Daylight Study

Homebase Kent Road Public School

Gardner Wetherill Associates

Prepared for
Gardner Wetherill Associates

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Surface Design

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Document control

Revision	Date	Revision details	Author	Signed	Verifier	Signed	Approver	Signed
00	20.09.2018	Draft Issued for Comment	BL		BK			
01	25.09.2018	Updated to include GWA comments	BL		BK			
02	09.11.18	Updated to include PWC comments	BL					

Contents

1. Introduction

1.1 Purpose of Report

The purpose of this report is to assess and report on the natural light levels for the proposed Administration Building and typical Homebase Building within the Kent Road Public School Development.

To verify natural light levels within the Administration Building and Homebase Building, computer modelling in Radiance, IES Virtual Environment 2017 calculated the Daylight Factor (DF) under CIE Uniform Sky for each space. This approach is recognised by Green Star Design and As-built v1.2 Visual Comfort Credit on the delivery of will-lit spaces that provide high levels of visual comfort to building occupants. Collaborative for High Performance Schools (CHPS) Best practice manual recognises that 'computer simulations such as Radiance give information about the distribution of lighting in spaces with contributions from windows and skylights' (CHPS Best Practice Manual, 2002, Daylighting).

1.2 Project Background

The proposed education buildings to Kent Road, Public School is in early design stage and identified as a State Significant Development. To assist the project requirements a daylight modelling assessment is to be undertaken to verify the natural light levels expected for all spaces and consider other design strategies to increase the natural light levels. The following buildings were required to form part of this study:

- 3 Storey Block Homebase (Typical)
- 2 Story Administration Building

1.2.1 Building Envelope Specification

The project has undertaken a Section JV3 assessment and report by Jones Nicholson to verify the proposed glazing thermal performance values. This has allowed the project team to specify glazing with higher thermal performance values and Visual Light Transmittance (VLT) optimise daylight levels in the building.

1.3 Terms of Reference

The following terms of reference apply to this report and confirm the expected natural light levels achieved under appropriate assessment conditions. Further reference has been made to other industry bodies, such as Green Building Council of Australia, Green Star Design and As-built tool and the Collaborative for High Performance Schools:

CIE 10,000 Lux Uniform Sky represents a sky with a constant value of luminance

Daylight Factor (DF) is a ratio of light levels inside a structure to the light levels outside the structure

GBCA: Green Building Council Australia

Green Star is an environmental tool administered by the Green Building Council Australia

Visible Light Transmittance (VLT) is the fraction of light that is transmitted through the glazing. Light is that portion of solar radiation that is visible, meaning it has a wavelength between ~380-780 nanometers. The quantity of daylight that enters a window is directly proportional to the VLT.

1.4 Document Referencing

The drawings and documents referenced in this report are listed below:

Table 1: Documents Referenced

Document Reference	Document Description	Revision	Author
-	State Design Review Panel Session 05	June-2018	GA NSW
SSDA-0000	Cover Page and Drawing Register	B	Gardner Wetherill Associates
SSDA-0200	Existing Site Plan	B	
SSDA-0201	Site Analysis Plan	B	
SSDA-0202	Concept Diagram	B	
SSDA-0400	Proposed Site Plan	E	
SSDA-1200	Ground Floor Plan	C	
SSDA-1201	Level 1 Plan	C	
SSDA-1202	Level 2 Plan	C	
SSDA-1300	Lower Roof / Clerestorey Plan	C	
SSDA-1301	Roof Plan	C	
SSDA-1501	Site Elevations	B	
SSDA-1601	Sections	B	
SSDA-1602	Detailed Section	B	
SSDA-1801	Typical GF Homebase, Canteen & Admin FF&E Plan	B	
SSDA-1802	Typical L1 & L2 Homebase FF&E Plan	B	
SSDA-1900	Aerial Perspective of Existing School (South)	B	
SSDA-1901	Aerial Perspective of Proposed School (South)	B	
SSDA-1902	Street / Entry Perspective From Kent Road	B	
SSDA-1903	Playground Perspective Looking North	B	
SSDA-1904	Road Reserve Perspective Looking South West	B	
SSDA-1910	Materials and Finishes 01	B	
SSDA-1911	Materials and Finishes 02	B	
SSDA-1920	Shadow Analysis - June	B	
SSDA-1921	Shadow Analysis - Equinox	B	
SSDA-1922	Shadow Analysis - December	B	
SDRPT.17011068	Kent Rd Public School-NCC Section J - JV3 Assessment Report	A	Jones Nicholson Consulting Engineers
-	High Performance Schools Best Practice Manual	2002 Edition	The Collaborative for High Performance Schools
-	Green Star Design & As Built v1.2 Submission Guidelines	v1.2	Green Building Council of Australia

2. Daylight Methodology

2.1 Background Research and benchmarking

Surface Design have considered several sources of literature for this daylight study. In particular, the Collaborative for High Performance Schools (CHPS), discusses the relationship between daylighting, sustainability and high-performance design for schools and highlights that 'research has shown that children achieve significantly higher test scores in classrooms that are daylit than in those that are not' (CHPS Best Practice Manual 2003, Daylighting, p209).

The manual outlines the benefits of daylighting as:

- **Academic Performance**: Well-lit spaces produce better performing stimulating environments and can enhance student performance
- **Energy Savings**: Well-designed lighting and control can save energy and reduce peak electrical demands. Integrating electric lighting to automatic photocell control can reduce the annual cost associated with lighting each space
- **Better Light**: Quality of light sources for visual tasks is enhanced by the provision of natural light
- **Connection to Nature**: Visual comfort and the connection to views, nature and the environment are added benefits to the provision of windows
- **Improved Health**: Views and connection to natural lighting improve health and the body's natural circadian rhythm
- **Environmental Education**: Experiential learning and the opportunity to see outside creates new educational experiences

These benefits should be considered and aligned with the following Basic Daylighting Principles, recommended for guidance in designing daylit schools.

- Prevent direct sunlight penetration
- Provide gentle, uniform light
- Avoid creating source of glare
- Control of daylight through louvers or blinds
- Electric lighting systems to complement the daylighting design
- Plan of interior space

Green Star Visual Comfort benchmark

Green Star assessment and certification is not targeted for this school. Instead, to quantify the daylight levels experienced in the Administration Building and Homebase Building, the daylight assessment has confirmed the Green Star Visual Comfort criteria as a benchmark reference. The credit criteria for Daylighting quantifies high levels of daylight as spaces that receive a Daylight factor (DF) of 2.00 or larger under 10,000 Lux CIE Uniform sky conditions.

This daylight assessment is to report on the area (m^2) and percentage (%) of each space that receives high levels of natural light.

2.2 Daylight Simulation Software

The daylight assessment has been undertaken using the Radiance analysis module within the IES Virtual Environment software. This module is used to analyse the daylight factor and illuminance levels within Administration Building and Homebase Building.

The Radiance module utilises a backward ray tracing methodology to provide accuracy in the outputs for uniform design sky conditions. The Daylight Factor has been determined based on the proportion of the internal illuminance levels as a ratio to the external horizontal illuminance levels, expressed as a percentage.

The daylight levels were assessed using the10,000 Lux CIE uniform sky, with the following properties of the Radiance module within IES Virtual Environment;

- Plan view
- High Quality
- Illuminance WP Zone image type

2.3 Building and Geometry

The model geometry, surrounding buildings and internal layout reflect the Site Plan, Elevation Drawings and General Arrangement Drawings outlined in Section 1.4. The building geometry for the proposed Administration Building and Homebase Building were constructed in IES Virtual Environment 2017. These include the covered walkways between each building and the entry canopy/COLA shade structure. Figure 1 illustrates the Proposed Site Plan and surrounding buildings that were included in the daylight assessment.

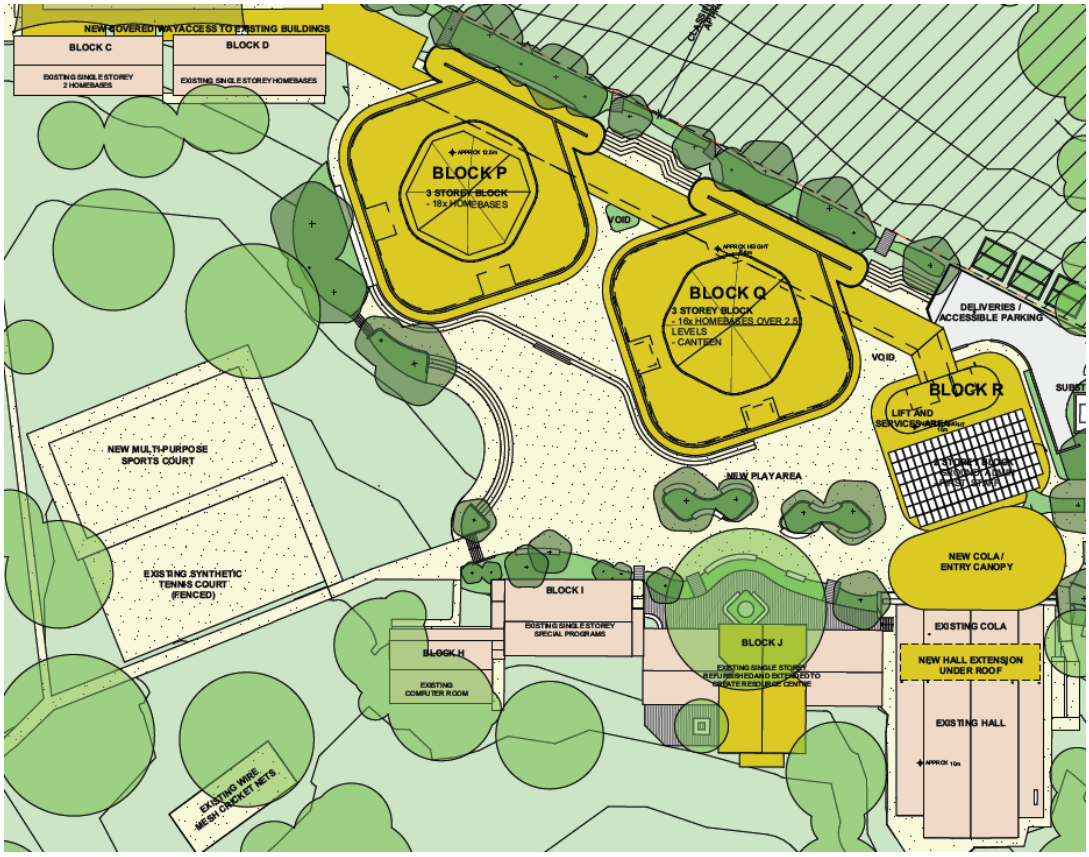


Figure 1: Proposed Site Pan

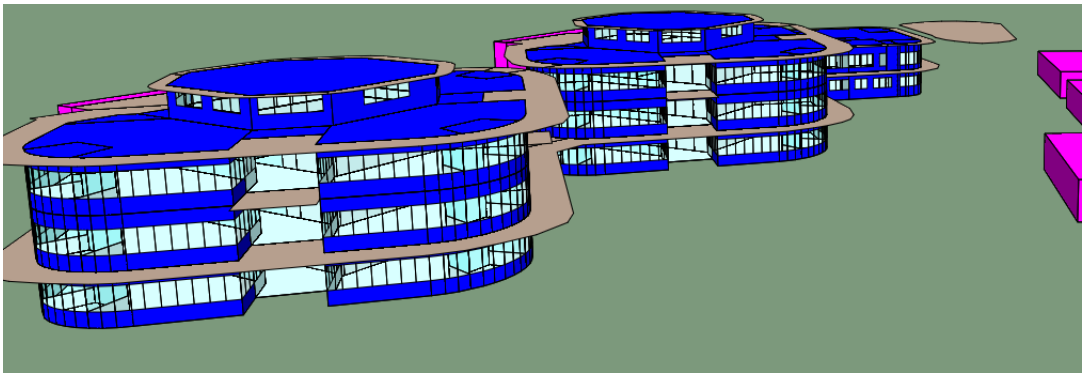


Figure 2: Conceptual Perspective of Homebase Kent Road Public School

2.4 Space Design Conditions

The incorporation of awnings, walkways and extent of glazing impact the amount of natural light into each space. Table 2 outlines the defining shading features that impact the penetration of natural light in this study:

Table 2: Defining Shading Features

Space Allocation			Design Features and Parameters
Level	Name	Total Area	
Homebase building (Block Q) Typical			
Ground	Learning Street B	65	Internal circulation space, external façade shaded by Level 1 Passive Outdoor Area
	Open Plan Learning Area B	130	External glazing with 1,600 windows, shaded by awning
	Learning Street A	65	Internal circulation space, external façade shaded by Level 1 Passive Outdoor Area
	Open Plan Learning Area A	130	External glazing with 1,600 windows, shaded by awning and Level 1 Walkway
	Shared PAA	65	Shaded by Level 1 Covered Walkway
	Shared Presentation	52	Internal space, with no external facade
Level 1	Open Plan Learning Area C	130	External glazing with 1,600 windows , no awning
	Learning Street B	65	Internal circulation space, external façade shaded by Level 2 Passive Outdoor Area
	Open Plan Learning Area B	130	External glazing, no awning
	Learning Street A	65	Internal circulation space, external façade shaded by Level 2 Passive Outdoor Area
	Open Plan Learning Area A	130	External glazing with 1,600 windows, no awning
	Shared PAA	65	Shaded by Level 2 Covered Walkway
	Shared Presentation	52	Internal space, with no external facade
Level 2	Open Plan Learning Area C	130	External glazing with 1,600 windows, shaded by awning
	Learning Street B	65	Internal circulation space, external façade shaded by Block Q Roof/Shade Structure
	Open Plan Learning Area B	130	External glazing with 1,600 windows, shaded by awning
	Learning Street A	65	Internal circulation space, external façade shaded by Block Q Roof/Shade Structure
	Open Plan Learning Area A	130	External glazing with 1,600 windows, shaded by awning
	Shared PAA	65	Shaded by Block Q Roof/Shade Structure
	Shared Presentation	52	Internal space, with no external facade
Administration Building			
Ground	Entry	26	Shaded by the COLA shade structure
	Clerical	60	Shaded by the COLA shade structure
	Deputy 2	15	Shaded by the COLA shade structure, Spandrel
	Deputy Double Office	25	Shaded by Level 1 Covered Walkway, Spandrel
	Deputy 1	14	Shaded by Level 1 Covered Walkway
	Interview/Office	10	Shaded by Level 1 Covered Walkway, Spandrel
	Principal's Office	20	Shaded by Level 1 Covered Walkway, limited glazing
	Interview 2	15	Shaded by Level 1 Covered Walkway, Spandrel
	Interview 1	15	Shaded by Level 1 Covered Walkway, Spandrel

Level 1	Open Plan Area/Staff Annex	150	Shaded by the COLA shade structure
	Special Programs 2	28	Shaded by Administration Building Roof/Shade Structure
	Special Programs 1	28	Shaded by Administration Building Roof/Shade Structure
	Balcony	12	Shaded by Administration Building Roof/Shade Structure
	Circulation	20	Internal circulation space

2.5 Building Space Use & Daylight Target

The function and use of space has an impact on the daylight requirement levels. The Kent Road Public Schools design of the Accommodation Building and typical Homebase Centre includes:

Table 3: Daylighting Requirement

Space	Functional Requirement	Importance of Daylighting
Typical Homebase Building		
Open Plan Areas (A, B & C)	To accommodate 60 students with flexible learning space	Significant
Learning Street A and B	transition space to allow students entry in and out of learning areas and access to presentation rooms	Less Significant
Presentation Rooms	temporary learning areas for collaborative learning	Less Significant
Administration Building		
Common Store/Storerooms	Temporary access for storage	Less Significant
Staff Annex Special Program Rooms	Temporary learning and activity rooms	Less Significant
Staff Open Plan Area	Breakout space for staff	Less Significant
Office and Interview Space	Temporary Staff Rooms	Less Significant
Internal circulation and amenities	Temporary circulation space	Less Significant

2.6 Input Parameters

The following reflectance values for floors, walls, ceilings and adjacent buildings has been used in the daylighting assessment:

Table 4: Reflectance Values

Surface	Reflectance
Floors	0.3
Walls	0.7
Ceilings	0.8
Adjacent Buildings	0.2

The glazing thermal performance values recorded in the Section J assessment by Jones Nicholson were modelled in this daylighting assessment. A conservative Visual Light Transmittance of 55% was used to assess the extent of natural light provision.

Table 5: Glazing Thermal Performance Values

Glazing Properties	Details
(Typical) Homebase (Internal/External Glazing)	
VLT	55%-70%
U-Value	≥4.9
SHGC	≤0.6
Accommodation Building (External Glazing)	
VLT	55%
U-Value	≥4.9
SHGC	≤0.6

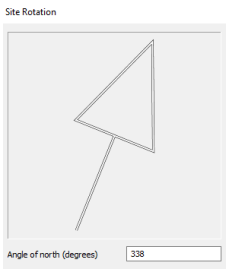
To determine the extent of natural light provision, the Radiance Module in IES Virtual Environment 2017 reflected the following sky conditions.

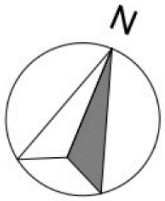
Table 6: Model Benchmark Parameters

Model Conditions	Model Parameters
Sky Conditions	10,000 Lux CIE Uniform Sky
View	Working Plan Image
Daylighting Measurement	Daylight Factor
Threshold	2.0% Daylight Factor

2.7 Orientation

The Kent Road Public School orientation reflects the orientation mark-up on the Architectural General Arrangement drawings by Gardner Wetherill Associates. The model site rotation is 338 degrees and aligns the angle of North for the simulation to the angle identified on the architectural drawings.





2.8 Disclaimer

This daylighting assessment provides an estimate of the penetration of daylighting into the building and is based off a simplified and idealised version of the building and surrounding environment. It cannot fully represent all the intricacies of the space once built. As a result, simulation results only represent an interpretation of the potential daylight levels experienced in the building. No guarantee or warrantee of the building in practice can be based on the simulation results alone.

This daylight assessment considers 10,000 Lux CIE Uniform Sky Conditions. This represents sky conditions equivalent to a Winter overcast day. It's understood that seasonal variations, including Summer days with clear sky, providing 100,000 lux is possible. No provision for overlit space, glare or thermal comfort has been considered in this assessment.

3. Results

3.1 Natural Light Calculations

The natural light levels has been assessed using computer simulation to evaluate the Daylight Factor (DF) experienced within the Homebase Building and Accommodation Building. Contoured mark-ups of the simulated Daylight Factor is overlayed on the General Arrangement Drawings included in **Appendix A**. Table 7 outlines the area (m^2) that receives a Daylight Factor >2, as a percentage (%) of total area. It provides results for glazing with a Visual Light Transmittance (VLT) of 55% and 70%.

Table 7: Natural Light Levels

Space Allocation			Area Daylight Factor (DF>2%)	
			Visual Light Transmittance (%)	
Level	Name	Total Area	55%	70%
Homebase building (Block Q) Typical				
Ground	Learning Street B	65	0.0	0.0
	Open Plan Learning Area B	130	20.26m^2 (15.6%)	36.97m^2 (28.4%)
	Learning Street A	65	0.0	0.0
	Open Plan Learning Area A	130	0.55m^2 (0.42%)	7.27m^2 (5.6%)
	Shared PAA	65	0.0	0.0
	Shared Presentation	52	0.0	0.0
Level 1	Open Plan Learning Area C	130	48.80m^2 (37.50%)	56.62m^2 (43.60%)
	Learning Street B	65	0.0	0.0
	Open Plan Learning Area B	130	53.92m^2 (41.50%)	62.49m^2 (48.10%)
	Learning Street A	65	0.0	0.0
	Open Plan Learning Area A	130	30.28m^2 (23.3%)	47.22m^2 (36.3%)
	Shared PAA	65	0.0	0.0
	Shared Presentation	52	0.0	0.0
Level 2	Open Plan Learning Area C	130	31.23m^2 (24.0%)	50.03m^2 (38.50%)
	Learning Street B	65	0.0	0.0
	Open Plan Learning Area B	130	31.54m^2 (24.3%)	48.96m^2 (37.70%)
	Learning Street A	65	0.0	0.0
	Open Plan Learning Area A	130	29.95m^2 (23.0%)	42.91m^2 (33.0%)
	Shared PAA	65	0.0	0.0
	Shared Presentation	52	0.0	0.0
Administration Building				
Ground	Entry	26	15.04m^2 (57.8%)	18.90m^2(72.7%)
	Clerical	60	0.0	0.0
	Deputy 2	15	0.14m^2 (0.9%)	4.51m^2 (30.10%)
	Deputy Double Office	25	0.0	0.0
	Deputy 1	14	0.0	0.0
	Interview/Office	10	2.6 m^2 (26.0%)	0.15m^2 (0.8%)
	Principal's Office	20	0.0	0.15m^2 (0.8%)
	Interview 2	15	0.0	0.18m^2 (1.2%)
	Interview 1	15	0.0	0.18m^2 (1.2%)

Level 1	Open Plan Area/Staff Annex	150	17.34 m² (11.6%)	20.39m² (11.6%)
	Special Programs 2	28	8.68 m² (31.0%)	10.46m² (37.40%)
	Special Programs 1	28	8.02 m² (28.6%)	9.68m² (34.6%)
	Balcony	12	8.52 m² (74.7%)	11.50m² (76.7%)
	Circulation	20	0.0	0.0

3.2 Discussion of Results

The quantity of natural light is influenced by the extent of shade provided by the walkway, awning and Visual Light Transmittance of the proposed glazing. These parameters reflect the proposed design of the Homebase Buildings and proposed glazing thermal performance values identified in the Section JV3 assessment by Jones Nicholson, dated 29th of August 2018.

Level 1 and Level 2 Open Plan Learning Areas

The Daylight Assessment indicated that Level 1 and 2 Open Plan Learning areas of the Homebase Building received satisfactory levels of natural light to at least 23% (29.95m²) of the floor area. Surrounding buildings, awnings and the Visual Light Transmittance (VLT) of the proposed glass limit high levels (200 lux) of natural light to a depth of at least 2.0m, under 10,000 Lux CIE Uniform Sky conditions.

These Open Plan Learning Areas are to be flexible learning environments, allowing Staff and Students opportunity to locate themselves according to the teaching requirements for satisfactory light levels.

Figure 3 and 4 illustrate expected natural light levels experienced within the Open Plan Learning Area in the Homebase Building. It illustrates the contoured natural light (lux) levels experienced internally with the Visual Light Transmittance (VLT) of glass at least 55%. Each image is from the perspective noted on the general arrangement drawing shown in Figure 5.

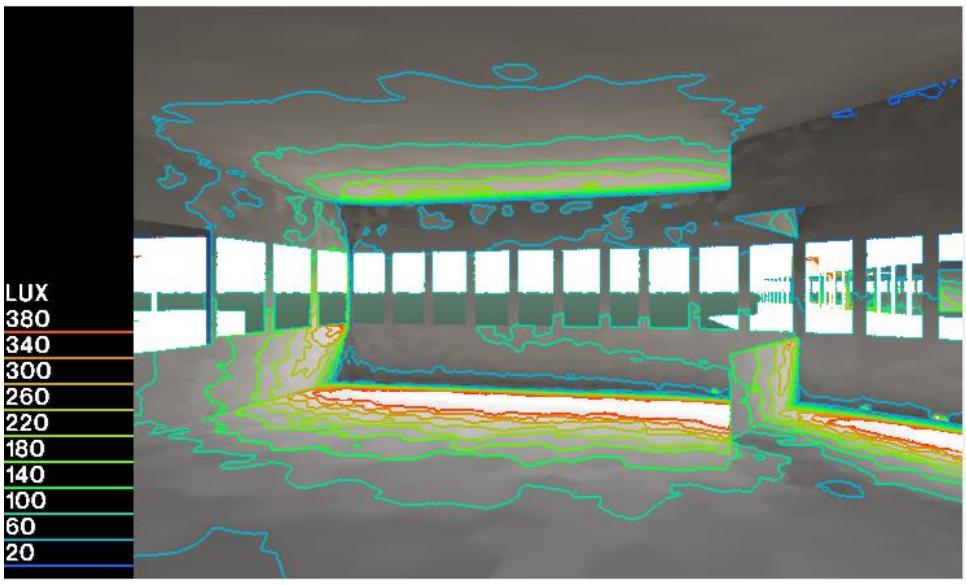


Figure 3: Internal View of Level 1, Open Learning Plan Learning Area

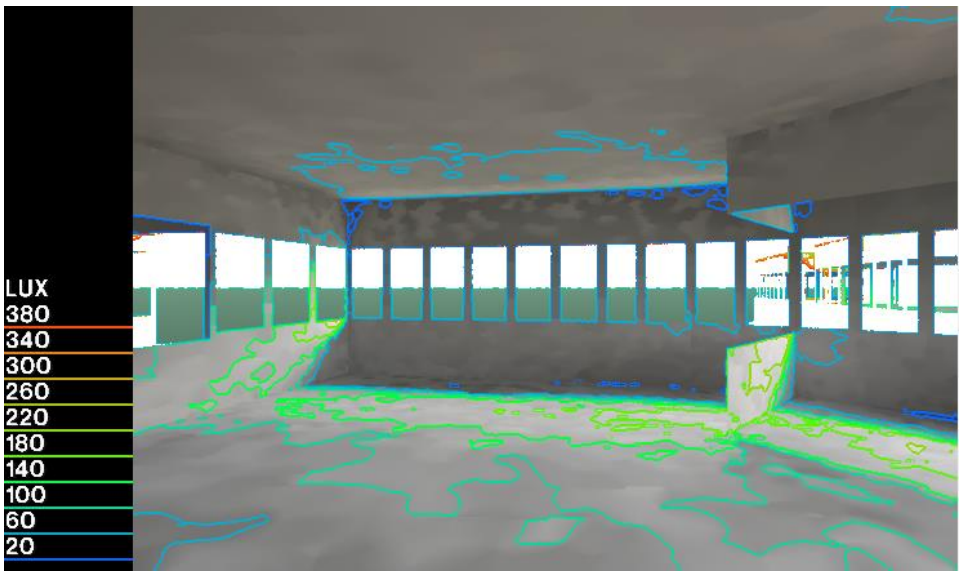


Figure 4: Internal View of Level 2, Open Learning Plan Learning Area

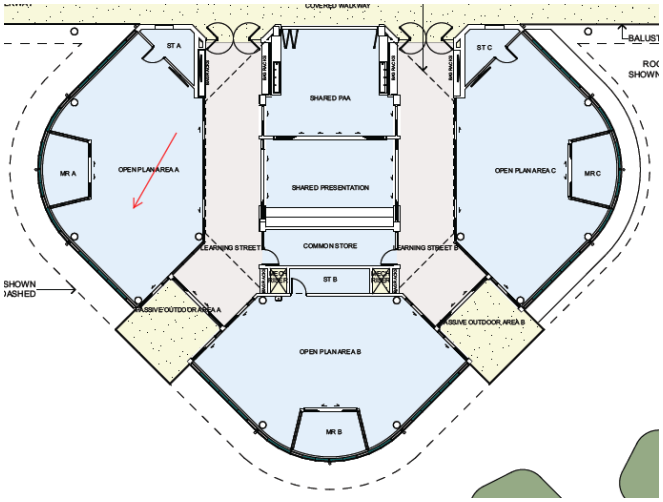


Figure 5: Occupant perspective for daylight images

Walkways and Awnings

The simulation considered the impact of transitional walkways, awnings and the covered entryway shade structure in the assessment. These structures provide shade, potential glare reduction and limit on the internal solar gains to the perimeter rooms without restricting the provision of natural light.

The daylight simulation demonstrated the impact of solar shading, provided by awnings and walkways to reduce light levels/solar gains to the Open Plan Learning Areas. It indicated the greatest impact was to the Ground Floor Open Plan Learning Areas A and C.

Ground Floor Open Learning Areas

Natural light levels to Ground Floor Open Plan Learning Areas A and C were directly impacted by the Level 1 walkway. This transition space allows for students and staff to extend their learning environment outside and move throughout the school. Figure 7 illustrates natural light levels are restricted by the Level 1 Walkway, regardless of the Northern services core and building. The internal Core and Circulation Spine areas are temporary learning areas and transition space and receive low levels of natural light. This design promotes high priority for the Open Plan Learning Areas to receive greater levels of natural light.

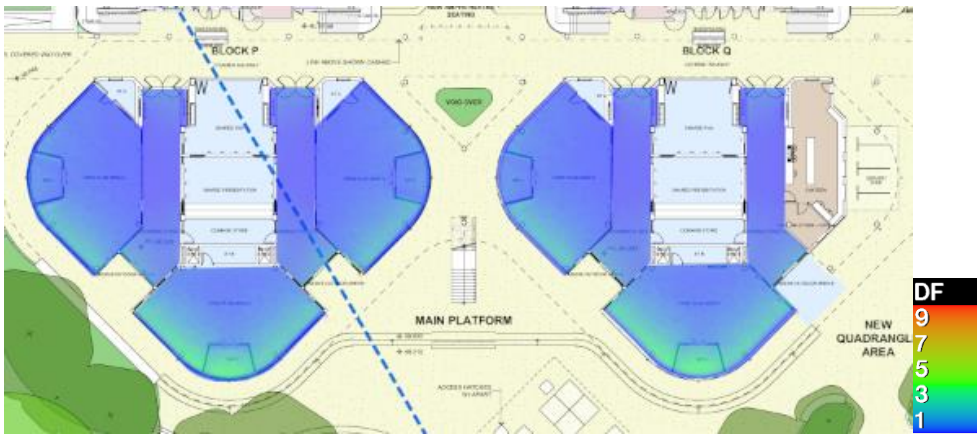


Figure 7: Ground Floor Provision of Daylight

Administration Building

The two (2) story Administration Building is connected to the Homebase design through the Level 1 walkway. This walkway provides shade to the Ground Floor perimeter Offices and Interview Rooms, reducing light levels/solar gains. Satisfactory levels of Natural Light (50-100 lux) were observed to throughout each space.

Level 1 perimeter Special Program Rooms and Staff Annex Rooms received high levels of natural lighting, with natural light levels of 200 lux observed to reach a depth of 2.0m, under 10,000 Lux CIE Uniform Sky.

Green Star Benchmark

The Green Star Benchmark rewards projects when at least 40% of the nominated area receive a Daylight Factor of at least 2% (200 lux). The spaces that could satisfy or come close to this include:

- Administration Building, Ground Floor Deputy 2 and Entry Area
- Administration Building, Level 1 Special Programs and Balcony
- Homebase Centre Level 1 and 2 Open Plan Learning Areas

3.3 Conclusion

The current design for the Kent Road Public School was assessed to understand the expected light levels for the Administration Building and typical Homebase Building. To assess the provision of high natural light into each space, the assessment considered the Green Star Credit criteria, defined as a Daylight Factor of 2% under 10,000 lux CIE Uniform Sky.

This assessment tested a range in glazing Visual Light Transmittance (VLT) between 55%-70% and indicated the impact of shading provided by the awning and walkway to the space directly below. The daylight assessment demonstrated the exposed Level 1 Open Plan Leaning Area B had the largest quantity of Natural Light, between ~53.92m^2(41.50%) to 62.49m^2 (48.10%). The other Open Plan Learning Areas had reduced levels of natural light levels due to awnings and transitional walkways located directly above. These structures form part of the solar shading strategy and reduce solar heat gain and glare to the space allowing the optimisation of daylighting to be met by selection high performance glazing and Visual Light Transmittance (VLT).

A minimum Visual Light Transmittance (VLT) of 55% should be nominated for the Homebase Kent Road Public School to achieve satisfactory natural light levels for the Open Plan Learning Areas. These areas are considered flexible learning environment spaces, allowing students and teachers the option to relocate lessons and seating arrangements, if greater access to natural light was required.

Appendix A

Natural Light Levels Overlayed on Architectural Drawings

SCHEMATIC DESIGN

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Kent Road Public School Development
Herring Road MARSFIELD NSW 2122

SCHOOL INFRASTRUCTURE NSW
School Infrastructure NSW
Level 3, 23 Bridge Street SYDNEY NSW 2000

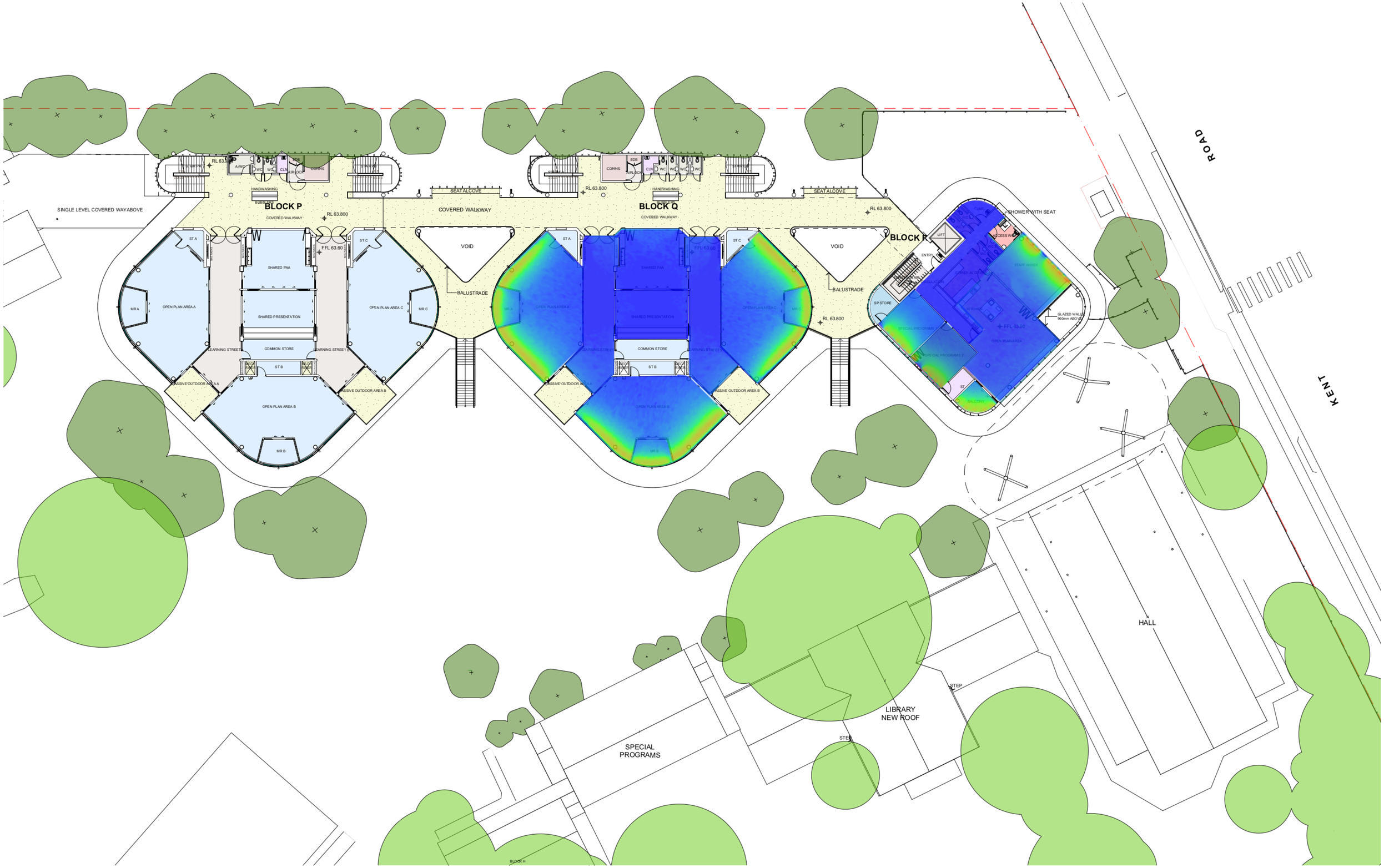
N

1:200 @ ORIGINAL SIZE
0 2 6 12 20m

DF 9 7 5 3 1

Ground Floor Plan

SCALE 1:200 @A1 17058-SD-1201[L]



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SCHOOL INFRASTRUCTURE NSW
School Infrastructure NSW
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N

1:200 @ ORIGINAL SIZE
0 2 6 12 20m

DF
9
7
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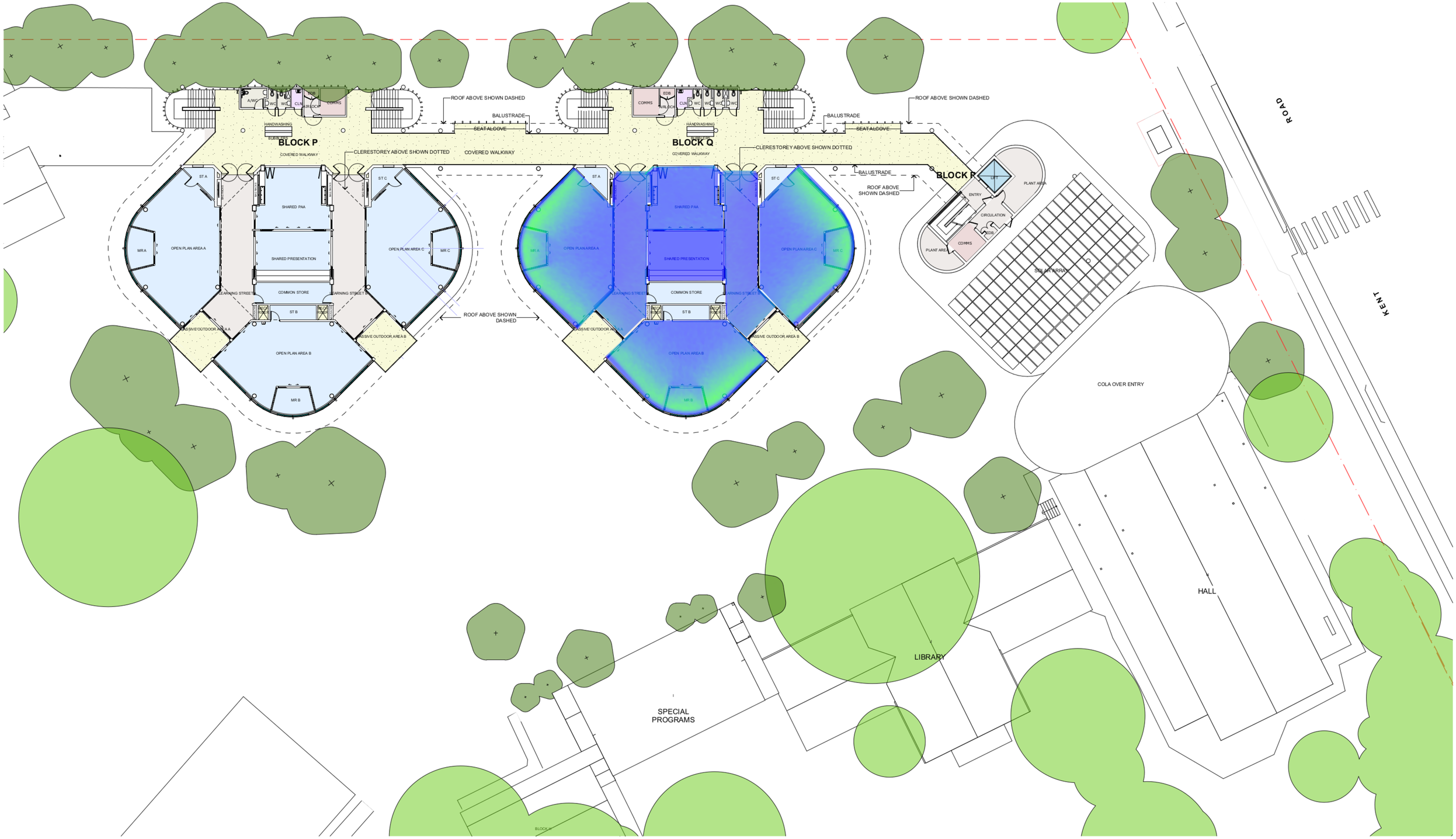
Level 1 Plan

SCALE 1:200 @A1 17058-SD-1202[J]



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Kent Road Public School Development
Herring Road MARSFIELD NSW 2122

SCHOOL INFRASTRUCTURE NSW
School Infrastructure NSW
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N

1:200 @ ORIGINAL SIZE
0 2 6 12 20m

DF 9 7 5 3 1

Level 2 Plan

SCALE 1:200 @A1

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