down air handling units that have smoke detectors.	Extreme Wind	Façade	Confirm mounting of solar panels i.e. flat mounted? Will provide a degree of self cleaning	Insignificant	Possible	Low	Insignificant	Possible	Low							
17	Smoke / dust impacting upon air quality, or accidentally shutting down air handling units that have smoke detectors.	Bushfire	Mechanical	No measures currently included in design.	Major	Unlikely	Medium	Major	Unlikely	Medium							
18	Airborne dust soiling ventilation filters more quickly, dirtying solar panels more quickly, dirtying façade more quickly.	Dust Storms	Mechanical	Easy access provided for regular maintenance. Designed for replacement.	Minor	Unlikely	Low	Minor	Unlikely	Low							
			Electrical & Comms	Confirm mounting of solar panels i.e. flat mounted? Will provide a degree of self cleaning	Insignificant	Possible	Low	Insignificant	Possible	Low							

APPENDIX F. PASSIVE DESIGN ANALYSIS





CONSULTANT ADVICE

Project: Green Square Public School Redevelopment

No: G-004[1.0]

Date: 30 July 2020

Pages: 11

Name: John Walsh

Company: BVN

Email: john_walsh@bvn.com.au

SUSTAINABILITY – PASSIVE DESIGN ANALYSIS

The Educational Facilities Standard Guidelines (EFSG) requires that all buildings incorporate best practice passive design principles including considerations of building shape, orientation, natural daylight and ventilation, insulation and thermal mass. In line with this requirement, Norman Disney & Young (NDY) have completed an analysis on the architectural concept design for the Green Square Integrated Community Facility & School (GSICFS) and have assessed the performance of the passive design elements of the building.

The assessment indicates that the building form, orientation and shading for the proposed design provide a good level of protection against direct solar heat gains through windows for most facades. Noting this and other drivers behind the design, NDY have provided some recommendations for potential further improvement and highlighted measures to be implemented throughout design development to ensure best practice passive design principles are achieved and maintained (refer to summary and recommendations section).

INTRODUCTION

Passive design in air-conditioned buildings is aimed at utilising the building's characteristics and passive components to reduce the energy required to achieve comfort conditions.

The following aspects have been reviewed in terms of their contribution to minimising the amount of heat gain in cooling mode and the amount of heat loss in heating mode:

- ▶ Building form, orientation and shading - The position of the building, along with its shape can play a major role in determining the level of solar exposure received by the building facades. Building form can provide self-shading effects that can be beneficial for cooling mode or detrimental for heating mode. These impacts are investigated in the analysis, as well as how additional shading can be applied appropriately to achieve a beneficial impact.
- ▶ Insulation - The insulating properties of the opaque building elements forming the thermal envelope (roofs, walls, exposed floors and ground slabs) determine the amount of heat conducted into or out of the building.
- ▶ Window thermal performance:
 - The insulating properties of the windows (U-value) determines the amount of heat gain or heat loss conducted through the glass due to different temperatures between internal and outdoor conditions.
 - The solar heat gain properties of the window (Solar Heat Gain Co-efficient – SHGC) determines the amount of direct solar radiation that enters the conditioned space. Where shading devices do not block direct solar radiation, the SHGC of the glass is the last line of defense in limiting solar loads into the space.



- ▶ Thermal mass – Thermal mass is the ability of material to absorb, store and release heat energy. The appropriate location of thermal mass is important to gain passive heating benefit and minimise excessive cooling in summertime.
- ▶ Thermal bridging effect – The benefit gained from insulation can be diminished if thermal bridging occurs through conductive materials within the building envelope, such as uninsulated fixings, connections and supports in roof and wall constructions. Thermal bridges shall be minimised as much as possible.
- ▶ Building sealing and air tightness – Cracks and gaps provide unregulated air flow between internal and external conditions. Restricting the amount of infiltration reduces the amount of heat gain / loss to the air conditioning system, by reducing the additional cooling/ heating of this untreated outside air.

ANALYSIS PROCESS

NDY utilised IES VE (Integrated Environmental Solutions – Virtual Environment) version 2019.2.0.0 to perform the solar shading analysis, thermal calculations and annual simulation. The climate data used was the International Weather for Energy Calculation (IWEC) for Sydney, developed by the US’s National Climatic Data Centre. The IWEC files contain hourly weather observations such as dry bulb temperature, dew point temperature, wind speed, and wind direction, and hourly solar radiation and illuminance data that are calculated from earth-sun geometry and cloud cover. Datasets are based on up to 18 years (1982-1999) of weather data from which twelve typical meteorological months were selected and assembled into an IWEC data file.

The simulation is carried out on IES Virtual Environment 2019, weather file containing hourly temperature data for Sydney ASHRAE IWEC file, provided by Energy Plus.

SITE ORIENTATION

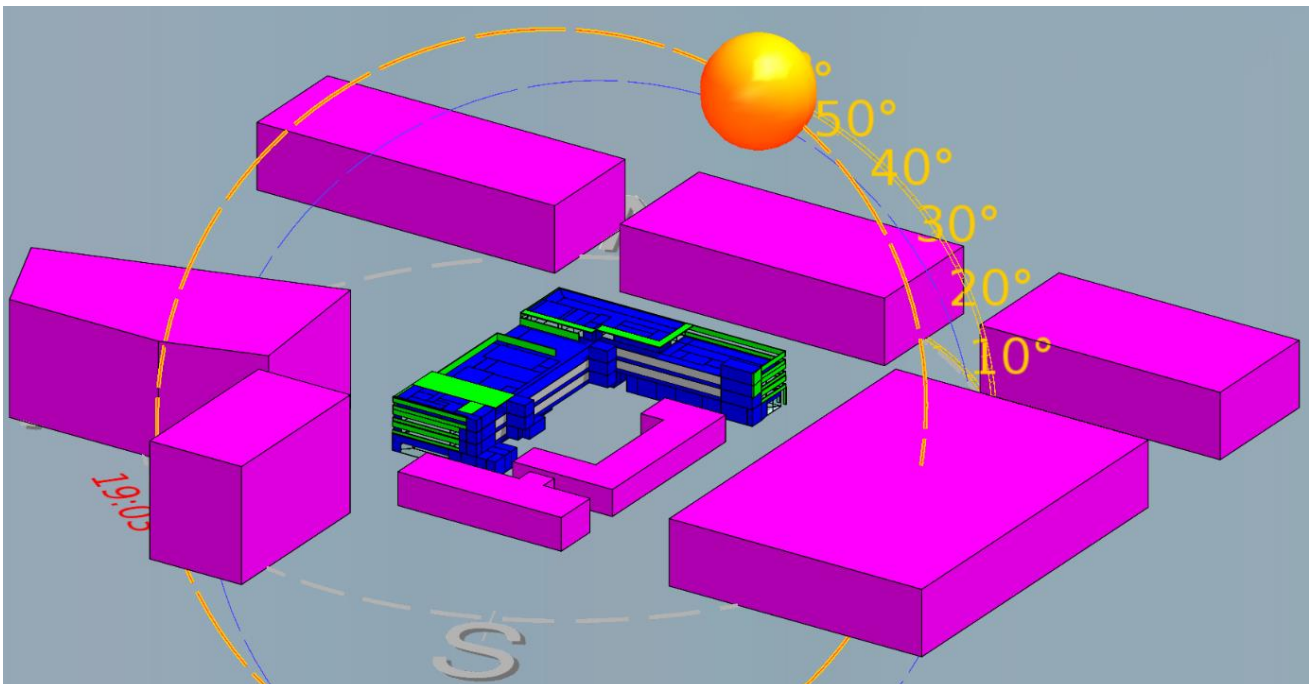


Figure 1: Site Orientation and Adjacent Buildings

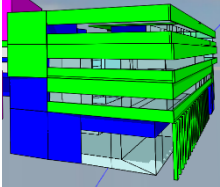
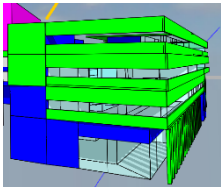
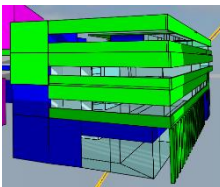
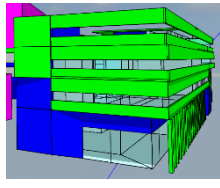
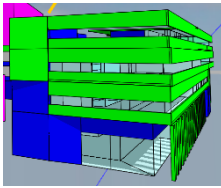
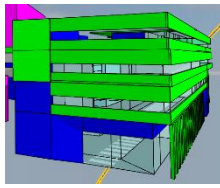
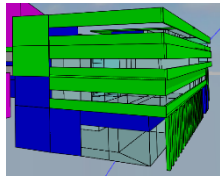
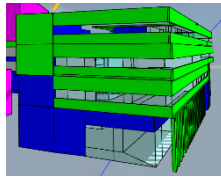
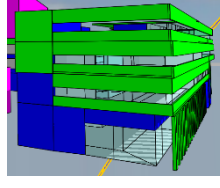
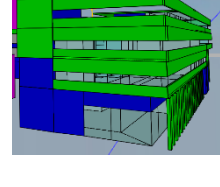
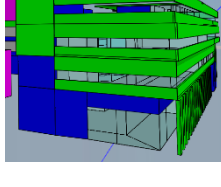
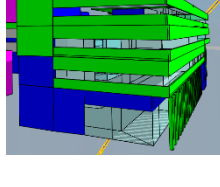
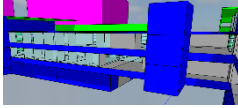
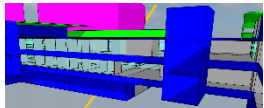
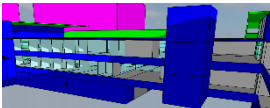
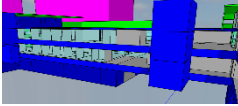
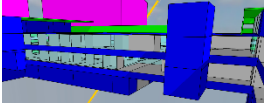
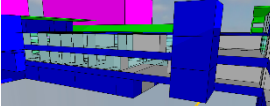
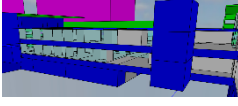
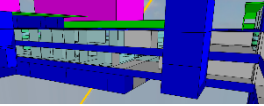
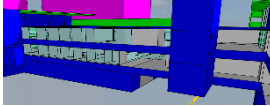
The proposed redevelopment of Green Square Integrated Community Facility & School (GSICFS) is situated in the centre of the Green Square urban renewal precinct in Sydney. The building is orientated towards North West direction, with the longer façade orientated on the West and East and the shorter façades on the North and South. It is noted that the direct solar



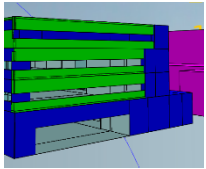
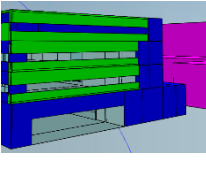
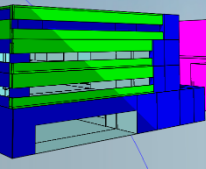
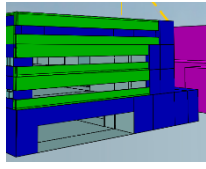
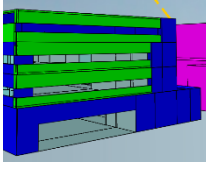
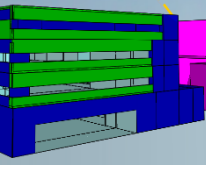
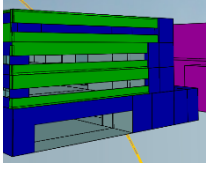
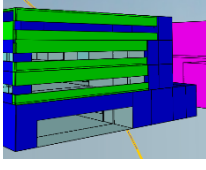
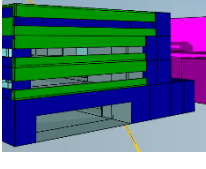
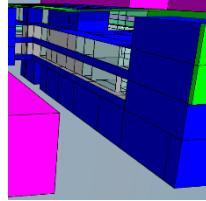
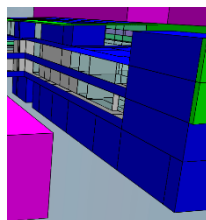
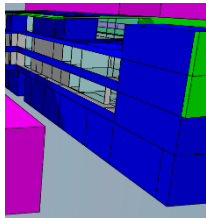
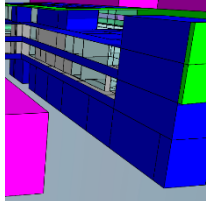
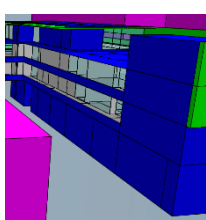
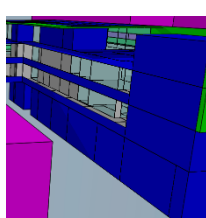
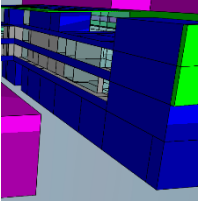
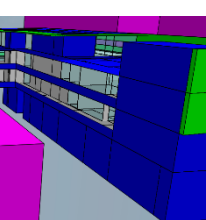
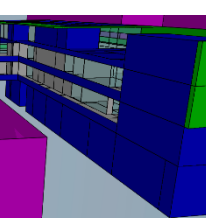
radiation is greater on the North, North West and West owing to the traversing path of the sun on the site. The massing is orientated in the direction of major wind directions. The two major wind directions North East and South have an unobstructed path. West having the longer façade is subjected to good West winds for Autumn and Spring months. The building is surrounded by adjacent buildings (Except a portion of the West façade).

BUILDING FORM, ORIENTATION AND SHADING

The following table details the solar shading analysis during summer solstice, winter and equinox (mid-season) of the several main façades to identify the effectiveness of the currently designed building form, orientation and shadings.

Orientation	Summer Season 22 nd December	Mid-Season 22 nd September	Winter Season 22 nd June	Comment
North Façade	8:00 am 			<p>In summer months the Northern façade is well shaded and is exposed to direct solar radiation for very short duration.</p> <p>In mid season the space is exposed to solar radiation till the afternoon.</p> <p>The shading design accomodates the winter sun allowing the influx of afternoon sun. Thus reducing the energy consumption required to heat the space. (Passive solar heating).</p>
	10:00 am 			
	12:00 pm 			
	2:00 pm 			
East Façade	8:00 am 			<p>East receives solar radiation only till 10:00am. It is well shaded throughout the year.</p> <p>Heating issue may occur in the afternoon of winter months.</p>
	10:00 am 			
	12:00 pm 			



<p>South Façade</p> <p>8:00 am</p> <p>12:00 pm</p> <p>4:00 pm</p>	  	  	  	<p>The south façade at community hall south wall does not receive solar radiation through the year.</p> <p>It is well shaded with adjacent building on the either side of the road.</p>
<p>South façade OLA 2 AND OLA 4 corridor – Facing inner court</p> <p>8:00 am</p> <p>12:00 pm</p> <p>4:00 pm</p>	  	  	  	<p>The Corridor is mostly shaded throughout the year, with sun exposure occurring in the evening of summer months (starting from 3:00pm). Consideration should be given to passive heating measures with minimum shading.</p>



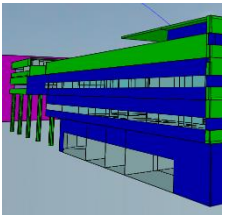
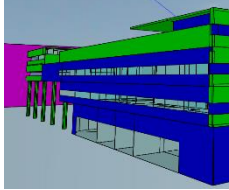
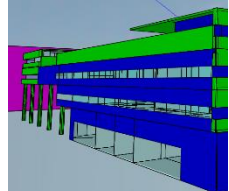
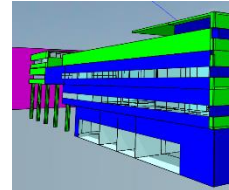
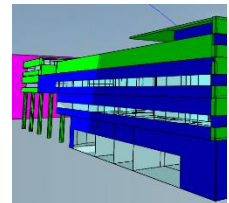
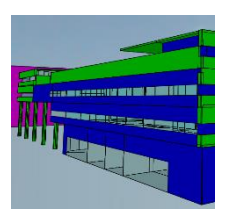
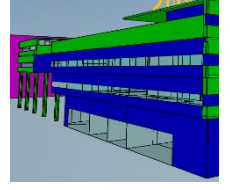
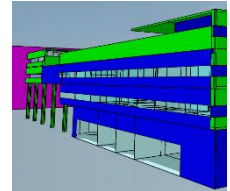
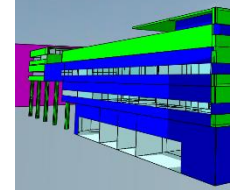
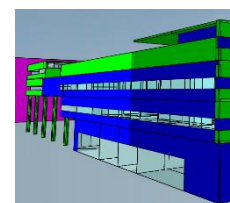
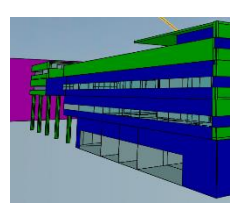
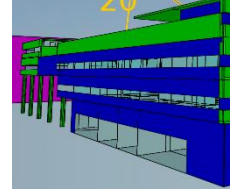
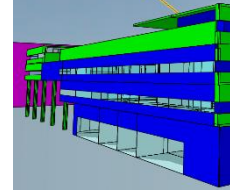
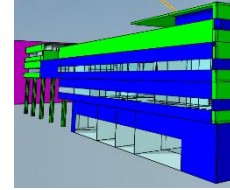
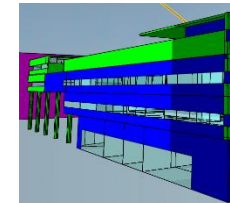
<p>West Façade</p> <p>8:00 am</p> <p>10:00 am</p> <p>12:00 pm</p> <p>2:00 pm</p> <p>4:00 pm</p>	    	    	    	<p>The West façade is the most exposed façade and is the largest façade on the building envelope.</p> <p>The façade is exposed to sun as early as 1:00pm onwards. However around 3:00 pm in the evening the adjacent building provides some shading to part of the west façade.</p> <p>West façades on Level 1 and 2 are naturally ventilated corridors that provide good shading to the conditioned rooms behind them. Shading is not as substantial for the GF west façade which would experience high solar gains in the afternoon.</p>
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Table 1: Shadow Cast Analysis of building envelope

SOLAR GAINS ASSESSMENT

The combined effect of orientation, shading and solar gain properties of the glass has been investigated using IES VE based on the amount W/m^2 of solar gain received by the rooms that add to its air conditioning load.

The assessment was completed using a SHGC of 0.28 in line with the NCC 2019 Section J Deemed to Satisfy (DtS) requirements.

The following figures show the solar gain received by North facades, with and without shading.

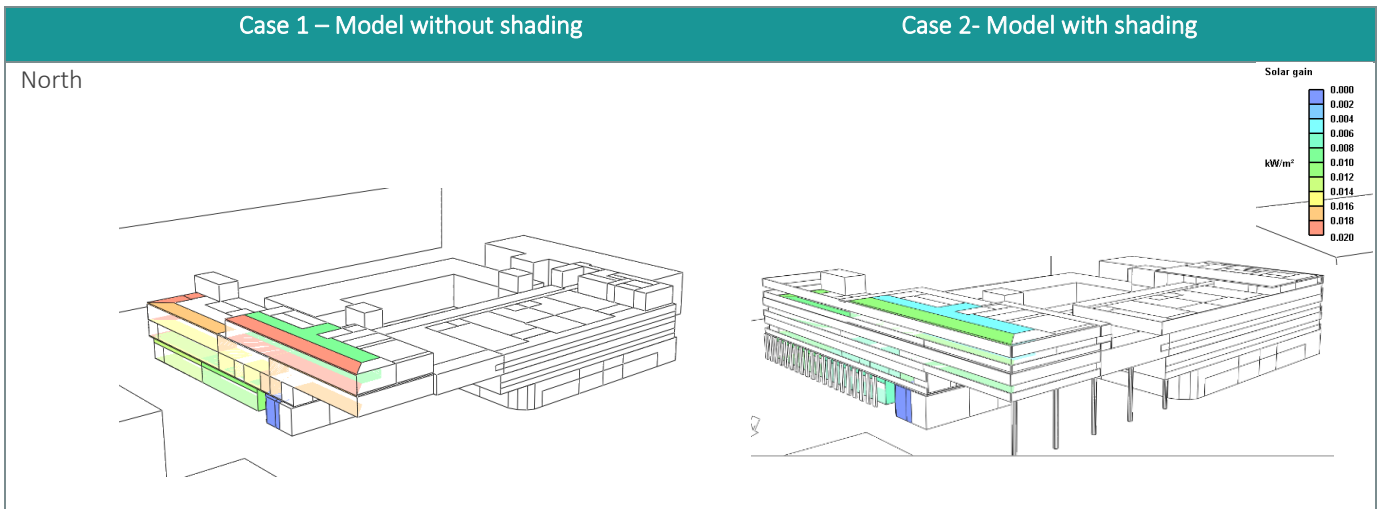


Figure 2: Case 1- Solar gain on North façade.

The following table provides a comparison of the solar heat gain received during a peak Summer day for the building with and without shading. The analysis shows that the shading has reduced the amount of heat gain by around 44%.

Table 2: Result of North façade solar gains

Conditioned spaces	No Shading W/m ² floor area	With shading W/m ² floor area
L00 Basin	0	0
L00 Int RM	0	0
L00 Multipurpose 1A NP	11.1	7.5
L00 Multipurpose 1B EP	12.9	11.9
L00 Multipurpose 1B NP	13	8.9
L00 SVR	0	0
L01 Clerical Prnt NP	15.7	7.7
L01 Depty 1 NP	15.8	7.7
L01 Depty 2 NP	16.3	8.1
L01 Learning HUB POD 2 EP	21.8	10.5
L01 Learning HUB POD 2 NP	15.6	7.6
L02 Learning HUB POD 3 NP	17	8.2
L02 Learning HUB POD 4 EP	23.1	11.3
L02 Learning HUB POD 4 NP	16.3	8
L02 Meet POD 4 EP	20.6	10.5
L03 Main Library CI	9	5.1
L03 Main Library NP	19.4	10.7

The following figures show the solar gain received by West facades, without shading; with shading provided by 200mm floor corridors; and with shading devices as per the architectural design (without flexbrick screen).

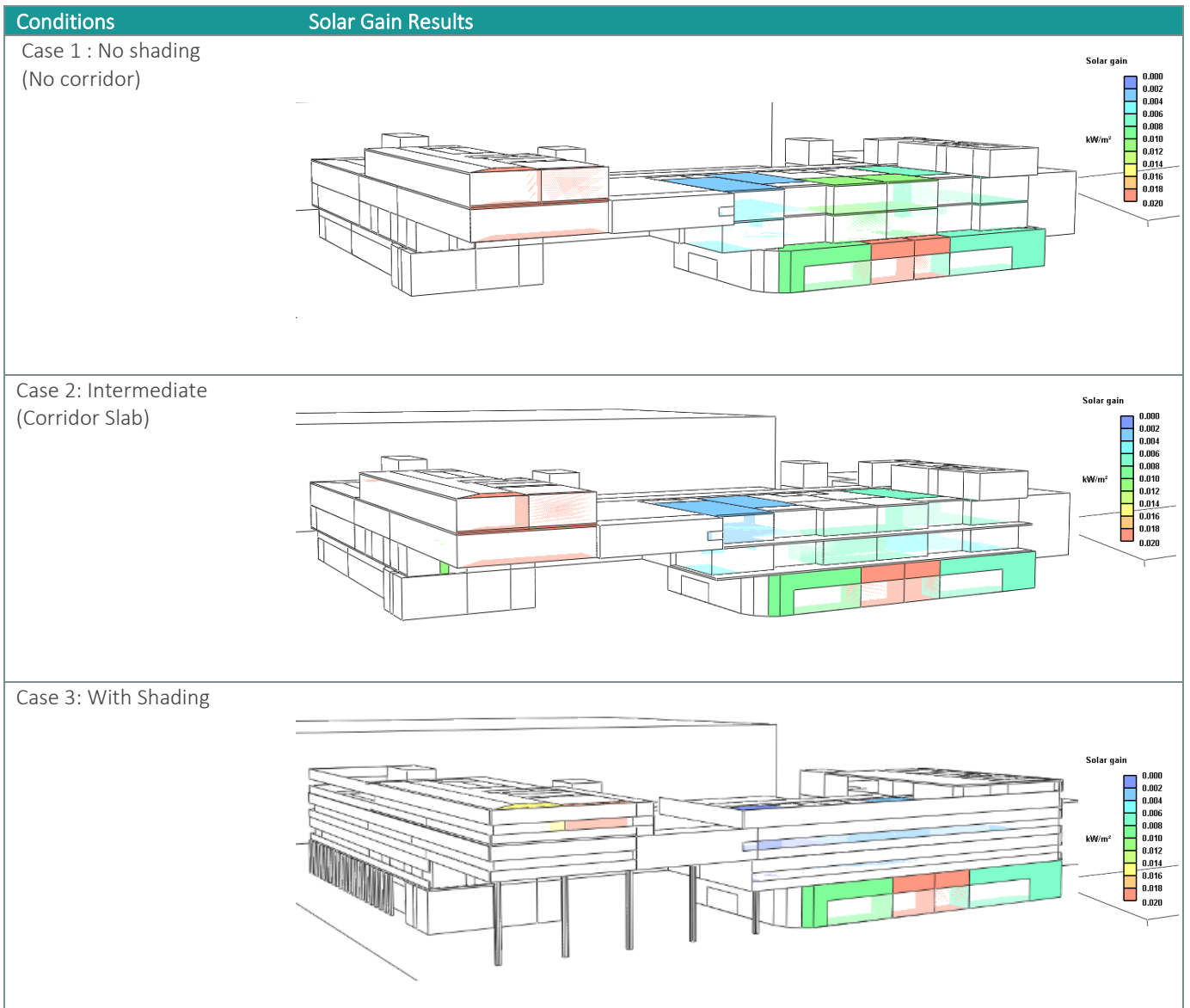


Figure 3: Case 1- Solar gain on West façade.

The solar gains on the West façade are reduced for Levels 1 and 2 but remain relatively unchanged for the Ground Floor. It is noted that shading on Ground Floor west does not provide significant levels of solar protection

Table 3: Result of West façade solar gains.

Conditioned spaces	No shading (No Corridor) W/m ² floor area	Intermediate (Corridor Slab) W/m ² floor area	With Shading (Corridor) W/m ² floor area
L00 Communal hall WP	10	10	10
L00 Multipurpose 2 WP	7.9	7.9	7.9
L00 Store 1	20	20	20
L00 Store 2	18.8	18.8	18.8
L01 Learning HUB POD 1 CI	5.5	4.1	1.4



Conditioned spaces	No shading (No Corridor) W/m ² floor area	Intermediate (Corridor Slab) W/m ² floor area	With Shading (Corridor) W/m ² floor area
L01 Learning HUB POD 5 CI	6.5	5.7	2.8
L01 Wet Studio WI	9.9	6.6	2.1
L01 Wet Studio WI	10.8	7	2
L02 Learning HUB POD 3 WP	19.3	19.3	9.2
L02 Learning HUB POD 6 CI	6.6	6.6	3
L02 Learning HUB POD 7 CI	3.4	3.4	0.7
L02 Wet Studio WI 1	11	11	2.1
L02 Wet Studio WI 2	10.1	10.1	2.2
L03 Main Library WP	26.9	26.9	15.1
L03 Store 2	84.5	84.5	46.5

INSULATION

Roofs, external walls, internal walls, exposed floors and slab on-ground that form part of thermal envelope boundary must be insulated in accordance with National Construction Code (NCC) 2019 Section J. Insulation acts as a barrier to conduction heat flow between internal and external conditions due to temperature difference. The code provides minimum level of thermal performance to be achieved by these building elements, with flexibility provided through performance verification method such as JV3 where there is a need to compensate non-compliance element by improving thermal performance of another element. Refer to NDY's NCC Section J Deemed to Satisfy (DtS) report for the minimum thermal performance of the element on the thermal envelope.

The following diagram shows the effect of applying the minimum DtS thermal performance requirement on the external conduction gain (in kW/m²) of the conditioned spaces.

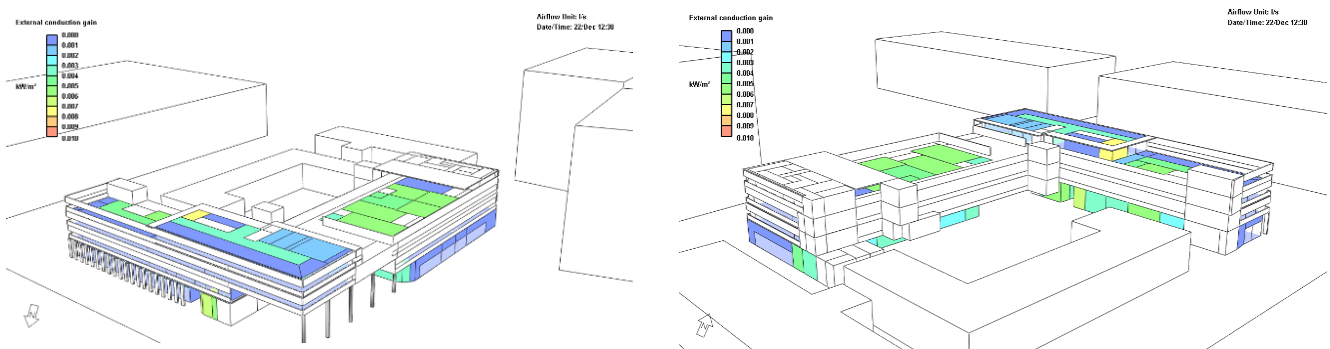


Figure 4: External Conduction Gain Distribution

The amount of conduction gain shown above is also a factor of the ratio between exposed thermal envelope of the rooms and the floor area (m²). Opportunities to improve the insulation level beyond the minimum compliance in order to minimise conduction losses should be investigated in the rooms with the lighter colours.

WINDOW THERMAL PERFORMANCE

- ▶ Insulating properties of glass determines the amount of heat gain or heat loss conducted through the glass due to temperature differences between internal and outdoor conditions. This performance is represented by the U-value figure



of the glass, with a lower U-value representing higher performing, less conductive glass. Single glazed windows provide less insulation than double glazed windows.

- ▶ It is recommended that double glazed windows are selected for the project especially to south facades to minimize the amount of heat loss in winter.
- ▶ Window frame affects the overall U-value performance of the window due to the frame often proving to be the lowest performing element in the window system. NCC 2019 requires compliance of the combined glazing and window performance. Window system with thermally broken frame can be opted if high window U-value is required.
- ▶ The amount of direct solar gain penetrating the conditioned space is dependent on the SHGC of the glazing system. High performing glass should have a lower SHGC, but a high Visual Light Transmittance to allow natural daylight to penetrate. There are various glazing options in the market from glass with low-e film to double and triple silver low-e. It is recommended that low SHGC windows with high LSG (Light to Solar Gain) ratio are selected for facades with high solar exposures such as North and West facades. Highly shaded façade and south façade will have least issue when applied with high SHGC (clear) windows, however it is expected that a consistent solution will be nominated throughout the development.
- ▶ Reducing the extent of windows reduces the solar heat gain and improve energy efficiency.

THERMAL MASS

- ▶ In order to gain the passive heating benefit, it is recommended that materials with high mass such as concrete, bricks and tiles are applied in southern side (unshaded part) of the East corridor to absorb the sun's energy in the winter morning and allow the element to re-radiate the heat back to the adjacent spaces in the afternoon.
- ▶ Excessive amount of thermal mass will be detrimental for the facades with high solar exposures. Therefore, lightweight materials are recommended for building elements at the North and West facades (including shading elements).

THERMAL BRIDGING EFFECT

The benefit gained from insulation can be diminished if bridging occurs through conductive material within the building envelope. Insulation needs to be continuous and thermal breaks must be provided to separate two conductive elements in the construction built-up.

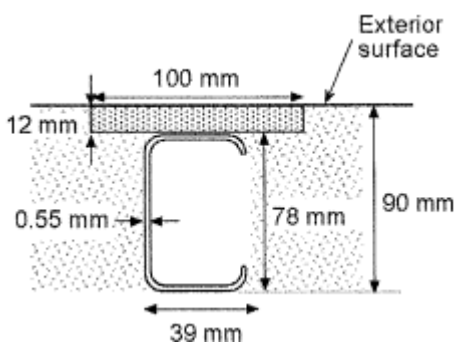


Figure 5: Example of thermal break provided between framing and cladding within metal stud wall – Source: NZS 4214:2006

NCC 2019 Section J requires that thermal bridging effect be included in the estimation of the R-value of the proposed walls and roofs. A thermally broken frame may be required if there is limited space available to provide continuous insulation in addition to the insulation provided in between the metal studs.

Where there are difficulties in achieving the required R-value, performance verification can be completed to compensate the non-compliance. However, consideration should be given to avoid leaving un-insulated and thermally bridged walls or columns as this may affect thermal comfort experienced by occupants due to asymmetry surface radiant temperature.

AIR TIGHTNESS



Leakage and infiltration refer to the unintentional and uncontrolled flow of outdoor air into a building through cracks and fissures in the building envelope.

The following prescribes the general guidance to achieve air tightness:

- ▶ For minimising air leakage through walls, around windows, door frames and joints between major building elements, a continuous air infiltration retarder shall be applied. Particular care must be taken to ensure its continuity at
 - all wall, floor, and ceiling joints;
 - at window and door frames;
 - at all penetrations of the retarder, such as electrical outlets and switches, plumbing connections, and utility service penetrations.
- ▶ Joints in the air/vapour retarder must be lapped and sealed.
- ▶ Plastic vapour retarders installed in the ceiling should be tightly sealed with the vapour retarder in the outside walls and should be continuous over the partition walls.
- ▶ A seal at the top of the partition walls prevents leakage into the ceiling space; a plate on top of the studs generally gives a poor seal.
- ▶ The air infiltration retarder can be installed either on the inside of the wall framing, in which case it usually functions as a vapour retarder as well, or on the outside of the wall framing, in which case it should have a permeance rating high enough to allow diffusion of water vapour from the wall.
- ▶ Interior air/vapour retarders must be lapped and sealed at electrical outlets and switches, at joints between walls and floors and between walls and ceilings, and at plumbing connections penetrating the wall's interior finish.
- ▶ A continuous exterior air infiltration retarder installed on the outside of wall framing can cover these problem areas. Joints in the air infiltration retarder should be lapped and sealed or taped. Exterior air infiltration retarders are generally made of a material stronger than plastic film and are more likely to withstand damage during construction. Sealing the wall against air leakage at the exterior of the insulation also reduces convection currents within the wall cavity, allowing insulation to retain more of its effectiveness.

SOLAR ABSORPTANCE

Direct solar loads on opaque elements of the building are absorbed in line with the solar absorptance value (SA) of the element exposed to the direct sun as related to the colour of the elements. It is recommended that SA less than 0.4 be selected to areas the exposed areas. Elements that are located next to shaded rooms e.g. floors and balcony walls of the southern east corridors can be applied with darker colours to absorb more sun energy for passive heating.

SUMMARY AND RECOMMENDATIONS

The following section summarises the key findings and recommendations on the performance of the passive design elements for the proposed design:

- ▶ Generally, the building form, orientation and shading provide a good level of protection against direct solar heat gains;
- ▶ The analysis found that good levels of shading are provided to the North and West facades, with the exception of the Ground Floor West façade, Level 3 West façade and Northern part of the Ground Floor East façade. To further improve these areas, additional shading could be considered.
- ▶ The following is recommended to minimise cooling mode energy consumption:
 - Insulation should be applied continuously, and thermal bridging avoided;
 - Glazing with low SHGC should be applied to all facades;
 - Lightweight materials are recommended for the main building materials and shading devices on the North, West and East facades; and
 - Light coloured walls and roofs with solar absorptance value less than 0.4 should be used on all North West and East facades.



- ▶ The following is recommended to minimise heating mode energy consumption, due to higher demand from the southern facades and heavily shaded facades (such as the southern part of the East façade):
 - Double glazed window systems with low U-value should be used;
 - High performing window framing, such as improved aluminium frame or thermally broken frames should be used;
 - Special attention should be given to the continuity of insulation, avoiding thermal bridging and air leakages.
 - Materials with high mass such as concrete, bricks and tiles are recommended for the southern side (unshaded part) of the East corridor to absorb the sun's energy and reradiate into the space. Darker coloured materials will also provide passive benefits in this area.
- ▶ Thermal breaks should be provided generally within lightweight external walls and internal walls that form part of the thermal envelope, as well as the roof construction.
- ▶ Sufficient attention to detailing should be provided in early design to construction stage to avoid air leakage and improve building sealing.
- ▶ Reduction in glazing areas should be considered in areas where shading does not provide adequate protection from direct solar gains, such as the Ground Floor West façade and the northern part of the Ground Floor East façade.

Please do not hesitate to contact the undersigned should you wish to discuss any of the above.

NORMAN DISNEY & YOUNG

Pracheeti Inamdar |
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APPENDIX G. DAYLIGHT MODELLING





BVN

Green Square Public School Redevelopment

Green Star – Visual Comfort Daylight

28 April 2021

CONFIDENTIAL | Revision: 2.0 – For Information | Issued: 28 April 2021





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EXECUTIVE SUMMARY

This study has been carried out to assess Green Square Integrated Community Facility and School development (GSICFS) daylight performance at Zetland Avenue, Green Square, NSW, Sydney, under a uniform design sky condition by application of simulation analysis software. Compliance with Green Star Design & As Built v1.3 credit 12.1 Daylight may then be established.

IES Virtual Environment dynamic thermal simulation software has been used to model and analyse the following building design:

- ▶ GSICFS comprises two four-storey buildings with open plan teaching spaces and administration spaces. The buildings have glazing on all façades. Shading devices are provided on the north and west façades.
- ▶ Assessed areas are all primary spaces
- ▶ Perez sky condition based in Sydney (latitude 33° S, longitude 151° E)
- ▶ Glazing visible light transmittance assumed based on conservative values
- ▶ Reflectance values per AS/NZS 1680.1:2006
- ▶ Shading from an adjacent building.

The above design has been assessed against the following criteria as required by Green Star Design & As Built v1.3 credit 12.1 Daylight:

- ▶ Up to 2 points are available where a percentage of the nominated area receives high levels of daylight:
 - For 40% of the nominated area - 1 point
 - For 60% of the nominated area - 2 points

Results

- ▶ 89% of the nominated area achieves high levels of daylight, achieving 2 points.



1 INTRODUCTION

1.1 Purpose

The purpose of this document is to present the daylight assessment results for the proposed GSICFS development to demonstrate compliance with the requirement of Green Star Design & As Built v1.3 credit 12.1 Daylight.

This report forms part of the Green Star Design & As Built v1.3 rating submission for Green Square Public School on behalf of BVN.

1.2 Information Sources

This report has been prepared with reference to the following documents:

- ▶ Green Building Council Australia
 - Green Star Design & As Built v1.3 Submission Guidelines
 - Green Star Daylight and Views Hand Calculation Guide v1.3.
-

1.3 Revision History

Table 1: Revision History

Rev	Date Issued	Comment
1.0	28/04/2021	For Information



2 GENERAL

2.1 Basis of Assessment

For this assessment, compliance has been demonstrated per Green Star Design & As Built v1.3 credit 12.1 Daylight method 12.1C Compliance Using Daylight Autonomy

Up to 2 points are available where it can be demonstrated that a specified proportion of the nominated area receives high levels of daylight.

- ▶ For 40% of the nominated area - 1 point
- ▶ For 60% of the nominated area - 2 points

Nominated areas are all primary spaces.

Daylight access is determined through:

- ▶ 12.1C - modelling Daylight Illuminance (DI) across the Nominated Area. High levels of daylight are deemed to have at least 160 lux due to daylight during 80% of the nominated hours.

2.2 Overshadowing

As per the Green Star Submission Guidelines, overshadowing of the design building must be taken into account. A nearby building or feature must be included in the model where:

- ▶ Its height is at least a third of the height of the proposed building design
- ▶ The angle between the nearest point at the top of that building or feature and the nearest base point of the proposed building is greater than the June 21st (winter solstice) midday altitude of the sun

2.3 Nominated Areas and Hours

For the purpose of the assessment of this credit, the nominated areas and hours for the building are summarised as follows:

Table 2: Summary of Nominated Areas and Hours

Space Type	Nominated Hours
Teaching Spaces	8am - 5pm
Administration / Community Spaces	8am - 5pm

The DI analysis was performed using IES Virtual Environment 2019, developed by Integrated Environmental Solutions Ltd. The software has been tested per ASHRAE Standard 140-2007 (Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs) and found to be within the acceptable limits of accuracy for computer programs of its type.

For each modelled space, the walls, windows, floor and ceiling are created to form analysis zones. The steps taken for the study are as follows:

- ▶ Build the model and incorporate material properties (walls, ceiling, floor, glazing)
- ▶ Add internal partitions (where applicable) and incorporate their material properties
- ▶ Build adjacent buildings and other physical obstructions surrounding the building
- ▶ Complete DI analysis of the base model



3 BUILDING-SPECIFIC INFORMATION

3.1 Weather Data

The daylight study for this project utilised the CIE overcast sky model, as provided with the IES Virtual Environment software.

3.2 Design Sky Illuminance

A Perez sky is used for the analysis according to the coordinates of Sydney:

- ▶ Latitude: 33° S.
- ▶ Longitude: 151° E.
- ▶ Universal Time Coordinate: GMT + 10.

3.3 Building Envelope

3.3.1 Glazing Systems

The glazing properties are modelled per the façade specification. Glazing types and performance parameters are summarised below.

Table 3: Summary of Envelope Glazing Systems

Façade Type	Glass Type	Visual Light Transmittance (%)
Exterior Glazing	Double glazing	60
Internal Glazing	Single Glazing	90

3.4 Overshadowing

The site location and the adjacent buildings are shown in Figure 1.

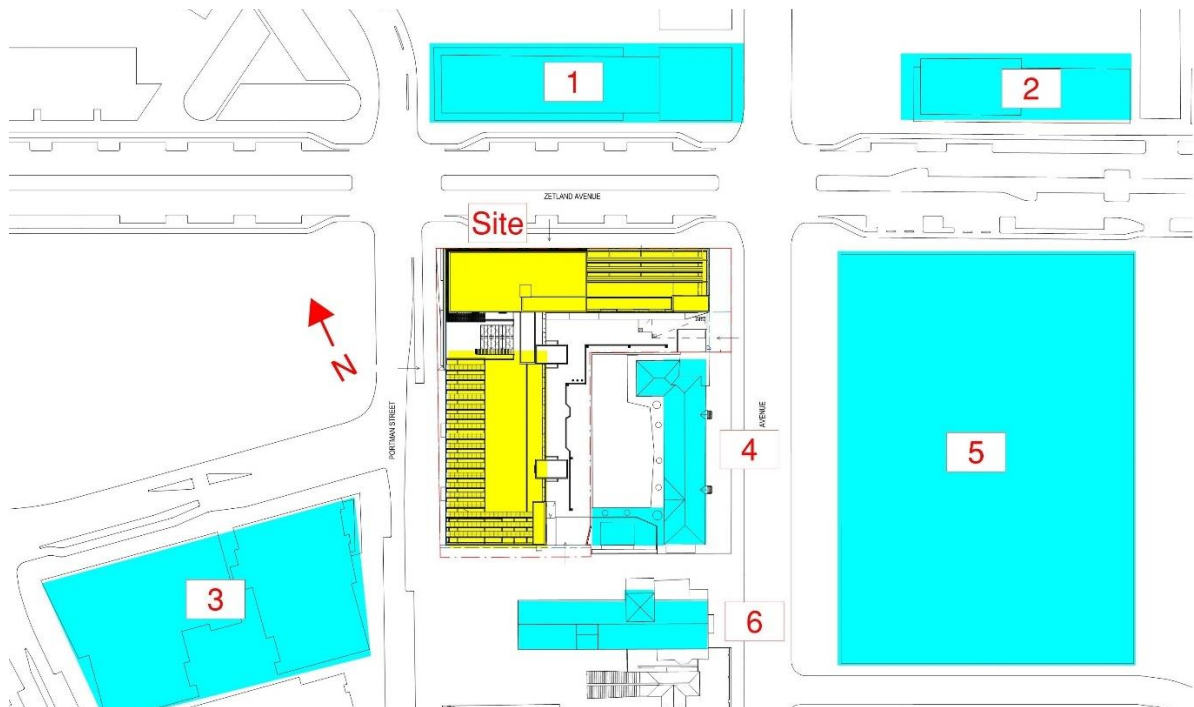


Figure 1: Site Plan Showing Neighbouring Buildings



The overshadowing criteria (refer to Section 2.2) have been assessed for each of the adjacent buildings and features, the results of which are as indicated in Table 4.

Table 4: Overshadowing Analysis Summary

Reference	Height (m)	Included in Model?
1	20	Yes
2	20	Yes
3	35	Yes
4	8	Yes
5	20	Yes
6	10	Yes

3.5 Surfaces

For the purpose of this simulation, the following reflectance and secularity values have been specified. These values are estimated from AS/NZS 1680.1 Table E1.

Table 5: Building Surface Parameters

Surface	Material/Colour	Reflectance
Ceiling	White	92%
Internal Floor	Grey	42%
Internal Wall	White	88%
External Wall	White	88%
External Roof	Grey - White	75%
Neighbour External Wall	White	88%
Neighbour Roof	Grey	50%
Shading/Walkway Walls	Grey	50%
Shading/Walkway Roof	Grey	50%
Shading/Walkway Ground	Grey	50%

3.6 Building Analysis Model

An image of the building analysis model is shown in Figure 2.



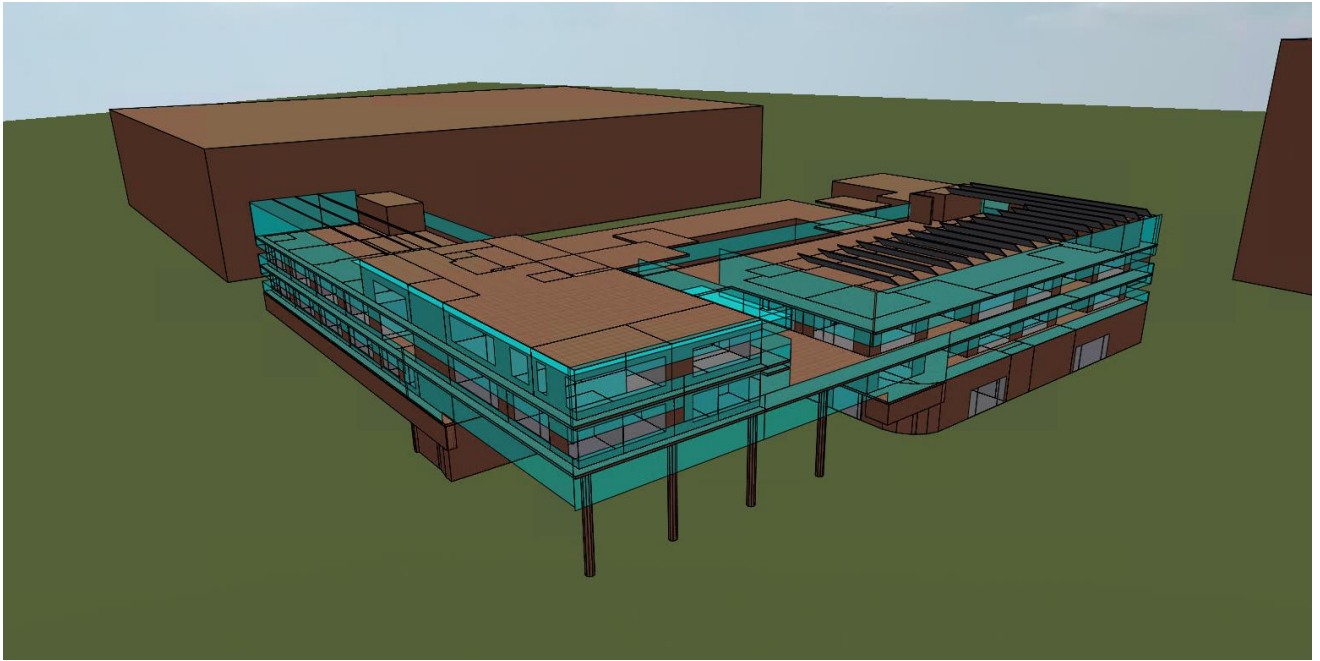


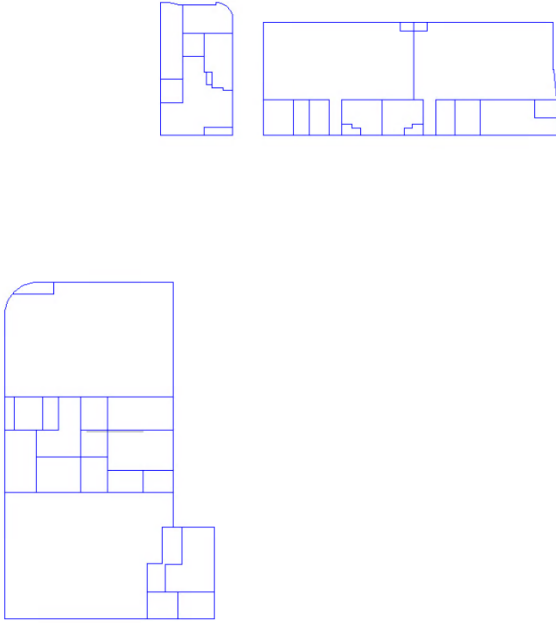
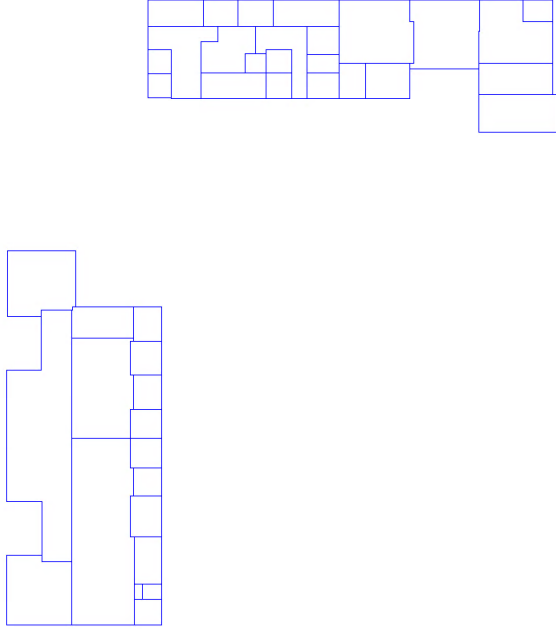
Figure 2: Building analysis model

3.7 Zoning of included spaces

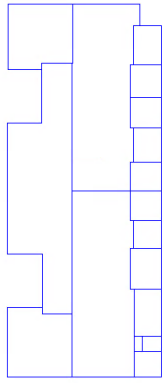
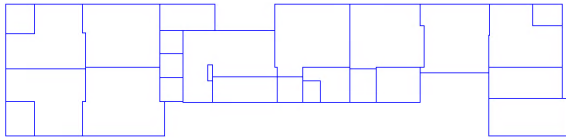
All modelled spaces have been zoned to reflect the system design performance and layout.

DI measurements are taken at a height of 0.7m and spacing of 0.5m.

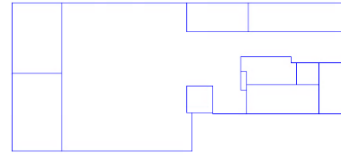
Table 6 Spaces Modelled in IES VE per Daylight Modelling Best Practice

Floor Plans from Modelling Software	
	
Ground	Level 1

Floor Plans from Modelling Software



Level 2



Level 3



4 RESULTS

The DI results for the nominated areas are summarised in Table 7. Table 8 demonstrates visual compliance with larger versions of marked-up floor plans attached in Appendix A.

The total compliant area is 3,623m² out of the total nominated area of 4,098m², equating to 89% of the area achieving 160 lux for more than 80% of the hours. This equates to 2 points per Green Star Design & As Built v1.3 credit 12.1 Daylight.

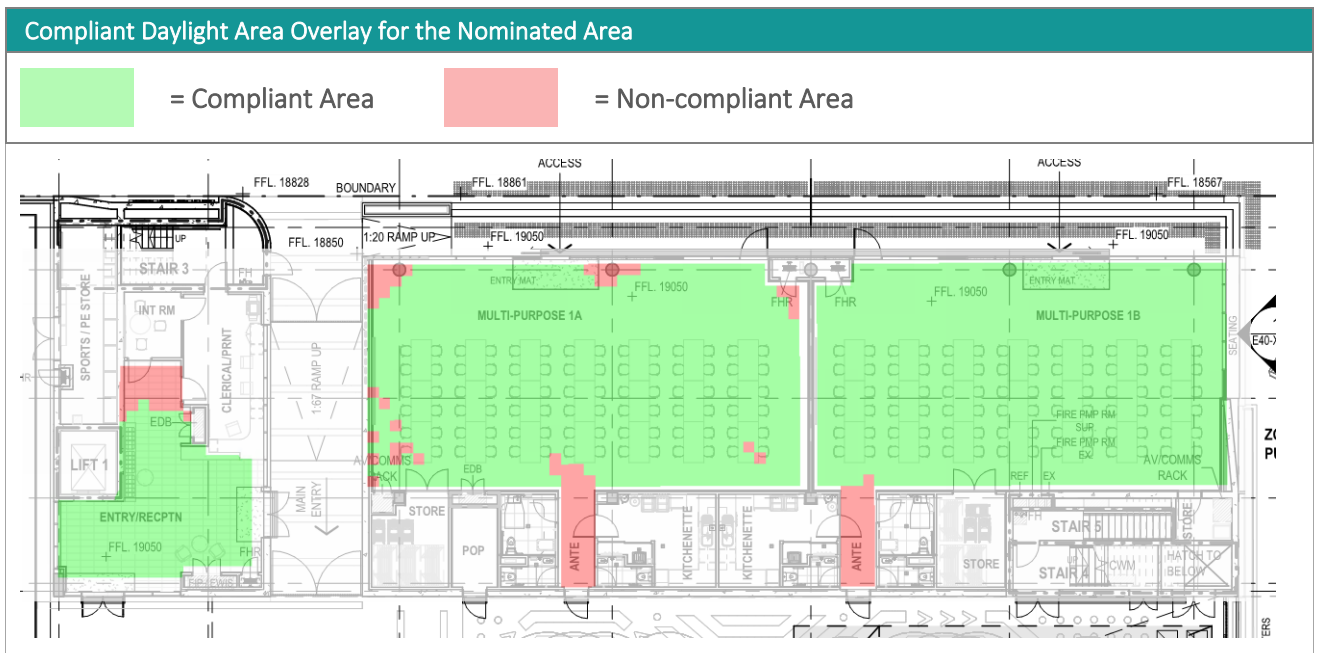
Table 7: Summary Nominated Area Compliance

Level	Area Name	Representative Area (m ²)	Compliant Area (m ²)	Proportion Compliant Area (%)
L00	Canteen	46	31	68%
	Communal Hall	328	326	99%
	Multi-purpose 1A	209	191	91%
	Multi-purpose 1B	196	188	96%
	Multi-purpose 2	338	337	100%
	Reception	62	55	88%
L01	Deputy 1	13	13	100%
	Deputy 2	28	28	100%
	Entry	26	26	100%
	Entry/Reception	48	11	22%
	Learning Hub POD 1	130	130	100%
	Learning Hub POD 2	140	138	99%
	Learning Hub POD 5	187	187	100%
	Presentation Studio 1 EP	69	67	97%
	Presentation Studio 2 EP	71	71	100%
	Presentation Studio 3 NP	75	74	99%
	Principal	15	6	40%
	Wet Studio EP	197	22	11%
	Wet Studio SP	39	39	100%
L02	Entry	26	2	6%
	Learning Hub POD 3	139	139	100%
	Learning Hub POD 4	140	140	100%
	Learning Hub POD 6	187	88	47%
	Learning Hub POD 7	186	178	96%
	Presentation Studio 1 EP	67	67	100%
	Presentation Studio 2 EP	71	71	100%
	Presentation Studio 1 NP	78	78	100%
	Presentation Studio 2 NP	76	59	78%
	Staff Annexe	82	60	73%
	Staff Room	82	82	100%
	Wet Studio 1 WP	197	197	100%



Level	Area Name	Representative Area (m ²)	Compliant Area (m ²)	Proportion Compliant Area (%)
	Wet Studio 2 EP	39	39	100%
	Wet Studio 3 SP	89	89	100%
L03	Main Library	329	311	94%
	Special PRGS 1	45	45	100%
	Special PRGS 2	49	49	100%
Total		4,098	3,632	89%

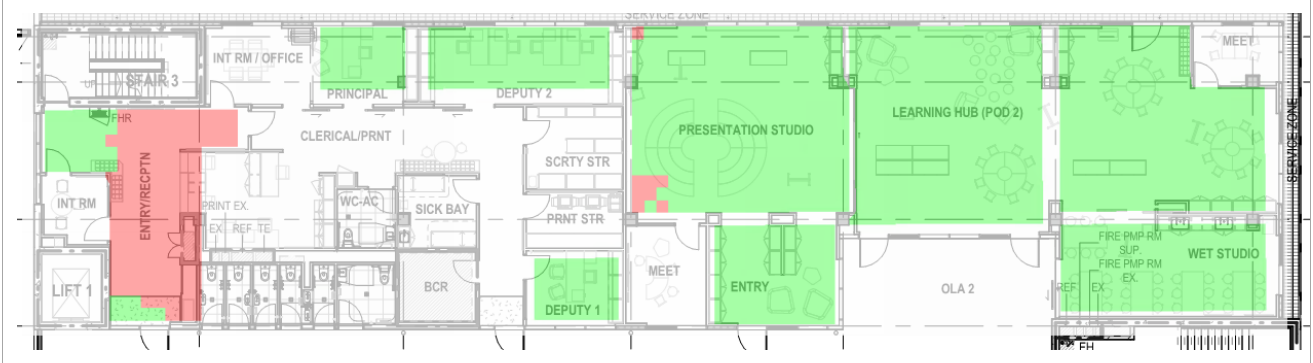
Table 8: Compliant Daylight Area Overlay for the Nominated Area



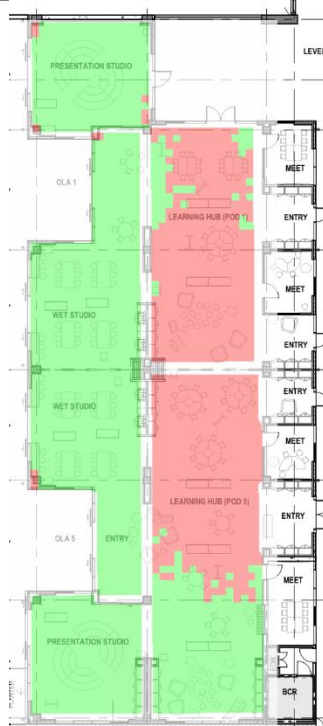
Compliant Daylight Area Overlay for the Nominated Area



Ground



Compliant Daylight Area Overlay for the Nominated Area



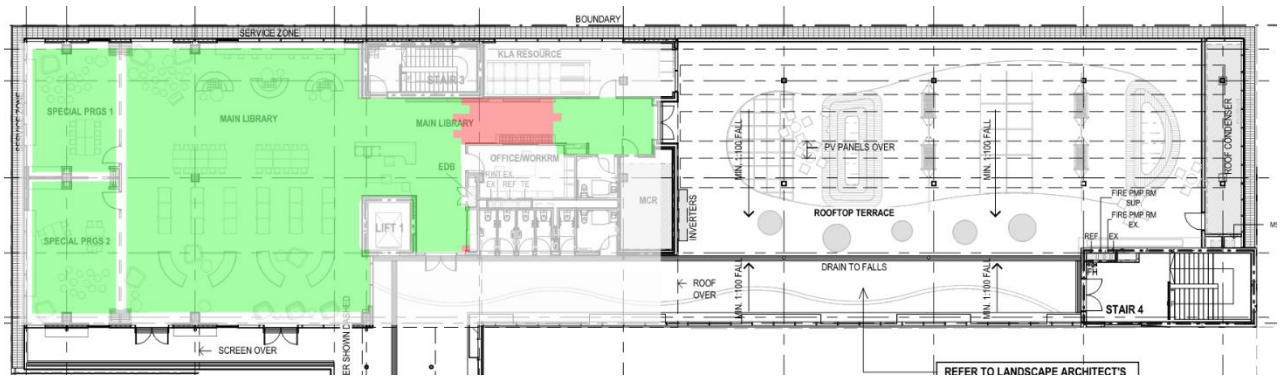
Level 1



Compliant Daylight Area Overlay for the Nominated Area



Level 2



Level 3



5 CONCLUSION

Based on the daylight analysis results described in this report, the proportion of the nominated area receiving high levels of daylight is 89%

Therefore, Green Square Public School meets the Green Star Design & As Built v1.3 credit 12.1 Daylight requirements and is eligible to claim 2 points for the rating.



APPENDIX A. COMPLIANT DAYLIGHT AREA OVERLAY FOR THE NOMINATED AREA

Refer over.



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NDY QA SYSTEM

Revision No: 2.0
Revision Date: 28 April 2021
Description: For Information
Filename: rp210423s0022
File Location: \\tt.local\ndy\syd\w\S385xx\S38578\001\
G-\24_Reports
Client Name: BVN
Client Contact: John Walsh
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APPENDIX H. GREEN STAR ENERGY MODELLING REPORT





Norman
Disney &
Young
A TETRA TECH COMPANY

BVN

Green Square Integrated Community Facility and School Green Star Design & As Built Greenhouse Gas Emissions and Peak Load Reduction

29 April 2021

CONFIDENTIAL | Revision: 1.0 – DRAFT | Issued: 29 April 2021

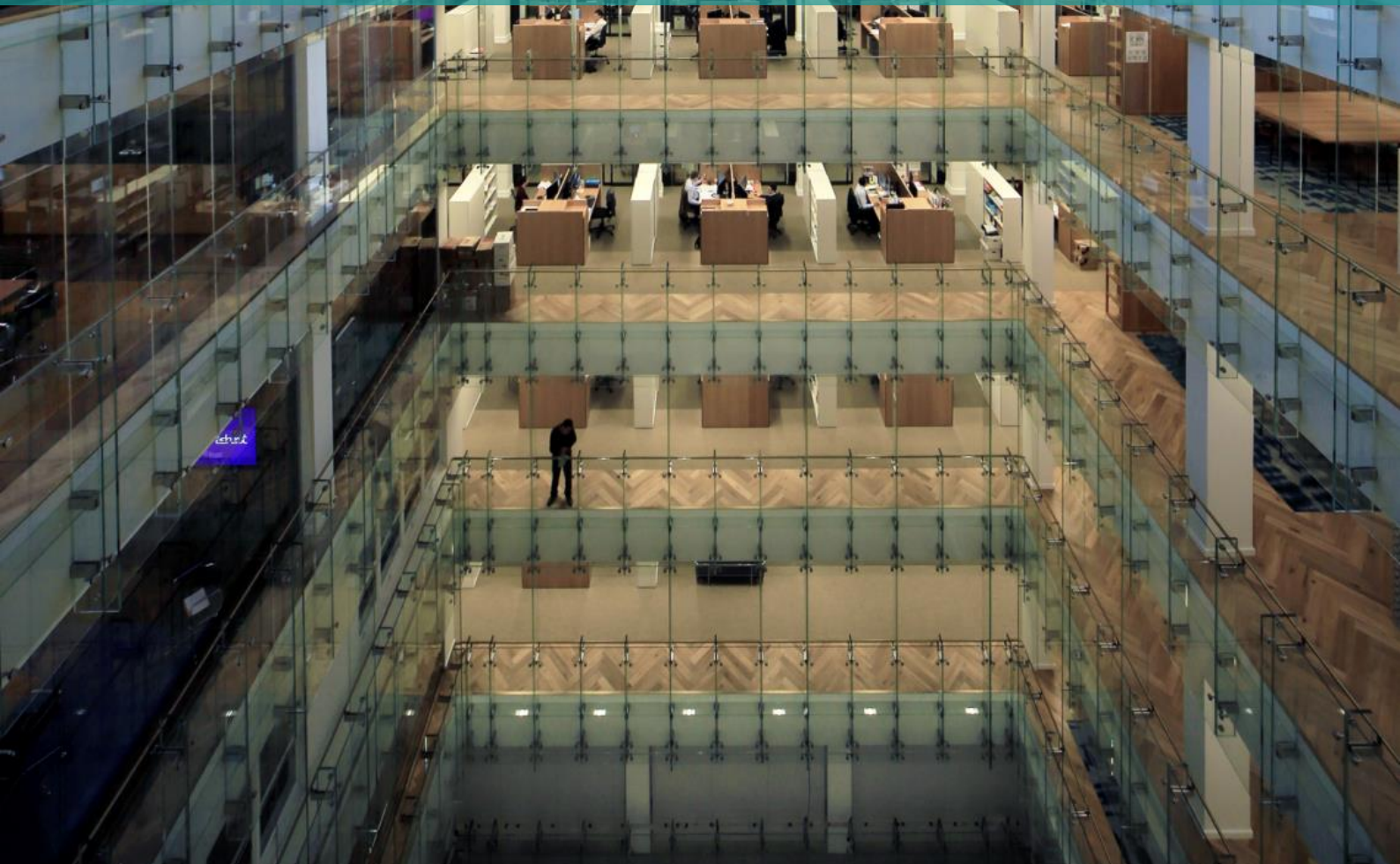




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1 EXECUTIVE SUMMARY

Norman Disney & Young (NDY) are engaged as the Sustainability Consultant for the Green Square Integrated Community Facility and School, Sydney. The building is targeting a 5-star Green Star Design & As-Built v1.3 rating.

This report outlines the methodology and results of the energy modelling undertaken for the project. Modelling has been undertaken in accordance with the energy assessment methodology outlined within the Green Star – Design and As Built v1.3 submission guidelines and in accordance with the Energy Consumption and Greenhouse Gas Emissions Calculator Guide.

The assessment uses Credit 15E Reference Project Pathway. Points awarded are determined on the basis of the predicted reduction of energy consumption due to building fabric improvements and total greenhouse gas emissions compared to an equivalent reference project. The project must also demonstrate that it has satisfied the conditional requirement of a minimum 10% improvement against the reference project which would achieve minimal compliance with the NCC Section J DTS provisions.

The results demonstrate the following:

Table 1: Green Star Points

Parameter	Points
Conditional Requirement	Met
Credit 15 Greenhouse Gas Emissions	16.5
Credit 16 Electrical Peak Demand Reduction	2.0
Total Energy	18.5
Credit 30A Innovative Technology or Process - Onsite Renewable Energy	2

2 INTRODUCTION

2.1 Purpose

This report has been prepared to document the energy modelling undertaken for Green Star Design & As-Built v1.3 Credit 15 Greenhouse Gas Emissions and Credit 16 Peak Energy Demand Reduction for Green Square Integrated Community Facility and School. Up to 20 points are available for demonstrating a reduction in the predicted energy consumption and greenhouse gas (GHG) emissions achieved by the proposed building when compared to an intermediate building and benchmark building; and up to 2 points for demonstrating a reduction in electrical peak demand when compared to a reference building.

This report sets out the attributes of the analysis software used, and the features of the proposed building included in the energy estimate. Based on the results of the simulation, and other supporting calculations, the GHG emission rate of the proposed building is calculated, and the points achieved against Green Star Design & As-Built Credit 15 and Credit 16 are determined.

2.2 Information Sources

The following documents have been used as the basis for the energy estimate:

- ▶ Green Building Council of Australia (GBCA)
 - Green Star Design & As Built v1.3 Submission Guidelines
 - Energy Consumption and Greenhouse Gas Emissions Calculation Guide, September 2019
- ▶ Australian Building Codes Board
 - National Construction Code 2019: Building Code of Australia Volume One
 - NCC 2019 Glazing Calculator
- ▶ Architectural drawings set by BVN , SSDA issue, project number 38578, received on 05/03/2021
- ▶ Mechanical information provided by Stantec:
 - 50% Detailed Design Issue set dated 19/03/2021
 - Mechanical Service Control Strategy dated 19/03/2021

2.3 Authority

Authority to undertake this report was provided by John Walsh at BVN

2.4 Revision History

Table 2: Revision history

REV	DATE ISSUED	COMMENT
1.0	29/04/2021	Green Star C15 & C16 report

3 ASSESSMENT INPUT DATA

The energy estimate has been calculated in accordance with the GBCA’s Energy Consumption and Greenhouse Gas Emissions Calculation Guide (Sept 2019). Dynamic building simulation was used to determine the energy consumption of the building in accordance with the methodology and default modelling conditions defined in the Calculation Guide.

3.1 Analysis Software Description

The software that has been used to undertake the dynamic thermal modelling is IES-VE (Integrated Environmental Solutions Virtual Environment) 2019. IES-VE is an integrated building performance modelling software package which is able to simulate the thermal environment of the building. Climatic data, building geometry, layout, occupancy, fabric information and HVAC usage informs a detailed mathematical simulation. The simulation captures the heat transfer process into and through the building as well as its thermal capacity.

Table 3: Energy simulation analysis software reporting requirements

Energy Simulation Analysis Software Summary	
Software name and version	IES VE 2019 Version 2019.2.0.0
Software developer	Integrated Environmental Solutions Limited
Software validation standard	ASHRAE 140: 2001, 2004, 2007, 2014
Simulator’s name and experience	Pracheeti Inamdar
Simulator reviewer’s name and experience	Noni Nuriani – 10+ years’ experience

3.2 Project Description

Green Square Integrated Community Facility and School is located at 3 Joynton avenue, Zetland NSW, 2017. The following table details the project’s general parameters.

Table 4: Energy simulation analysis software reporting requirements

Parameter	Proposed Project	Reference Project
NCC climate zone	5	
Weather data (location and format)	Sydney Intl Airport , Australia Sydney IWEC.fwt	
Number of stories (below ground/above ground)	4 Floors (GF to Level 3)	
Total Gross Floor Area (GLA) (m ²)	5888 m ²	
Heating fuel(s)	Electricity	Heating hot water – Gas fired boiler
Cooling fuel(s)	Electricity	Chilled water – Air cooled chiller

3.3 Energy Coverage

The energy assessment covers the all anticipated end uses within the base building as per the Green Star Calculator Guide requirements.

Energy coverage inclusions applicable to this project:

- ▶ All HVAC systems for control of the internal environment, including server, communications, equipment and electrical rooms;
- ▶ All HVAC systems for control of processes, where these are provided as part of the services engineer’s scope of works (specialist systems by others are excluded);
- ▶ All internal and external artificial lighting, including task lighting, provided as part of the services engineer’s scope of works (lighting provided as part of architectural or FFE scope of works are excluded);
- ▶ All water supply and treatment systems, including cold water pressurisation, domestic hot water heating and rainwater distribution;
- ▶ Vertical and horizontal transportation systems (lifts). There are no escalators or moving walkways in the project

There is no swimming pool in this project.

3.4 Geometry

Figure 1 below is taken from the modelling software and depicts the geometry of the model used.

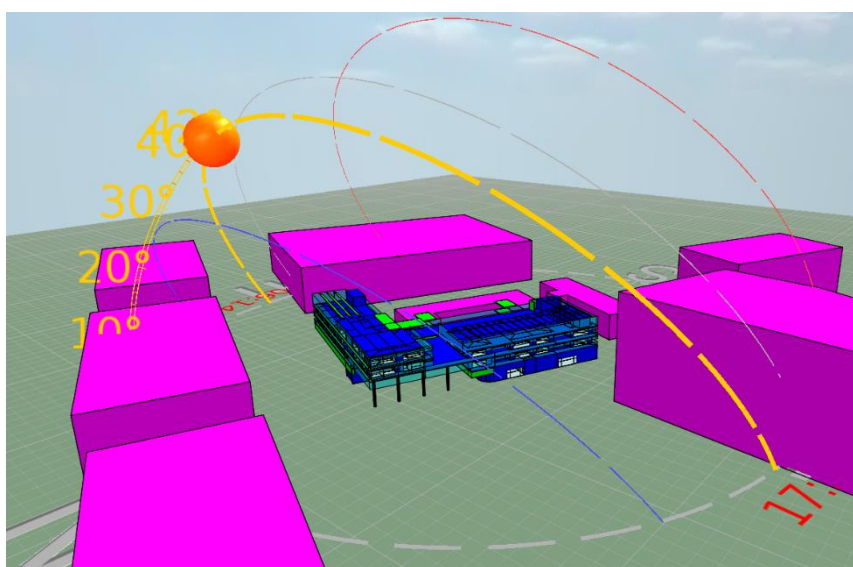


Figure 1: Building geometry as represented within the IES software

3.5 Project Space Summary

The following table shows the project space types and associated parameters.

Table 5: Project area summary

Level	Modelled GFA	Modelled Conditioned Area	Space Types
GF	1793	1620	School Reception, School Canteen, Multipurpose Halls, Community Hall, OSHC Office.
L1	1501	1362	Classroom, Office.
L2	1882	1715	Classroom, Staff Room.
L3	712	507	Library, Special Program, KLA resource, Work room.
Total	5888	5204	

Table 6 indicates the operating profile, temperature range, occupancy density and equipment load assumed for each space type. As some design data are yet to be completed, such as lighting, lighting power density

from NCC 2019 Section J6.2a has been used. Temperature control ranges are in accordance with the mechanical design

Table 6: Simulation input summary

Space Type	Operating Profile(s) Applied	Temperature Control Range (oC)	Occupancy Density (m ² /person)	Equipment Load (W/m ²)
School - 1. Learning Hub, 2. Presentation Studio 3. Wet Studio	School working hours 9:00am to 3:00pm. Referenced GS Design & As Built v1.3 Table 39 School Classroom and modified Occupancy, Lighting, Equipment and HVAC schedules to align with the school's actual working hours.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	2.5	10
School - Meet Room	School working hours 9:00am to 3:00pm. Referenced GS Design & As Built v1.3 Table 39 School Classroom and modified Occupancy, Lighting, Equipment and HVAC schedules to align with the school's actual working hours.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	2.3	10
Office - Reception office Principle office Work room	Normal business hours: Office Schedules of GS Design & As Built v1.3 for Occupancy, Lighting, Equipment and HVAC have been used.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	10	11
Office - Staff Room	Normal business hours: Office Schedules of GS Design & As Built v1.3 for Occupancy, Lighting, Equipment and HVAC have been used.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	3.5	11
School- Canteen	Normal business hours: Office Schedules of GS Design & As Built v1.3 for Occupancy, Lighting, Equipment and HVAC have been used.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	3.5	25
School – Library	School working hours 9:00am to 3:00pm. Referenced GS Design & As Built v1.3 Table 39 School Classroom and modified Occupancy, Lighting, Equipment and HVAC schedules to align with the school's actual working hours.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	2.6	10
School – Special Prgs 1 & 2	School working hours 9:00am to 3:00pm. Referenced GS Design & As Built v1.3 Table 39 School Classroom and modified Occupancy, Lighting, Equipment and HVAC schedules to align with the school's actual working hours.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	2.4	10
OSHC Office	OSHC working hours- 6:30am to 8:00pm. 3:30pm to 6:00pm	22.5 (±) 1.5 °C 40% to 60%	10	11

Space Type	Operating Profile(s) Applied	Temperature Control Range (oC)	Occupancy Density (m ² /person)	Equipment Load (W/m ²)
	Referenced GS Design & As Built v1.3 Table 28 Office and modified Occupancy, Lighting, Equipment and HVAC schedules to align with the school's actual working hours.	Rh no humidification		
OSHC Kitchen	OSHC working hours- 6:30am to 8:00pm. 3:30pm to 6:00pm. Referenced GS Design & As Built v1.3 Table 28 Office and modified Occupancy, Lighting, Equipment and HVAC schedules to align with the school's actual working hours.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	3.5	25
Multipurpose Hall 1a & 1b	Working hours weekday - 6:30pm to 10:00pm. Working hours weekend – 08:00am to 10:00pm Referenced GS Design & As Built v1.3 Table 39 School Classroom and modified Occupancy, Lighting, Equipment and HVAC schedules to align with the school's actual working hours.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	2.35	10
Multipurpose Hall 2	Working hours weekday - 8:00am to 10:00pm. Working hours weekend – 08:00am to 10:00pm Referenced GS Design & As Built v1.3 Table 39 School Classroom and modified Occupancy, Lighting, Equipment and HVAC schedules to align with the school's actual working hours.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	2.1	10
Community Hall	Working hours weekday - 6:30pm to 10:00pm. Working hours weekend – 08:00am to 10:00pm Referenced GS Design & As Built v1.3 Table 39 School Classroom and modified Occupancy, Lighting, Equipment and HVAC schedules to align with the school's actual working hours.	22.5 (±) 1.5 °C 40% to 60% Rh no humidification	1.6	10

3.6 Building Fabric

The reference project is based on the minimum performance requirements of Parts J1 and J3 of NCC Section J 2019. Plans, Sections and Elevations illustrating construction properties are available in Appendix A.

3.6.1 Opaque Fabric Components

The following table summarises the performance parameters for opaque building fabrics.

Table 7: Building opaque fabric parameters

Opaque Fabric Parameters	Building Element	Proposed Project		Reference Project	
		R-value	Solar Abs.	R-value	Solar Abs.
External above-grade envelope walls	External Wall	R1.0	SA 0.6	R1.0	SA 0.6
Internal envelope walls	Internal Wall	R1.0	NA	R1.0	NA
Roofs	Roof	R4.3 (downward direction of heat flow)	SA 0.65	R3.7 (downward direction of heat flow)	SA 0.45
Floors	Exposed Slab (Slab between conditioned/un-conditioned space)	R2.0	NA	R2.0	NA

3.6.2 Transparent Fabric Components

The following table summarises the performance parameters for transparent building fabrics. Completed NCC Glazing Calculators for proposed and reference buildings can be found in Appendix A.

Table 8: Building opaque fabric parameters

Building Level	Proposed Project		Reference Project	
	R-value	Solar Abs.	R-value	Solar Abs.
Ground level	R3.32	0.66	R4.6	0.57
L1, L2, L3	R3.32	0.35		

3.7 HVAC Services

The reference building has systems as defined in the Green Building Council of Australia (GBCA) Energy Consumption and Greenhouse Gas Emissions Calculation Guide, Sept 2019.

3.7.1 Summary Description

The building mechanical services are summarised as follows:

Heating and cooling are provided by concealed ceiling ducted VRF units with outdoor condenser units installed on level 3. The indoor VRF units are modelled in group according to the condenser units serving them. Outside air fans supply outdoor air to groups of indoor units. The amount of outside air is determined by CO2 sensors as well as outdoor enthalpy sensor for economy cycle. Tertiary spaces such as toilets and stores are provided with exhaust fans.

3.7.2 Air Conditioning Systems

The following performance parameters have been applied to the proposed and reference buildings.

Table 9: Air conditioning system parameters: VRF Unit

Air conditioning parameters	Proposed Project	Reference Project
Space served	Level GF to Level 3	VAV with AHU - GF (Multipurpose Hall 1A,1B, Community Hall, Level 1 to Level 3) DX System – GF (Multipurpose Hall 2, Reception, OSHC, Canteen, Comms Room)
Temperature Control Range	22°C +1.5 and 22°C -1 (21.0°C – 23.5°C) - max 65% RH no humidification	As per Proposed Project
Air conditioning type	VRF with Outdoor Condenser Units	<ul style="list-style-type: none"> - Variable air volume with air handling unit per perimeter orientation and central zone. - Independent VAV for area > 500m² on GF (Multipurpose Hall 1A,1B, Community Hall) - DX system (Multipurpose Hall 2, Reception, OSHC, Canteen, Comms Room)
Other air conditioning system types(s)	None.	-
Design supply air temperature difference (K) - Cooling	9.5°C	11°C
Design supply air temperature difference (K) - Heating	7.5°C	11°C
Supply air temperature control	Supply air temperature reset in response to the zone temperature sensor	No reset
Outdoor air design volume flow rate (L/s/person)	7.5 L/s per	10 L/s per person
Fan design supply air volume flow rate (L/s)	Constant Supply Air Refer to Table 10 for details of proposed model FCUs.	AHU, refer to Refer Table 12 for details of reference model FCUs.
Estimated fan total pressure (Pa)	200	N/A. Refer to Table 14 for details of FCU fans.
Fan design absorbed power (kWe)	9.63	Calculated as per J5.4(b)
Minimum flow rate turndown (%)	FCU fans to 70%	40%

Air conditioning parameters	Proposed Project	Reference Project
Economy cycle control	Differential enthalpy	21°C high limit shut off
Heat recovery type	Sensible	Sensible
Heat recovery effectiveness	80%	50%
Heat recover parasitic power (kWe)	Not applicable	0.54 kW

3.7.3 Ventilation Systems

The following performance parameters have been applied to the proposed and reference buildings.

Table 10 : Proposed FCU fan parameters

Reference	Cooling Capacity Total (kW)	Heating kW	Supply Air Rate (L/s)	Estimated Total Pressure Modelled (Pa)	Modelled Fan Power (kW)	Condenser Unit
FCU-GF-01	1.3	0.7	150	100	0.081	CU-L3-03
FCU-GF-02	9.0	7.1	533	200	0.376	CU-L3-03
FCU-GF-03A/03B	11.0	5.4	533	200	0.376	CU-L3-01
FCU-GF-04A/04B	10.7	5.2	533	200	0.376	CU-L3-01
FCU-GF-05C/05D	12.3	6.7	650	200	0.461	CU-L3-02
FCU-GF-05A/05B	12.3	6.7	650	200	0.461	CU-L3-02
FCU-GF-06A/06B/06C/06D	26.5	12.9	1200	200	1.684	CU-L3-09
FCU-GF-07	1.2	0.8	150	100	0.043	CU-L3-15
FCU-GF-08	0.7	0.4	150	100	0.043	CU-L3-15
FCU-GF-09	1.2	0.7	150	100	0.043	CU-L3-15
FCU-GF-10	6.8	4.0	192	100	0.059	CU-L3-15
FCU-GF-11	3.7	2.1	242	100	0.092	CU-L3-15
FCU-GF-12A/12B/12C	28.1	14.2	1200	200	1.684	CU-L3-10
FCU-L1-01	1.8	1.2	150	100	0.081	CU-L3-03
FCU-L1-02	2.1	1.8	150	100	0.081	CU-L3-03
FCU-L1-03	2.7	1.6	150	100	0.081	CU-L3-03
FCU-L1-04	2.8	1.7	150	100	0.081	CU-L3-03
FCU-L1-05	2.4	1.5	150	100	0.081	CU-L3-03
FCU-L1-06	3.3	2.4	158	100	0.085	CU-L3-03
FCU-L1-07	1.0	0.5	150	100	0.081	CU-L3-03
FCU-L1-08	1.1	0.9	150	100	0.081	CU-L3-03
FCU-L1-09	1.0	0.6	150	100	0.081	CU-L3-03
FCU-L1-10	0.9	0.5	150	100	0.081	CU-L3-03
FCU-L1-11	1.5	1.0	150	100	0.081	CU-L3-03
FCU-L1-12	2.3	1.4	150	100	0.081	CU-L3-04

Reference	Cooling Capacity Total (kW)	Heating kW	Supply Air Rate (L/s)	Estimated Total Pressure Modelled (Pa)	Modelled Fan Power (kW)	Condenser Unit
FCU-L1-13A/13B	5.5	3.1	300	200	0.215	CU-L3-04
FCU-L1-14	4.3	2.8	267	160	0.194	CU-L3-04
FCU-L1-15	4.2	2.7	267	160	0.194	CU-L3-04
FCU-L1-16	3.4	2.0	158	100	0.085	CU-L3-04
FCU-L1-17	2.8	1.8	150	100	0.081	CU-L3-04
FCU-L1-18	3.6	2.2	158	100	0.085	CU-L3-04
FCU-L1-19	10.0	5.4	533	200	0.376	CU-L3-04
FCU-L1-20A/20B	5.3	3.0	300	200	0.215	CU-L3-04
FCU-L1-21A/21B	6.9	4.0	325	200	0.23	CU-L3-11
FCU-L1-22	3.2	2.3	158	100	0.085	CU-L3-11
FCU-L1-23A/23B/23C	8.2	4.5	417	200	0.298	CU-L3-11
FCU-L1-24	2.1	1.3	150	100	0.081	CU-L3-11
FCU-L1-25	4.7	2.8	300	200	0.215	CU-L3-11
FCU-L1-26A/26B	8.7	5.2	417	200	0.298	CU-L3-11
FCU-L1-27	4.2	2.7	267	160	0.194	CU-L3-11
FCU-L1-28A/28B	6.9	4.0	325	200	0.23	CU-L3-12
FCU-L1-29	3.2	2.3	158	100	0.085	CU-L3-12
FCU-L1-30A/30B/30C	8.2	4.5	417	200	0.298	CU-L3-12
FCU-L1-31	2.1	1.3	150	100	0.081	CU-L3-12
FCU-L1-32	4.7	2.8	300	200	0.215	CU-L3-12
FCU-L1-33A/33B	8.7	5.2	417	200	0.298	CU-L3-12
FCU-L2-01	2.9	1.9	158	100	0.085	CU-L3-06
FCU-L2-02	3.2	2.2	158	100	0.085	CU-L3-06
FCU-L2-03	7.3	4.4	417	200	0.298	CU-L3-06
FCU-L2-05	7.1	4.0	417	200	0.298	CU-L3-06
FCU-L2-06	8.1	3.8	417	200	0.298	CU-L3-06
FCU-L2-08	2.9	1.9	158	100	0.085	CU-L3-06
FCU-L2-07	7.1	3.9	325	200	0.23	CU-L3-06
FCU-L2-10	1.7	1.5	150	100	0.081	CU-L3-06
FCU-L2-11	12.7	7.4	650	200	0.461	CU-L3-06
FCU-L2-12	4.9	3.2	300	200	0.215	CU-L3-03
FCU-L2-13	6.0	3.8	325	200	0.23	CU-L3-03
FCU-L2-14	11.1	6.3	533	200	0.376	CU-L3-03
FCU-L2-15	2.3	1.4	150	100	0.081	CU-L3-05
FCU-L2-16A/16B	5.5	3.1	300	200	0.215	CU-L3-05
FCU-L2-17	4.3	2.8	267	160	0.194	CU-L3-05

Reference	Cooling Capacity Total (kW)	Heating kW	Supply Air Rate (L/s)	Estimated Total Pressure Modelled (Pa)	Modelled Fan Power (kW)	Condenser Unit
FCU-L2-18	4.2	2.7	267	160	0.194	CU-L3-05
FCU-L2-19	3.4	2.0	267	160	0.194	CU-L3-05
FCU-L2-20	2.8	1.8	150	100	0.081	CU-L3-05
FCU-L2-21	3.6	2.2	158	100	0.085	CU-L3-05
FCU-L2-22	10.0	5.4	533	200	0.376	CU-L3-05
FCU-L2-23A/23B	5.3	3.0	300	200	0.215	CU-L3-05
FCU-L3-01	10.2	6.4	533	200	0.376	CU-L3-07
FCU-L3-02	10.5	6.7	533	200	0.376	CU-L3-07
FCU-L3-03A/03B/03C/03D	9.3	5.4	533	200	0.376	CU-L3-07
FCU-L3-04	7.7	5.0	417	200	0.298	CU-L3-07
FCU-L3-05	7.7	5.3	417	200	0.298	CU-L3-07
FCU-L3-06	2.2	1.2	150	100	0.081	CU-L3-07
FCU-L2-24A/24B	7.0	4.1	325	200	0.23	CU-L3-13
FCU-L2-39	3.2	2.4	158	100	0.085	CU-L3-13
FCU-L2-26A/26B/26C	8.4	4.7	417	200	0.298	CU-L3-13
FCU-L2-27	2.1	1.4	150	100	0.081	CU-L3-13
FCU-L2-28	4.8	2.9	300	200	0.215	CU-L3-13
FCU-L2-29A/29B	8.7	5.2	417	200	0.298	CU-L3-13
FCU-L2-30	4.2	2.7	267	160	0.194	CU-L3-13
FCU-L2-31	6.9	4.0	325	200	0.23	CU-L3-14
FCU-L2-32/33	3.2	2.3	158	100	0.085	CU-L3-14
FCU-L2-33A/33B/33C	8.2	4.5	417	200	0.298	CU-L3-14
FCU-L2-34	2.1	1.3	150	100	0.081	CU-L3-14
FCU-L2-35	4.7	2.8	300	200	0.215	CU-L3-14
FCU-L2-36A/36B	8.7	5.2	417	200	0.298	CU-L3-14
FCU-L2-37	4.2	2.7	267	160	0.194	CU-L3-14
FCU-GF-N-COMMS	3.5	3.5	142	100	0.04	CU-L3-08
FCU-GF-S-COMMS	3.5	2.8	142	100	0.04	CU-L3-16
FCU-L1/L2-N-COMMS	3.5	2.8	142	100	0.04	CU-L3-08
FCU-L1/L2-S-COMMS	3.5	2.8	142	100	0.04	CU-L3-16
FCU-L3-COMMS-A/B	4.5	3.6	250	100	0.043	CU-L3-16

Table 11: Proposed Outdoor air fan parameters

Reference	Supply OA Rate (L/s)	Estimated Total Pressure Modelled (Pa)	Power (kw)	Absorbed Power (kWe)
OAF-GF-01	110	120	0.1	0.07
OAF-GF-02	600	180	0.37	0.28
OAF-GF-03	600	180	0.37	0.28
OAF-GF-04	1500	180	1	0.92
OAF-GF-05	260	180	0.37	0.25
OAF-GF-06	1125	180	0.84	0.63
OAF-L1-01	205	150	0.12	0.12
OAF-L1-02	150	150	0.09	0.09
OAF-L1-03	540	225	0.40	0.29
OAF-L1-04	540	225	0.40	0.29
OAF-L1-05	500	225	0.40	0.29
OAF-L1-06	500	225	0.40	0.29
OAF-L1-07	660	250	0.40	0.29
OAF-L1-08	660	250	0.40	0.29
OAF-L2-01	1080	180	0.60	0.4
OAF-L2-02	400	150	0.40	0.14
OAF-L2-03	540	225	0.40	0.29
OAF-L2-04	540	225	0.40	0.29
OAF-L2-05	654	250	0.40	0.29
OAF-L2-06	654	250	0.40	0.29
OAF-L2-07	654	250	0.40	0.29
OAF-L2-08	654	250	0.40	0.29
OAF-L3-01	288	180	0.37	0.14
TEF-L4-01	1215	300	1.1	0.95
GEF-L4-01	150	220	0.19	0.19
GEF-L4-02	120	200	0.19	0.19
GEF-L4-03	75	200	0.12	0.08
FPSF-L4-01	400	250	0.40	0.23
FPEF-L4-01	400	250	0.40	0.23
OAF-L4-01	65	180	0.1	0.08
GEF-L4-04	240	220	0.37	0.14
KEF-L4-01	200	250	0.29	0.25
KEF-L4-02	200	250	0.29	0.25
TEF-L4-02	945	250	1.21	0.61
GEF-L4-05	580	250	0.40	0.26

Table 12: Reference ventilation system parameters- Ground Level – VAV with Air cooled chillers

Reference	Supply Air Rate (L/s)	DtS fan Power (Kw)
AHU Supply Fan- AHU-North - GF	1700.75	2.318
AHU Supply Fan- AHU-East - GF	872.31	1.234
AHU Supply Fan- AHU-West- GF	806.55	0.647
AHU Supply Fan- AHU-Internal - GF	2017.33	2.724

Table 13: Reference ventilation system parameters -Ground Level– VAV with Air cooled chillers – Heat recovery

Reference	Supply Air Rate (L/s)	DtS fan Power (Kw)
AHU HRV Fan- AHU-Internal - GF	1387.64	4.001

Table 14 : Reference ventilation system parameters- Level 1 to Level 3 – VAV with Air cooled chillers

Reference	Supply Air Rate (L/s)	DtS fan Power (Kw)
AHU Supply Fan- AHU-North -L1,2,3	6976	8.827
AHU Supply Fan- AHU-East -L1,2,3	4503.72	5.828
AHU Supply Fan- AHU-South-L1,2,3	4896.69	6.309
AHU Supply Fan- AHU-West -L1,2,3	4441.58	5.752
AHU Supply Fan- AHU-Internal -L1,2,3	6332.01	8.052

Table 15 : Reference ventilation system parameters- Level 1 to Level 3 – VAV with Air cooled chillers

Reference	Exhaust Air Rate (L/s)	DtS fan Power (Kw)
AHU HRV Fan- AHU-North -L1,2,3	6596.8	26.770
AHU HRV Fan- AHU-East -L1,2,3	1523.59	5.741
AHU HRV Fan- AHU-South-L1,2,3	4861.1	19.816
AHU HRV Fan- AHU-West -L1,2,3	1443.29	5.776
AHU HRV Fan- AHU-Internal -L1,2,3	3615.48	14.803

Table 16: Reference ventilation system parameters- Ground Level – Split DX System – FCU

Reference	Flow Rate (L/s)	Dts Fan Power (kW)
M1:PTHP Multipurpose Hall2	2825	1.852
M1:PTHP Reception	652	0.345
M1:PTHP Reception Int Room	42	0.022
M1:PTHP OSHC Kitchen	242	0.142
M1:PTHP OSHC Office	64	0.034
M1:PTHP Canteen	340	0.223
M1:PTHP Canteen office	61	0.032
M1:PTHP BCR L1 -S	114	0.065

Reference	Flow Rate (L/s)	Dts Fan Power (kW)
M1:PTHP BCR L1-N	110	0.063
M1:PTHP BCR L2-N	115.6	0.066
M1:PTHP BCR L2-S	118	0.067
M1:PTHP BCR GF - S	164	0.093
M1:PTHP BCR GF - N	381	0.217
M1:PTHP MCR L3 Comms B	143	0.082
M1:PTHP MCR L3 Comms A	60	0.034

Table 17 : Reference ventilation system parameters- Ground Level – Split DX System – Outdoor Fan

Reference	Outdoor Air rate (L/s)	Dts Fan Power (kW)
E1:Supply Fan Multipurpose Hall2	1610.2	1.056
E1:Supply Fan Reception & Int Room	101.43	0.054
E1:Supply Fan OSHC Office & Kitchen	257.10	0.137
E1:Supply Fan Canteen & canteen office	301.45	0.161
M1:PTHP BCR	1207.61	0.688

Table 18: Reference ventilation system parameters- Ground Level – Split DX System – Exhaust Fans

Reference	Flow Rate (L/s)	Dts Fan Power (kW)
E1: Exhaust Fan- Multipurpose Hall2	1610.2	0.853
E1: Exhaust Fan- Reception & Int Room	101.43	0.058
E1: Exhaust Fan- OSHC Office & Kitchen	257.10	0.069
E1: Exhaust Fan- Canteen & Canteen Office	301.45	0.080
M1:PTHP BCR	92.03	0.052

3.7.4 Unitary Plant

Packaged equipment details are given in the table below.

Table 19: Unitary plant parameters: Proposed

Unit Reference	Cooling Capacity (kW)	Heating Capacity (kW)	Unitary Plant parameters	Proposed Project
CU-L3-01	45.0	50.0	Vrf Outdoor Unit cooling performance (EER)	3.46
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-02	45.0	50.0	Vrf Outdoor Unit cooling performance (EER)	3.46
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-03	56.0	63.0	Vrf Outdoor Unit cooling performance (EER)	3.11
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-04	56.0	63.0	Vrf Outdoor Unit cooling performance (EER)	3.11

Unit Reference	Cooling Capacity (kW)	Heating Capacity (kW)	Unitary Plant parameters	Proposed Project
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-05	56.0	63.0	Vrf Outdoor Unit cooling performance (EER)	3.11
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-06	50.0	56.0	Vrf Outdoor Unit cooling performance (EER)	3.25
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-07	78.5	87.5	Vrf Outdoor Unit cooling performance (EER)	3.62
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-08	11.2	12.5	Vrf Outdoor Unit cooling performance (EER)	3.89
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-09	106.0	120.0	Vrf Outdoor Unit cooling performance (EER)	3.51
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-10	90.0	100.0	Vrf Outdoor Unit cooling performance (EER)	3.46
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-11	73.5	82.5	Vrf Outdoor Unit cooling performance (EER)	3.75
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-12	67.0	75.0	Vrf Outdoor Unit cooling performance (EER)	3.87
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-13	73.5	82.5	Vrf Outdoor Unit cooling performance (EER)	3.75
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-14	73.5	82.5	Vrf Outdoor Unit cooling performance (EER)	3.75
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-15	16.0	18.0	Vrf Outdoor Unit cooling performance (EER)	3.86
			Vrf Outdoor Unit Heating performance (COP)	3.2
CU-L3-16	22.4	25.0	Vrf Outdoor Unit cooling performance (EER)	3.77
			Vrf Outdoor Unit Heating performance (COP)	3.2

Table 20: Unitary plant parameters: Reference- DX System

Room or Zone	Total Cooling Load (kW)	ACOP	Product Description
L00 Multi-purpose 2	46.576	2.9	All config
L00 Reception EP	9.173	3.1	Non Ducted Unitary
L00 Int Room	0.585	3.1	
L00 OSHC Kitchen EP	3.712	3.1	
L00 OSHC Office CI	0.904	3.1	
L00 Canteen	5.968	3.1	
L01 BCR	2.239	3.1	
L01 BCR	2.057	3.1	
L02 BCR	2.185	3.1	
L02 BCR	2.244	3.1	
L03 MCR	3.856	3.1	

Room or Zone	Total Cooling Load (kW)	ACOP	Product Description
L00 BCR	3.11	3.1	

Note MEPS compliant performance has been assumed for the reference building.

3.7.5 Cooling and Heat Rejection Plant

Details of the cooling and heat rejection plant are given in Table 21.

During staging up, the operating chiller to operate at 55% of maximum design capacity and during stage down the load at 100% of the chiller at the previous sequence step. The sequence has been simplified as shown in the following Figure 2.

		Part load range (up to %) and chiller/cooling device											
Active sequence -->		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Chillers/cooling devices	Type	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	55.0	100	% CHWL capacity	Cooling capacity (kW)
NCC2019O2 Dts AC	EAC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	50.00	373.87
NCC2019O2 Dts AC	EAC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	50.00	373.87

Figure 2: Chiller Sequencing

Table 21: Reference project cooling plant parameters

Cooling and heat rejection plant parameters		CH-01	CH-02
Chiller type		Air Cooled Chiller	Air Cooler Chiller
Chiller capacity (kW _r)		374	374
Design CHW flow temperature (°C)		6.5 °C	6.5 °C
Design CHW temperature difference (K)		6.67 K	6.67K
Design CCW entering temperature (°C)		10 °C	10 °C
Chiller full-load performance (EER)		2.7	2.7
CHW temperature control			
Chiller sequencing and staging control	55%	ON	OFF
	100%	ON	ON
Primary pump absorbed power (kWe) (total)		3.15	3.15
Primary pump control		Variable speed	Variable speed
Primary pump minimum flow (if variable flow) (%)		70%	70%

3.7.6 Heating Plant

Details of the heating plant are given in Table 22 : Reference project heating plant parametersTable 22 (Note team is to provide details of each system and each individual item of equipment. If multiple systems, duplicate tables and reference accordingly. Add or delete columns as required to reflect all equipment).

Table 22 : Reference project heating plant parameters

Heating plant parameters		B-01.01	B-0.02
Heat source type		Gas fired boiler	Gas fired boiler
Heat source capacity (kW _r)		204	204
Design HHW flow temperature (oC)		80	80
Design HHW temperature difference (K)		15	15
Heat source full-load performance (gross efficiency) (%)		97	97
Heat source 15% performance (gross efficiency) (%)		70	70
HHW flow temperature control		Reset based on outdoor temperature.	
Heat source sequencing and staging control	50%	ON	OFF
	60%	ON	ON
	70%	ON	ON
	80%	ON	ON
	90%	ON	ON
	100%	ON	ON
System distribution losses (kW)		0	0
System thermal inertia (kW)		0	0
Primary pump motor power (kW _e)		2.54	2.54
Primary pump control		Constant Primary Flow	Constant Primary Flow

3.8 Infiltration

The infiltration rates allowed for in the simulations are as detailed in Table 23.

Table 23: Air infiltration rates

Model	Air-conditioned Zone	Schedule	Infiltration Rate
Reference	Perimeter Zone	HVAC system on	0.35 ACH
	Whole Building	HVAC system off	0.7 ACH
Proposed	Perimeter Zone	HVAC system on	0.35 ACH
	Whole Building	HVAC system off	0.7 ACH

3.9 Manual Calculation

3.9.1 Lighting Energy

Internal lighting was modelled to operate in line with Green Star profiles.

The reference building artificial lighting performance is based on NCC 2019 J6 compliance and the proposed building artificial lighting performance is based on the current design where information was available. No advanced controls (e.g. daylight dimming) have been modelled in either the proposed or reference models, although they are included in the proposed lighting design, detail of the control strategy was not developed at this stage of the design. This is a conservative approach.

The control strategy for the different space types was not available at the time of design. Similarly the lighting power density determined for the proposed lighting design in all ground floor spaces, plant room spaces and circulation spaces were not available.

It is likely that the lighting design shall progress and change through the construction stage, once a contractor is engaged. As a conservative approach, NCC J6 compliance figures have been considered for both the proposed and reference building for all School, Office and Multipurpose space.

The following NCC J6 DTS lighting parameters have been used for the proposed and reference buildings.

Table 24: Lighting power density per space type

Space Type	Area	Ref LLP (W/m ²)	Prop LPD (W/m ²)	Control Type	Ref (kW)	Prop (kW)
School- Learning Hub, Presentation Studio, Wet Studio, Meet Room	2594.13	4.5	4.1	Motion Detector (as per J6)	11673.6	10506.2
School- Library	315.73	4.5	4.1	Motion Detector (as per J6)	1420.8	1278.7
School- Special Prgs	94.472	4.5	4.1	Motion Detector (as per J6)	425.1	382.6
Office- Reception Block, Principle, work room	323	4.5	4.1	Motion Detector (as per J6)	1453.5	1308.2
Office- Staff Room	174.09	3.0	2.7	Motion Detector (as per J6)	522.3	470.0
School- Canteen, OSHC Kitchen, Multipurpose Hall Kitchen	132	4.0	3.6	Motion Detector (as per J6)	528.0	475.2
GF-Multipurpose Hall 1A,1B,2 & Cmty Hall	997	8.0	7.2	Motion Detector (as per J6)	7976.0	7178.4
Toilet	277	4.5	4.1	Motion Detector (as per J6)	1244.8	1120.4
Comms Room/Control Room	96.14	3.0	2.7	Motion Detector (as per J6)	288.4	259.6
Storage	429	1.5	1.4	Motion Detector (as per J6)	643.5	579.2
Staircase	283	2	1.8	Motion Detector (as per J6)	566.0	509.4

Space Type	Area	Ref LLP (W/m ²)	Prop LPD (W/m ²)	Control Type	Ref (kW)	Prop (kW)
Lift	9	3	2.7	Motion Detector (as per J6)	27.0	24.3
Estimated Energy Consumption					26769.06	24092.15

3.9.2 External Lighting

No reduction of proposed external lighting compared reference model has been claimed. The annual operating hours used as per External Lighting Operational Profiles Table 34 of the Greenhouse Gas Emissions Guide for 24-hour operation. External lighting has been estimated as a percentage (1%) of total reference building lighting energy consumption for this report. This is due to the lack of design data around this element at this stage of the project. This will require updating once more design data becomes available.

3.9.3 Lift

Lift energy consumption has been calculated in accordance with the methodology described in the Energy Consumption and Greenhouse Gas Emissions Calculation Guide. The inputs are the same for both the reference and proposed buildings. Table 21 shows all the lift parameters required for the energy estimate.

Table 25 shows all the lift parameters required for the energy estimate.

Table 25: Lift parameters – energy estimate

Lift Parameters	Lift 1
Building Type	Library
Terminal Travel time (s)	30
Number of trips per annum	52,000
Travel Distance (m)	12.40
Rated Speed (m/s)	1.00
Average Trip Time (s)	6.2
Rated Capacity (kg)	1000
Drive Motor Rating (kW)	3.2
Regenerative braking	No
Standby Power (kW)	0.25
Power Off (in standby)	Yes
Reference Building Energy Estimate (kWh)	1,289
Proposed Building Energy Estimate (kWh)	1,539

3.9.4 Domestic Hot Water Services

The proposed and reference buildings' domestic hot water energy consumption is calculated based on the total domestic hot water usage calculated by the Potable Water Calculator.

Table 26 shows the estimate of all the domestic hot water services parameters included in the energy modelling.

Table 26: Domestic hot water services parameters

	Unit	Proposed	Reference
Water heater type		Instantaneous	Instantaneous
Primary fuel		Electricity	Electricity
Indirect heating		No	No
Solar thermal heating		No	No
Storage tank volume	L	315	394
Quantity		2	2
Total storage	L	630	787
No of outlets		42	42
DHW usage (from D&AB Potable Water Calculator)	kL/annum	370	463
Days of operation	per annum	278	278
Turnover ratio		2.12	2.12
Circulation pump		No	No
Storage loss factor		0.05	0.00
Distribution loss factor		0.04	0.04
Average make up water temperature	°C	15.0	15.0
Water heater rated input	kW	2	2
Water heater efficiency (gross)		84%	80%
Water delivery temperature	°C	65.0	65.0
Quantity of solar panels		N/A	N/A
Number of REC per panel		N/A	N/A
Solar thermal input	kWh	N/A	N/A
Energy Consumption	kWh	27,974	35,032
	MJ	100,707	126,114

3.9.5 Other Energy Consumption

The following Table 29 provides estimate of annual energy consumption from hydraulic equipment.

Table 27: Hydraulic equipment – Energy Estimate

Items	Flow (L/s)	kPa	Estimated absorbed power (kW)	Hour/yr	Ref Energy Consumption (kWh)	Prop Energy Consumption (kWh)	Prop Model (VSD (Y/N))
CW Pump 1	3.2	400	2.56	2780	7,117	3,117	Y
CW Pump 2 (assume as standby)							
Storm water pump 1	22	150	6.6	200	1,320	1,320	N
Hot water pump1	1	400	0.8	2780	2,224	2,224	N
Rainwater	1.8	400	1.44	2780	4,003	4,003	N

Items	Flow (L/s)	kPa	Estimated absorbed power (kW)	Hour/yr	Ref Energy Consumption (kWh)	Prop Energy Consumption (kWh)	Prop Model (VSD (Y/N))
Estimated Energy Consumption					14,664	10,665	

3.10 On-Site Renewable Power Generation

3.10.1 Photovoltaic Cells

The estimated proposed design photovoltaic system details and key system parameters are summarised here.

Table 28: Photovoltaic system parameters

Parameter	Proposed Building
Total PV array area (m ²)	800
PV Array Azimuth	0 degrees
PV Array Tilt Angle	10 degrees
PV array capacity (kWe)	125kW
Annual Energy Production (kWh)	155,202

PV generation estimates have been made with the National Renewable Energy Laboratory (NREL) online calculator, PVWatts. Detail PV panels information and performance is not available at this stage in the design. As built PV assessment to be undertaken by PV contractor using a software programs that are deemed by the GBCA to comply with the below requirements;

- ▶ System Advisory Model (SAM) (developed by the National Renewable Energy Laboratory, USA); and
- ▶ PVSyst (developed by PVSyst SA, Switzerland).

3.11 Green Power

The site is connected to City of Sydney wire. City of Sydney have a power purchase agreement whereby 100% of electricity supplied to site is certified Green Power. This has been included in the Green Star Energy calculator.

4 RESULTS

4.1 Credit 15 Greenhouse Gas Emissions

The following tables provide the summary of the energy simulation results for the Green Star Greenhouse Gas Emissions credit.

Table 29: Energy Consumption Improvement

Energy End-use Summary	Intermediate Energy-elec (kWh/annum)	Reference Energy-elec (kWh/annum)
Heating plant	109,934	107,525
Cooling plant	81,061	88,720
Cooling plant - Heat Rejection	1,719	1,710
Cooling plant - Fans	122,728	121,000
Cooling plant - Pumps	12,347	13,450
Miscellaneous Ventilation Fans	3,697	3,690
Lighting	26,769	26,769
External Lighting	270	270
Lift	1,289	1,289
Domestic Hot water	126,114	126,114
Hydraulic	14,664	14,664
Total Energy Consumption kWh/annum)	500,592	505,201
Reduction against Reference Building (kWh/annum)		4,609
Reduction against Reference Building (kgCO₂-e/annum)		16,499
Improvement over Reference Building		0.9%
Energy Consumption Reduction Point		0.5

Table 30: Greenhouse gas emissions improvement

Energy End-use Summary	Proposed Energy-Elec (kWh/annum)	Reference Energy-Elec (kWh/annum)
Heating plant	27,231	107,525
Cooling plant	103,921	88,720
Cooling plant - Heat Rejection	25,916	1,710
Cooling plant - Fans	78,735	121,000
Cooling plant - Pumps	0	13,450
Miscellaneous Ventilation Fans	3,690	3,690
Lighting	26,769	26,769
External Lighting	270	270
Lift	1,539	1,289
Domestic Hot water	100,707	126,114
Hydraulic	10,665	14,664
Photovoltaic	-155,202	
SUBTOTAL (kWh/annum)	224,241	505,201
Greenhouse Gas Emissions (kgCO₂e/annum)	206,306	390,739
Off-site Renewable electricity percentage		100% - 8.7 points
Reduction against Benchmark Building (kgCO₂e/annum)		145,359
Conditional Requirement Met?		Yes
Improvement over Benchmark Building		41.3%
Greenhouse Gas Emissions Reduction Point		16.5

4.2 Credit 16 Peak Demand Reduction

The following graphs provide the summary of the electrical load simulation results for the Green Star Electrical Peak Demand Reduction credit.

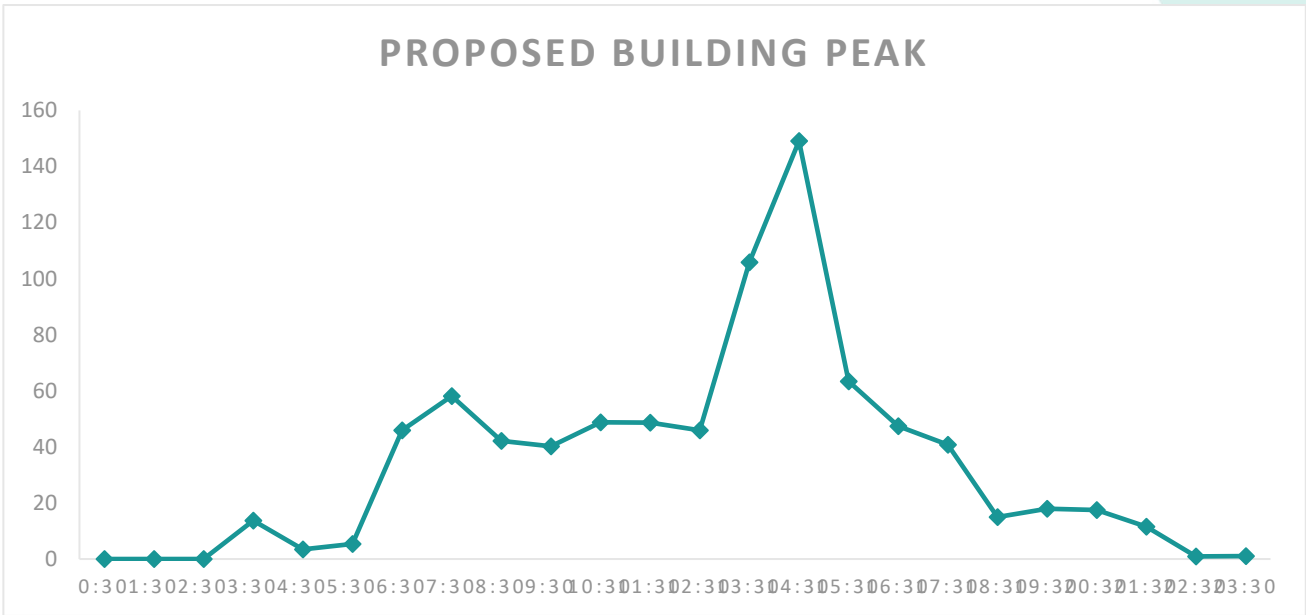


Figure 3: Proposed project electrical load profile and peak demand day 05/Sept

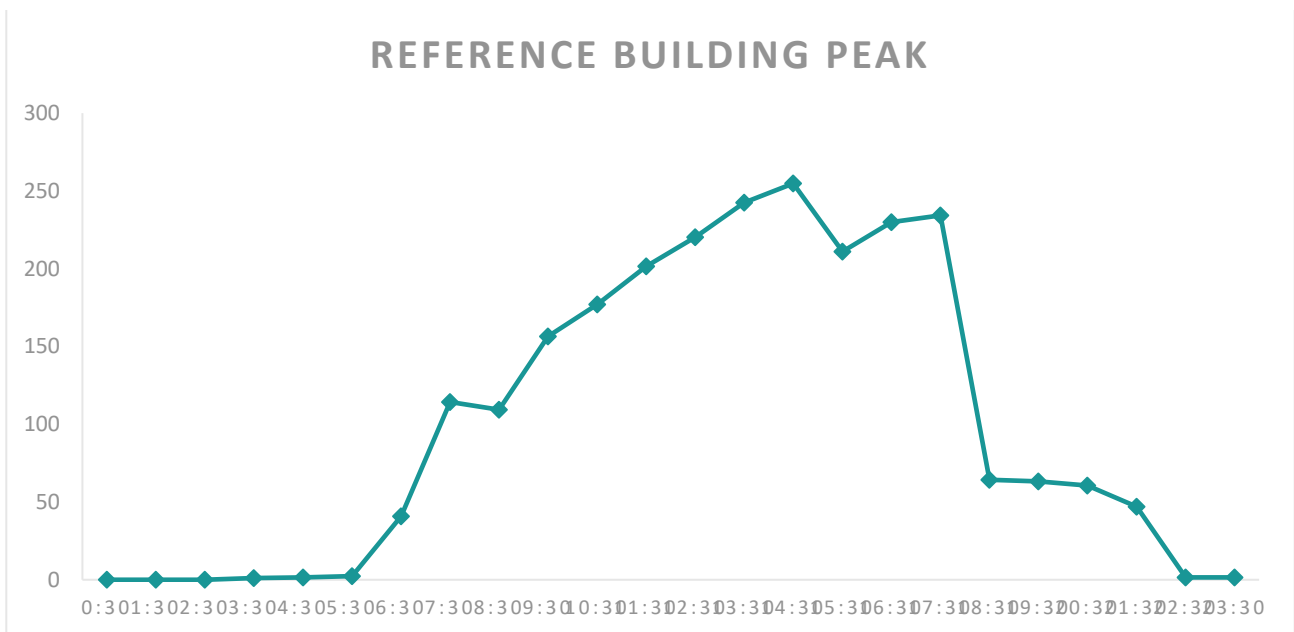


Figure 4: Reference project electrical load profile and peak demand day 02/Feb

Based on the above load profiles, the peak demand reduction for the site and hence the points achieved for Credit 16 Electrical Peak Demand Reduction are as follows:

Table 31: Green Star Credit 16 Electrical Peak Demand Reduction points achieved

Parameter	Proposed	Reference	Difference
Building peak demand (kWe)	149	254	105.7
Time of proposed building peak demand	05/Sept 12:30pm	02/Feb 02:30pm	
Peak demand reduction	41.5%		

4.3 Points Summary

Based on the above energy and greenhouse gas emissions improvements, the overall points achieved for are as follows:

Table 32: Green Star points achieved

Parameter	Percentage	Points
Conditional Requirement	-	Met
15E.1 GHG Emissions Reduction: Building Fabric	0.9%	0.5
15E.2 GHG Emissions Reduction	41.3%	16
Credit 15 Greenhouse Gas Emissions	-	16.5
Credit 16 Electrical Peak Demand Reduction	-	2.0
Total Energy	-	18.5
Credit 30A Innovative Technology or Process - Onsite Renewable Energy	-	2.0

5 LIMITATIONS

Norman Disney & Young will not be held liable for building energy performance estimates, nor for the reliance by any party on those results, for any purpose. Building energy performance models are necessarily simplified and idealised representations of actual buildings, and are imperfect in the way they simulate these, and in particular the air conditioning systems and controls. Assumptions have been made on a wide range of input parameters, such as building occupancy, equipment usage and the like. Calculations are based on Test Reference Year weather data (or similar), which will not be equivalent to any given year's actual weather. Consequently, the results presented are only one possible representation of a building's potential energy performance.

Actual performance of the constructed building is dependent on many interrelated factors including the quality of construction, the quality of commissioning, and the ongoing management of the building. Significant differences between modelled and actual building energy performance can result.

Norman Disney & Young takes all reasonable professional care in the preparation of building energy performance estimates. However, we stress that significant variation can occur in actual building energy performance due to circumstances beyond our control, and due consideration of this fact should be taken before relying on these estimates for any purpose.

6 APPENDICES

6.1 Reference Building



Virtual Environment 2019

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Project File: 20210329_Final Reference Model_Green Square School.mit
 Sim File: 20210420_AA_GSCIFS_Reference Model(RA deleted).aps 29/Apr/2021
 Weather File: SydneyIWEC.fwt

	Space Heating - Natural Gas: Meter 1 (MWh)	Space Heating - Electricity: Meter 1 (MWh)	Space Cooling - Electricity: Meter 1 (MWh)	Heat Rejection - Meter 1 (MWh)	Interior Central Fans - Meter 1 (MWh)	Interior Local Fans - Meter 1 (MWh)	Exhaust Fans - Meter 1 (MWh)	Pumps - Meter 1 (MWh)
Date	20210420_AA_GSCIFS_Reference Model(RA deleted).aps	20210420_AA_GSCIFS_Reference Model(RA deleted).aps	20210420_AA_GSCIFS_Reference Model(RA deleted).aps	20210420_AA_GSCIFS_Reference Model(RA deleted).aps	20210420_AA_GSCIFS_Reference Model(RA deleted).aps	20210420_AA_GSCIFS_Reference Model(RA deleted).aps	20210420_AA_GSCIFS_Reference Model(RA deleted).aps	20210420_AA_GSCIFS_Reference Model(RA deleted).aps
Jan 01-31	0.3899	0.0016	5.9166	0.0605	3.6679	0.1669	0.0512	1.4396
Feb 01-28	2.2514	0.0067	23.0943	0.3855	8.2443	1.2600	0.3583	2.1214
Mar 01-31	3.1547	0.0411	18.5428	0.3328	8.3637	1.4092	0.3966	2.0036
Apr 01-30	2.9722	0.1156	6.4286	0.1204	5.3169	0.7173	0.2175	0.9854
May 01-31	11.5315	0.9589	3.0546	0.0930	11.5512	1.4093	0.3966	0.7311
Jun 01-30	19.3450	1.8925	0.5555	0.0299	14.2754	1.3233	0.3710	0.5089
Jul 01-31	18.1977	1.4972	0.3438	0.0181	10.1271	0.8061	0.2431	0.5154
Aug 01-31	18.6524	1.9309	1.8828	0.0599	13.6818	1.4335	0.3966	0.6892
Sep 01-30	10.6808	0.9116	1.3885	0.0438	10.0492	1.1136	0.3199	0.5726
Oct 01-31	5.9166	0.3433	5.6050	0.1272	8.0441	1.0591	0.3071	0.9880

No v 01-30	4.0693	0.1485	10.8418	0.2377	8.1411	1.3642	0.3838	1.4012
Dec 01-31	2.4645	0.0513	11.0748	0.1920	6.5428	0.8934	0.2559	1.5015
Summed total	99.6259	7.8991	88.7292	1.7009	108.0054	12.9558	3.6977	13.4579

6.2 Intermediate Building



Virtual Environment 2019

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Project File: Inter.mit
 Sim File: 20210420_Intermediate Model.aps 29/Apr/2021
 Weather File: SydneyIWEC.fwt

	Space Heating - Natural Gas: Meter 1 (MWh)	Space Heating - Electricity: Meter 1 (MWh)	Space Cooling - Electricity: Meter 1 (MWh)	Heat Rejection - Meter 1 (MWh)	Interior Central Fans - Meter 1 (MWh)	Interior Local Fans - Meter 1 (MWh)	Exhaust Fans - Meter 1 (MWh)	Pumps - Meter 1 (MWh)
Date	20210420_Intermediate Model.aps	20210420_Intermediate Model.aps	20210420_Intermediate Model.aps	20210420_Intermediate Model.aps	20210420_Intermediate Model.aps	20210420_Intermediate Model.aps	20210420_Intermediate Model.aps	20210420_Intermediate Model.aps
Jan 01-31	0.4313	0.0016	5.5993	0.0605	3.5900	0.1669	0.0512	1.4000
Feb 01-28	2.5014	0.0066	21.6778	0.3851	8.0886	1.2588	0.3583	2.0321
Mar 01-31	3.3837	0.0380	16.9494	0.3339	8.2416	1.4093	0.3966	1.8373
Apr 01-30	3.0797	0.1116	5.4650	0.1220	5.3084	0.7174	0.2175	0.8405
May 01-31	11.7731	0.8987	2.5450	0.0967	11.8007	1.4090	0.3966	0.5765
Jun 01-30	19.5570	1.7843	0.5025	0.0321	14.6665	1.3226	0.3710	0.4699
Jul 01-31	18.8065	1.4328	0.3114	0.0189	10.4357	0.8061	0.2431	0.5012
Aug 01-31	19.5267	1.8348	1.5021	0.0614	14.2955	1.4335	0.3966	0.5885

Sep 01-30	11.0073	0.8504	1.0985	0.0461	10.4805	1.1116	0.3199	0.4783
Oct 01-31	5.7000	0.3183	5.0573	0.1303	8.2363	1.0583	0.3071	0.8650
Nov 01-30	4.2111	0.1382	10.0145	0.2395	8.1568	1.3643	0.3838	1.3155
Dec 01-31	2.4954	0.0455	10.3389	0.1927	6.4771	0.8927	0.2559	1.4423
Sum med total	102.4733	7.4607	81.0616	1.7192	109.7778	12.9506	3.6977	12.3473

6.3 Proposed Building



Virtual Environment 2019

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Project File: 20210408_GSCIFS_Gree Star-Propose Model.mit
 Sim File: 20210411_GSCIFS_Green Star_Proposed.aps 11/Apr/2021
 Weather File: SydneyIWEC.fwt

	Space Heating - Natural Gas: Meter 1 (MWh)	Space Heating - Electricity: Meter 1 (MWh)	Space Cooling - Electricity: Meter 1 (MWh)	Heat Rejection - Meter 1 (MWh)	Interior Central Fans - Meter 1 (MWh)	Interior Local Fans - Meter 1 (MWh)	Exhaust Fans - Meter 1 (MWh)	Pumps - Meter 1 (MWh)
Date	20210411_GS CIFS_Green Star_Proposed.aps	20210411_GS CIFS_Green Star_Proposed.aps	20210411_GS CIFS_Green Star_Proposed.aps	20210411_GS CIFS_Green Star_Proposed.aps	20210411_GS CIFS_Green Star_Proposed.aps	20210411_GS CIFS_Green Star_Proposed.aps	20210411_GS CIFS_Green Star_Proposed.aps	20210411_GS CIFS_Green Star_Proposed.aps
Jan 01-31	0.0000	0.0202	8.5145	0.7011	3.0508	0.9263	0.0000	0.0000
Feb 01-28	0.0000	0.1281	16.4996	1.8373	3.9659	2.9498	0.0000	0.0000
Mar 01-31	0.0000	0.1314	16.2651	2.0498	4.2768	3.3324	0.0000	0.0000
Apr 01-30	0.0000	0.3168	8.9727	1.1703	3.4609	1.7944	0.0000	0.0000
May 01-31	0.0000	3.0283	6.4299	3.7281	4.2247	3.2281	0.0000	0.0000
Jun 01-30	0.0000	6.4120	1.4904	2.7457	4.4443	3.1603	0.0000	0.0000
Jul 01-31	0.0000	6.5205	0.7040	1.2254	3.8792	2.0130	0.0000	0.0000

Aug 01- 31	0.0000	6.4825	3.4903	3.7126	4.5309	3.4142	0.0000	0.0000
Sep 01- 30	0.0000	2.8509	4.5302	3.2733	3.8465	2.6406	0.0000	0.0000
Oct 01- 31	0.0000	0.9196	10.2072	2.1363	3.8719	2.5001	0.0000	0.0000
Nov 01- 30	0.0000	0.2972	13.9425	1.7808	3.9842	3.1504	0.0000	0.0000
Dec 01- 31	0.0000	0.1231	12.8745	1.5549	3.8061	2.2831	0.0000	0.0000
Sum med total	0.0000	27.2307	103.9210	25.9157	47.3420	31.3927	0.0000	0.0000

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Revision No: 1.0
Revision Date: 29 April 2021
Description: DRAFT
Filename: rp210415s0007
File Location: \\tt.local\ndy\syd\w\S385xx\S38578\001\G-\24_Reports
Client Name: BVN
Client Contact: Client Contact
Project Leader: Nathaniel Masters
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APPENDIX I. NCC DTS REPORT





CONSULTANT ADVICE

Project: Green Square Public School Redevelopment

No: G-003[2.0]

Date: 1 August 2020

Pages: 16

SUSTAINABILITY – NCC 2019 SECTION J – DTS REQUIREMENTS

Norman Disney & Young, a Tetra Tech company (NDY) has been engaged to provide preliminary advice on achieving the Deemed to Satisfy (DtS) requirements of the National Construction Code (NCC) 2019 for the Green Square Integrated Community Facility & School (GSICFS).

INFORMATION SOURCES

The assessment is based on the following:

- ▶ Architectural drawings by BVN Architect
 - GA Plan – Ground Level AR-B10 00-00 Issue 4, Dated 21.04.2021
 - GA Plan – Level 01 AR-B10 01-00 Issue 3, Dated 21.04.2021
 - GA Plan – Level 02 AR-B10 02-00 Issue 3, Dated 21.04.2021
 - GA Plan – Level 03 AR-B10 03-00 Issue 3, Dated 21.04.2021
 - GA Plan – Roof Plan AR-B10 04-00 Issue 3, Dated 21.04.2021
- ▶ The site is located in Green Square Sydney, NSW, categorized as being in NCC Climate Zone 5.
- ▶ Class 9b building classification

BUILDING ENVELOPE

The DtS requirements of the NCC 2019 Section J regarding the building fabric applies to building elements forming the thermal envelope. Thus, defining the extent of the thermal envelope is crucial in determining the DtS Requirements of Part J1 and J3.

In accordance with the NCC 2019, the thermal envelope is defined as parts of the building fabric that separate a conditioned space or habitable room from the exterior of the building or a non-conditioned space. Refer to **Appendix D** for thermal performance mark-ups applied to the elements that form parts of the thermal envelope boundary.

J1 – BUILDING FABRIC

Part J1 applies to all elements of the building that form part of the thermal envelope (see the extent as shown in **Appendix D**). All elements of the thermal envelope must meet or exceed the R-values identified in Table 1 below, noting that these represent total system values, inclusive of the effects of linear thermal bridging.



J1 BUILDING FABRIC

The City of Sydney Sustainable Design Technical Guidelines (SDTG) require that the thermal performance of the opaque building elements achieve a 15% improvement on the NCC Section J Deemed to Satisfy requirements. Thermal performance requirements to achieve DtS compliance with Section J, and a 15% improvement are nominated in Table 1 below (for roofs only).

Additionally, the SDTG requires that the glazing performance is no greater than 85% of the allowable performance level using the NCC Glazing calculator. Table 2 below summarises the glazing thermal performance required to meet the DtS requirements and the SDTG requirement. It is noted that these requirements have not been applied for internal or external walls.

Table 1: Thermal Performance Requirements – Opaque Constructions

Item	Minimum Performance Requirement (s) (NCC DtS)	CoS SDTG Performance Requirement	Comment
Roof	<ul style="list-style-type: none"> ▶ R3.7 for roof below conditioned spaces with Solar Absorptance (SA) value less than 0.4 ▶ R3.7 for ceiling where above is a non-conditioned space 	<ul style="list-style-type: none"> ▶ R4.3 for roof below conditioned spaces with Solar Absorptance (SA) value less than 0.4 ▶ R4.3 for ceiling where above is a non-conditioned space 	Total construction R value including thermal bridging effect. SA value stated is slightly improved compared to the nominated DtS value of SA 0.45, to allow for a buffer to be used in the JV3 modelling.
External Walls and Internal Walls	<ul style="list-style-type: none"> ▶ R1.0 For all external and internal walls that form part of the thermal envelope boundary, with Solar Absorptance value less than 0.55 	<ul style="list-style-type: none"> ▶ R1.0 For all external and internal walls that form part of the thermal envelope boundary, with Solar Absorptance value less than 0.55 	Total construction R value including thermal bridging effect. SA value stated is slightly improved compared to the nominated DtS value of SA 0.6 required for reference building in the JV3 modelling.
Ground floor under slab insulation	<ul style="list-style-type: none"> ▶ R2.0, including R-Value provided by soil in contact with the floor. Additional slab insulation R0.95 for Entry/Reception area. 	<ul style="list-style-type: none"> ▶ R2.0, including R-Value provided by soil in contact with the floor. Additional slab insulation R0.95 for Entry/Reception area. 	Due to the floor to perimeter ratio, the R-value provided by soil that is in-contact with the floor does not achieve R2.0. Additional insulation required.
Floor	<ul style="list-style-type: none"> ▶ R2.0 to ceiling of non-conditioned spaces where above them are conditioned spaces 	<ul style="list-style-type: none"> ▶ R2.0 to ceiling of non-conditioned spaces where above them are conditioned spaces 	

GLAZING

Glazing has been measured off the plans and elevations. The minimum required performance of all vision glazing (accounting for shading as allowable under DTS) is detailed below, as well as the proposed glazing solution for the project. The proposed solution exceeds the minimum Section J requirements.

the SDTG requires that the glazing performance is no greater than 85% of the allowable performance level using the NCC Glazing calculator. Table 2 below summarises the glazing thermal performance required to meet the DtS requirements and the SDTG requirement



Table 2: Thermal Performance Requirements – Glazing

	Window System U-Value (W/m ² .K)	System SHGC
DtS Glazing Performance	≤ 4.5	≤ 0.57
SDTG Glazing Performance	≤ 3.7	≤ 0.48

- ▶ Refer to **Appendix D** for thermal performance mark-up detailing the locations of insulation for walls, partitions, floors/ceilings, and roofs. Please advise if there are components that form part of the thermal envelope boundaries that cannot achieve this requirement.
- ▶ The construction process must adhere to the quality requirements outlined in clause J1.2. See **Appendix A**.
- ▶ Note that requirement to meet the maximum solar absorptance value is required for roof and walls – Refer to Table 3 for typical absorptance values of different material colours. Please advise if the proposed buildings are not achieving this requirement.

Table 3: Solar Absorptance Value and Colour – Colorbond

Colour	Solar Absorptance
Classic Cream™	0.32
Surfmist®	0.32
Paperbark®	0.42
Evening Haze®	0.43
Shale Grey™	0.43
Sandbank®	0.46
Dune®	0.47
Windspray®	0.58

Source: <http://www.colorbondcolours.com/index.cfm?objectid=8B6F92BE-F527-A741-658154CA970272AA>

- ▶ The extent of shading entered into the façade calculation to determine glazing performance is as per the prescribed architectural drawings. Changes to the shadings will require the façade calculation to be re-performed.

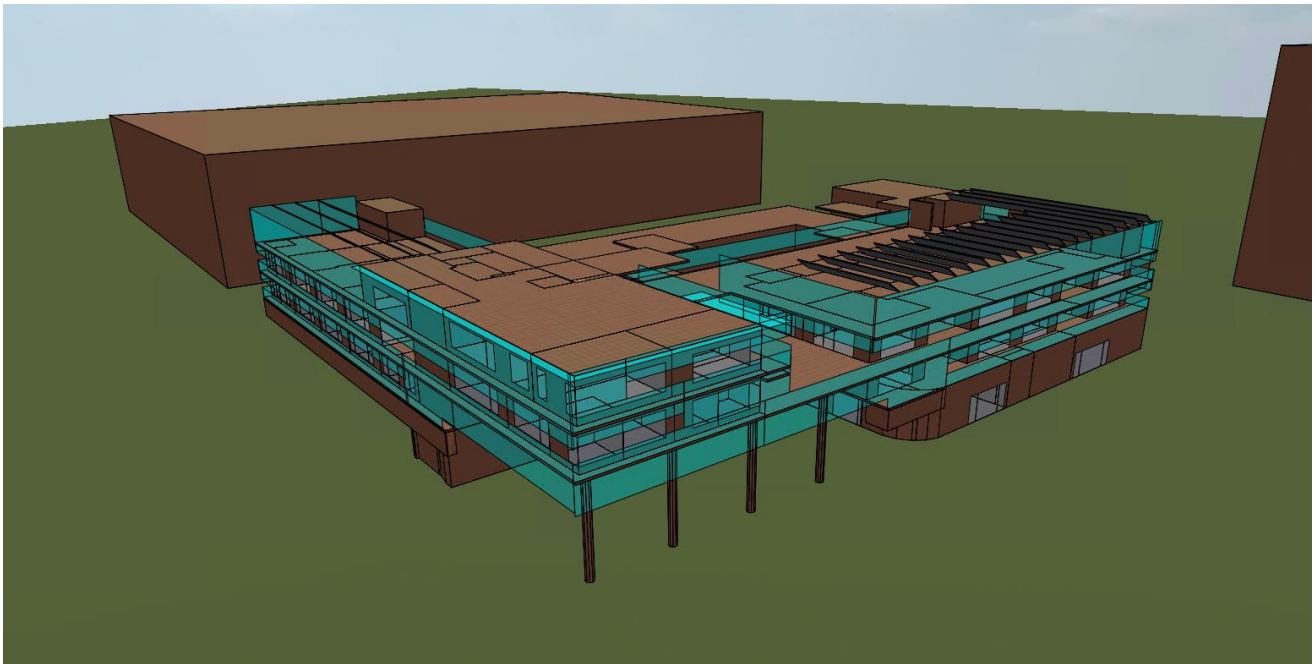


Figure 1 – Geometry and shading

J3 – BUILDING SEALING

The Deemed to Satisfy provisions of Part J3 – Building Sealing apply to elements forming the thermal envelope of Class 9b Buildings.

- For areas of the buildings where mechanical ventilation provides sufficient pressurisation to prevent infiltration, the following provisions of Part J3 do not apply.
- For areas where positive pressure cannot be maintained e.g. areas served by a split air conditioning system with no outside air provisions, or the area is considered as a conditioned space from Section J perspective with make-up air coming from the adjacent conditioned space (toilet, store rooms, etc), then the Part J3 requirement is applicable.

Table 4 Part J3 Building Sealing Compliance

Part J3 Building Sealing Compliance	
Section J3.3 – Roof Lights	
Requirement:	A roof light must be sealed, or capable of being sealed and constructed with: <ul style="list-style-type: none"> ▶ An imperforate ceiling diffuser or the like installed at the ceiling or internal lining level; or ▶ A weatherproof seal; or ▶ A shutter system readily operated either manually, mechanically or electronically by the occupant.
Action Required:	Architect to ensure the design meets these requirements.
Section J3.4 – Windows and Doors	



Part J3 Building Sealing Compliance	
<p>▶ Requirement:</p>	<p>Doors and windows that form part of thermal enveloped boundary must meet or exceed the following requirements:</p> <ul style="list-style-type: none"> ▶ must be fitted with a seal to restrict air infiltration: <ul style="list-style-type: none"> - a draft protection device to the bottom edge of doors and - foam or rubber compression strips, fibrous seals, or equivalent, to the other edges of doors and edges of openable windows. ▶ The entrance doors must be provided with a self-closing mechanism, except if leading to conditioned space of less than 50m² or for a café, restaurant, open front shop or the like, be provided with a 3m deep un-conditioned zone. ▶ Exceptions are allowed for windows complying with AS 2047, a fire door or smoke doors and roller shutter doors, roller shutter grilles and other security doors or device installed only for out-of-hours security.
Action Required:	Architect to ensure the design meets these requirements.
Section J3.5 – Exhaust fans	
Requirement:	Clause J3.5 required that exhaust fans when serving conditioned spaces and habitable room are fitted with a sealing device, such as a self-closing damper.
Action Required:	The mechanical engineer to confirm that all applicable fans meet these requirements.
Section J3.6 – Construction of Roofs, Walls and Floors	
Requirement:	Roofs, ceilings, walls, floors and any openings through the building envelope are constructed to minimise air leakage, with internal lining systems that are close fitting at ceiling, wall and floor junctions, or sealed by close fitting architrave, skirting or cornice or by expanding foam, rubber compressible strip, caulking or the like.
Action Required:	Architect to ensure requirements incorporated into the design.

Please do not hesitate to contact the undersigned should you wish to discuss any of the above.

NORMAN DISNEY & YOUNG

Nathaniel Masters | Project Engineer
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- Enclosed:
- Appendix A General Requirement for Thermal Construction
 - Appendix B Glazing Calculation
 - Appendix C Typical Construction Details
 - Appendix D Thermal Performance Requirement



APPENDIX A – GENERAL REQUIREMENT FOR THERMAL CONSTRUCTION

J1.2 Thermal construction — general

- a) Where required, insulation must comply with AS/NZS 4859.1 and be installed so that it—
 - i. abuts or overlaps adjoining insulation other than at supporting members such as studs, noggings, joists, furring channels and the like where the insulation must be against the member; and
 - ii. forms a continuous barrier with ceilings, walls, bulkheads, floors or the like that inherently contribute to the
 - iii. thermal barrier; and
 - iv. does not affect the safe or effective operation of a service or fitting.
- b) Where required, reflective insulation must be installed with—
 - i. the necessary airspace to achieve the required R-Value between a reflective side of the reflective insulation and a building lining or cladding; and
 - ii. the reflective insulation closely fitted against any penetration, door or window opening; and
 - iii. the reflective insulation adequately supported by framing members; and
 - iv. each adjoining sheet of roll membrane being—
 - a. overlapped not less than 50 mm; or
 - b. taped together.
- c) Where required, bulk insulation must be installed so that—
 - i. it maintains its position and thickness, other than where it is compressed between cladding and supporting members, water pipes, electrical cabling or the like; and
 - ii. in a ceiling, where there is no bulk insulation or reflective insulation in the wall beneath, it overlaps the wall by not less than 50 mm.
- d) Roof, ceiling, wall and floor materials, and associated surfaces are deemed to have the thermal properties listed in Specification J1.2.
- e) The required Total R-Value and Total System U-Value, including allowance for thermal bridging, must be—
 - i. calculated in accordance with AS/NZS 4859.2 for a roof or floor; or
 - ii. determined in accordance with Specification J1.5a for wall-glazing construction; or
 - iii. determined in accordance with Specification J1.6 or Section 3.5 of CIBSE Guide A for soil or sub-floor spaces.



APPENDIX B – DEEMED TO SATISFY WALL- GLAZING CALCULATOR

Table 5: Green Square Integrated Community Facility & School (GSICFS) – Option 1 Ground Floor Glazing Calculator 100%

Climate Zone	5							
	Method 1				Method 2			
	System U value	Allowance used	Solar admittance	Allowance used	System U value	Allowance used	Air-conditioning energy	Allowance used
North	2.47	123%	0.146	112%	2.00	100%	705.849	100%
East	2.32	116%	0.090	69%				
South	2.43	121%	0.145	111%				
West	2.45	122%	0.109	84%				
Internal	0.00	0%	NA	NA				

Wall	Orientation	Area (m ²)	R value (m ² .K/W)	Class	Exposure	WWR	Minimum R value (m ² .K/W)	Wall R value	Total U value [1]
Level 00									
L00 North	North	310.9	1.0	9b	External	33%	1.0	✓	✗
L00 East	East	306.3	1.0	9b	External	23%	1.0	✓	✓
L00 South	South	267.7	1.0	9b	External	23%	1.0	✓	✓
L00 West	West	325.9	1.0	9b	External	15%	1.0	✓	✓
	Internal	275.5			Internal	0%			
Level 01									
L01 North	North	231.0	1.0	9b	External	46%	1.0	✓	✗
L01 East	East	230.3	1.0	9b	External	45%	1.0	✓	✗
L01 South	South	214.8	1.0	9b	External	48%	1.0	✓	✗
L01 West	West	195.0	1.0	9b	External	61%	1.0	✓	✗
	Internal	144.0			Internal	0%			



Level 02									
L02 North	North	337.8	1.0	9b	External	47%	1.0	✓	✗
L02 East	East	246.0	1.0	9b	External	46%	1.0	✓	✗
L02 South	South	280.2	1.0	9b	External	50%	1.0	✓	✗
L02 West	West	245.5	1.0	9b	External	57%	1.0	✓	✗
	Internal	194.0			Internal	0%			
Level 03									
L03 North	North	111.8	1.0	9b	External	39%	1.0	✓	✗
L03 East	East	61.1	1.0	9b	External	47%	1.0	✓	✗
L03 South	South	98.9	1.0	9b	External	45%	1.0	✓	✗
L03 West	West	60.6	1.0	9b	External	52%	1.0	✓	✗
	Internal	131.3			Internal	0%			
Window	Wall	Width	Height	Area	System U value	System SHGC	Display window?	P	H
Level 00									
W1-W3,W3a	L00 North			71.7	4.5	0.57		2.6	5.2
W8a	L00 North	1.0	3.0		4.5	0.57		6.5	5.2
W8b	L00 North	2.0	3.0		4.5	0.57		7.5	5.2
W8c	L00 North	0.8	3.0		4.5	0.57		9.5	5.2
W9	L00 North			20.4	4.5	0.57		9.2	5.2
W4	L00 East			18.8	4.5	0.57		0.6	5.2
W10toW12	L00 East			52.8	4.5	0.57		5.2	5.2
W6	L00 South			15.5	4.5	0.57		2.0	5.2
W13	L00 South			45.0	4.5	0.57		0.3	5.2
W7	L00 West			7.2	4.5	0.57		20.4	5.2



W14,W15	L00 West			41.3	4.5	0.57		0.0	0.0
Level 01									
W16toW21	L01 North			71.5	4.5	0.57		0.7	3.0
W35a	L01 North	1.3	2.8		4.5	0.57		14.2	3.6
W35b	L01 North	1.3	2.8		4.5	0.57		13.0	3.6
W35c	L01 North	2.5	2.8		4.5	0.57		10.5	3.6
W35d	L01 North	1.3	2.8		4.5	0.57		9.2	3.6
W36	L01 North			3.5	4.5	0.57		6.7	3.6
W22toW24	L01 East			19.1	4.5	0.57		0.7	3.6
W27	L01 East			10.6	4.5	0.57		4.2	3.6
W34	L01 East			14.6	4.5	0.57		16.5	3.6
W37toW44	L01 East			59.5	4.5	0.57		5.2	3.6
W26	L01 South			23.8	4.5	0.57		7.9	3.6
W28-W32	L01 South			44.0	4.5	0.57		4.2	3.6
W45-W46	L01 South			22.0	4.5	0.57		0.7	3.6
W33a	L01 West	1.3	2.1		4.5	0.57		4.5	3.4
W33b	L01 West	1.3	2.1		4.5	0.57		5.7	3.4
W33c	L01 West	1.3	2.1		4.5	0.57		7.0	3.4
W25	L01 West			9.3	4.5	0.57		4.6	3.6
W47,W51,W52,W56	L01 West			63.0	4.5	0.57		2.4	3.6
W49,W54	L01 West			38.6	4.5	0.57		6.7	3.6
W50a	L01 South	1.3	2.8		4.5	0.57		4.4	3.6
W50b	L01 South	1.3	2.8		4.5	0.57		5.7	3.6
W48a	L01 North	1.3	2.8		4.5	0.57		4.4	3.6
W48b	L01 North	1.3	2.8		4.5	0.57		5.7	3.6



W55a	L01 South	1.3	2.8		4.5	0.57		4.4	3.6
W55b	L01 South	1.3	2.8		4.5	0.57		5.7	3.6
W53a	L01 North	1.3	2.8		4.5	0.57		4.4	3.6
W53b	L01 North	1.3	2.8		4.5	0.57		5.7	3.6
Level 02									
W57-W66	L02 North			109.3	4.5	0.57		0.7	3.0
W85a	L02 North	1.3	2.8		4.5	0.57		4.5	3.6
W85b	L02 North	2.5	2.8		4.5	0.57		5.7	3.6
W85a	L02 North	1.3	2.8		4.5	0.57		8.2	3.6
W86c	L02 North	1.3	2.8		4.5	0.57		14.1	3.6
W86b	L02 North	2.5	2.8		4.5	0.57		11.6	3.6
W86c	L02 North	1.3	2.8		4.5	0.57		10.4	3.6
W88a	L02 North	1.3	2.8		4.5	0.57		6.6	3.6
W88b	L02 North	1.5	2.8		4.5	0.57		5.1	3.6
W101a	L02 North	1.3	2.8		4.5	0.57		4.5	3.6
W101b	L02 North	1.3	2.8		4.5	0.57		5.7	3.6
W106a	L02 North	1.3	2.8		4.5	0.57		4.5	3.6
W106b	L02 North	1.3	2.8		4.5	0.57		5.7	3.6
W67-W69	L02 East			19.3	4.5	0.57		0.7	3.0
W72a	L02 East	0.4	2.8		4.5	0.57		4.1	3.6
W72b	L02 East	1.3	2.8		4.5	0.57		5.8	3.6
W72c	L02 East	1.3	2.8		4.5	0.57		7.0	3.6
W76	L02 East			9.9	4.5	0.57		6.3	3.6
W87	L02 East			5.3	4.5	0.57		7.9	3.6
W89-W97	L02 East			69.7	4.5	0.57		5.1	3.6
W71	L02 South			21.0	4.5	0.57		7.9	3.6



W73-W75	L02 South			54.4	4.5	0.57		4.1	3.6
W77a	L02 South	1.3	2.8		4.5	0.57		7.9	3.6
W77b	L02 South	1.3	2.8		4.5	0.57		9.1	3.6
W77c	L02 South	2.5	2.8		4.5	0.57		10.4	3.6
W77d	L02 South	1.3	2.8		4.5	0.57		12.9	3.6
W77e	L02 South	1.3	2.8		4.5	0.57		14.1	3.6
W88	L02 South	1.3	2.8		4.5	0.57		0.7	3.6
W79	L02 South	1.3	2.8		4.5	0.57		4.5	3.6
W78	L02 South	2.5	2.8		4.5	0.57		6.9	3.6
W89-W99	L02 South			22.0	4.5	0.57		0.7	2.8
W103a	L02 South	1.3	2.8		4.5	0.57		4.5	3.6
W103b	L02 South	1.3	2.8		4.5	0.57		5.7	3.6
W101,W104,W105,W109	L02 West			70.0	4.5	0.57		2.6	3.6
W102,W107	L02 West			38.6	4.5	0.57		6.9	3.6
W81-W84	L02 West			31.5	4.5	0.57		0.7	2.8
Level 03									
W107toW111	L03 North			43.8	4.5	0.57		0.7	3.6
W112a	L03 East	1.3	3.8		4.5	0.57		0.9	3.6
W112b	L03 East	1.3	3.4		4.5	0.57		2.2	3.6
W121	L03 East			10.0	4.5	0.57		3.4	2.8
W113	L03 East			9.9	4.5	0.57		6.3	3.6
W120	L03 South			9.9	4.5	0.57		3.7	3.6
W114toW117	L03 South			35.0	4.5	0.57		2.4	3.6
W118,W119	L03 West			31.5	4.5	0.57		0.7	3.0



APPENDIX C – TYPICAL CONSTRUCTION DETAILS

The following tables provide R-value calculation for typical construction in order to provide preliminary estimates of the construction built-up to achieve the required R-value. The calculations are to be verified by façade consultant. Note to achieve some of the higher insulation levels, insulative materials other than rock wool should be considered to reduce thicknesses.

Table 6: R1.0 Internal walls

Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Indoor Air Film			0.12	100%	0.12
200mm Concrete	200	1.44	0.14	100%	0.14
Insulation (Rockwool)	40	0.034	1.18	89%	0.57
Framing 35mm (600mmx600mm)	90	50	0.11	11.3%	
Plasterboard	13	0.17	0.076471	100%	0.08
Indoor Air Film			0.12	100%	0.12
R total					1.03

Table 7: R1.2 Internal walls

Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Indoor Air Film			0.12	100%	0.12
200mm Concrete	200	1.44	0.14	100%	0.14
Insulation (Rockwool)	90	0.034	2.65	89%	0.76
Framing 35mm (600mmx600mm)	90	50	0.11	11.3%	
Plasterboard	13	0.17	0.076471	100%	0.08
Indoor Air Film			0.12	100%	0.12
R total					1.21



Table 8: R1.0 Internal walls

Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Indoor Air Film			0.12	100%	0.12
Plasterboard	13	0.17	0.076471	100%	0.08
Insulation (Rockwool)	90	0.034	2.65	89%	0.76
Framing 35mm (600mmx600mm)	90	50	0.11	11.3%	
Plasterboard	13	0.17	0.076471	100%	0.08
Indoor Air Film			0.12	100%	0.12
R total					1.06

Table 9: R1.2 Internal walls

Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Indoor Air Film			0.12	100%	0.12
Plasterboard	13	0.17	0.076471	100%	0.08
Insulation (Rockwool)	230	0.034	2.65	89%	0.89
Framing 35mm (600mmx600mm)	90	50	0.11	11.3%	
Plasterboard	13	0.17	0.076471	100%	0.08
Indoor Air Film			0.12	100%	0.12
R total					1.20

Table 10: R1.0 External walls



Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Outdoor Air Film			0.03	100%	0.03
300mm Concrete	300	1.44	0.21	100%	0.21
Insulation (Rockwool)	50	0.034	1.47	89%	0.54
Framing 35mm (600mmx600mm)	50	50	0.09	11.3%	
Plasterboard	19	0.17	0.11	100%	0.11
Indoor Air Film			0.12	100%	0.12
R total					1.01

Table 11: R1.2 External walls

Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Outdoor Air Film			0.03	100%	0.03
300mm Concrete	300	1.44	0.21	100%	0.21
Insulation (Rockwool)	240	0.034	1.47	89%	0.73
Framing 35mm (600mmx600mm)	50	50	0.09	11.3%	
Plasterboard	19	0.17	0.11	100%	0.11
Indoor Air Film			0.12	100%	0.12
R total					1.01

Table 12: R2.0 Slab on Ground – Entry Reception - with additional insulation

Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Soil contact - R-value			1.052	100%	1.05
200mm Concrete	200	1.44	0.14	100%	0.14
Insulation (Polystyrene extruded)	20	0.028	0.71	100%	0.71
Indoor Air Film - upward			0.11	100%	0.11
R total					2.02

Table 13: R2.0 Exposed Floor Slab – R2.0



Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Indoor Air Film - downward			0.16	100%	0.16
200mm Concrete	200	1.44	0.14	100%	0.14
Insulation (Polystyrene extruded)	46	0.028	1.64	100%	1.64
Indoor Air movement			0.08	100%	0.08
R total					2.02

Table 14: R3.7 Roof/Ceiling

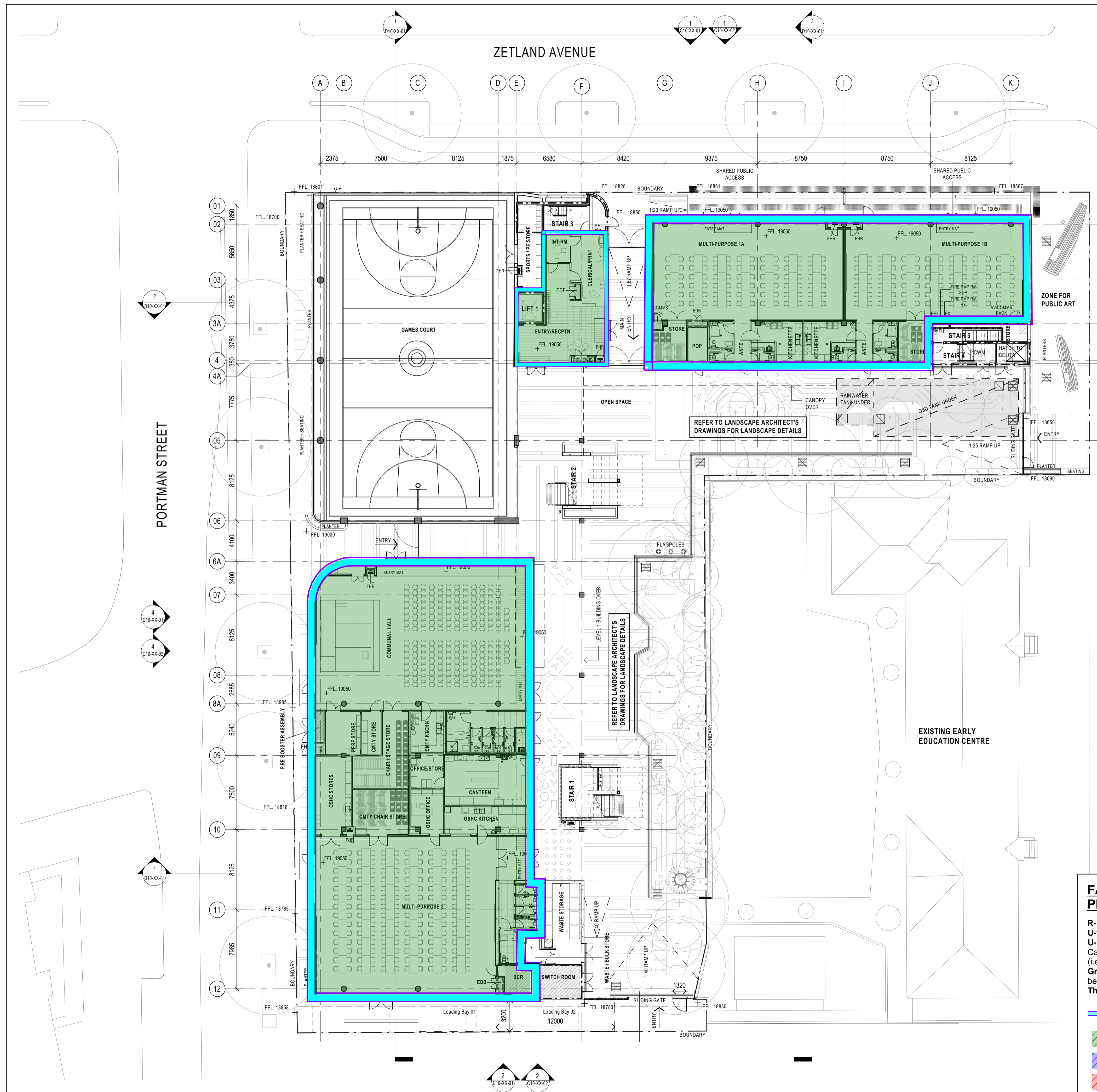
Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Outdoor Air Film			0.03	100%	0.03
Metal Roof Cladding	1.2	210	0.000006	100%	0.00
Insulation (Rockwool)	120	0.034	3.53	90%	1.36
Framing 60mm BMT 1.0 (1200mmx1200mm)	120	50	0.20	9.8%	
Additional continuous insulation - not in between roof battens	73	0.034	2.15	100%	2.15
Indoor Air Film - downward			0.11	100%	0.16
R total					3.70

Table 15: R4.3 Roof/Ceiling

Material Description	Thickness (mm)	Conductivity (k) W/m.K	R (m ² .K/W)	Area percentage	Total
Outdoor Air Film			0.03	100%	0.03
Metal Roof Cladding	1.2	210	0.000006	100%	0.00
Insulation (Rockwool)	900	0.034	3.53	90%	1.95
Framing 60mm BMT 1.0 (1200mmx1200mm)	120	50	0.20	9.8%	
Additional continuous insulation - not in between roof battens	73	0.034	2.15	100%	2.15
Indoor Air Film - downward			0.11	100%	0.16
R total					4.29



APPENDIX D – THERMAL PERFORMANCE REQUIREMENT



- FIRE RATED WALLS**
- 1 HOUR
 - 1.5 HOUR
 - 2 HOUR
 - 1 HOUR & SMOKE SEALED
- FIRE SERVICES ABBREVIATIONS**
- FHR FIRE HOSE REEL
 FH FIRE HYDRANT
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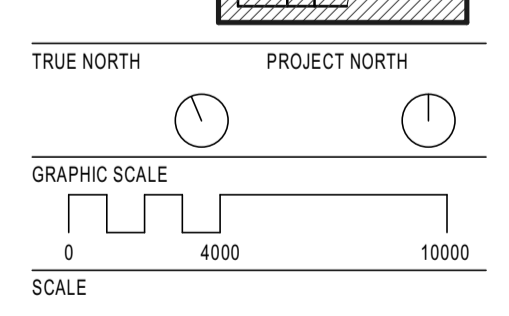
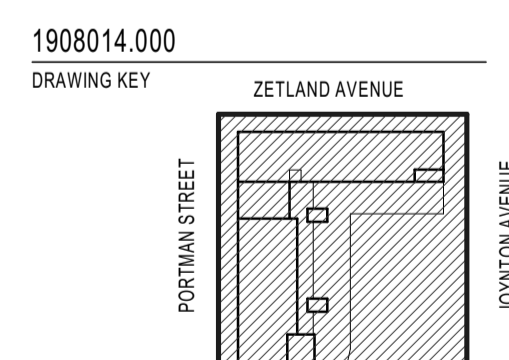
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 PROJECT

GREEN SQUARE INTEGRATED COMMUNITY FACILITY AND SCHOOL
 ZETLAND AVENUE, GREEN SQUARE 2017
 BVN PROJECT NUMBER



DESIGN DEVELOPMENT
 DRAWING

GA PLAN - GROUND LEVEL

ISSUE

AR-B10-00-00

4

FABRIC CONDUCTIVE THERMAL PERFORMANCE REQUIREMENTS

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Ground-contact floors: The allowable contribution under Specification J1.6 has already been accounted for.
Thermal construction quality: Comply with NCC 2019 clauses J1.2(a), (b) and (c).

- OVERALL WALLS - R1.0
 OVERALL WALL-GLAZING CONSTRUCTION AVERAGE: U2.0
- FLOOR - R2.0 TOTAL- SLAB-ON-GROUND (LOOKING DOWN) WITH R0.95 ADDITIONAL INSULATION
- FLOOR - R2.0 TOTAL- EXPOSED-GROUND (LOOKING DOWN)
- ROOF/ CEILING - R4.3 (DOWNWARD HEAT FLOW)

Norman Disney & Young

Project: Green Square School Redevlopment

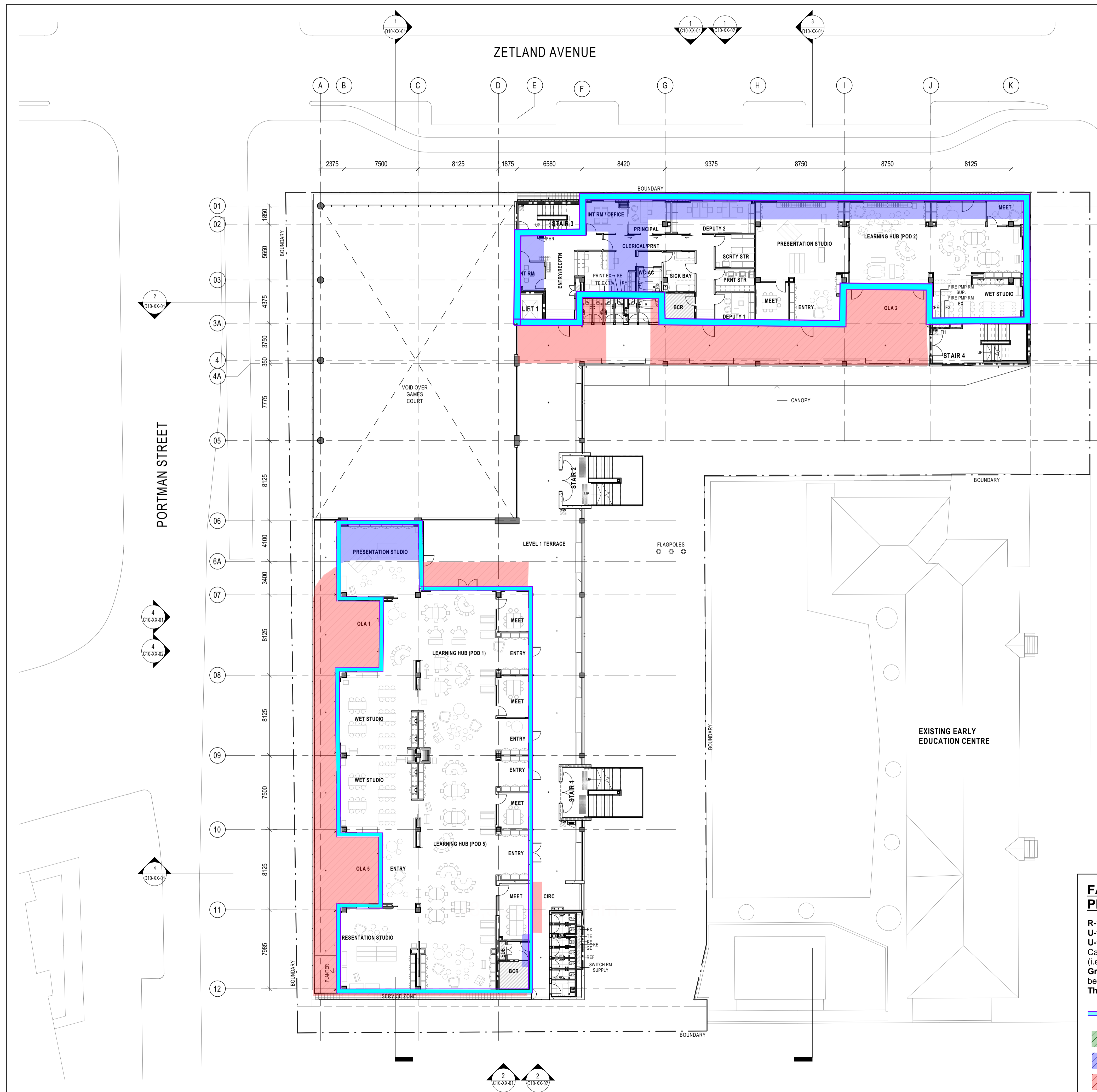
Rev: Section J - Thermal Insulation Requirements

Document Number: 200720_NDY-SK-G-001

Project No: 98879-001 Drawn: ST Date: 20/04/21 Scale: 1:200 Rev: 4.0

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FIRE RATED WALLS

- 1 HOUR
- 1.5 HOUR
- 2 HOUR
- 1 HOUR & SMOKE SEALED

FIRE SERVICES ABBREVIATIONS

FHR FIRE HOSE REEL
FH FIRE HYDRANT

SERVICES DISCIPLINES

- MECHANICAL SERVICES
- FIRE SERVICES
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- COMMS SERVICES
- HYDRAULIC SERVICES

SERVICES ABBREVIATIONS

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KE KITCHEN EXHAUST
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GREEN SQUARE INTEGRATED
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ZETLAND AVENUE, GREEN SQUARE 2017
BVN PROJECT NUMBER

1908014.000

DRAWING KEY

ZETLAND AVENUE

PORTMAN STREET

JOYNTON AVENUE

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

0 4000 10000

SCALE

1:200@A1

STATUS

DESIGN DEVELOPMENT
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GA PLAN - LEVEL 01

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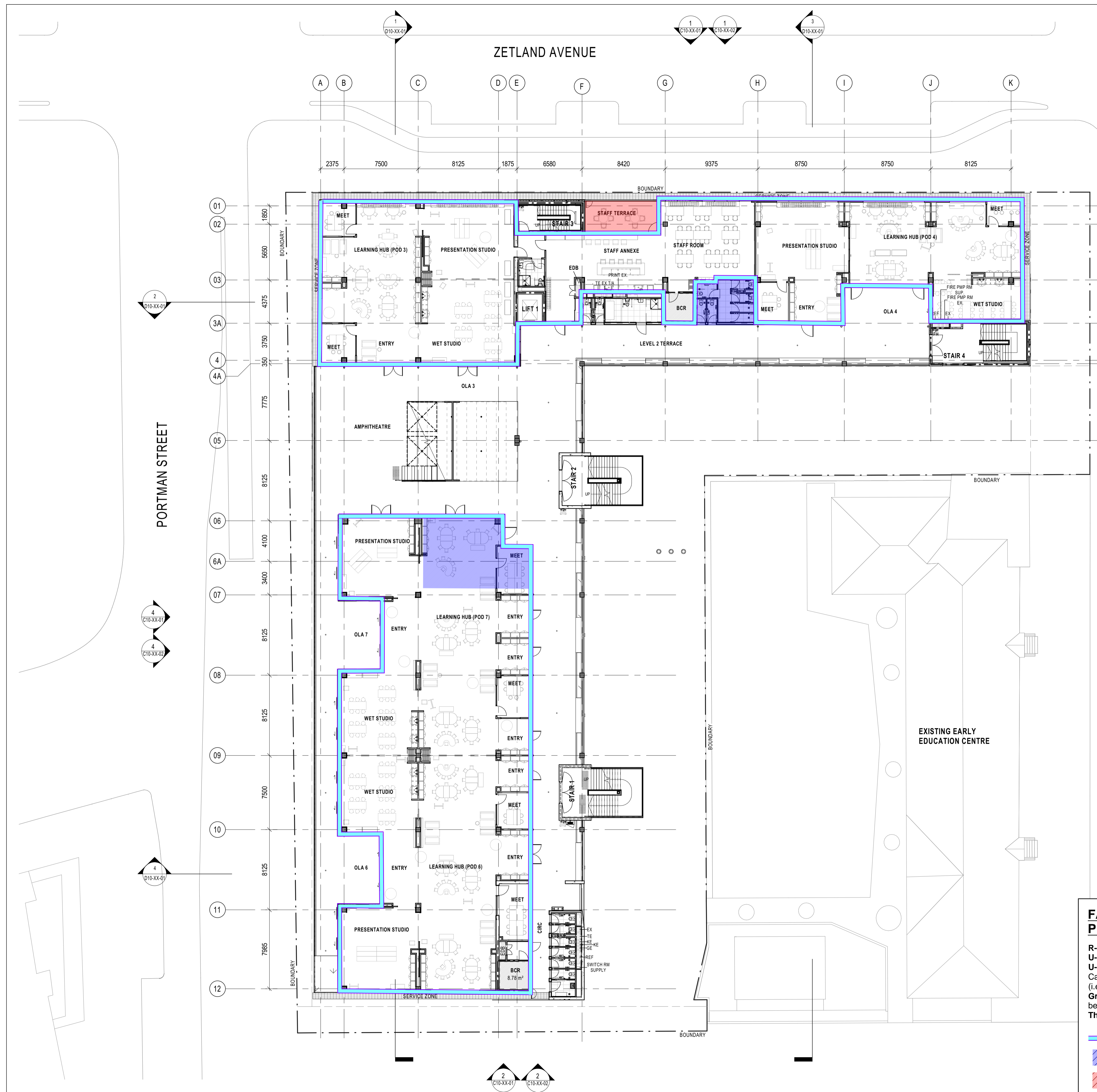
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OVERALL WALL-GLAZING CONSTRUCTION AVERAGE: U2.0
- FLOOR - R2.0 TOTAL- SLAB-ON-GROUND (LOOKING DOWN) WITH R0.95 ADDITIONAL INSULATION
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A TETRA TECH COMPANY

Project: Green Square School Redevelopment
Title: Section J - Thermal Insulation Requirements
Document Number: 200720_NDY-SK-G-001
Project No: 98879-001 Drawn: ST Date: 20/03/21 Scale: 1:200 Rev: 4.0



- FIRE RATED WALLS**
- 1 HOUR
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 - 2 HOUR
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GREEN SQUARE INTEGRATED
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 ZETLAND AVENUE, GREEN SQUARE 2017
 BVN PROJECT NUMBER

1908014.000

DRAWING KEY

ZETLAND AVENUE

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TRUE NORTH

PROJECT NORTH

GRAPHIC SCALE

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1:200@A1

STATUS

DESIGN DEVELOPMENT

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Project: Green Square School Redevelopment

Title: Section J - Thermal Insulation Requirements

Document Number: 200720_NDY-SK-G-001

Project No: 98879-001 Drawn: ST Date: 20/03/21 Scale: 1:200 Rev: 4.0

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 OVERALL WALL-GLAZING CONSTRUCTION AVERAGE: U2.0
- FLOOR - R2.0 TOTAL- EXPOSED-GROUND (LOOKING DOWN)
- ROOF/CEILING - R4.3 (DOWNWARD HEAT FLOW)

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1908014.000

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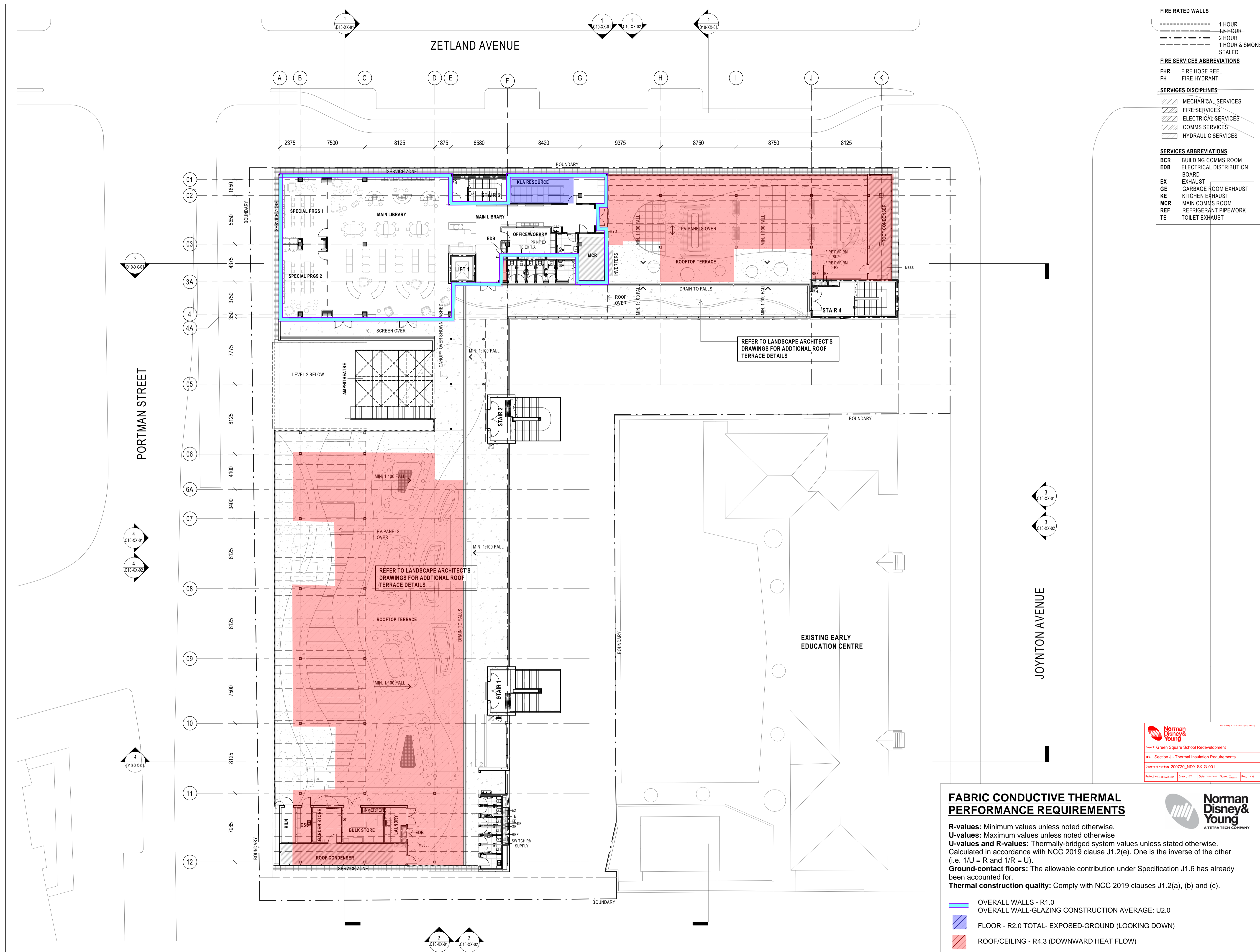
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GA PLAN - LEVEL 02

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3



- FIRE RATED WALLS**
- 1 HOUR
 - 1.5 HOUR
 - 2 HOUR
 - 1 HOUR & SMOKE SEALED
- FIRE SERVICES ABBREVIATIONS**
- FHR FIRE HOSE REEL
 FH FIRE HYDRANT
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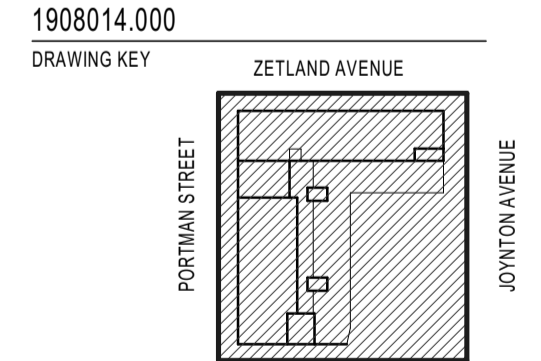
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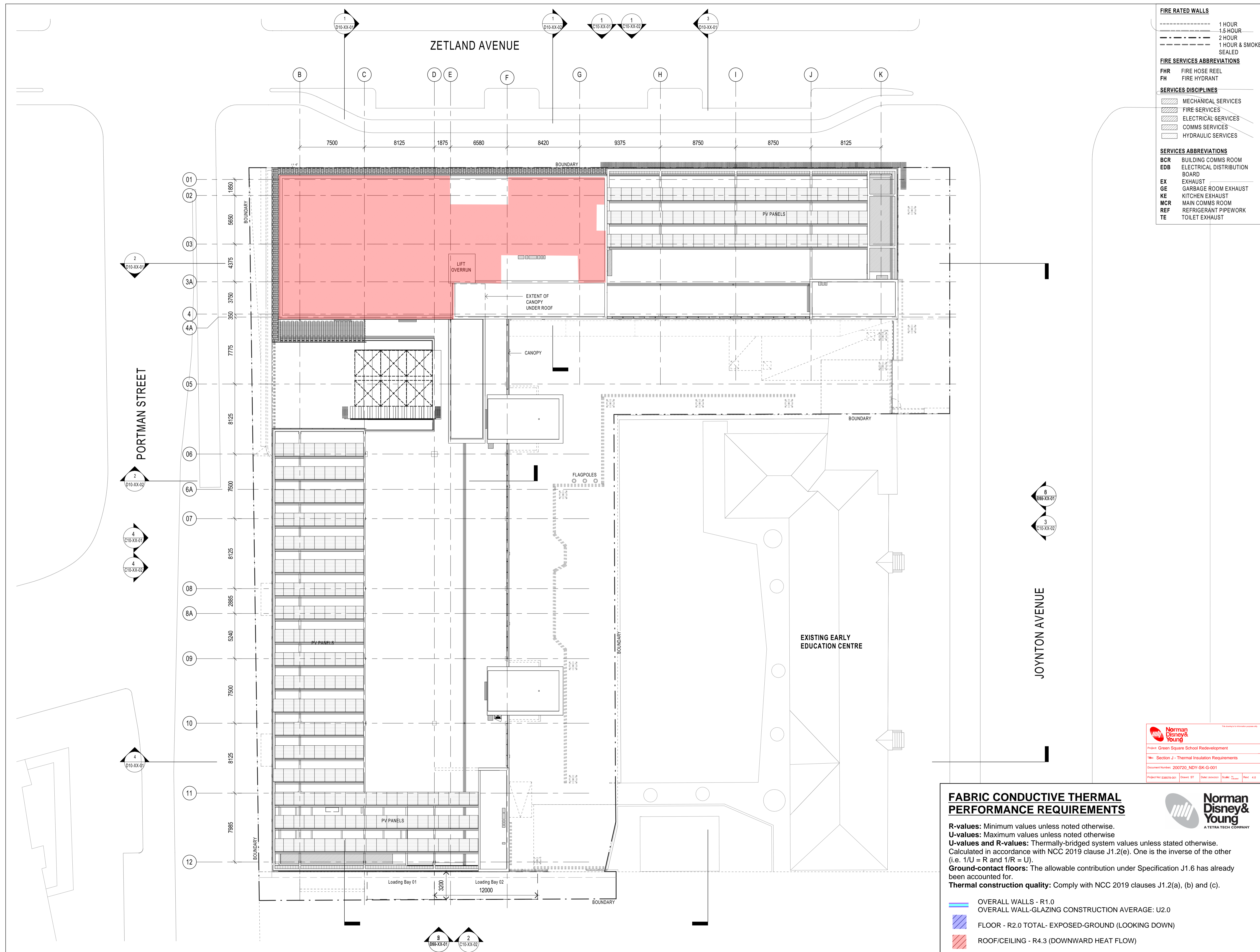
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- OVERALL WALLS - R1.0
- OVERALL WALL-GLAZING CONSTRUCTION AVERAGE: U2.0
- FLOOR - R2.0 TOTAL - EXPOSED-GROUND (LOOKING DOWN)
- ROOF/CEILING - R4.3 (DOWNWARD HEAT FLOW)

Norman Disney & Young
 A TETRA TECH COMPANY

Project: Green Square School Redevelopment
 Title: Section J - Thermal Insulation Requirements
 Document Number: 200720_NDY-SK-G-001
 Project No: 200720-001 | Client: B1 | Date Issued: | Scale: | Rev: 4.0



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PROJECT

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ZETLAND AVENUE, GREEN SQUARE 2017
BVN PROJECT NUMBER

1908014.000

DRAWING KEY

ZETLAND AVENUE

PORTMAN STREET

JOYNTON AVENUE

TRUE NORTH

PROJECT NORTH

GRAPHIC SCALE

0 4000 10000

SCALE

1:200@A1

STATUS

DESIGN DEVELOPMENT

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GA PLAN - ROOF PLAN

ISSUE

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3

FABRIC CONDUCTIVE THERMAL PERFORMANCE REQUIREMENTS

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- FLOOR - R2.0 TOTAL - EXPOSED-GROUND (LOOKING DOWN)
- ROOF/CEILING - R4.3 (DOWNWARD HEAT FLOW)

Norman Disney & Young
A TETRA TECH COMPANY

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Title: Section J - Thermal Insulation Requirements
Document Number: 200720_NDY-SK-G-001
Project No: 200720-001 | Drawn: ST | Date Issued: | Scale: | Rev: 4.0

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NDY QA SYSTEM

Revision No: 0.5
Revision Date: 26 July 2021
Description: FOR SSSA SUBMISSION
Filename: rp200923s0001_Green Square Integrated
File Location: Community Facility & School_DA Report
\\tt.local\ndy\syd\w\S385xx\S38578\001\
G-\24_Reports
Client Name: BVN
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