GHDWOODHEAD

Ecologically Sustainable Development Report

North Kellyville New Primary School

New and Upgrade Works for schools in North and West Sydney
DoEAMD–16–71
August 2017
Revision 0

Architecture
Interior Design
Planning
Urban Design
Landscape Architecture
Sustainable Design

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Document Status

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01 Introduction

Ecologically Sustainable Development (ESD) is governed by certain statutory regulations and guidelines, as well as GHDWoodhead's best practice ESD principles and methodology. The following section outlines the statutory regulations and guidelines that this ESD report complies with, relevant to the design of North Kellyville New Primary School.

1.1 Governance

As a State Significant Development (SSD) the project has been designed in accordance with the Department of Education Secretary's Environmental Assessment Requirements (SEARs), Item 6. Ecologically Sustainable Development (ESD). For the definition of ESD SEARS refers to Environmental Planning Assessment Regulation (EPAR, 2000). As a guide to how this should best be implemented, this assessment refers to EFSG (Education Facilities Standards and Guidelines) DG02 Ecologically Sustainable Development.

1.1.1 Environmental Planning Assessment Regulation (EPAR, 2000)

7.(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.

1.1.2 SEARS ITEMS

SSD 8344 ITEM	ACTION TO ADDRESS REQUIREMENT	DOCUMENTATION
6. Ecologically Sustainable Development (ESD) · Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated in the design and ongoing operation phases of the development.	Prepare an ESD report outlining ESD principles (as defined by EPAR [2000]) as they have been applied to the project design	ESD Report
· Demonstrate that the development has been assessed against a suitably accredited rating scheme to meet industry best practice.	Conduct a Self-Assessment of the project against the GBCA Green Star Rating Tool (As per EFSG DG02)	ESD Report, Appendix 01
· Include a description of the measures that would be implemented to minimise consumption of resources, water (including water sensitive urban design) and energy.	Minimisation of consumption of resources incorporated into the project design	ESD Report, Sections 02 & 03

Table 1.1 SEARS Items

1.1.3 ESFG DG02

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

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

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

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

EFSG 02.02 NSW Government Resource Efficiency Policy (GREP)

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

EFSG 02.03 Environmental Design Policies

The following design policies are applicable to DoE facilities:

Green Building Design and Green Star

The Green Building Council of Australia (GBCA) is an independent body whose key objective is to promote the integration and advancement of sustainable building technologies and design practices into the mainstream building design processes.

To assist the building design industry the Green Building Council have developed Green Star rating tools to assess a building's sustainable design credentials.

The Green Star - Education v1 Design & As Built rating tool* would be the most appropriate for assessing new school sustainable design principles.

Green Star Requirements

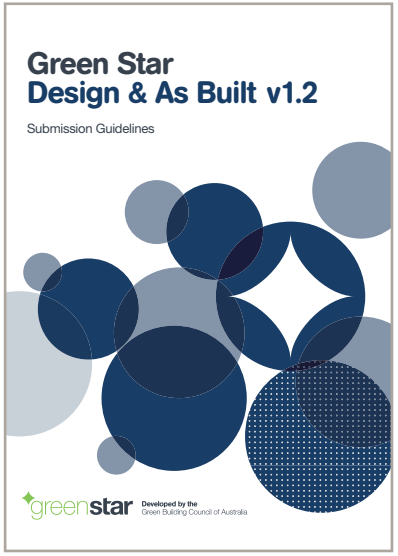
SEARS requires the assessment of the development against a suitably accredited rating scheme. The DoE EFSG refers to the green star rating tool. The current green star rating tool was chosen to meet the sears requirements.

1.1.4 Green Star Rating Scheme

Green Star is an internationally recognised rating system that delivers independent verification of sustainable outcomes throughout the life cycle of the built environment. '**Green Star – Design & As Built v1.2**' certification identifies projects that have demonstrated the achievement of a specific level of sustainability. The rating describes to the industry the sustainability attributes of the project in terms that are widely understood and accepted.

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

- Management;
- Indoor Environment Quality;
- Energy;



GREEN STAR RATING SCHEME

- Transport;
- Water;
- Materials;
- Land Use and Ecology;
- Emissions; and
- Innovation

*This Legacy Rating Tool is now superseded by *Green Star – Design & As Built v1.2*

1.2 Description of the Project

This section outlines ESD challenges and opportunities that are specific to the North Kellyville New Primary School project, including:

- local climate;
- site investigation;
- sustainable design principles; and
- environmental performance targets.

1.2.1 Climate

The North Kellyville New Primary School site is within Climate Zone 6, Sydney West (ABCB; Figure 1.1). This climate zone is characterised as mild temperate, which has low diurnal temperature range near the coast to high diurnal range inland, and has four distinct seasons. Summer and winter can exceed human comfort ranges, while spring and autumn are ideal for human comfort. The zone also has variable humidity, with mild to cool winters with low humidity and hot to very hot summers with moderate humidity.[1]

The site has a high ridge line running approximately northeast to southwest. This elevates the majority of the site, so it is exposed to the high winds of the Sydney inland region, which bring hot dry winds from the north-west in summer and cold winter winds from the west. As demonstrated by Sydney wind rose (Figure 1.3), the site experiences cooling summer breezes from the south-south-east that swing around to north-westerly in the afternoon but can also be subject to severe hail and wind storms, carried by cold winter winds from the west and south.

The graph in Figure 1.2 shows a variable temperature range for the site, which includes an extreme high temperature of over 42.5°C in summer and an extreme low temperature of -7.2°C in winter.

[1]Source: http://www.yourhome.gov.au/passive-design/design-climate

1.2.2 Site Specific Design Challenges

The site covers approximately 2.5 hectares currently being used as rural land. The surrounding area is currently undergoing extensive residential (small lot houses) and community infrastructure development. There is also a proposed park across Prentice Ave to the south of the site, which may be an asset to both the school for future shared use.

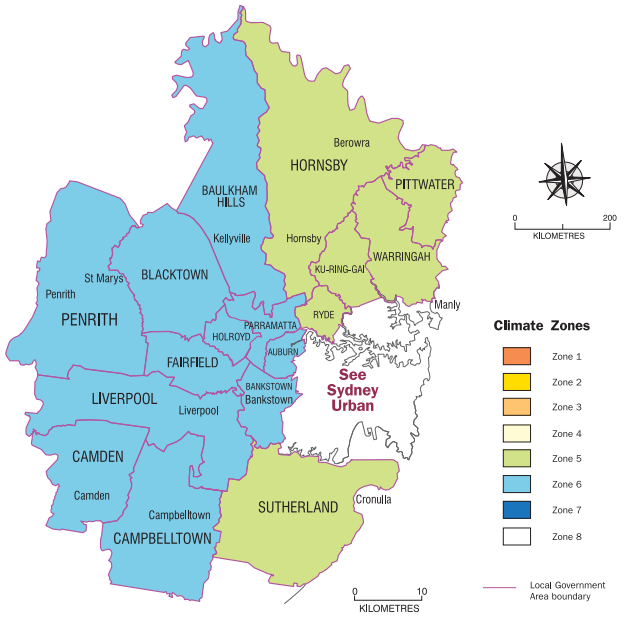


Figure 1.1 NCCA climate zones for the Sydney Region
Source: NCCA

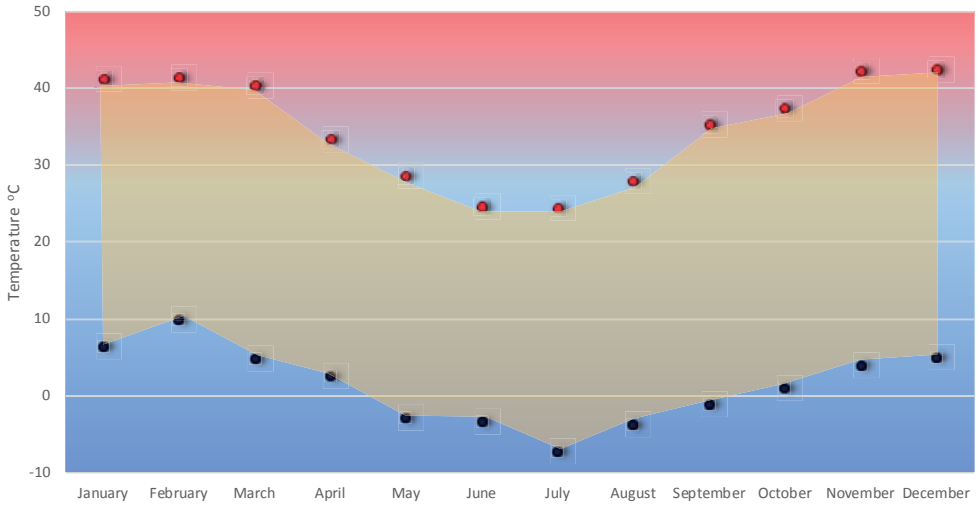


Figure 1.2 Temperature range expressing the lowest and highest recorded temperatures per month for Richmond, NSW *Source: BOM Climate (Station 067021 RICHMOND - UWS HAWKESBURY)*

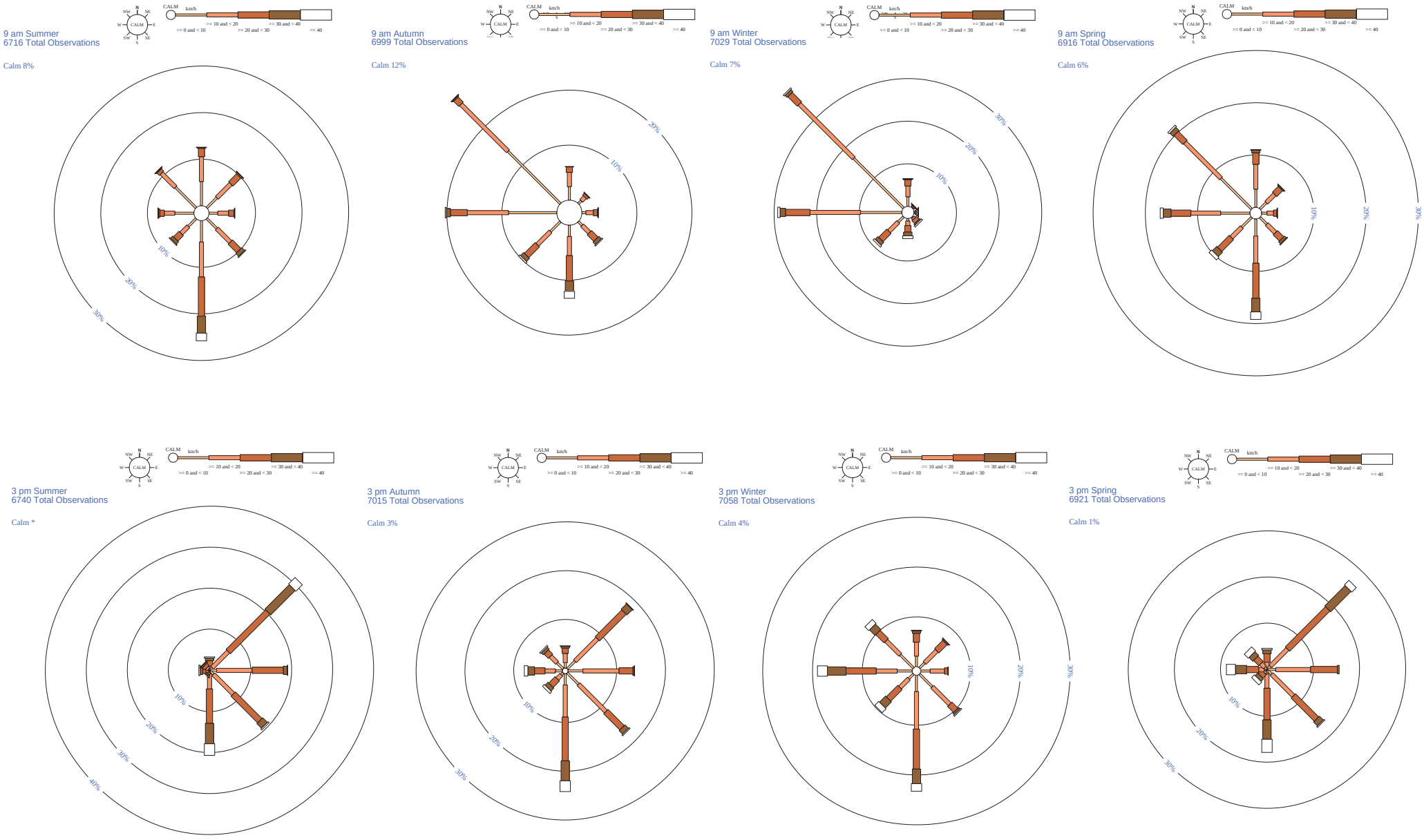


Figure 1.3 Wind rose for the Sydney region for 9am and 3pm by season
Source: BOM Climate

The site has a fall of approximately 7 meters from the Eastern boundary to the Western boundary and the northern section is sloped to the north-west, where an existing farm dam collects stormwater. The southern section, which has less dense vegetation, is sloped to the west where the surface runoff is collected by a dam outside of the proposed site boundary. It is assumed that the existing Curtis Rd raingarden system will be appropriate to connect the proposed new sites stormwater drainage network into.

1.2.3 Environmental Performance Targets

In order to achieve ESD outcomes for the project in line with SEARS and EFSG requirements and guidelines, environmental performance targets were established during concept design phase. A complete sustainable building strategy includes a multitude of tactics including, but not limited to, energy efficiency, air quality, and water use reduction. The aim of the design is to develop a building and landscape where the culture of environmental awareness and minimising our ecological impact is manifested in the building design and in how user groups utilise the building. In this way, the building is an educational tool for learning about sustainability.

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

- Maintaining and restoring local landscape and creating habitat
- Optimising built forms for natural ventilation and cooling
- Minimising building depths
- Optimising for natural daylighting
- North-South orientation, and minimising exposure to the West
- Reducing building footprint by having a two storey building
- Treating run-off on site and capture run-off and rainfall for re-use on site

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

Site Sustainability

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

Water Efficiency

- Low flow fixtures
- Tanks

Material & Resources

- Use of material containing recycled content wherever possible

Indoor Environmental Quality

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

Energy & Atmosphere

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

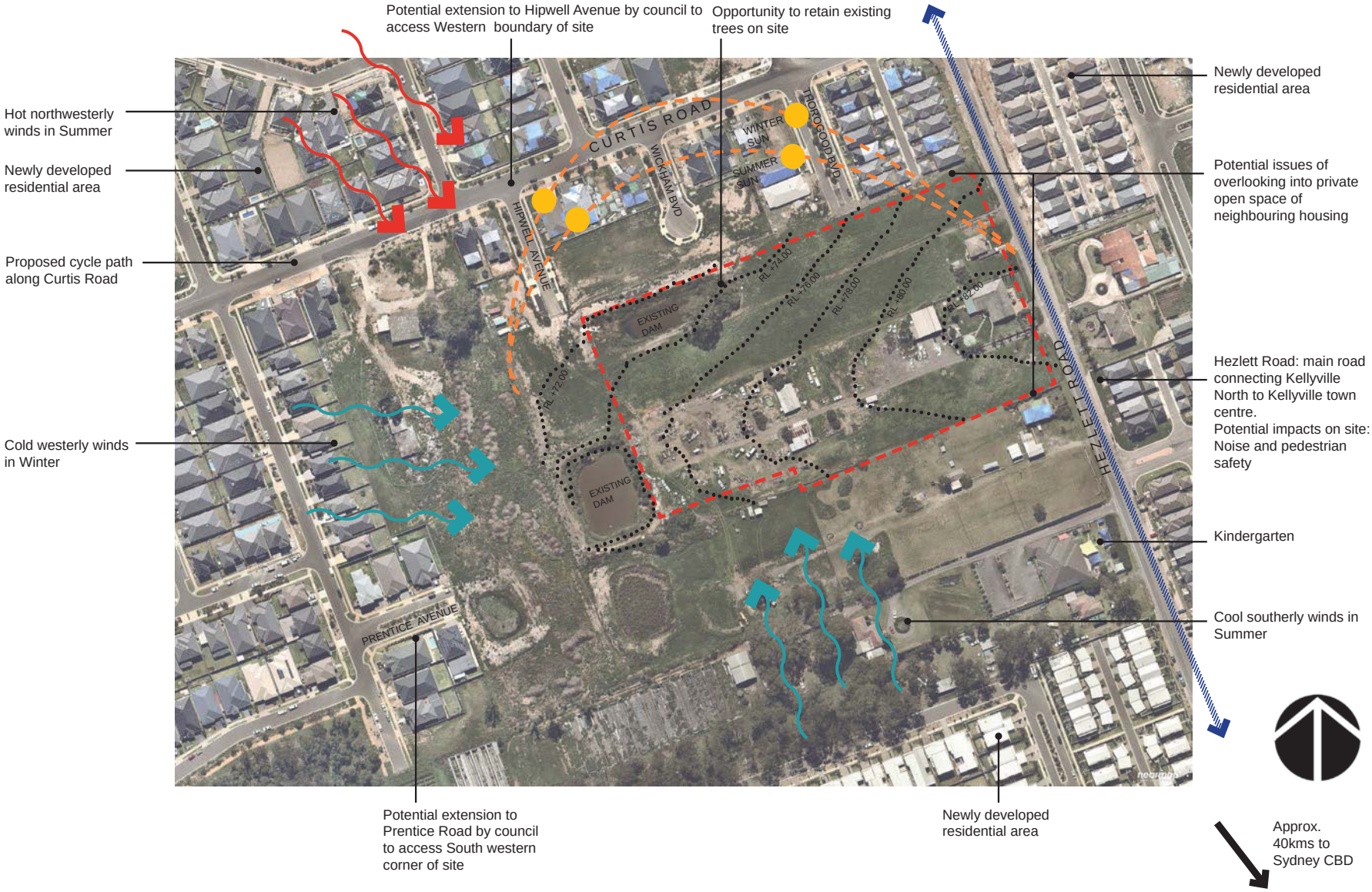


Figure 1.4 Site assessment

02 Indoor Environment Quality

2.1 Passive Design Principles

Passive design principles were developed early in the project and were crucial to guiding design since the project required the design of liveable spaces during all times of the year, which are reliant on natural ventilation. The following section outlines how these principles have been applied to the design.

The Courtyard

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

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

Formal landscaping is used in the spaces between the blocks. The courtyard shapes are replicated in the external landscaped squares to the west. Playing fields are wrapped around to the north to allow good solar access to the learning areas.

Advantages:

- Provides spaces protected from winds
- Provides visual privacy
- The orthogonal spaces respond well to the site geometry
- Allows for good cross ventilation for mainly single loaded learning areas

Disadvantages:

- Some west facing areas may be required
- More difficult to provide deeper floor plans for Leaning centre type planning

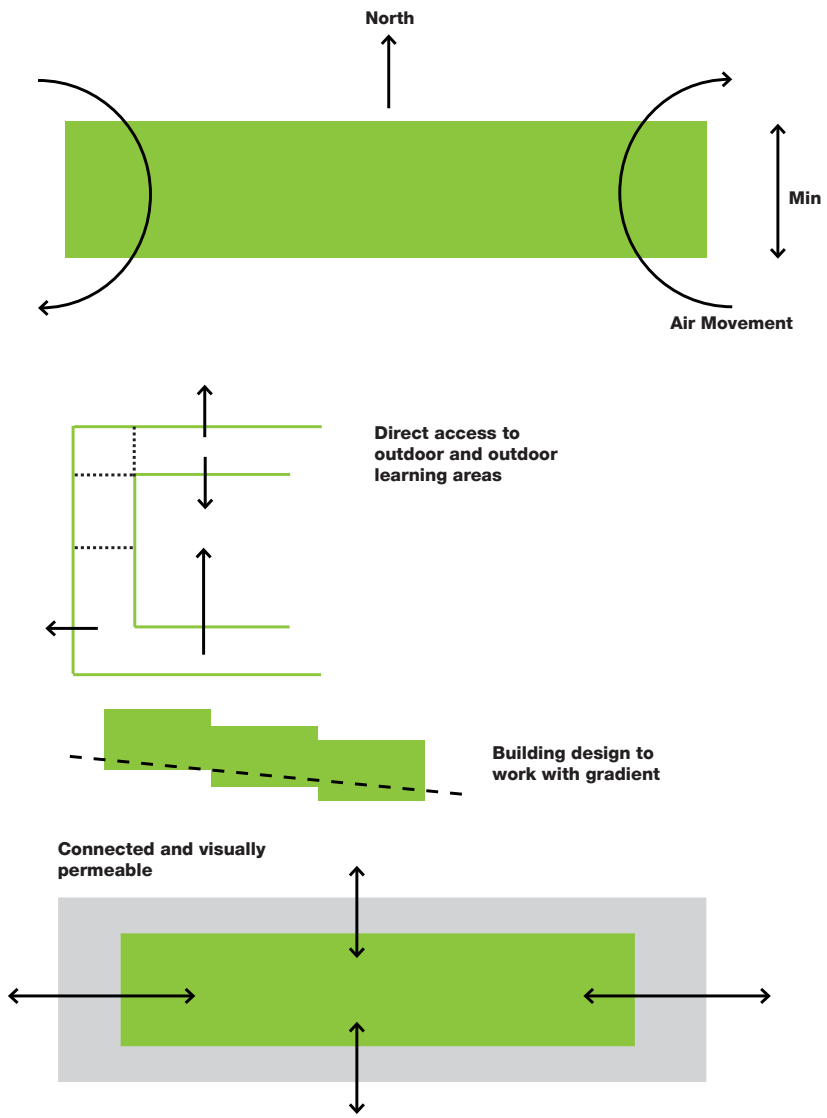


Figure 2.1 Passive design principles

2.2 Daylighting and Solar Access

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

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

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

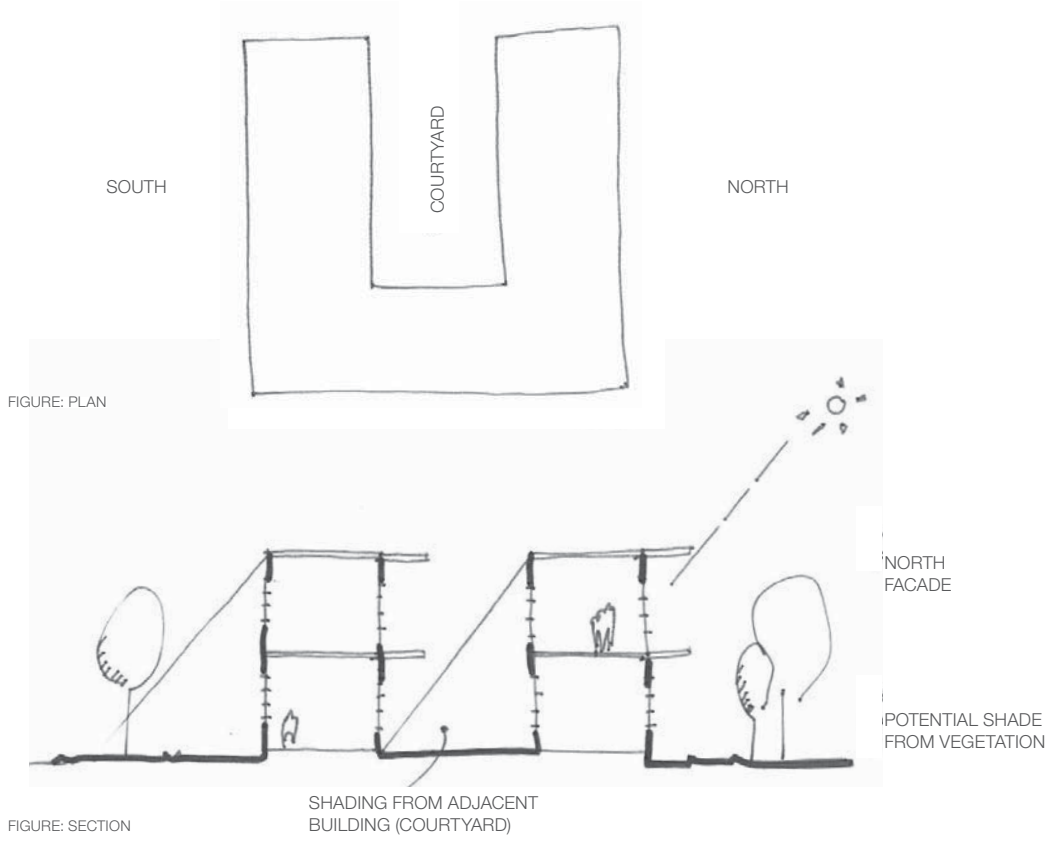


Figure 2.2 Courtyard shading

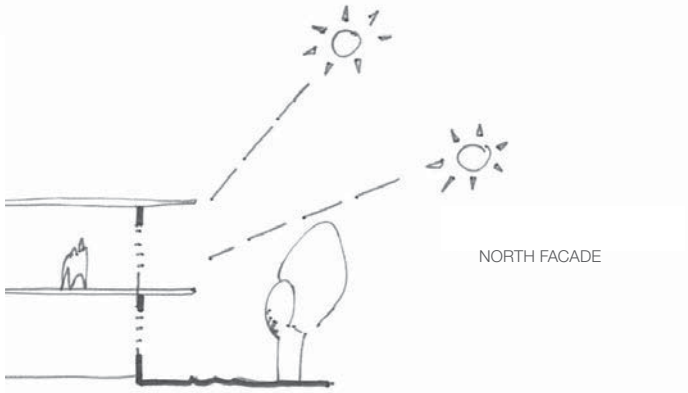


FIGURE: SECTION

Sun Shading Option: Overhanging Eaves

Potential N / E / W Elevations

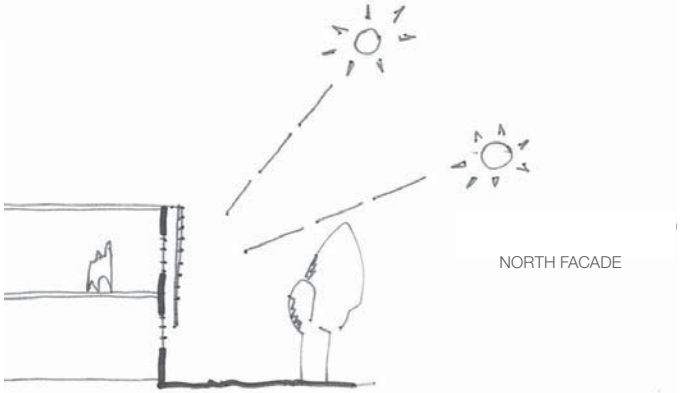


FIGURE: SECTION

Sun Shading Option: Vertical Blinds

Potential E / W Elevations

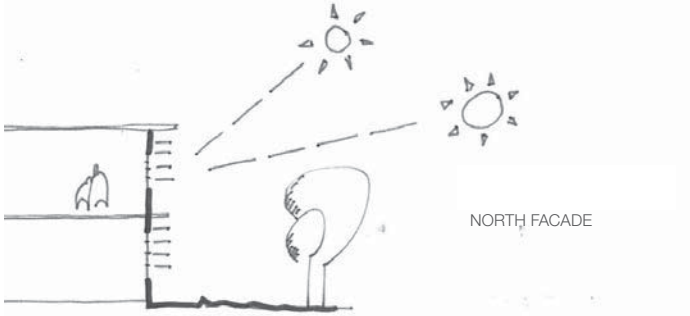


FIGURE: SECTION

Sun Shading Option: Horizontal Blades

Potential E / W Elevations

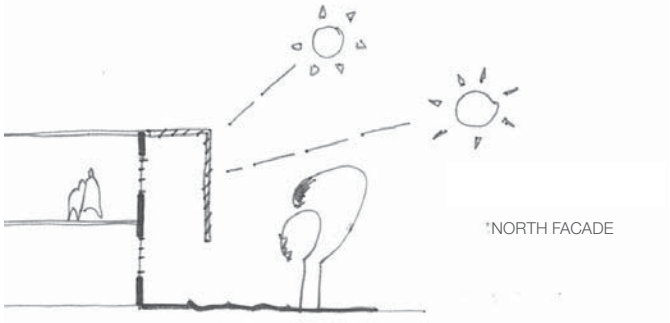


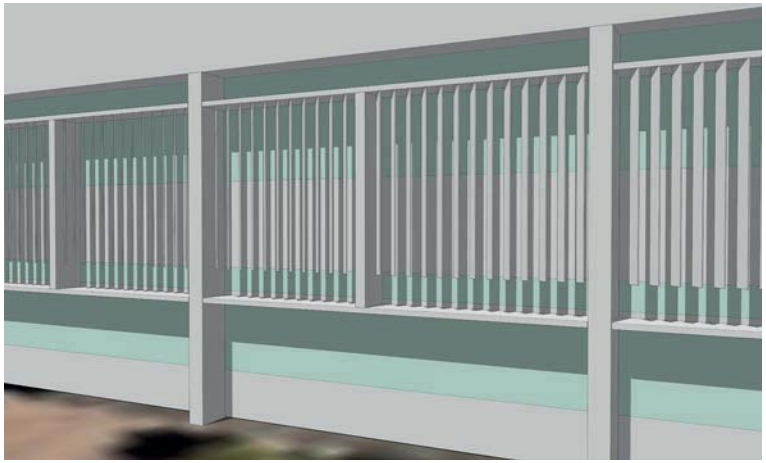
FIGURE: SECTION

Sun Shading Option: Screen

Potential E / W Elevations

Figure 2.3 External glazing shading options

Modelling of the building façades shading system was conducted early on in the concept design phase. This led to a shading system being selected for each facade which allowed maximum daylight to penetrate into the building in winter, while also maximising shading to the facade glazing in summer.



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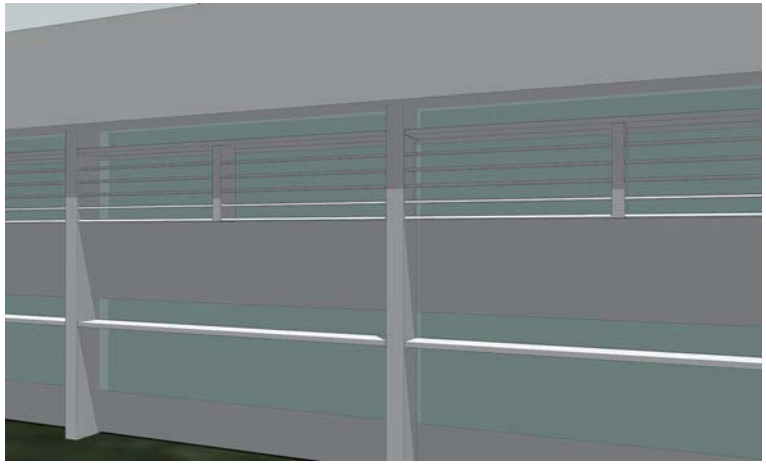

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Figure 2.4 Facade shading modelling for the west (LHS) and north (RHS) facade in summer (top) and winter (bottom)

Ecotect Daylight Analysis

The daylight factor (DF) has been determined through modelling. High levels of daylight are deemed by the GBCA to have daylight factors above 2.0% for all spaces.

The Radiance simulation engine was used within Ecotect. An overcast sky was modelled and readings were taken at finished floor level. The modelling includes the extensive shading on each facade.

As is demonstrated by Figure 2.6, each floor plane in the model achieves 2.0% daylight factor for over 80% of the nominated hours. This modelling will need to be revised as the design progresses to detailed design phase.

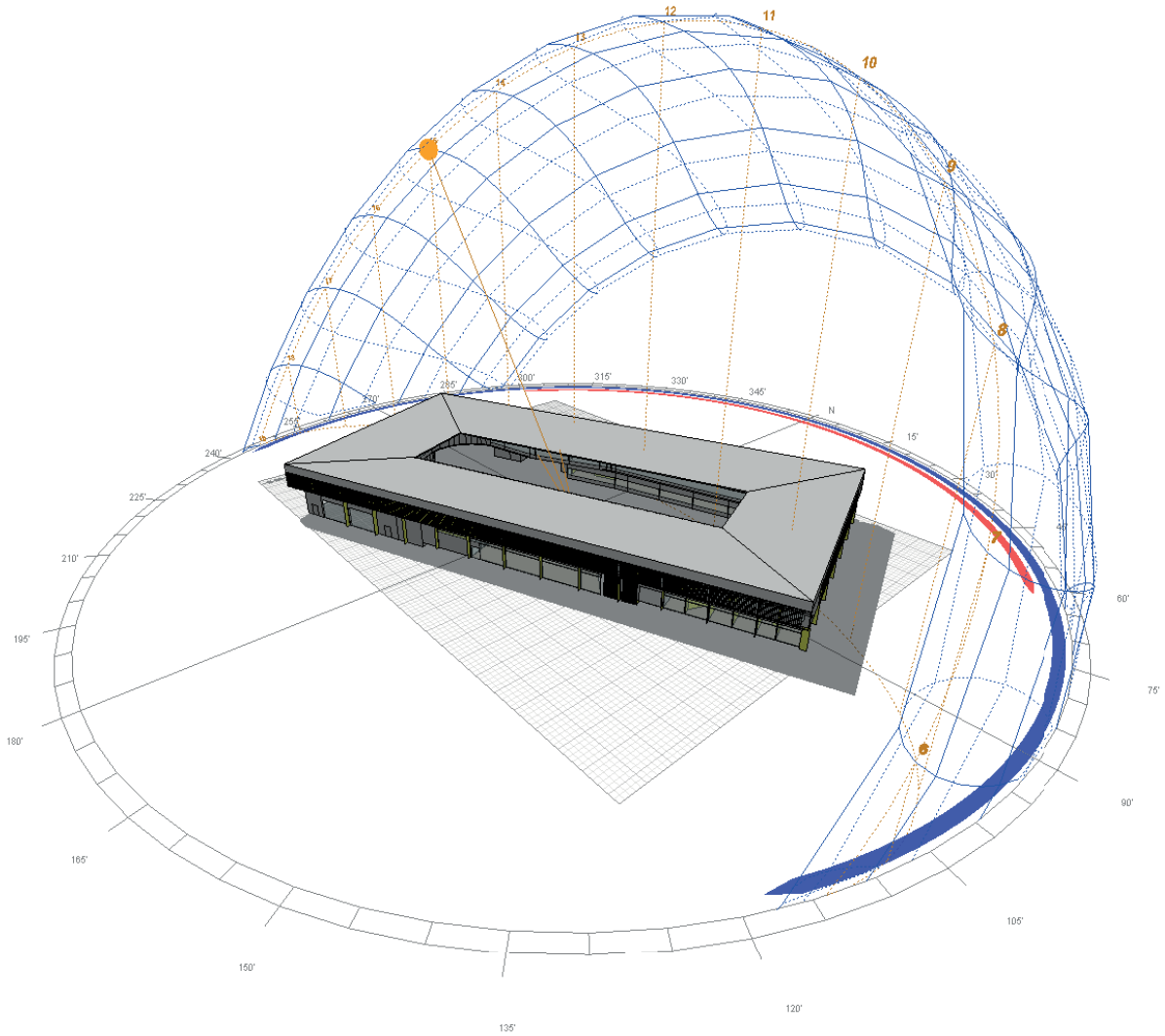
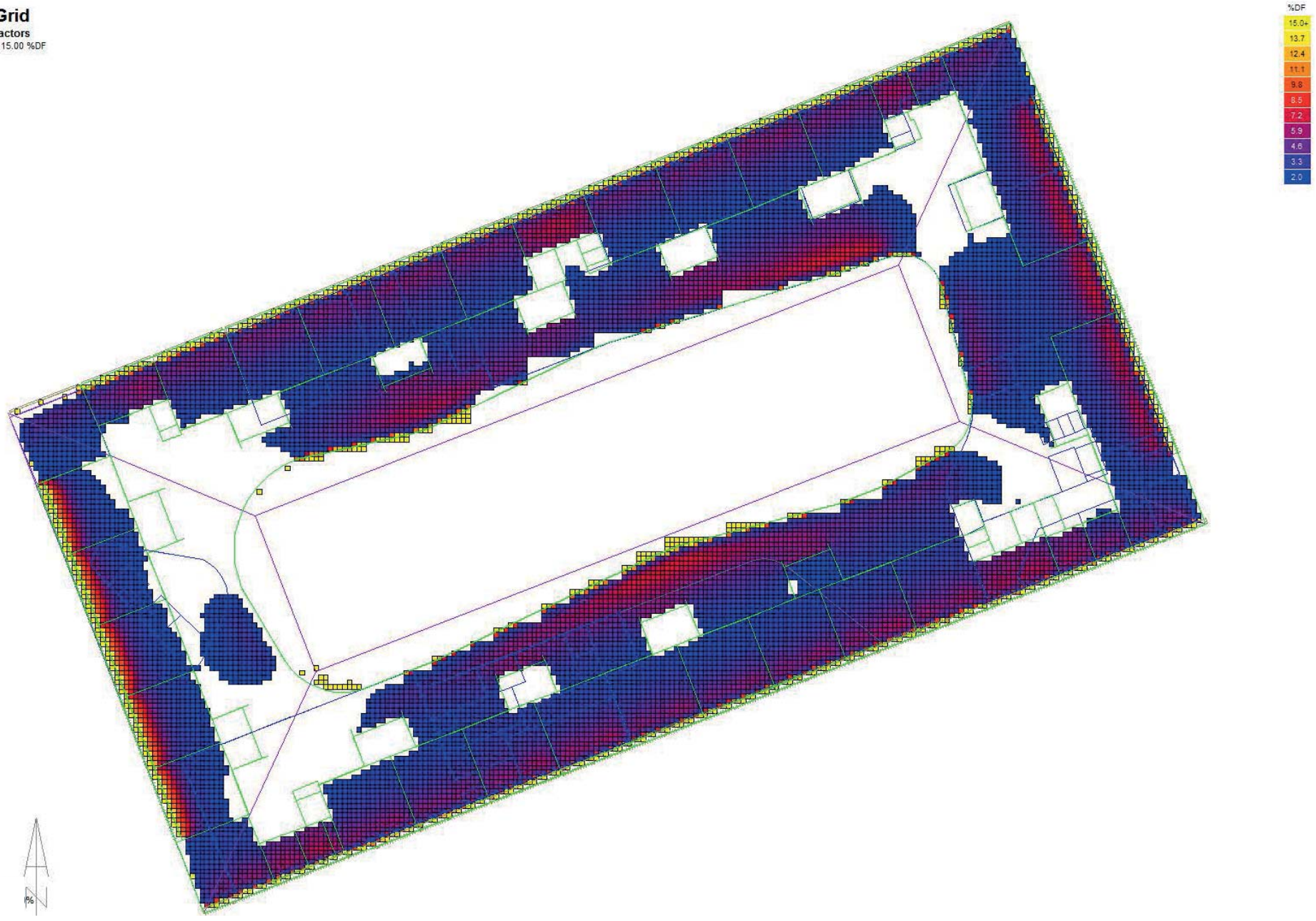


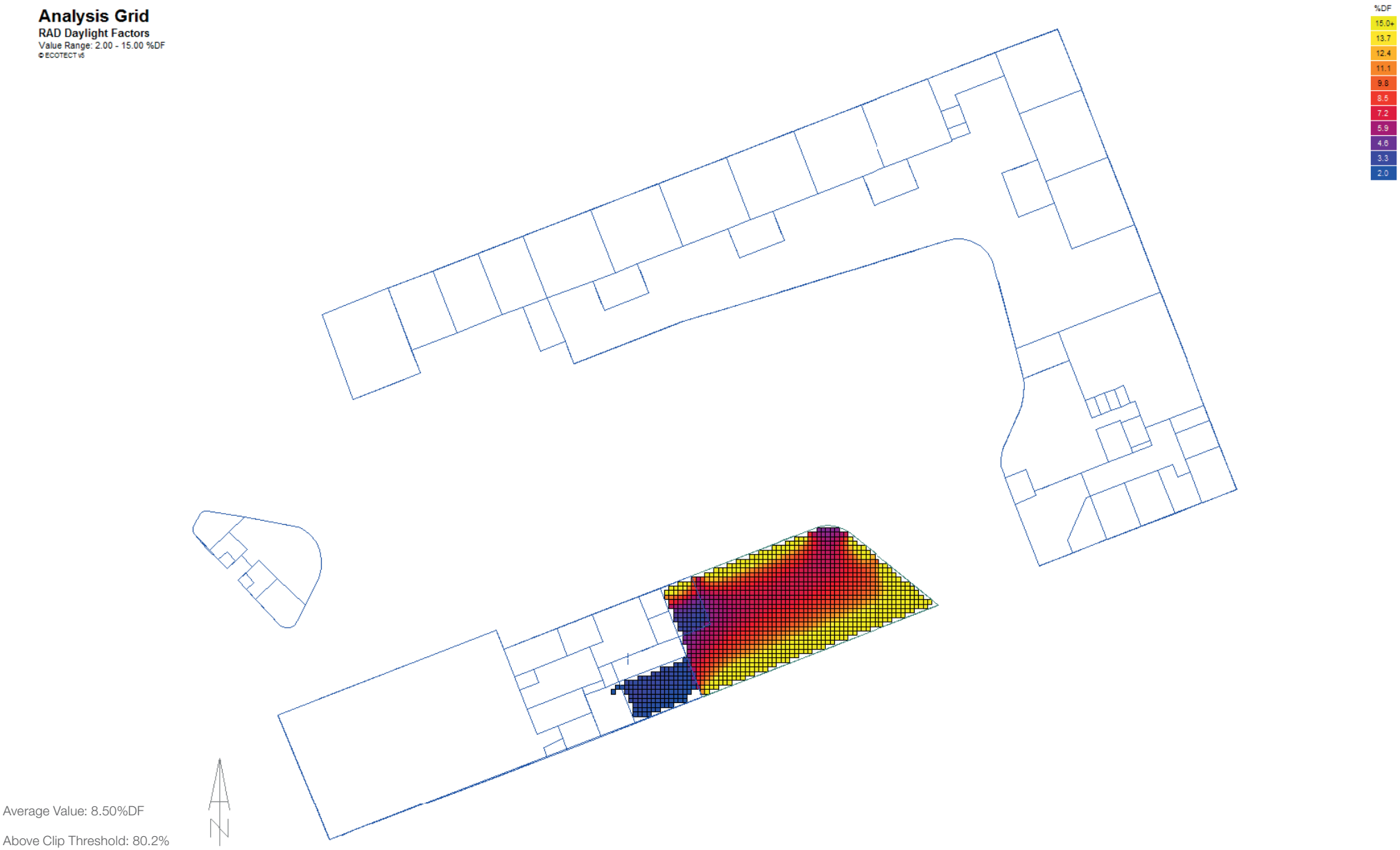
Figure 2.5 Annual sun paths at the North Kellyville New Primary School Site



Average Value: 5.01%DF

Above Clip Threshold: 80%

Figure 2.6a Daylight factor results for Level 2



Average Value: 8.50%DF

Above Clip Threshold: 80.2%

Figure 2.6b Daylight factor results for Level 1 Mid Level (Library)

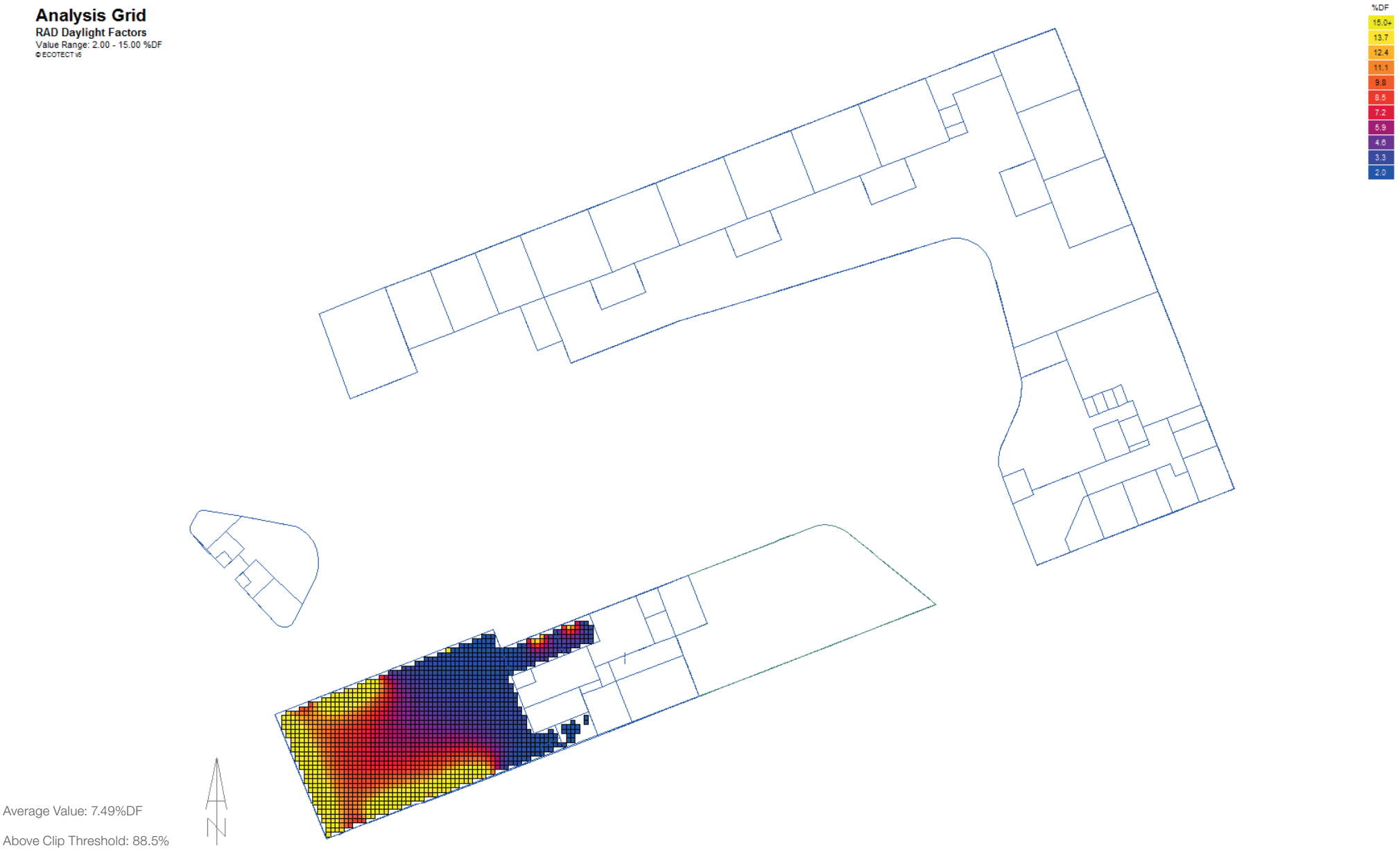
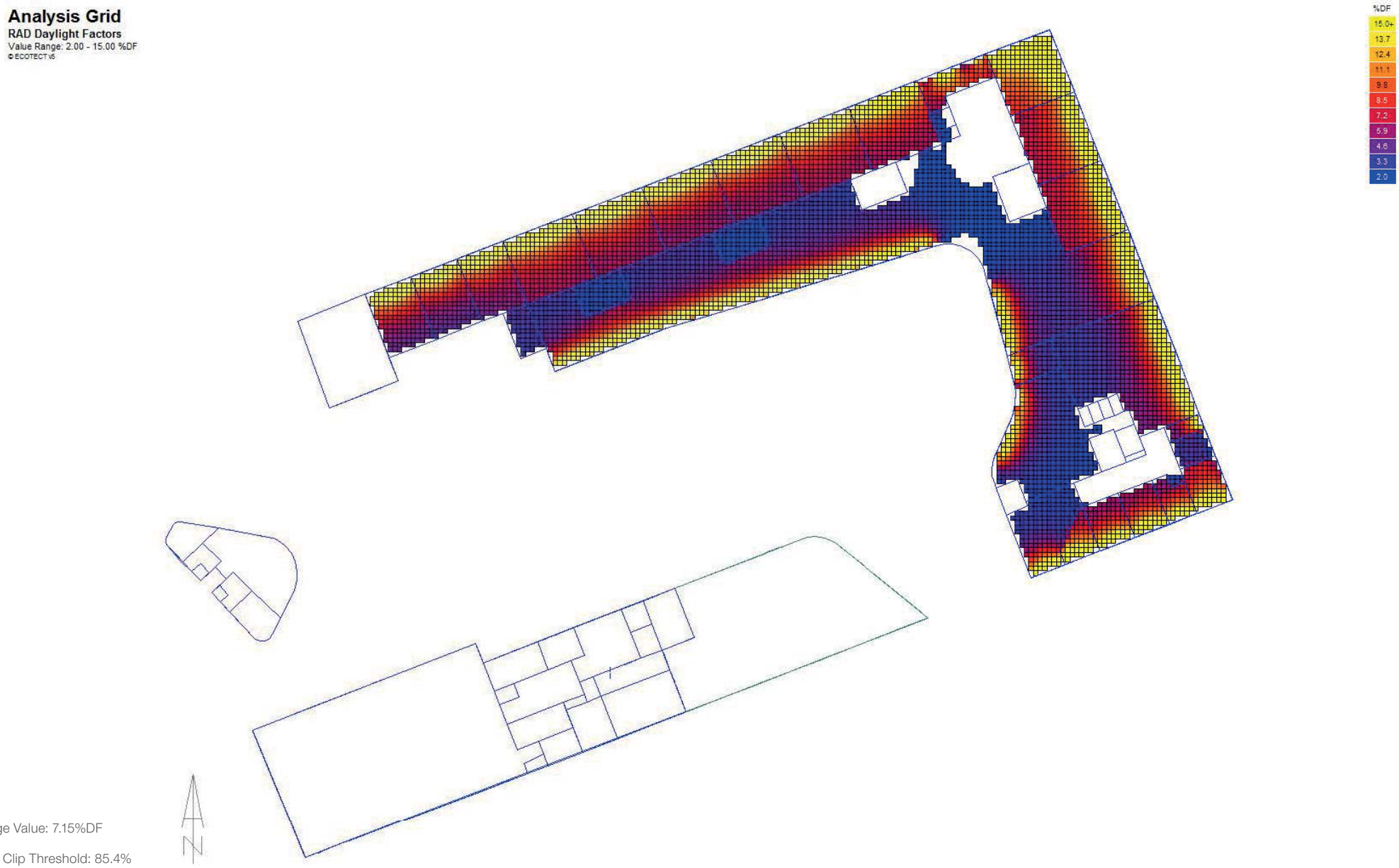


Figure 2.6c Daylight factor results for Level 1 Lower (Hall)



Average Value: 7.15%DF

Above Clip Threshold: 85.4%

Figure 2.6d Daylight factor results for Level 1 Upper

2.3 Thermal Comfort Requirements

Thermal comfort in a building is affected by its:

- envelope shape and material composition;
- spatial planning;
- ventilation area; etc.

in response to:

- ambient temperature;
- relative humidity;
- wind speed and direction; etc.

in addition to how the building is used (opening of windows and doors etc.).

Section J of the NCC (ABCB) determines minimum standards for building fabric and sealing, ventilation areas and amount of glazing for a building. Thermal comfort ranges used in testing the project design were developed based on ASHRAE-55, a global thermal comfort standard adopted by Green Star (See Appended Section J Report for compliance calculations).

AS1668.4 makes reference to ASHRAE to be used as a guideline to achieve adequate natural ventilation. No thermal comfort range has been determined by the client, so in order to design to a set of thermal comfort conditions, this project relied on ASHRAE-55

The courtyard form was employed to minimise the cross section width of the building, to allow for good cross ventilation of learning areas, supplemented by ceiling fans.

The occupants will discover by trial and error, the ambient (external) conditions that will prove to be beneficial in enhancing the internal comfort conditions. As a rule of thumb, when the ambient is below about 15°C it will probably be too cool to operate the windows for long periods of time; and similarly when the ambient is over about 28°C it will probably be too warm.

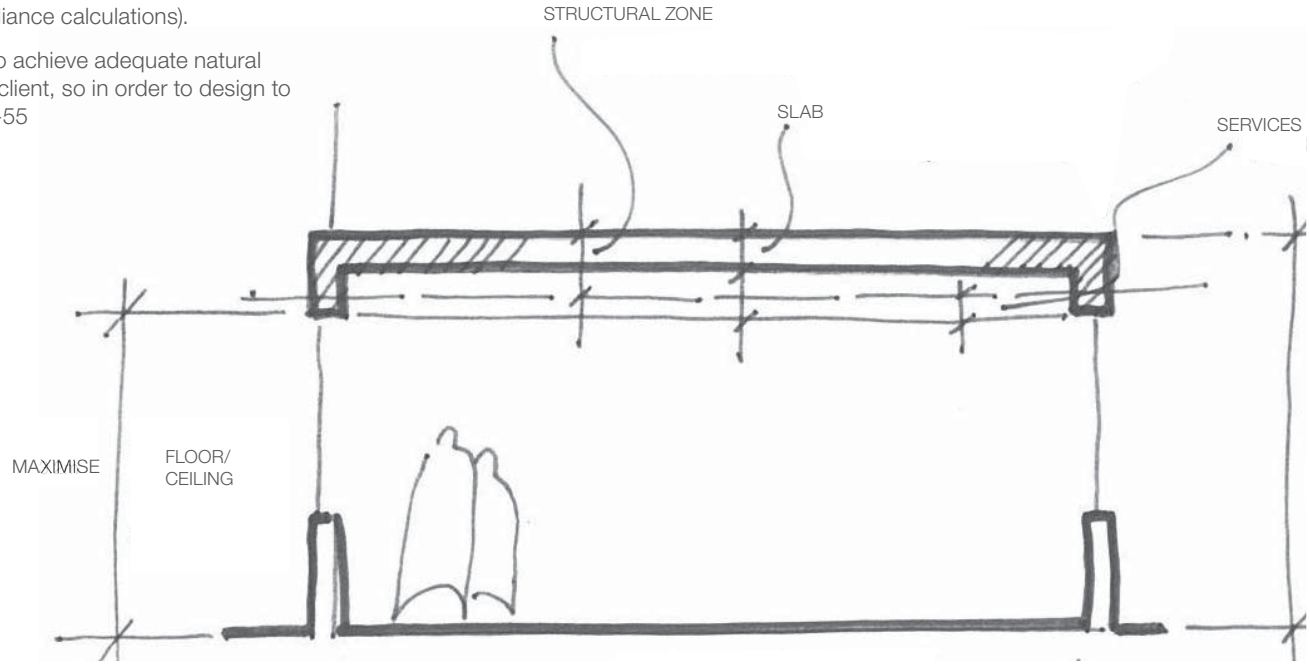


Figure 2.7 Room height provisions for thermal comfort

ASHRAE-55 Comfort Criteria

We have used ASHRAE Standard 55 “Thermal Environmental Conditions for Human Occupancy” to determine what the acceptable operative temperature range should be for a naturally ventilated space.

The range of temperatures are established based upon the prevailing mean outdoor air temperature (with the mean temperatures being taken over a period of not fewer than 7 days and more than 30 sequential days prior to the day in question).

The actual temperature is then interpolated from the graph in Figure 2.8. For example, from the graph, we can determine that for a mean ambient temperature of 21.7°C the allowable indoor operative temperature (t_o) lies between 21°C and 28°C for the 80% acceptability limits.

ASHRAE-55 Maximum allowable indoor operative temperatures were determined for each month of the year based on climate conditions on the site and the ASHRAE-55 equations. Two representative spaces within the building were analysed for thermal comfort. The Library on Level 1 and a representative Homebase on the most exposed north-west corner of the building were chosen. Modelling assumptions included:

- Occupation for the Library was set at 1 person/5m^2 and for the Homebase 32 persons.
- Activity level is sedentary (70W/person)
- Internal gains were set at 18W/m^2 sensible gain
- Air change rate set at a maximum of 7.5 ac/hr and allowed to reduce to a minimum of 5 ac/hr

Schedules for occupancy were set to accompany these coefficients, based on standard school occupancy and windows and doors being opened for most of the day, apart from the middle of the day when hot conditions should result in them being closed. Night purging was allowed for.

Weather data was assembled from an analysis of the past 25 years of meteorological data. The year selected was not the maximum nor the minimum, but the year that had the least variance of standard deviation from the mean of all 25 years.

Because it is a real year, rather than a set of averaged conditions, the modelling is more representative of conditions that are most likely to occur for most of the time.

A computer model was created, to simulate the internal space temperature that

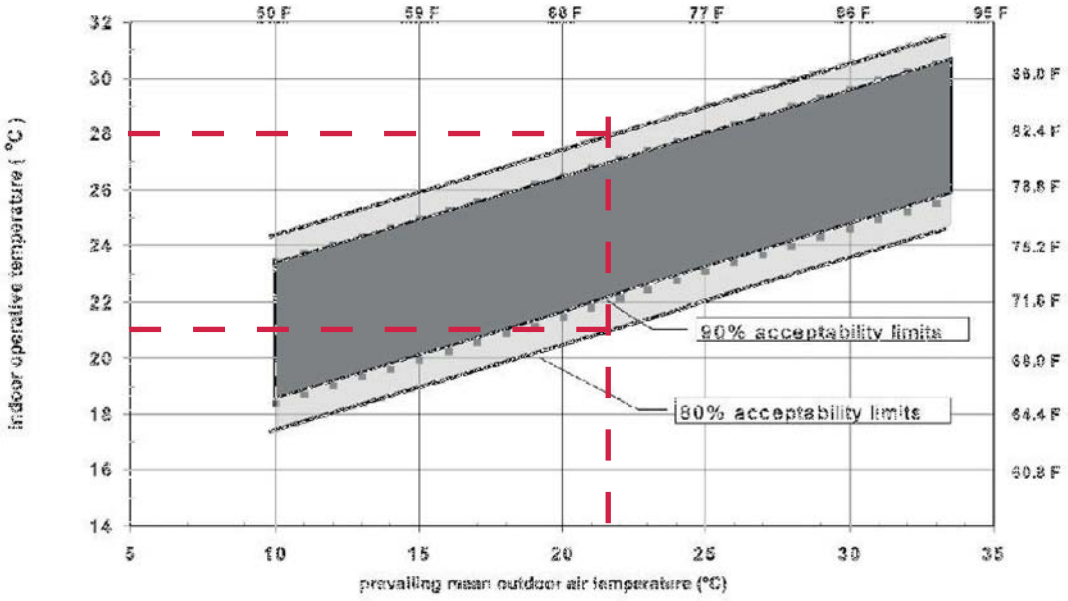


Figure 2.8 ASHRAE-55 thermal comfort range calculation example

would exist with natural ventilation and heating only. The resultant ASHRAE-55 compliant indoor operative maximum temperatures, calculated per month, against the modelled resultant temperatures, are displayed in Table 2.1.

If we only consider term times (and we have taken 2017 NSW term times as an example) the total hours that the space exceeds the ASHRAE 55 guideline temperature drops during the year. Green Star Guidelines state project teams must demonstrate that, for 95% of the nominated area and 98% of the year, a high degree of thermal comfort is provided. This high degree is defined as the internal temperatures in each space are within 80% of Acceptability Limit 1 of ASHRAE Standard 55-2013 (Figure 2.8). For both the Library and the Typical homebase selected, the hours below the ASHRAE-55 maximum are over 99% of hours in a year. Modelling results therefore show North Kellyville New Primary School currently complies with Green Star Guidelines.

Our analysis has indicated that increasing natural ventilation rates does not improve the internal comfort conditions. Unless the air being drawn into the space being ventilated is cooler than ambient; on hot days, increasing the ventilation rate will make the space hotter, not cooler. If the frequency of internal temperatures being in excess of the acceptable operative temperature as determined from ASHRAE 55, then some form of tempering of the ventilating air must be considered.

We have experimented with increasing the thermal performance of the glazing and external walls, without any significant change to internal temperatures. This modelling will need to be revised as the design progresses to detailed design phase.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	Ambient Max Temperature (°C)	40	34	30	27	23	21	25	26	27	30	32	31	
	ASHRAE-55 Max Operable Temperature	28.61	27.86	27.90	26.76	25.80	24.59	24.62	24.97	25.57	26.60	27.04	27.52	**TOTAL HOURS**
HOMEBASE	Number of hours in excess of Max (whole year) (°C)	1	20	12	23	0	0	0	0	0	0	0	0	**56**
LIBRARY	Number of hours in excess of Max (term time) (°C)	0	17	11	19	0	0	0	0	0	0	0	0	**47**

Table 2.1 ASHRAE-55 operable temperature range analysis results

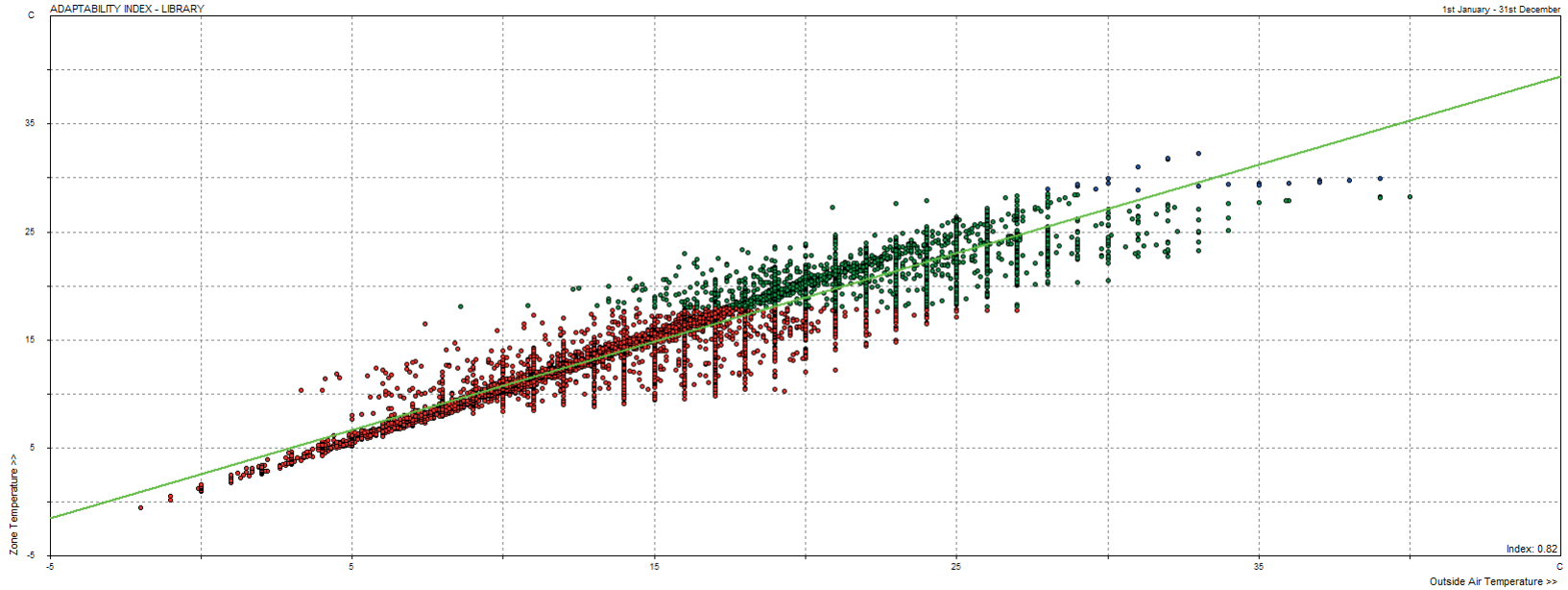


Figure 2.9 Annual temperature distribution results for the Library

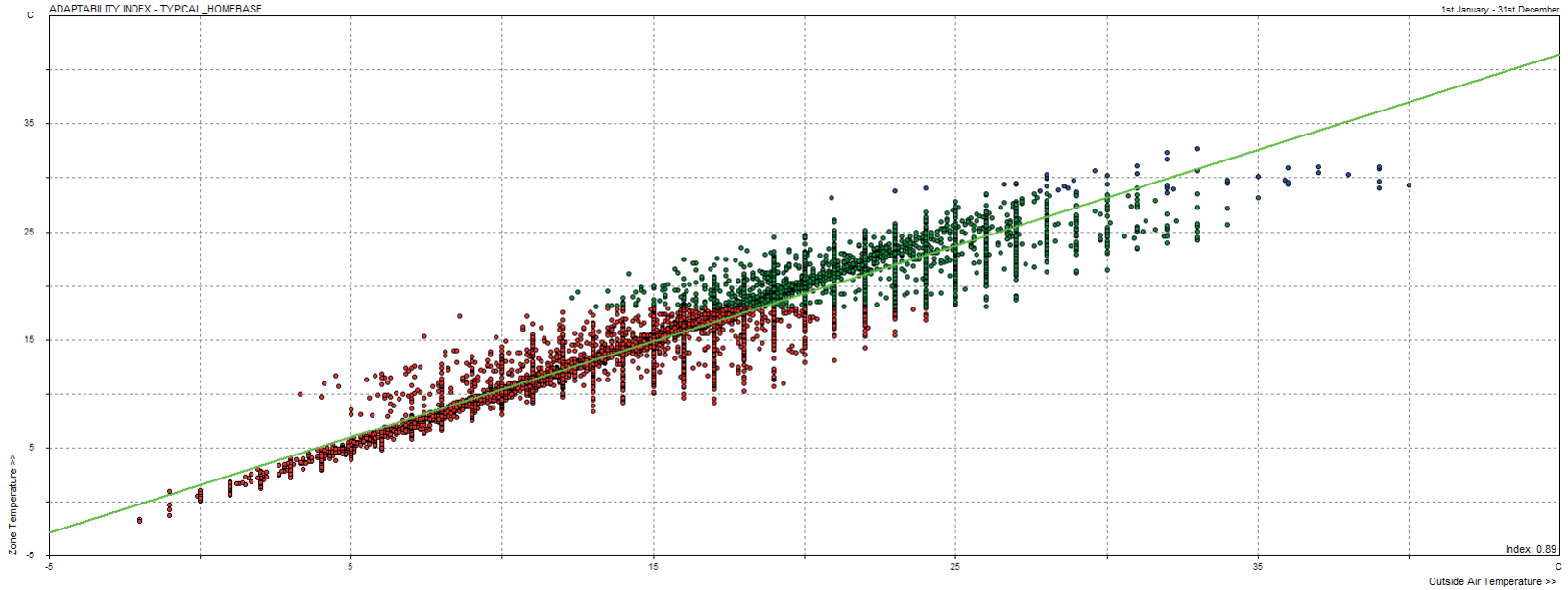


Figure 2.10 Annual temperature distribution results for the Homebase

2.4 Ventilation

Natural Ventilation is the preferred option to maintain good indoor environmental air quality through all school areas. Cross ventilation is the primary means of achieving good air movement and comfort conditions in all occupied rooms.

The classrooms have been designed for natural ventilation and heating only.

The windows and louvres are openable, encouraging a high level of natural ventilation to flow through the classrooms, which in addition to flushing away the build up of CO_2, serves to provide an additional perception of cooling. To maximise the ventilation effect, the windows at high level on the front perimeter wall as well as the windows in the raised roof area should be opened.

Mechanically Assisted Natural Ventilation

The outside air is introduced naturally into all occupied spaces or borrowed from adjacent spaces and exhausted generally by natural means, but may at times be assisted by mechanical exhaust fans.

Printing areas have a dedicated exhaust to ensure adequate indoor air quality (Figure 2.12).

Standards and Guidelines for Natural Ventilation

The natural ventilation system has been designed in accordance with NCC Section F4.6 (Natural Ventilation), which determines minimum compliance for spaces to be adequately naturally ventilated with respect to spaces that open to spaces open to the sky and spaces that borrow ventilation from an adjoining room.

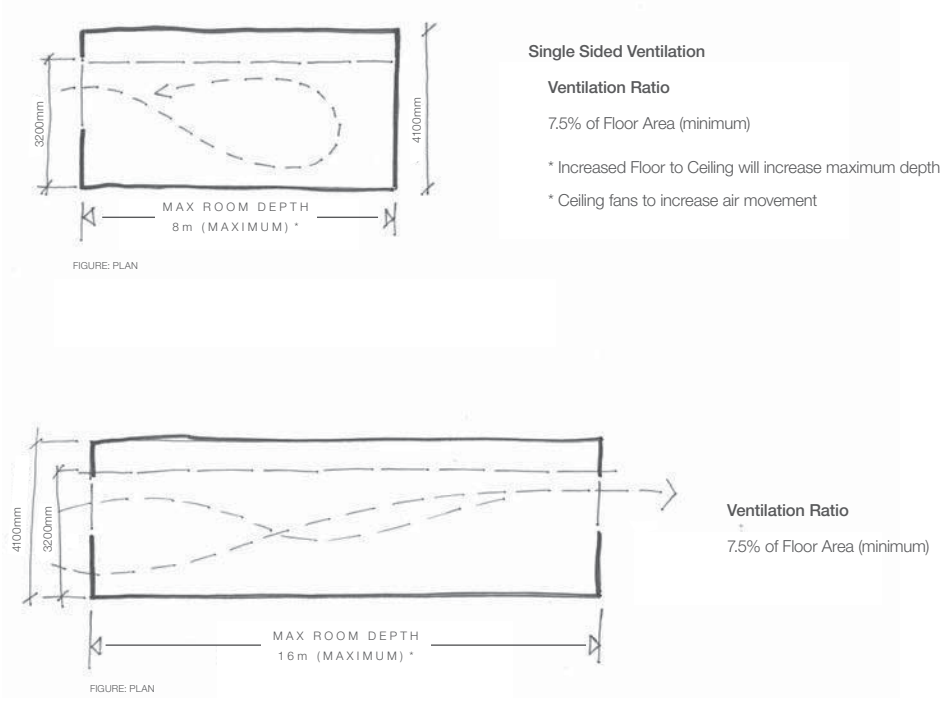


Figure 2.11 Ventilation principles in cross section

VENTILATION RATIOS

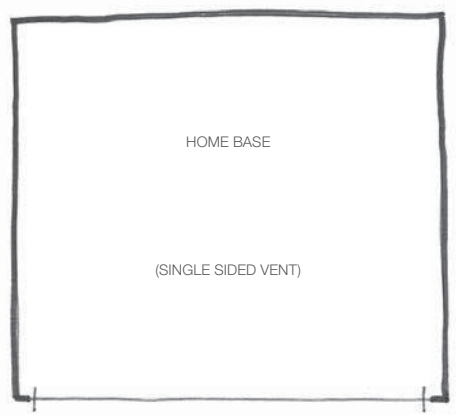


FIGURE: PLAN

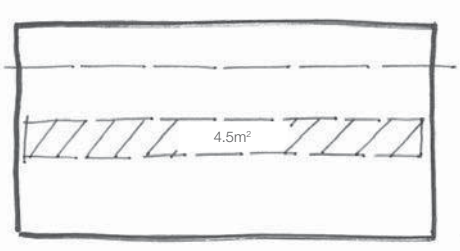


FIGURE: ELEVATION

Openable WIndow Area

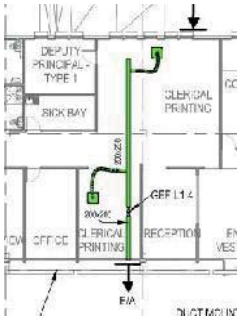


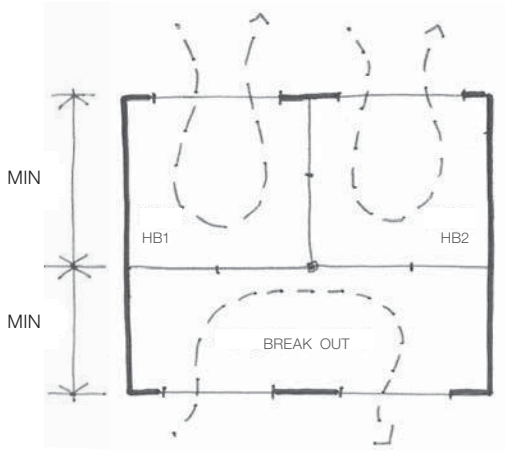
Figure 2.12 Dedicated exhaust for printing areas

Floor Area to Openable Window Area

Window Preferance	1) Louvres 2) Sliding 3) Awning

Figure 2.13 Ventilation ratio calculations

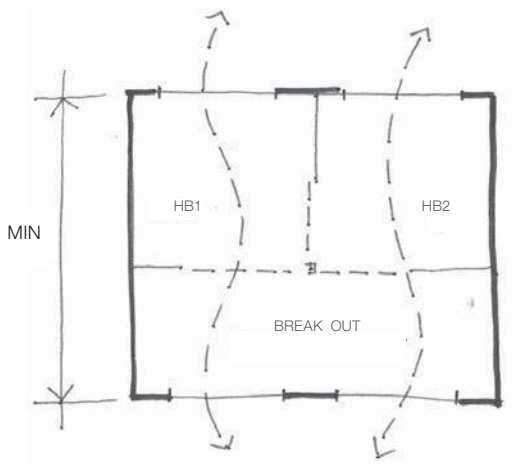
TYPICAL LEARNING NODE VENTILATION



Closed Learning Areas

Single sided ventilation

FIGURE: PLAN



Open Learning Areas

Natural cross ventilation (when learning areas are opened)

FIGURE: PLAN

Natural Ventilation of a Typical Homebase

North Kellyville space planning and building envelope has been designed in accordance with passive design ventilation principles, developed specifically for the schools geographic location (Figure 2.11 and 2.13) and in accordance with AS1668.4 and NCC (F4.6). Ventilation calculations will need to be revisited at detailed design phase, to account for changes in the design.

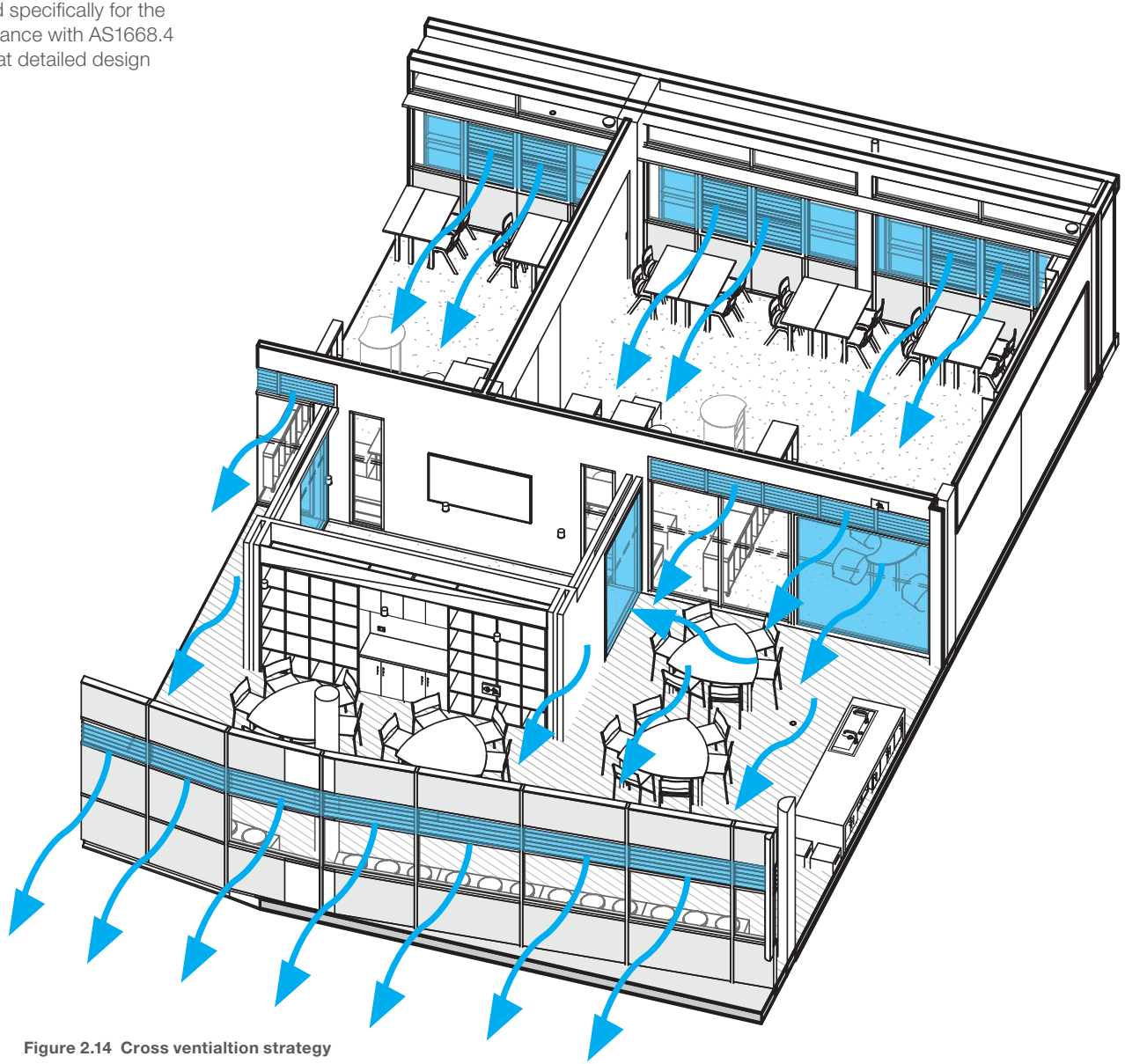


Figure 2.14 Cross ventialtion strategy

03 Energy: Demands and Conservation

ESFG 02.04 Environmental Design Features of Education Facilities states; *A major objective in the design of Education Facilities is to achieve good indoor environmental quality and comfort conditions with minimum energy consumption.*

3.1 Overall Energy Demand

Energy requirement assumptions include:

- Air conditioning will not be provided as part of these works.
- Heating for the homebases will be achieved through gas heating systems, not requiring electric heaters
- 1 lift will be required to serve the school at 30kW power demand each.

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

3.2 Energy Use Reduction and Generation Methods

Renewable Energy Generation is identified as an environmental design feature of education facilities. Onsite generation of electricity is proposed to supplement base load demand at the school. A 70kW* grid connected solar PV system will be installed on the roof of the new school to offset the energy usage in accordance with EFSG design guidelines. Space provision will be allowed for addition of future of solar panels to further offset increases in energy use.

All luminaires in rooms are to automatically turn off five minutes after the period bell has rung and all students have left the room. Alternatively include systems to turn off lights when the room is not in use. A conscious decision is required to turn the lights on again.

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

3.3 Building Performance Monitoring Systems

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

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

* To be confirmed at detailed design phase

04 Water: Demand and Conservation

4.1 Water Systems Overview

The overarching design approach for the water cycle management is to re-use collected rainwater as much as possible and to use recycled water from the authority where it can substitute domestic water.

4.2 Water Use Reduction

As per the EFSG, sanitary fixtures have been specified with minimum Water Efficiency Labelling and Standards Scheme (WELS) star ratings as stipulated under W3 of the NSW Government Resource Efficiency Policy:

Showerheads - 3 stars

Toilets and urinals - 4 stars

Washing machines - 4 star

Dishwashers - 4 stars

Taps and flow controllers - 4.5 stars

4.3 Water Recycling

The site has frontage to a Sydney Water recycled water main. It is proposed to use the recycled water main to top-up the rainwater re-use system in times of prolonged dry weather.

This design approach will ensure that no domestic water is required to provide water for toilet flushing. This will reduce the total demand of domestic water by 60%.

FIRE SERVICE WATER CONSUMPTION

Table 4.2 details the calculated fire service water usage. The current design allows for test water to be diverted back to the rainwater collection tank for re-use.

RAINWATER

Roof runoff is to be collected in a raintank and an overflow point from the raintank will be provided in the stormwater drainage. Based on the rainfall patterns, the available surface area to capture rainwater and the estimated demands, it is recommended that a 20m^3 storage tank be used in the proposed building. This volume will provide 63% of water that is required for toilet flushing without excessive capital cost.

Demand Type	Standard Demand	Proposed Building Demand
Ablutions	16.7 L/EP/Day	13.7 L/EP/Day
Toilet (WC)	25 L/EP/Day	Provided by treated rainwater and recycled water
Leakage and Wash down	2.6 L/EP/Day	2.0 L/EP/Day

Table 4.1 Water Demand (taken from Hydraulic Infrastructure & Services and Water Cycle Management Report)

Test	Unit	Litres	Test Frequency	Justification
Fire Hydrants (all)	L/FH/Test	150	Annual	AS 1851 Table 4.4.3, item 3.2. Allowance to observe water at each hydrant.
Fire Hose Reel	L/FHR/Test	5	6 monthly	AS 1851 Table 9.4.1, item 10.1. Allowance to observe water at each FHR.
Fire Hydrant Flow and Pressure Testing	L/Test	6,000	Annual	AS 1851 Table 4.4.3, item 3.7. Allowance for fire hydrant flow and pressure testing. 10L/s per operational hydrant for 5 minutes.
Fire pump flow test	L/Test	6,000	Monthly	AS 1851 Table 3.4.1, item 3.7. Allowance for pump flow and pressure testing. 10L/s per operational hydrant for 10 minutes.
Fire Brigade Boost Assembly Flow and Pressure Testing	L/Test	21000	5 yearly	AS 1851 Table 4.4.4, item 4.2. Allowance for fire brigade booster assembly boost test. 20L/s Hydrants and 15L/s SPR for 10 minutes.

Table 4.2 Fire System Water Requirement (taken from Hydraulic Infrastructure & Services and Water Cycle Management Report)

It is recommended that grey water and black water treatment systems should not be used as the capital cost, ongoing operational and maintenance cost, occupational health and safety issues, energy consumption and low contribution that these systems make to the overall water efficiency of the building do not justify such systems.

4.4 Stormwater

The proposed school will increase the size of the impervious land use from existing and as a result increase stormwater runoff. Therefore, the management of stormwater runoff from the site post development of the proposed school will incorporate stormwater pit and pipe drainage and on-site detention to mitigate impacts on the downstream stormwater network from increased runoff.

A stormwater assessment has confirmed that on-site detention will be required. The results below show that on-site detention basin can be used to detain increased flows. For all development in the Smalls Creek Catchment a minimum detention storage volume of 239m^3 per hectare is required. For this project, the detention basin and outlet have been sized to provide 1790m^3 storage. Stormwater runoff quality is to be managed through swales, raingardens and proprietary treatment devices.

4.5 Water Sensitive Urban Design (WSUD)

The management of stormwater across the site is integral to not only providing a suitable environment for operation of a school but also to mitigate any downstream impacts on neighbouring properties from this new development. Post-construction (occupation) phase stormwater management objectives are to be achieved by all development through the innovative application of Water Sensitive Urban Design (WSUD). WSUD infrastructure recommended for implementation in the North Kellyville Precinct includes rainwater tanks, raingardens (bio-retention basin), road side swales (bio-infiltration), Gross Pollutant Traps (GPTS) and combined constructed wetlands and detention basins.

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

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

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

Pollutant	DCP Reduction Target (%)	Proposed Treatment Reduction (%)
Total Suspended Solids	85	90
Total Phosphorus	65	67
Total Nitrogen	45	66
Gross Pollutants	90	100

Table 4.3 Stormwater Pollution Reduction Targets

05 Waste Management

Green Star recommends the implementation of waste management plans that facilitate the re-use, upcycling, or conversion of waste into energy, and stewardship of items to reduce the quantity of outgoing waste.

5.1 Waste Systems Overview

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

- Separation of Waste Streams;
- Dedicated Waste Storage Area; and
- Access to Waste Storage Area.

Details of how these best practice outcomes have been adopted by the project are outlined in the North Kellyville New Primary School Waste Management Plan (GHD, 2017).

5.2 Separation of Waste Streams

On the basis of the City of Melbourne guidelines, which is the most recently published reference, the waste generation rates for 1,000 students would be 500 litres per week of waste and 500 litres per week of recycling. It has been estimated that servicing the school when operational would require two 660 litre rear lift bins per week. However, it is likely that bins would be collected daily, which gives an effective capacity of five times this amount, or 660 litres for waste and 660 litres for recycling per day (rather than per week). Larger bins such as 1,100 litres could be used if needed.

It would also be sensible to have a third bulk bin for bulk cardboard. Some contractors may also wish to have a separate bin for high quality office paper. In addition, items such as batteries and fluorescent tubes may be separated by staff for recycling.

A total of 77 tonnes of waste has been estimated to be produced from construction activities, based on the Hills Shire DCP 2102 Appendix A Waste Management Plan factors. This is based on office building construction factors, as no factors are available for schools.

5.2 Dedicated Waste Storage Areas

Dedicated waste storage areas have been placed in the design adjacent to the main building, where most waste would be generated. The area is sufficiently sized to fit waste and recycling bins.

5.3 Access to Waste Storage Areas

The outdoor waste bin area is located near an access road of the site, to allow access for waste collection and other vehicles to the waste bin area. Roads and driveways have been designed and constructed in accordance with the relevant authority requirements to allow the safe passage of a laden collection vehicle in all seasons.

06 Materials

6.1 Life Cycle Impacts Considerations

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

6.2 Low Pollutant Materials

Green Star addresses toxicity by prescribing VOC and formaldehyde limits for common materials used in the interior fit-out of a design (Table 6.1 and 6.2). This project has adopted these prescribed limits, to ensure the interior design of the project meets best practice performance.

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

Table 6.1 Maximum TVOC Limits for Paints, Adhesives and Sealants (taken from Green Star Design & As Built V1.2)

Compliance Option	Test Protocol	Limit
ASTM D5116	ASTM D5116 - Total VOC limit*	0.5mg/m2/hr
	ASTM D5116 - 4-PC (4-Phenylcyclohexene)*	0.05mg/m2/hr
ISO 16000 / EN 13419	ISO 16000 / EN 13419 - TVOC at three days	0.5 mg/m2/hr
ISO 10580 / ISO/TC 219 (Document N238)	ISO 10580 / ISO/TC 219 (Document N238) - TVOC at 24 hours	0.5mg/m2/hr

Table 6.2 Carpet Test Standards and TVOC Emissions Limits (taken from Green Star Design & As Built V1.2)

The exterior cladding system will be determined based on a set of criteria that has been generated from the DOE requirements and school/community input.

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

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

– Contributes to sustainability of the whole building in the following categories:

- Energy Efficiency - including solar loading and insulation
- Local and Regional Materials
- Renewable Resources
- Daylight to interior spaces
- Acoustics

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

–– Curtain Wall - Stick Built

–– Curtain Wall - Unitized

–– Fritted glass for curtain wall systems and skylights

–– Metal screen panels with custom cut openings

–– Metal panel system, such as Alucobond,

–– Fiber Cement Panel rain screen systems

–– Brick cavity wall

–– Pre-cast concrete panels

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

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

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

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

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

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

Table 6.3 Formaldehyde Emission Limit Values for Engineered Wood Products (taken from Green Star Design & As Built V1.2)

EFSG DG02

Encourages the use of materials and products which:

- Adequately and economically perform their intended functions, and also have lower adverse environmental impacts throughout their life cycle.
- Contain reduced or no hazardous substances (Low VOC)
- Reduce the demand for rare or non-renewable resources
- Are made from or contain recycled materials or can be recycled at the end of their useful life.

02.07 Pesticides

The school has been designed, to not used chemicals for termite and other pest control, preventive treatments are by physical means.

07 Transport

North Kellyville New Primary School is to be developed as part of the rapidly expanding Metro West Central Region. The site is a part of the NWRL North primary school assets Cluster which is within the Sydney West Central District (the District). The District is identified in the NSW Department of Planning and Environment's metropolitan plan 'A Plan for Growing Sydney" as a significant focus for intensive growth and infrastructure investment over the next 20 years.

Within the primary school catchments in this cluster urban development plans include an additional 35,725 dwellings, which equates to a likely demand for 2,560 additional Government primary school students within the precinct by 2031. The site is centrally located in this cluster to cater for the increased residential population.

Green Star makes provisions to reward projects that implement design and operational measures that reduce the carbon emissions arising from occupant travel to and from the project, when compared to a reference building. This also promotes the health and fitness of commuters, and the increased liveability of the location.

7.1 Public Transport Linkages

Bus stops are located in close proximity to North Kellyville New Primary School (Figure 7.1), which could service school staff. The neighbourhood rates very highly in terms of walkability, with retail, food and beverage and other services located at both ends of Hezlett Road, within 400m of the site.

7.2 Sustainable Transport Infrastructure

Available on-site parking spaces at the school have been limited to 12 spaces, including 2 accessible spaces, in order to promote the use of public transport. In conjunction, ample bicycle parking and associated facilities are provided for staff and students. Initially 30 cycle racks are provided and will be increased in stages to keep pace with the ongoing development of the school.

Figure 7.1 Bus stop locations

08 Ecological Protection and Enhancement

The North Kellyville School site is a greenfield site in a neighbourhood that was once rural but now consists of 1-2 storey modern townhouses and houses. The topography of the site is undulating, with a high point near Hezlett Road, and the land falls away to the west. Hezlett Road forms a ridge-line, providing the site with incredible, sweeping views to the west and clear visibility to the Blue Mountains. Despite the urban surrounds, the landscape character of the site is semi-rural, with neighbouring patches of remnant vegetation.

Previously on the site were houses and outbuildings and a large number of vehicles and smaller structures, as well as planted vegetation including palm trees. The site will be cleared prior to construction commencing.

Towards the lowest point of the site is a dam, which is currently collecting the majority of the site's overland flow. The dam has a large berm along its northern edge to retain the water. The site has no remnant vegetation - there is only one significant tree located next to the dam. This existing tree is worth retaining where possible to keep the natural bushland character of the site.

A significant amount of overland flow comes from the site and adjacent properties. The water is collected in planted bio-retention swales along Curtis Road, before being channelled into the street stormwater system.

8.1 Land Rehabilitation

Given the former use of the site for rural purposes a phase 2 Contamination Report has been prepared for the site by Douglas Partners (2017).

Based on the observations at the time of sampling and the reported analytical results, the surface and fill soils at the site can be preliminarily classified as General Solid Waste (non-putrescible) as defined in EPA (2014). However, as noted in Sections 11 and 13.1, ACM has been identified on the surface of the dam wall (location AA) and at several positions in the footprints of the former buildings (Drawing 2, Appendix A). Where present, soils impacted with ACM pre-classify as Special Waste (Asbestos).

Given the low concentrations of chemical contaminants in the fill and surface soils, and the typical background concentrations of chemical contaminants in the natural soil samples analysed, it is considered that the natural soils and bedrock at the site have a preliminary classification of virgin excavated natural material (VENM).

Based on the observations at the time of sampling and the reported analytical results, the soils in

Figure 8.1 Site photo (facing south)

Figure 8.2 Site photo (facing north)

the stockpile at the southern boundary of the site can be preliminarily classified as General Solid Waste (non-putrescible) as defined in EPA (2014). The handling, transport and disposal of the materials should be conducted in accordance with regulatory and statutory requirements.

Based on the results of this DSI, presented herein, it is concluded that the site can be made suitable, from a contamination perspective, for the proposed primary school development subject to:

- Delineation and localised remediation of the TRH impacted soils at TP36. Remediation could comprise either waste classification and off-site disposal, or on-site land farming and validation prior to re-using within the site;
- Delineation and localised remediation / management of the B(a)P impacted soils at TP11. Remediation / management could comprise either waste classification and off-site disposal, or onsite relocation of the impacted soils away from future landscaping;
- Delineation and removal of soils impacted with ACM, including location AA and other areas noted on Drawing 2, Appendix A, and any other ACM identified during future civil and construction works. Remediation / management could comprise either waste classification and off-site disposal, or on-site relocation of the impacted soils under a capping system and long term Environmental Management Plan (EMP);
- Testing of the dam water prior to disposal to inform the disposal requirements;
- Testing of dam sediment, which can be an accumulator of surface contaminants, to inform the requirements for specific management and/or remediation; and
- Development of a Construction Environmental Management Plan (CEMP), incorporating an unexpected finds protocol, to be initiated during the planned civil and construction works, to inform the appropriate management of asbestos or other potential contaminants encountered during the works.

The Aboriginal Heritage Due Diligence Assessment Lot 100 and 101 in DP 1216659, 120 Hezlett Road, Kellyville, NSW is to consider the potential for harm to Aboriginal objects on the subject land prior to the construction of a new primary school.

No known sites are recorded within the study area boundaries. No Aboriginal objects were located during the site inspection. No trees with the potential for cultural scars were located within the study area. The site inspection revealed a disturbed landscape.

There is no impediment to development in the study area on archaeological grounds and it is recommended that development can ‘proceed with caution’ as outlined in the due diligence guidelines.

Figure 8.3 Site aerial photo

8.2 Landscape Design Strategy

Outdoor Learning

The concept allows for the Learning Zones to open up directly into a sheltered outdoor learning space, that would be shared between a few of the adjacent Learning Zones.

These areas would be framed by vegetation or mounding to provide shelter and shade. There is also an opportunity to utilise the low point in the north western area of the site to create a shallow wetland for stormwater retention and treatment as well as outdoor learning around subjects like biodiversity, water cycle and habitat.

Shade

All major play structures would include a shade structure as well as a designated covered play area that could be incorporated into the internal courtyards.

Main circulation routes and outdoor seating areas with trees will provide shade relief while moving through the school grounds.

Water

There is an opportunity to use the natural grades of the site to establish some shallow feature drainage swales, like a dry creek bed, that would direct local runoff to either the small proposed wetland in the north east corner or other water storage areas.

These swales could also act as non-prescribed play areas when dry or low flows. Incorporating water sensitive urban design (WSUD) treatments would provide invaluable education experiences for the school students.

8.3 Promotion of Ecological Diversity

The ESFG requires a project to conserve for future generations, the biological diversity of genetic materials, species and ecosystems.

There is a large existing *Eucalyptus tereticornis* tree located in the north west corner of the site, on the bund of an existing dam. This tree cannot be retained, but will be replaced by extensive replanting of native vegetation, which as it establishes itself over time, should markedly increase the biodiversity of the site.

ESD Requirements

Green Star Self-Assessment

A

A Green Star Self-Assessment

A green star self-assessment, using the Green Building Council of Australia's Green Star Design and As Built V1.2, has been performed to address SEARS Item 6:

Demonstrate that the development has been assessed against a suitably accredited rating scheme to meet industry best practice.

Under the Green Star Self-Assessment (attached) the possible achievable points were estimated to be 51, which if formally assessed is likely to lead to a Green Star rating for North Kellyville New Primary School of **4 Stars (minimum 45 points)**. Pending more intensive testing of building systems, there is potential for North Kellyville to be eligible for a 5 Star Rating (minimum 60 points).

TOTALS	AVAILABLE	SELF-ASSESSMENT
CORE POINTS	100	48.0
CATEGORY PERCENTAGE SCORE		48.0
INNOVATION POINTS	10	3.0
TOTAL SCORE TARGETED		51.0

Green Star - Self Assessment Scorecard

Project:	**North Kellyville New Primary School**
Targeted Rating:	**4 Star - Best Practice**

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED	ASSESSMENT COMMENTS
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	Paul Whatnell (GSAP Design and As Built and Performance); Michelle Stark (GSAP Design and As Built)
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	Environmental performance targets are set our by the EFSG and are documented throughout each project reporting phase.
		2.1	Services and Maintainability Review	1	1	A services and maintainability review of the project will be performed.
		2.2	Building Commissioning	1	1	Pre-commissioning and commissioning activities will be performed for all nominated building systems.
		2.3	Building Systems Tuning	1	1	A tuning process is in place that addresses all nominated building systems
		2.4	Independent Commissioning Agent	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		
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	Operations and maintenance information will be developed and made available to the facilities management team and relevant and current building user information is developed and made available to all relevant stakeholders
Commitment to Performance	To recognise practices that encourage building owners, building occupants and facilities management teams to set targets and monitor environmental performance in a collaborative way.	5.1	Environmental Building Performance	1	1	There is a commitment to set targets and measure results for the environmental performance of the building, through a building performance monitoring system.
		5.2	End of Life Waste Performance	1		
Metering and Monitoring	To recognise the implementation of effective energy and water metering and monitoring systems.	6.0	Metering	-	Complies	Accessible metering is prescribed through the EFSG
		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	EFSG - All projects will require the preparation of an appropriate site-specific Environmental Management Plan
		7.1	Formalised Environmental Management System	1	1	Refer to Environment Management Plan
		7.2	High Quality Staff Support	1	1	
Operational Waste	Prescriptive Pathway	8B	Performance Pathway - Facilities	1	1	Refer to Waste Management Plan
		8B	Prescriptive Pathway - Facilities	1		Refer to relevant employee policies for contractor and permanent staff
Total				14	10	

Indoor Environment Quality				17		
Indoor Air Quality	To recognise projects that provide high air quality to occupants.	9.1	Ventilation System Attributes	1	1	The project mitigates the entry of outdoor air pollutants, design system for ease of maintenance/cleaning and clean prior to occupation - - To be confirmed at Detailed Design Phase
		9.2	Provision of Outdoor Air	2	2	The building is naturally ventilated in accordance with AS 1668.4-2012
		9.3	Exhaust or Elimination of Pollutants	1	1	A dedicated exhaust system has been designed for printing areas
Acoustic Comfort	To reward projects that provide appropriate and comfortable acoustic conditions for occupants.	10.1	Internal Noise Levels	1	1	Refer to Kellyville North Public School Acoustic Report (GHD, 2017)
		10.2	Reverberation	1	1	Refer to Kellyville North Public School Acoustic Report (GHD, 2017)
		10.3	Acoustic Separation	1	1	Refer to Kellyville North Public School Acoustic Report (GHD, 2017)
Lighting Comfort	To encourage and recognise well-lit spaces that provide a high degree of comfort to users.	11.0	Minimum Lighting Comfort	-	Complies	Refer to Interior Design specifications (GHDWoodhead, 2017)
		11.1	General Illuminance and Glare Reduction	1	1	Surface finishes specified to reduce glare, operable blinds and shading fitted to windows, refer to solar access analysis
		11.2	Surface Illuminance	1	1	Refer to Interior Design specifications (GHDWoodhead, 2017)
		11.3	Localised Lighting Control	1	1	Lighting for all teaching spaces seperately controlled - task lighting; lights fitted with auto switch off function as per EFSG

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	Operable blinds and shading fitted to windows, refer to solar access analysis
		12.1	Daylight	2	2	See solar access analysis
		12.2	Views	1	1	All main teaching spaces have access to views of surrounding landscape or courtyard
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	Internal air pollutant levels reduced as per criterion for this point see ESD Report (GHDWoodhead, 2017).
		13.2	Engineered Wood Products	1	1	95% of all engineered wood products meet stipulated formaldehyde limits or no new engineered wood products are used in the building
Thermal Comfort	To encourage and recognise projects that achieve high levels of thermal comfort.	14.1	Thermal Comfort	1	1	A high degree of thermal comfort is provided to occupants in the space, equivalent to 80% of all occupants being satisfied in the space
		14.2	Advanced Thermal Comfort	1		
Total				17	16	

Energy				22		
		15A.0	Conditional Requirement: Prescriptive Pathway	-	Complies	For each pathway a Conditional Requirement must be met in order for the project to be eligible for Green Star – Design & As Built rating
		15A.1	Building Envelope	1	1	1 point is awarded where the roof and ceiling, walls, and flooring construction achieves a 15% increase on the minimum required R-values specified in J1.3, J1.5 and J1.6 - To be confirmed at Detailed Design Phase
		15A.2	Glazing	1	0	For vertical glazing, the total energy used for each orientation and each storey is not greater than 85% of the total allowance according to the Australian Building Codes Board glazing calculator or the calculated aggregated air-conditioning energy value as defined in part J2.4 of the NCC; and Where there are roof lights, the SHGC and total U-Value of these roof lights exceed the requirements of section J1.4 by 15%
		15A.3	Lighting	1	1	The actual installed aggregate illumination power density is 30% less than the maximum illumination power densities defined in Table J6.2a, Automated lighting control systems, such as occupant detection and daylight adjustment, are provided to 95% of the nominated area; and For Class 5 and 9a buildings only, the size of individually switched lighting zones does not exceed 100m2 for 95% of the nominated area
		15A.4	Ventilation and Air-conditioning	1	1	The building is naturally ventilated in accordance with AS 1668.4-2012

Greenhouse Gas Emissions	**A. Prescriptive Pathway**	**15A.5**	**Domestic Hot Water Systems**	**1**	**1**	**Hot water systems are powered by Renewable Energy (which may include electric/gas boost); or Natural Gas**
		15A.6	**Accredited GreenPower**	**5**		
		15B.0	Conditional Requirement: NatHERS Pathway	-		
		15B.1	NatHERS Pathway	-		
		15C.0	Conditional Requirement: BASIX Pathway	-		
		15C.1	BASIX Pathway	-		
		15D.0	Conditional Requirement: NABERS Pathway	-		
		15D.1	NABERS Energy Commitment Agreement Pathway	-		
		15E.0	Conditional Requirement: Reference Building Pathway	-		
		15E.1	Comparison to a Reference Building Pathway	-		
Peak Electricity Demand Reduction	**Prescriptive Pathway**	**16A**	**Prescriptive Pathway - On-site Energy Generation**	**1**	**1**	**The use of on-site electricity generation systems reduces the total peak electricity demand by at least 15%**
		16B	Performance Pathway - Reference Building	-		
Total				**11**	**5**	

Transport				**10**		
		17A.1	Performance Pathway	0		
		17B.1	**Access by Public Transport**	**3**	**0**	**No points are available using the *Access by Public Transport Calculator* due to the location of the School (Calculated rating = 2.3%)**
		17B.2	**Reduced Car Parking Provision**	**1**	**1**	**On site car parking spaces are under 50**

Sustainable Transport	Prescriptive Pathway	17B.3	Low Emission Vehicle Infrastructure	1		
		17B.4	Active Transport Facilities	1	1	Bicycle parking and related support facilities are provided - Note: numbers of bicycle parking facilities to be staged to match development equivalent to secure bicycle parking is provided for 40% of students over grade 4
		17B.5	Walkable Neighbourhoods	1	1	At least eight (8) amenities for all other types of buildings, are within 400m of the project
Total				7	3	

Water				12		
Potable Water	Prescriptive Pathway	18A.1	Potable Water - Performance Pathway	0		
		18B.1	Sanitary Fixture Efficiency	1	1	Low flow fixtures are specified as per the EFSG
		18B.2	Rainwater Reuse	1		*Rainwater reuse is designed for the school, however tank volume is less than 200kL
		18B.3	Heat Rejection	2		
		18B.4	Landscape Irrigation	1	1	No potable water is used for irrigation - recycled mains water will be suplemented by rainwater re-use
		18B.5	Fire System Test Water	1	1	Fire system rest water is reduced and re-used (See Hydraulic Infrastructure & Services and Water Cycle Management Report)
Total				6	3	

Materials				14		
Life Cycle Impacts	Prescriptive Pathway - Life Cycle Impacts	19A.1	Comparative Life Cycle Assessment	0		
		19A.2	Additional Life Cycle Impact Reporting	4		
		19B.1	Concrete	3	1	Refer structural plans

		19B.2	Steel	1		
		19B.3	Building Reuse	4		
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		
		20.2	Timber Products	1	1	Refer structural plans
		20.3	Permanent Formwork, Pipes, Flooring, Blinds and Cables	1		
Sustainable Products	To encourage sustainability and transparency in product specification.	21.1	Product Transparency and Sustainability	3		
Construction and Demolition Waste	Fixed Benchmark	22A	Fixed Benchmark	1		
		22B	Percentage Benchmark	-		
Total				12	2	

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	no critically endangered, endangered or vulnerable species, or ecological communities were present on the site - Refer to Environmental Impact Statement
		23.1	Ecological Value	3	2	The ecological value of the site is improved by the project.
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	Refer to Environmental Impact Statement
		24.1	Reuse of Land	1		
		24.2	Contamination and Hazardous Materials	1	1	A contamination assessment will be carried out prior to construction of the school, which will result in the site being deemed suitable for the intended use as a school, in terms of meeting the SEPP55 Contamination requirements.
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	At least 75% of the WHOLE SITE AREA comprises of one or a combination of vegetation, green roofs or a prescribed solar reflecantce index
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	Refer to Kellyville North Public School Civil and Stormwater Management Report (GHD, 2017)
		26.2	Stormwater Pollution Targets	1	1	Refer to Kellyville North Public School Civil and Stormwater Management Report (GHD, 2017)
Light Pollution	To reward projects that minimise light pollution.	27.0	Light Pollution to Neighbouring Bodies	-	Complies	All outdoor lighting on the project complies with AS 4282:1997 Control of the obtrusive effects of outdoor lighting
		27.1	Light Pollution to Night Sky	1	1	The reductions in light pollution specified in 27.1 has been achieved
Microbial Control	To recognise projects that implement systems to minimise the impacts associated with harmful microbes in building systems.	28.0	Legionella Impacts from Cooling Systems	1	1	*Building is naturally ventialted
Refrigerant Impacts	To encourage operational practices that minimise the environmental impacts of refrigeration equipment.	29.0	Refrigerants Impacts	1	1	*There are no refrigerants employed within the building systems
Total				5	5	

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	10		
Market Transformation	The project has undertaken a sustainability initiative that substantially contributes to the broader market transformation towards sustainable development in Australia or in the world.	30B	Market Transformation		1	Building monitroing systems will be fitted with a smart user interface that provides education on the building function - promoting ESD education for students, staff and the wider community
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		1	One (1) additional point may be awarded where project teams and building owners carry out a comprehensive services and maintainability review of supplementary or tenancy fitout systems, in addition to all nominated base building systems as outlined above
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			
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	30E	Global Sustainability		1	Achieve points under the WELL building standard for structured fitness opportunities
Total				10	3	

Core Points Available	Total Score Targeted
100	51.0

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