PROPOSED MIXED-USE DEVELOPMENT

116-122 Lydiard St N & 8-10 Mair St
Ballarat Central

SUSTAINABLE MANAGEMENT PLAN &

WATER SENSITIVE URBAN DESIGN RESPONSE

FOR

NIGRO GROUP

28 November 2022

File 744O

ark resources

CONTENTS

APPENDICES

Issue	Date	Prepared	Approved	Status
A	14 April 2022	MR/FP/ LD	JT	Draft
B	29 April 2022	MR/FP/ LD	JT	TP issue
C	28 November 2022	DO/FP/LD	MR	RFI Response

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1. Executive Summary

The proposed mixed-use development at 116-122 Lydiard St N & 8-10 Mair St, Ballarat Central has been designed to meet the objectives of the Ballarat City Council's Sustainability Policy Clauses 19-03-3S, 15.02-1S (Energy and Resource Efficiency) and 53.18 (Stormwater Management in Urban Development) of the Ballarat Planning Scheme. This report demonstrates how the development meets policy objectives of Clauses 15.02, 19.03-3S and 53.18 of the Planning Scheme.

This report confirms that a combination of sustainable building management practices, design initiatives, fixtures, systems, appliances, materials and finishes will be integrated into the building in order to attain a 4 star Green Star Buildings performance standard. The standard achieved can be defined as future Best Practice in terms of environmental design.

The development also meets the Best Practice standard for Urban Stormwater Quality and is therefore also consistent with the Ballarat City Council's Stormwater Management objectives.

Accordingly, the performance outcomes achieved by the proposed development considered to be appropriate for a mixed-use development of this scale.

2. Introduction

Ark Resources has been engaged by Nigro Group to provide advice in relation to environmentally sustainable development outcomes from the proposed development at 116-122 Lydiard St N & 8-10 Mair St, Ballarat Central.

This Sustainable Management Plan has been prepared to meet the Application Requirements of Clauses 19.03-3S, 15.02-1S (Energy and Resource Efficiency) and 53.18 (Stormwater Management in Urban Development) of the Ballarat Planning Scheme.

This report contains a summary of:

- Environmental objectives adopted for the development
- Sustainable design initiatives integrated into the design of the project.

Performance outcomes in this report are based on:

- Discussions and correspondence with:
- [redacted], Plus Architecture
- Town Planning Architectural drawings prepared by Plus Architecture set out below.

Description	Drawing No.	Revision	Date
Existing Site and Demolition Elevation	TP096	-	04/10/2022
Proposed Site Plan	TP097	-	04/10/2022
Basement 01	TP099	-	04/10/2022
Basement 01 – Zone 1	TP099-Z1	-	04/10/2022
Basement 01 – Zone 2	TP099-Z2	-	04/10/2022
Lower Ground	TP100	-	04/10/2022
Lower Ground – Zone 1	TP100-Z1	-	04/10/2022
Lower Ground – Zone 2	TP100-Z2	-	04/10/2022
Mezzanine	TP101	-	04/10/2022
Mezzanine – Zone 1	TP101-Z1	-	04/10/2022
Mezzanine – Zone 2	TP101-Z2	-	04/10/2022
Upper Ground	TP102	-	20/10/2022
Upper Ground – Zone 1	TP102-Z1	-	20/10/2022
Upper Ground – Zone 2	TP102-Z2	-	20/10/2022
Level 01	TP103	-	20/10/2022
Level 01 - Zone 1	TP103-Z1	-	20/10/2022
Level 01 - Zone 2	TP103-Z2	-	20/10/2022
Level 02	TP104	-	20/10/2022
Level 02 - Zone 1	TP104-Z1	-	20/10/2022
Level 02 - Zone 2	TP104-Z2	-	20/10/2022
Level 03	TP105	-	20/10/2022
Level 03 - Zone 1	TP105-Z1	-	20/10/2022
Level 03 - Zone 2	TP105-Z2	-	20/10/2022
Level 04	TP106	-	20/10/2022

Description	Drawing No.	Revision	Date
Level 04 - Zone 1	TP106-Z1	-	20/10/2022
Level 04 - Zone 2	TP106-Z2	-	20/10/2022
Level 05	TP107	-	20/10/2022
Level 05 - Zone 1	TP107-Z1	-	20/10/2022
Level 05 - Zone 2	TP107-Z2	-	20/10/2022
Level 06 - Zone 1	TP108	-	20/10/2022
Level 07 - Zone 1	TP109	-	20/10/2022
Roof Plan	TP110	-	20/10/2022
Elevation East - Zone 1	TP200	-	20/10/2022
Elevation East - Zone 2	TP201	-	20/10/2022
Elevation South - Zone 1	TP202	-	20/10/2022
Elevation South - Zone 2	TP203	-	20/10/2022
Elevation West - Zone 1	TP204	-	20/10/2022
Elevation West - Zone 2	TP205	-	20/10/2022
Elevation North - Zone 1	TP206	-	20/10/2022
Elevation North - Zone 2	TP207	-	20/10/2022

3. Site Description

The proposed development comprises hospitality venues, hotel accommodation, office tenancies and childcare services.

Zone 1 comprises the following uses:

Level	Use
Basement 01	Carparking (65 spaces), rainwater tanks, services, storage
Lower Ground	Gym/wellness, hospitality/wellness, waste room, substation, services
Mezzanine	Library/business centre, hotel BOH
Upper Ground	Restaurant, retail/hospitality, café, 3 hotel rooms
Level 1	Function/conference space, hotel BOH, 3 hotel rooms
Level 2	20 hotel rooms, hotel BOH
Level 3	20 hotel rooms, hotel BOH
Level 4	20 hotel rooms, hotel BOH
Level 5	19 hotel rooms, hotel BOH
Level 6	19 hotel rooms, hotel BOH
Level 7	Hospitality, mineral pool, hotel BOH, amenities, services
Roof	Services

Zone 2 comprises the following uses:

Level	Use
Lower Ground	Hospitality, carparking (22 spaces), bike parking (156 spaces), amenities, services
Mezzanine	Carparking (21 spaces), end of trip, cleaners room, services
Upper Ground	Office (1,221m2), amenities, services
Level 1	Office (1,343m2), amenities, services
Level 2	Office (1,493m2), amenities, services
Level 3	Office (1,494m2), amenities, services
Level 4	Meeting rooms/breakout space (231m2), childcare, hospitality, amenities, services
Roof	Solar PV system, services

The development is located within the Ballarat City Council and has a total site area of approximately 3,662m^2. The surrounding buildings are mainly commercial use.

An image of the site and the surrounding locale is provided below.

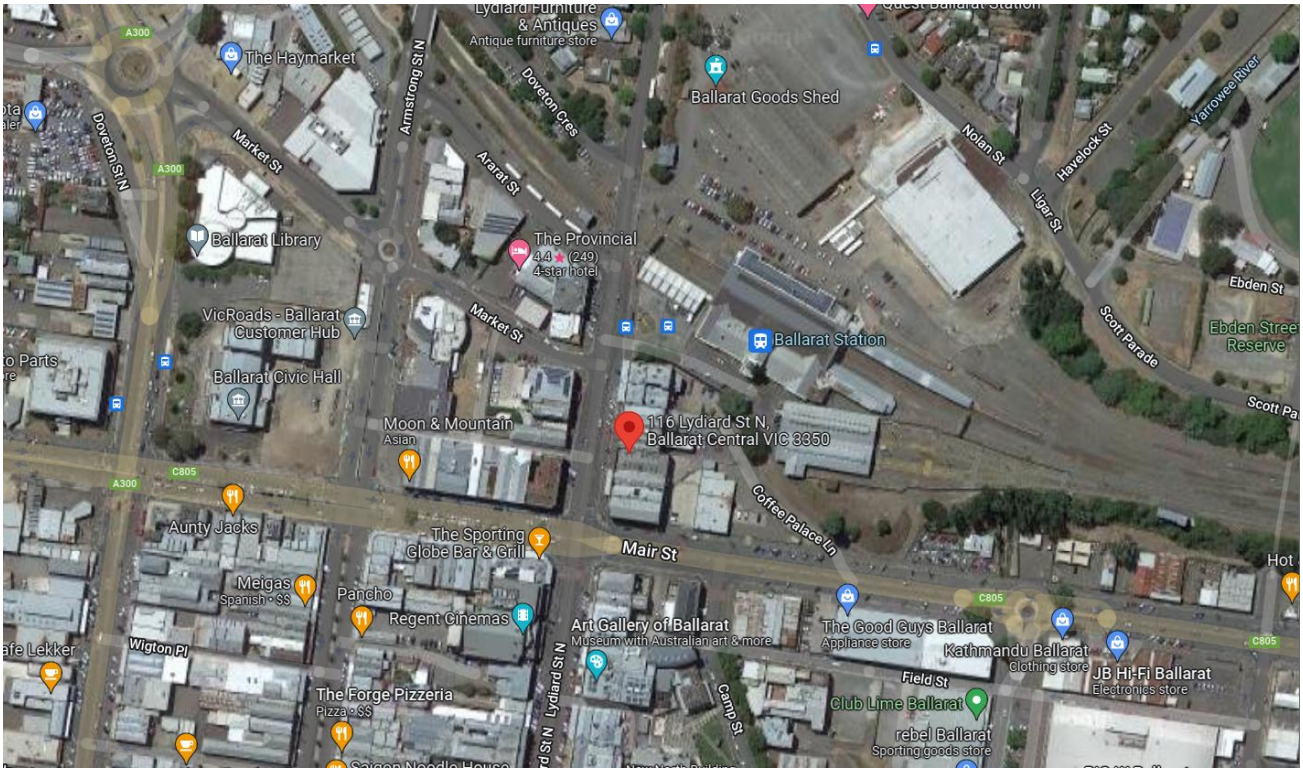


Image accessed February 2022 ©Google Earth

4. Summary of Key ESD Initiatives

A detailed analysis has been undertaken in order to nominate the ESD initiatives required and confirm the performance outcomes achieved. The results of this analysis are set out in the remainder of this report.

The following key sustainable design initiatives have been incorporated into this project:

- Rainwater harvesting system for toilet flushing and irrigation;
- Achieve sustainable water cycle management through:
    - Efficient use of potable water supplies
    - Recycling and re-use of alternative water sources
    - Integration of stormwater treatment into the design of urban spaces and landscapes
- Rooftop photovoltaic systems with a peak capacity of 115kW distributed across all buildings.
- High-performance glazing and energy efficient building services, appliances and fixtures;
- Environmentally preferable internal finishes; and
- Encourage walking and cycling to reduce the extent of private car use.

An assessment of sustainable design outcomes of the proposed development has been undertaken with *Green Star Buildings*, *MUSIC* and *FirstRate 5* benchmarking tools. The information presented in this report demonstrates that:

The information presented in this report demonstrates that:

- The development will achieve a 4 star *Green Star Buildings* rating
- The development will achieve a 5.5 star NABERS Office base building rating
- The development will exceed NCC 2019 Section requirements by 10%
- The development meets the *BESS* daylight standard
- The development meets the *Best Practice* standard for stormwater quality

The results of the performance assessment are summarised below.

5. MUSIC Modelling

To assess the quality of stormwater runoff from the site, an analysis has been undertaken using MUSIC Modelling software.

A rainwater harvesting system will be installed comprising:

- Rainwater harvesting from approx. 2,199m^2 roof areas (Zone 1 Level 2 Heritage roof and Level 7, Zone 2 Level 5):
- Total storage volume of 65,000kL rainwater tanks
- Re-use of captured water for flushing of all toilets

In addition to the harvesting and re-use of rainwater, the following features will be incorporated into the proposed design to facilitate treatment of stormwater runoff:

- Landscape areas that promote infiltration and reduce runoff during storm events.
- A SPEL Vortceptor gross pollutant trap (or equivalent primary treatment device) to capture suspended solids and litter generated onsite
- A SPEL Hydrosystem (or equivalent upflow filtration device) for removing the remaining nitrogen, phosphorous and suspended solids located near stormwater Legal Point of Discharge.

MUSIC RESULTS

The proposed development exceeds the pollutant load reduction targets set out in the Best Practice Environmental Management Guidelines (BPEMG) for Total Suspended Solids (TSS), Total Phosphorus (TP), Total Nitrogen (TN) and Gross Pollutants (GP).

- Reduction in Stormwater Discharge 46%
- Reduction in Total Suspended Solids (TSS) load: 92.1%
- Reduction in Total Phosphorus (TP) load: 66.7%
- Reduction in Total Nitrogen (TN) load: 65.9%
- Reduction in Gross Pollutants (GP) load: 99.9%

The results indicate that the project meets both the flow reduction, and pollutant (particulate and nutrient) reduction requirements of Green Star Buildings credit 39 Waterway Protection.

Refer to Appendix A for the MUSIC rating results, Appendix B for rainwater harvesting and reliability results and Appendix C for the WSUD Maintenance Manual.

6. Green Star

The *Green Star Buildings* (v1 Rev B) tool has been used as a benchmarking framework for the proposed scheme and demonstrates that the development has the preliminary design potential to achieve a **4 star** standard[1].

A detailed Green Star assessment has been undertaken to confirm the credits achievable by the proposed scheme.

Please note that this analysis is based on the best information currently available in relation to the technical and commercial feasibility of the initiatives proposed. Further investigation will be undertaken during design development which may result in change to the package of initiatives specified in order to meet the 4 star Green Star standard.

The initiatives which contribute to the 4 star *Green Star Buildings* rating are detailed in Section 7.1 below.

6.1. Green Star Buildings Criteria

The key design elements and processes which underpin the preliminary Green Star rating are summarised in the table below. The design attributes will be incorporated into the design in accordance with the technical criteria for each credit set out in the *Green Star Buildings* Technical Manual (v1 Revision B, 10 December 2021).

It should be noted that the *Green Star Buildings* tool has more stringent baseline requirements (for which no points are awarded) than the *Green Star Design & As Built* tool. These requirements are summarised in the extract below from the Technical Manual.

Minimum Expectations

There is a set of *Minimum Expectations* that must be targeted by all projects looking to achieve a Green Star rating. *Minimum Expectations* are not awarded points, therefore to achieve a rating the project must accumulate points in addition to the *Minimum Expectations*.

The *Minimum Expectations* aim to ensure all Green Star rated buildings meet a basic definition of a green building (energy efficient, water efficient, good healthy spaces, built responsibly, and on sites that are not highly sensitive areas). In summary, buildings must be designed and built to:

- Protect environmentally significant areas
- Emit less carbon in construction and during operations
- Be water efficient
- Have improved air, light, acoustics, and product finishes
- Promote physical activity
- Be built with climate change in mind
- Manage environmental impacts during construction
- Embrace the diversity of our population
- Enable practices that reduce operational waste
- Be verified to work

***Green Star Buildings* Minimum Expectations (v1 Revision B, 10 December 2021)**

[1] Note that a minimum of 15 points must be achieved for a 4 star Green Star Buildings rating to be achieved. The development will attain a 4 star Green Star standard however certification of the rating with the Green Building Council will not be undertaken. A points margin of 10-20% has been incorporated into the pathway presented in this report as a contingency to allow for the inevitable change to the pathway inclusive of attrition which typically occurs during the detailed design and construction phases. This does not imply that the applicant commits to delivering more than the points required for the rating targeted.

Green Star Credit		Project Outcomes	Credit Outcome		Project Stage
1	Industry Development	The development facilitates industry transformation through partnership, collaboration, and data sharing	The building owner or developer appoints a Green Star Accredited Professional (GSAP)	1	Strategy Brief Concept Design Tender Construction Handover Use
			The building owner or developer discloses the cost of sustainable building practices to the GBCA		
			The building owner or developer markets the building's sustainability achievements		
2	Responsible Construction	The builder's construction practices reduce impacts and promote opportunities for improved environmental and social outcomes	The builder must have an environmental management system (large builders will need to be ISO14001 accredited)	MINIMUM EXPECTATION	Tender Construction
			The site must have an environmental management plan		
			80% of Construction and demolition waste must be recycled		
			Sustainability training is provided to construction workers		
			90% of construction and demolition waste is diverted from landfill, and waste contractors and facilities comply with the Green Star Construction and Demolition Waste Reporting Criteria	1	
3	Verification and Handover	The building has been optimised and handed over to deliver a high level of performance in operation	The building is set up for optimum ongoing management due to its appropriate metering and monitoring systems	MINIMUM EXPECTATION	Design Tender Construction Handover Use
			The building has set environmental performance targets, designed and tested for airtightness, been commissioned, and will be tuned		
			The project team create and deliver operations and maintenance information to the facilities management team at the time of handover. Information is available to building users on how to best use the building		

Green Star Credit		Project Outcomes	Credit Outcome		Project Stage
			An independent level of verification is provided to the commissioning and tuning activities through the involvement of an independent commissioning agent **or** The project uses a soft landings approach that involves the future facilities management team	1	
4	Operational Waste	Operational waste can be separated and recovered in a safe and efficient manner The building must have appropriate spaces for waste management and an appropriately sized loading dock	The building is designed for the collection of separate waste streams	MINIMUM EXPECTATION	Design Handover Use
			The building provides a dedicated and adequately sized waste storage area		
			The building ensures safe and efficient access to waste storage areas for both occupants and waste collection contractors		
10	Clean Air	Pollutants entering the building are minimised, and a high level of fresh air is provided to ensure levels of indoor pollutants are maintained at acceptable levels	The ventilation system must have appropriate filtration	MINIMUM EXPECTATION	Design Tender Construction Handover Use
			The building must be provided with at an adequate amount of outside air		
			Point source pollutants must be exhausted directly outside (printers, kitchens)		
11	Light Quality	The building provides good daylight and its lighting is of high quality	Lighting within the building meets minimum comfort requirements	MINIMUM EXPECTATION	Concept Design Tender
			Good lighting levels suitable for the typical tasks in each space are available		
			The building provides adequate levels of daylight		

Green Star Credit		Project Outcomes	Credit Outcome		Project Stage
			The building provides best practice artificial lighting **or** The building provides best practice access to daylight	2	
12	Acoustic Comfort	The building provides acoustic comfort for building occupants	Internal noise levels from services and the outside is limited through an acoustic comfort strategy.	MINIMUM EXPECTATION	Design Tender Construction Handover
13	Exposure to Toxins	The building's occupants are not directly exposed to toxins in the spaces they spend time in	The building's paints adhesives, sealants, and carpets are low in TVOC or non-toxic	MINIMUM EXPECTATION	Design Tender Construction Handover
			The building's engineered wood products are low in TVOC or non-toxic		
			Occupants are not exposed to banned or highly toxic materials in the building		
16	Climate Change Resilience	The building has been built to respond to the direct and indirect impacts of climate change	The project team completes the climate change pre-screening checklist. The project team communicates the building's exposure to climate change risks to the applicant	MINIMUM EXPECTATION	Strategy Brief Concept Design
			The project team develops a project-specific climate change risk and adaptation assessment for the building	1	
			Extreme and high risks are addressed		
17	Operations Resilience	The building can respond to acute shocks and chronic stresses that can affect its operations over time	The project team undertakes a comprehensive review of the acute shocks and chronic stresses likely to influence future building operations	2	Strategy Brief

Green Star Credit		Project Outcomes	Credit Outcome		Project Stage
			The building's design and future operational plan addresses any high or extreme system-level interdependency risks		Concept Design
			The building's design maintains a level of survivability and design purpose in a blackout		
21	Upfront Carbon Emissions	The building's upfront carbon emissions from materials and products have been reduced and offset	The building's upfront carbon emissions are at least 10% less than those of a reference building	MINIMUM EXPECTATION	Strategy Brief Concept Design
22	Energy Use	The building has low energy consumption	The building's energy use is modelled to perform at a specified minimum NABERS star rating (by building class)	MINIMUM EXPECTATION	Brief Concept Design Tender
			The building's energy use is modelled to perform at a specified NABERS star rating (by building class)	3	
23	Energy Source	The building's energy comes from renewables	The building provides a Zero Carbon Action Plan	MINIMUM EXPECTATION	Brief Concept Design Tender
			100% of the building's electricity comes from renewable electricity	3	

Green Star Credit		Project Outcomes	Credit Outcome		Project Stage
25	Water Use	The building has low water use	The building installs efficient water fixtures **or** The building uses 15% less potable water compared to a reference building	MINIMUM EXPECTATION	Design Tender Construction Use
25	Water Use (Class 3)	The building has low water use	The building installs efficient water fixtures: ○ Taps 5 star ○ Toilets 4 star ○ Showers 3 star (<= 7.5 l/m) ○ Dishwashers 5 star **or** The building uses 10% less potable water compared to a reference building	MINIMUM EXPECTATION	Design Tender Construction Use
27	Movement and Place	The building's design and location encourage occupants and visitors to use active, low carbon, and public transport options instead of private vehicles	There are showers, lockers, and change rooms in the building The facilities are accessible, inclusive, and located in a safe and protected space	MINIMUM EXPECTATION	Strategy Brief Concept Design Tender Construction

Green Star Credit		Project Outcomes	Credit Outcome		Project Stage

			The building's access prioritises cycling and includes bicycle parking facilities
			• 153 cycle spaces for staff and visitors
			• Cycle maintenance rack and foot-pump
			• Staff EoT facilities including:
			  ○ 16 showers,
			  ○ 154 lockers
			  ○ changing area with benching & ironing facilities
			Clear, safe and inclusive access to cyclist facilities via 2 lifts. 2-way ramp also provided (non-dedicated) – gradients of 1:10 or greater to incorporate minimum slip resistance classification of P5 in accordance with AS 4586.		

			Sustainable Transport Plan to be prepared and implemented	3	
			EV charging infrastructure: • Chargers to 5% of car spaces: 6 chargers (minimum 7kW capacity) • EV charging to include load management supervisor hardware • Electrical containment e.g. trunking/conduit installed to facilitate future installation of cabling supplying a further 20% of car spaces (22 spaces)		
			Transport options that reduce the need for private fossil fuel powered vehicles are prioritised		
			Walkability encouraged via access to at least 10 amenities across 5 categories		

Green Star Credit		Project Outcomes	Credit Outcome		Project Stage
31	Inclusive Construction Practices	The builder's construction practices promote diversity and reduces physical and mental health impacts	There are provisions for providing gender appropriate facilities and personal protective equipment The head contractor also installs policies on-site to increase awareness and reduces instances of discrimination, racism, and bullying	MINIMUM EXPECTATION	Strategy Brief Tender Construction
			The head contractor provides high-quality staff support on-site to reduce at least 5 key physical and mental health impacts relevant to construction workers. They must also evaluate effectiveness of their interventions.	1	
35	Impacts to Nature	Ecological value is conserved and protected	The building was not built on, or significantly impacted, a site with a high ecological value	MINIMUM EXPECTATION	Strategy Brief Concept Design
			The building's light pollution has been minimised		
			There is ongoing monitoring, reporting, and management of the site's wetland ecosystem		
39	Waterway Protection	Local waterways are protected, and the impacts of flooding and drought are reduced	The project demonstrates a reduction in average annual stormwater discharge (ML/yr) of 40% across the whole site	2	Concept Design Construction Handover
			Specified pollution reduction targets are met		
Total Green Star Points					**20**
Green Star Rating					**4 stars**

7. Conclusion

This report sets out a range of sustainable design features, which are integrated into the design and specification of the proposed development, to improve environmental outcomes during occupation.

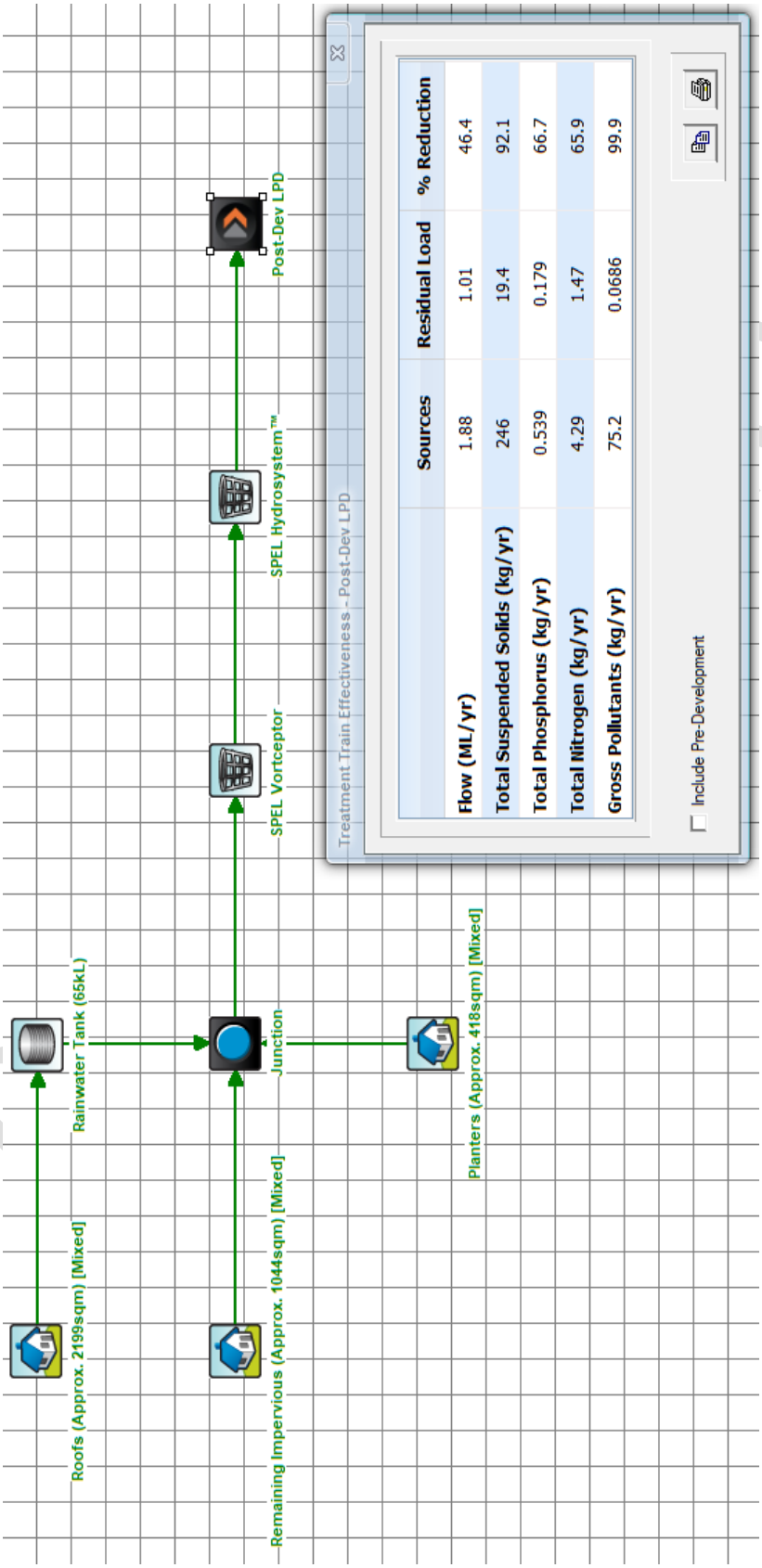
In terms of performance outcomes, the analysis presented in this report demonstrates that the proposed development:

- Attains a 4 star *Green Star Building*s rating
- Achieves a 5.5 star NABERS Office rating
- Exceeds NCC 2019 Section J energy efficiency requirements by more than 10%
- Attains the *Best Practice* standard for urban stormwater quality

Accordingly, the sustainable design outcomes from the proposed development are considered to be satisfactory for a mixed-use development of this scale and are consistent with the objectives set out in Clauses 19.03-3S, 15.02-1S (Energy and Resource Efficiency) and 53.18 (Stormwater Management in Urban Development) of the Ballarat Planning Scheme.

APPENDIX A. MUSIC RESULTS

A.1 MUSIC SCHEMATIC



	Sources	Residual Load	% Reduction
Flow (ML/yr)	1.88	1.01	46.4
Total Suspended Solids (kg/yr)	246	19.4	92.1
Total Phosphorus (kg/yr)	0.539	0.179	66.7
Total Nitrogen (kg/yr)	4.29	1.47	65.9
Gross Pollutants (kg/yr)	75.2	0.0686	99.9

A.2 MODELLING ASSUMPTIONS AND INPUTS

Assumptions			
Area Name			**Area [m^2]**
Total Roof Areas to Rainwater Tank			2,199
L7 Roof Site A			525
L5 Roof Site B			1,035
L2 Roof Site A (Heritage Bldg)			640
Part Pervious Landscape Areas			418
Remaining Impervious Area			1,044
Total Site Area			**3,662**

MUSIC Model 30/03/2022			
Treatment Devices Features			
RWT			65 kL
Est. daily water demand for TF			3.2 kL/day
Toilets			Hopsitality toilets Site A, All toilets Site B
**Primary Treatment System 1 (GPT)			SPEL Vortceptor (or equivalent)
***Secondary/Tertiary Treatment System			SPEL Hydrosystem (or equivalent)
Results			
Reduction in Total Suspended Solids (TSS)			92.1%
Reduction in Total Phosphorus (TP)			66.7%
Reduction in Total Nitrogen (TN)			65.9%
Reduction in Total Gross Pollutants			99.9%

Pollutant	MUSIC Model Results	Green Star Building Targets (Credit Achievement)	Melbourne Water Targets
Reduction in Stormwater Discharge	46.4%	40.0%	-
Reduction in Total Suspended Solids (TSS)	92.1%	85.0%	80.0%
Reduction in Total Phosphorus (TP)	66.7%	65.0%	45.0%
Reduction in Total Nitrogen (TN)	65.9%	45.0%	45.0%
Reduction in Total Gross Pollutants	99.9%	90.0%	70.0%
Compliance with Project Targets		✓	✓

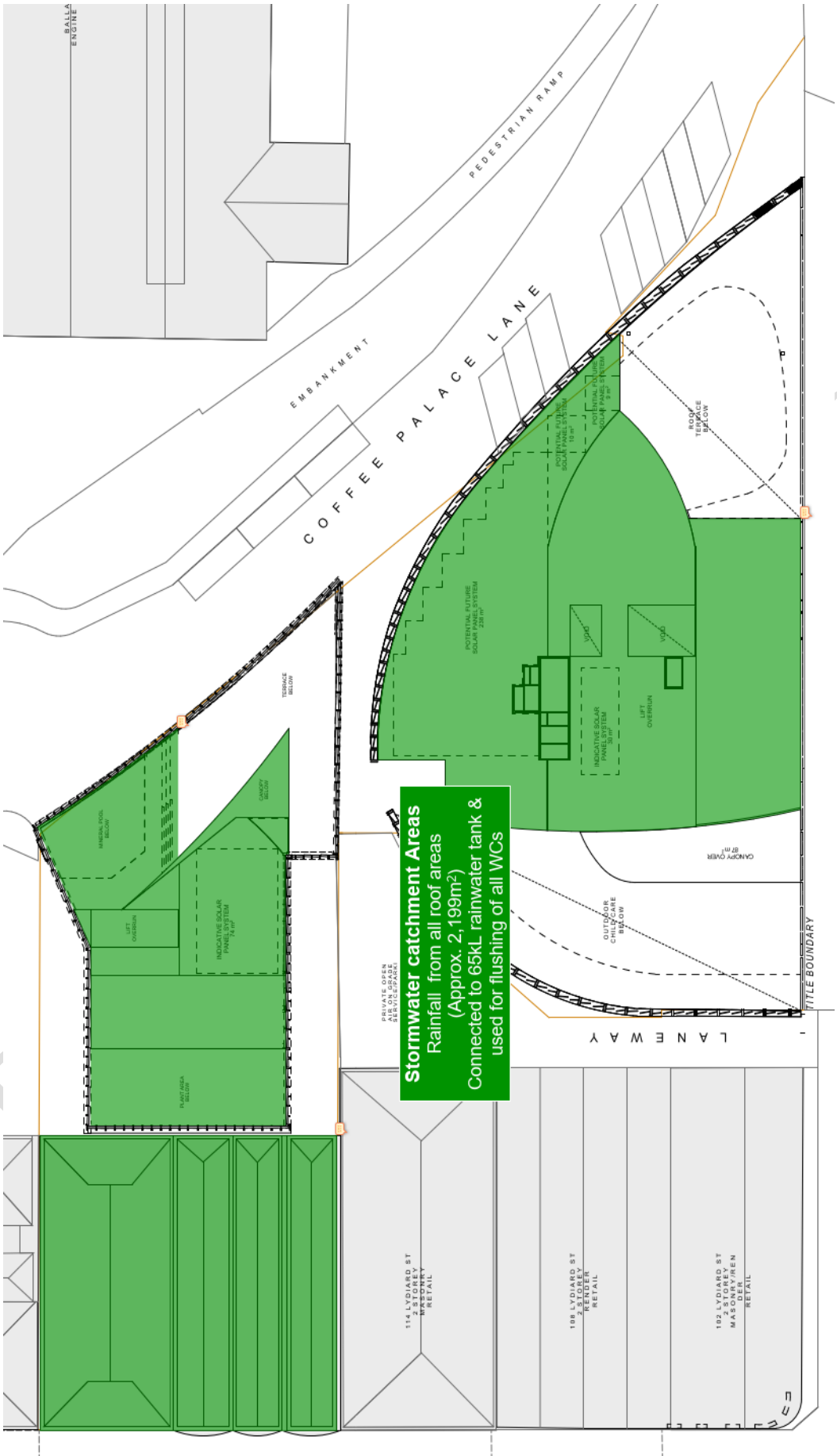
NOTES:
**Nutrient reduction (Phosphorous and Nitrogen) not attributed to GPT as per Melbourne Water MUSIC guidelines.
***Treatment System size is indicative only - to be further specified during Detailed Design.

Acronyms

RWT: Rain Water Tank
TF: Toilet Flushing
GPT: Gross Pollutant Trap

MUSIC v6.3.0 Input Parameters	
Rainfall data	
Rainfall Range & Station Name	Ballarat Aerodrome
10 Year Period	1954-1999
Time step	6 minutes
Estimation method	Stochastically generated
Soil properties - Melbourne	
Soil store capacity	120mm
Field capacity	50mm
GPT Pollutant Removal Rates	
Total Suspended Solids	70%
Total Phosphorous	0%
Total Nitrogen	0%
Gross Pollutants	98%
Validation report	CRC for Catchment Hydrology
Pollutant Removal Rates (SPEL Hydrosystem)	
Total Suspended Solids	85%
Total Phosphorous	66%
Total Nitrogen	43%
Gross Pollutants	100%
Validation report	QUT Report 24 August 2017

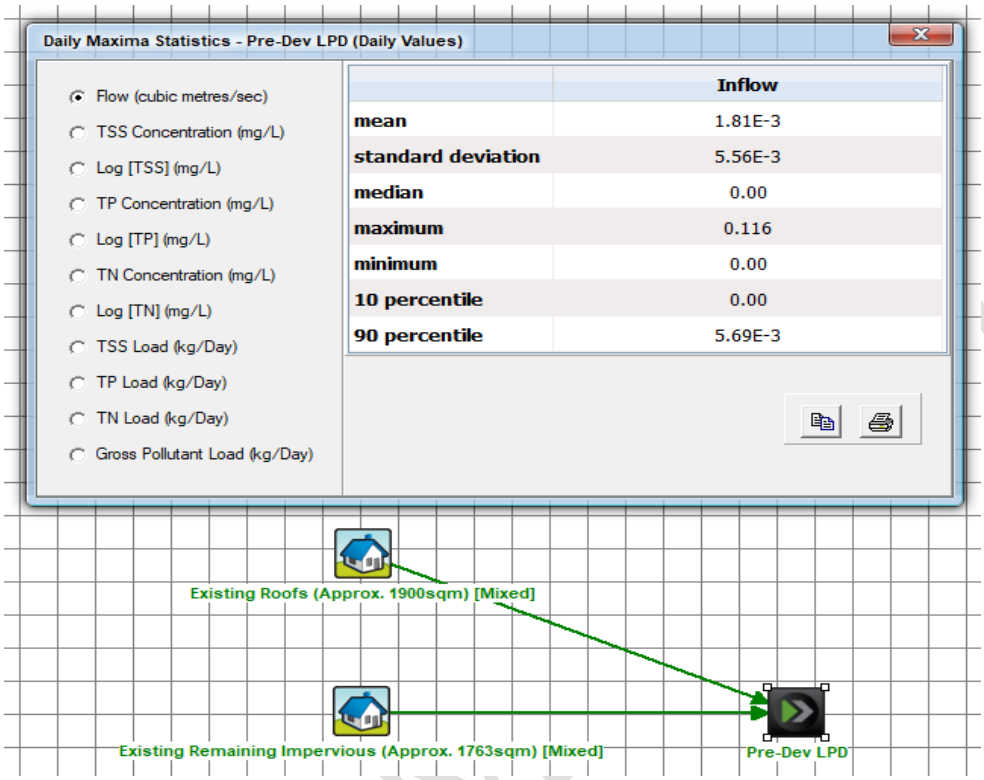
A.3 RAINWATER CATCHMENT AREA



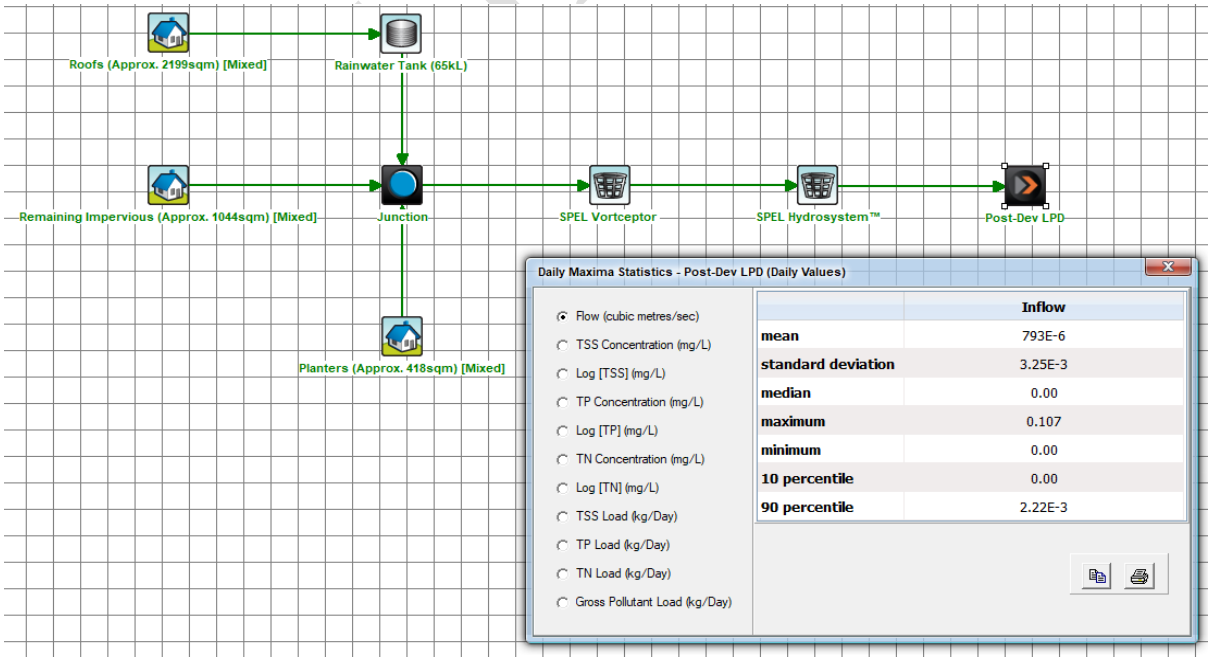
A.4 PRE AND POST DEVELOPMENT PEAK DISCHARGE

The Pre-Development maximum peak inflow is 0.116, and the Post-Development maximum peak inflow is 0.107, or 8% improvement.

PRE-DEVELOPMENT



POST-DEVELOPMENT



APPENDIX B. RAINWATER HARVESTING

Property 116-122 Lydiard Street, Ballarat
Version

box 1

Inputs:

Commercial	Floor Area - NLA (m2)	6052	
	PPL [M / F]	303	303
	Flush/Person/Day [M - Urinal]	2	
	Flush/Person/Day [M / F - WC]	0.3	2.3
	Litres/Flush [Urinal / WC]	1	3.3
	Total Daily usage (litres)	3201.508	
Residential	PPL	0	
	Flush/Person/Day	5	
	Litres/Flush	4	
	Total Daily usage (litres)	0	
Development	Total Daily usage (litres)	3202	
	Roof area (m2)	2,199	
	Collection Evaporation	5%	
	Tank Capacity (litres)	65,000	
	Irrigation Area (m2)	0	
	T'off if Total Rain (mm)	10	
	in the last	5 days	

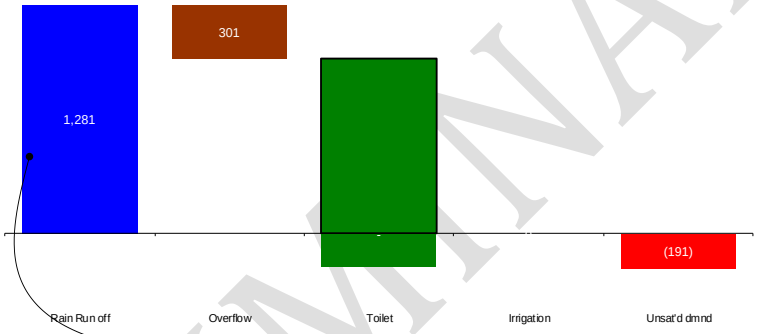
Recalc, update pivots, table and graphs

Irrigation Schedule

	l /m2	S	M	T	W	Th	Fr	S
Jan	10		y			y		
Feb	10		y			y		
Mar	10		y			y		
Apr	5		y					
May	5			y				
Jun	5			y				
Jul	5				y			
Aug	5				y			
Sep	5					y		
Oct	5					y		
Nov	10						y	
Dec	10		y				y	

box 2

System components (kls per year)



box 3

System components (kls per year) based on 12 years of actual historical daily rainfall

12 years of Averages
(k l)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rain Run off	86	89	78	133	108	111	99	111	107	100	138	119	1,281
Overflow	(17)	(23)	(17)	(36)	(19)	(25)	(9)	(15)	(20)	(25)	(46)	(48)	(301)
Rain Water saved	69	67	61	97	89	86	90	96	87	75	93	71	980
Toilet	(99)	(90)	(99)	(96)	(99)	(96)	(99)	(99)	(96)	(99)	(96)	(99)	(1,169)
(Shortfall)/Surplus before Irrigation	(30)	(24)	(38)	1	(10)	(10)	(10)	(3)	(9)	(24)	(3)	(28)	(188)
Irrigation	-	-	-	-	-	-	-	-	-	-	-	-	-
Unsatisfied Demand	(30)	(24)	(38)	1	(10)	(10)	(10)	(3)	(9)	(24)	(3)	(28)	(188)

Actual Years
(k l)

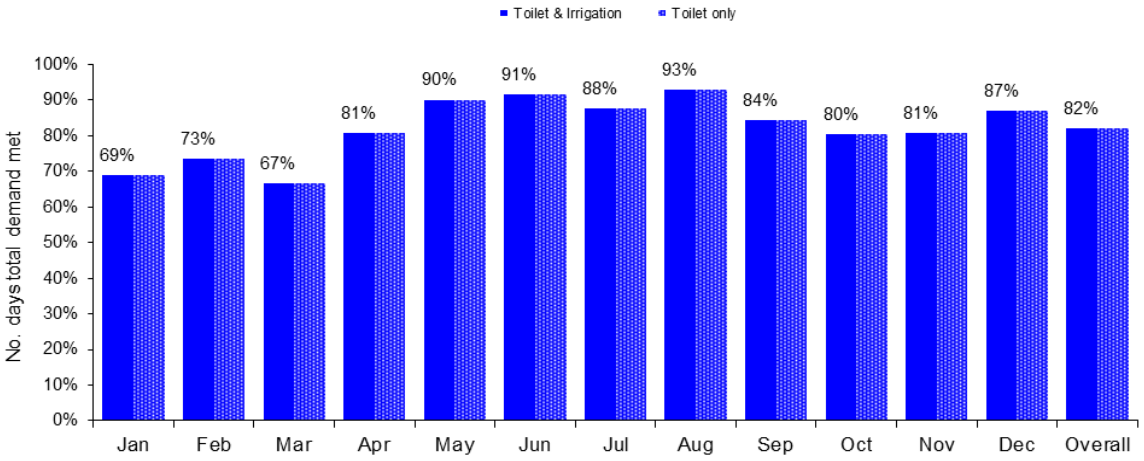
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Rain Run off	1,046	1,630	1,618	1,314	1,416	990	1,018	1,409	1,304	1,168	873	1,592	15,380
Overflow	(195)	(564)	(567)	(270)	(372)	(108)	(54)	(303)	(305)	(293)	(67)	(516)	(3,615)
Rain Water saved	851	1,066	1,051	1,044	1,044	882	964	1,106	999	875	806	1,076	11,765
Toilet	(1,169)	(1,169)	(1,169)	(1,172)	(1,169)	(1,169)	(1,169)	(1,172)	(1,169)	(1,169)	(1,169)	(1,165)	(14,026)
(Shortfall)/Surplus before Irrigation	(317)	(103)	(118)	(128)	(124)	(286)	(205)	(66)	(170)	(293)	(363)	(89)	(2,261)
Irrigation	-	-	-	-	-	-	-	-	-	-	-	-	-
Unsatisfied Demand	(317)	(103)	(118)	(128)	(124)	(286)	(205)	(66)	(170)	(293)	(363)	(89)	(2,261)

box 4

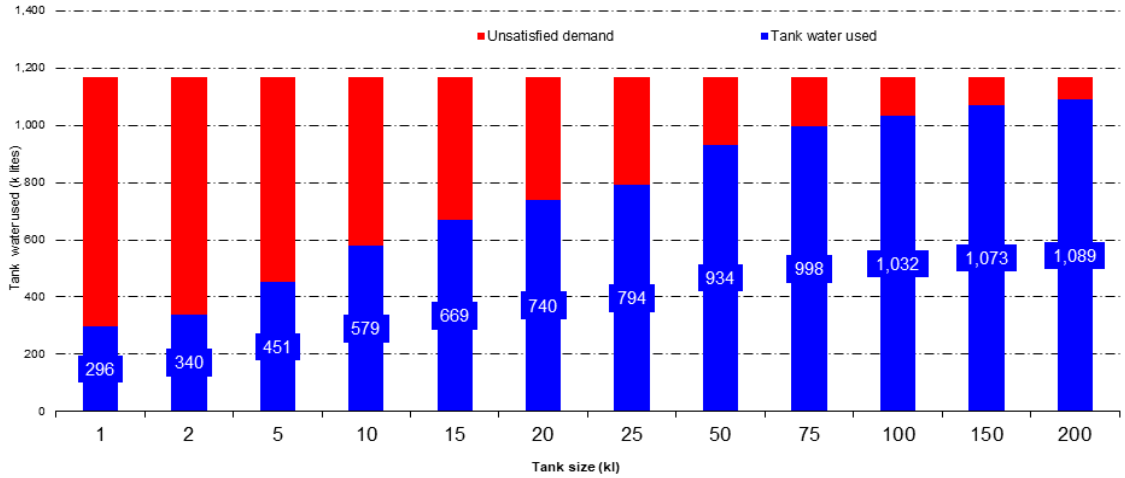
Reliability of supply (daily demand met)- Tank size what ifs

Tank	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
1k	13%	11%	12%	16%	23%	22%	22%	27%	21%	19%	17%	14%	18%
2k	13%	11%	13%	16%	24%	22%	23%	28%	21%	20%	18%	14%	19%
5k	20%	20%	21%	27%	39%	37%	38%	42%	33%	31%	29%	25%	30%
10k	29%	30%	31%	41%	56%	54%	54%	59%	47%	45%	42%	41%	44%
20k	38%	43%	42%	58%	72%	70%	67%	77%	62%	60%	56%	60%	59%
50k	62%	68%	59%	78%	86%	90%	81%	90%	82%	74%	77%	83%	78%
100k	75%	77%	76%	85%	93%	95%	93%	97%	90%	85%	90%	89%	87%
200k	85%	88%	86%	92%	95%	98%	97%	97%	95%	88%	93%	94%	92%

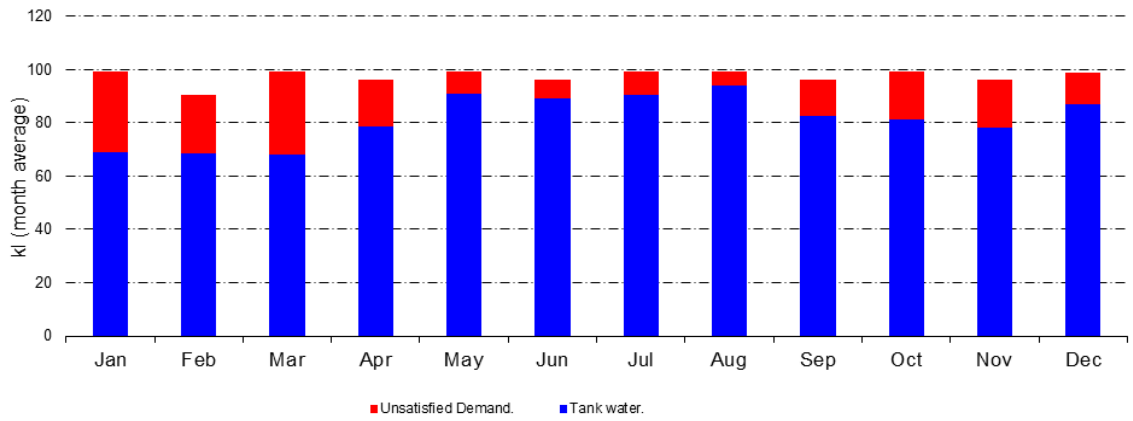
Graph 2 - Reliability of supply from tank (average across 12 years)



Graph 3 -Tank water used (per year) V Tank size
Kls per year



Graph 4 - Tank water used v unsatisfied demand
by month (kls per month)



APPENDIX C. WSUD MAINTENANCE MANUAL

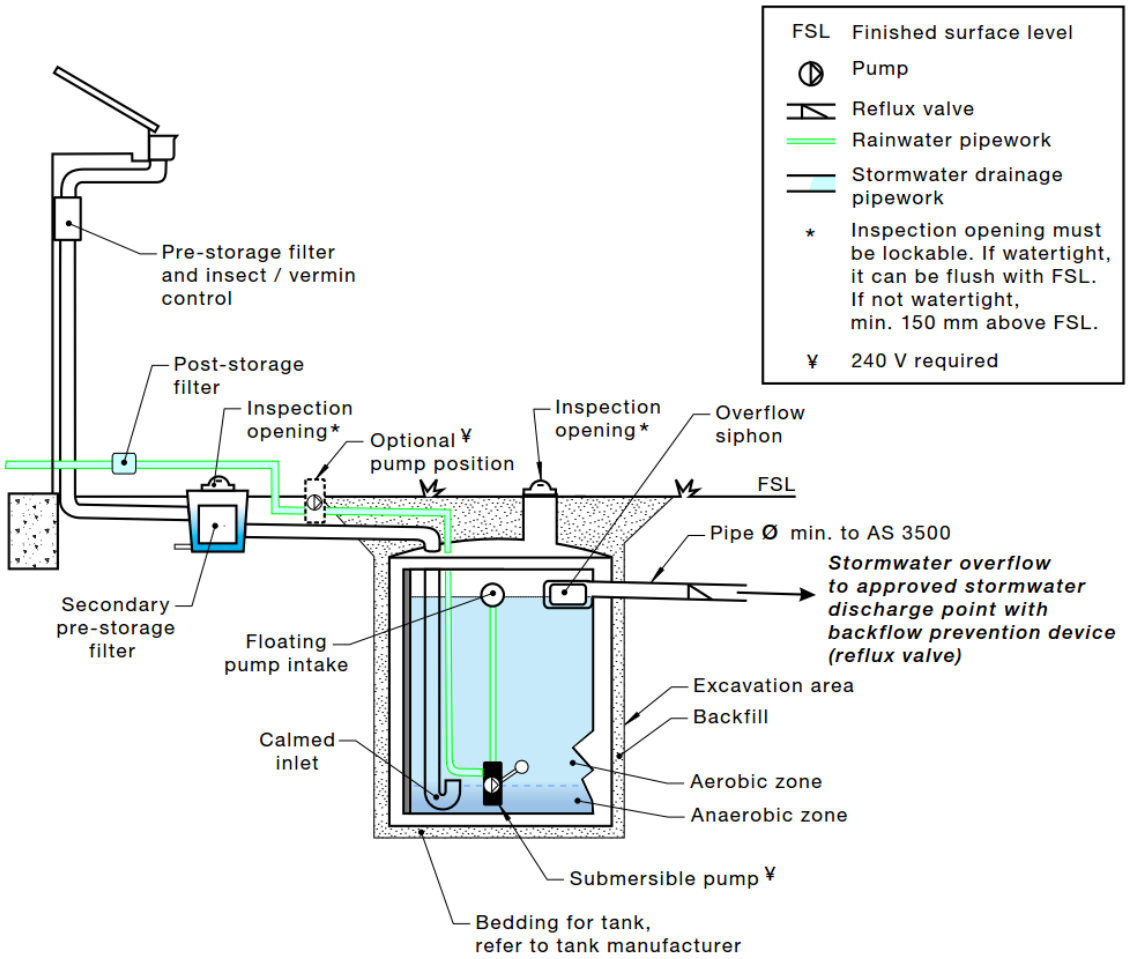
Once installed, a systematic maintenance program will be implemented by the owner's corporation maintenance contractor to ensure the rainwater harvesting system operates as designed and water quality is maintained.

The scope of the maintenance program will include inspection and rectification of issues associated with:

- Roof gutters and downpipes
- First flush screens and filtration devices
- Pumps
- Distribution pipework and reticulation systems
- Overflow systems

Inspections of the system and any maintenance works required will be undertaken on a quarterly basis or as per manufacturers guidelines.

The rainwater harvesting system will be installed in accordance with the guidelines set out in the Rainwater Design & Installation Handbook published by the National Water Commission[2]. A schematic diagram of the rainwater tank installation is provided below.



C.1 MAINTENANCE CHECKLIST

[2] Rainwater Design & Installation Handbook, National Water Commission, 2008

Rainwater Tank Element	Inspection Item	Y/N	Likely Maintenance Task
Roof gutters and downpipes	Is there leaf litter or debris in the gutters?		Remove by hand and dispose responsibly
First flush diverter	Is there anything blocking the first flush diverter (Leaves etc.)?		Remove by hand and dispose responsibly
Potable mains back up device	Is the potable mains back up switch operating correctly?		Repair or replace devise. Consider a manual switching device.
Mesh cover	Has the mesh cover deteriorated or have any holes in is?		Replace mesh cover.
Tank volume	Is there large amounts of sediment or debris sitting in the bottom of the tank, reducing the volume available in the tank to store water?		Remove sediment and dispose responsibly.
Pump	Is the pump working effectively? Have you heard it on a regular basis?		Check the potable mains back up is not permanently on. Repair or replace pump.
Pipes and taps	Are pipes and taps leaking?		Repair as needed.
Overflow	Is the overflow clear and connected to the storm water network?		Remove blockages and/or restore connections to stormwater network.

Maintenance Frequency												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
All tasks	**X**			**X**			**X**			**X**		

C.2 GROSS POLLUTANT TRAP (GPT) MAINTENANCE PROGRAM

Once installed, a systematic maintenance program will be implemented by the landowner to ensure the GPT operates as designed and water quality is maintained.

Cleaning and maintenance will be carried out in accordance with the manufacturer's written guidelines. Maintenance requirements and frequencies are dependent on the pollutant load characteristics.

The scope of the maintenance program will include inspection and rectification of issues associated with:

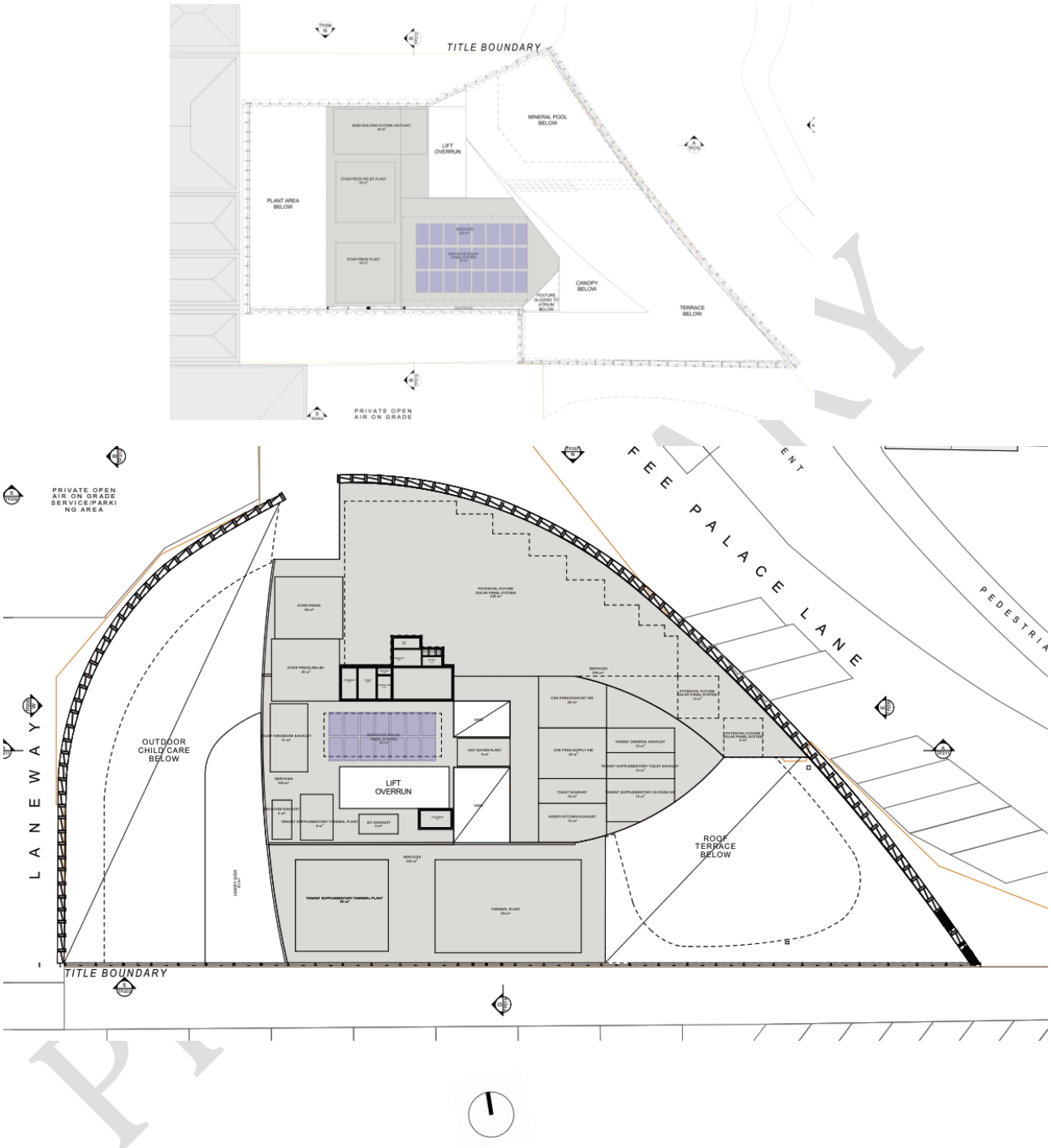
- Manhole cover
- Inlet pipe
- Outlet
- Screening area
- Collection area

Inspections of the GPT and any maintenance works required will be undertaken as outlined as a guide in the maintenance schedule below. Manufacturer's guidelines will take precedence.

Component	Maintenance Action
3-6 MONTHLY	
• Check components for damage. • Check that the inlet and outlet are free from debris or obstructions. • Remove large floating pollutants. • Measure sediment depth.	
12-24 MONTHLY (or as guided by sediment depth)	
• Removal of accumulated sediment and gross pollutants. • Inspection of screen and cleaning if required.	

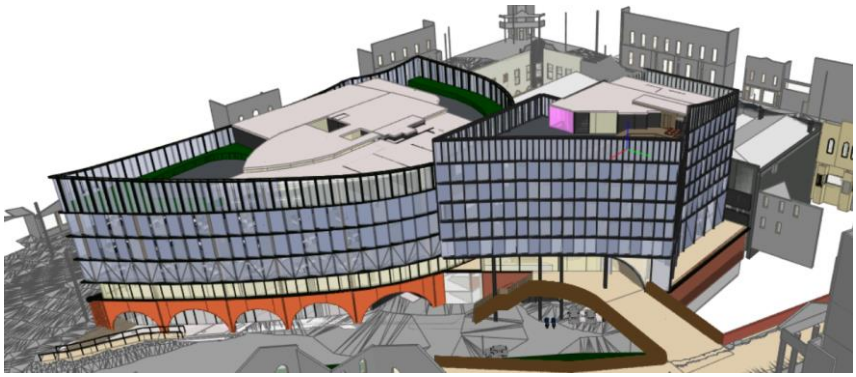
APPENDIX D. SOLAR PHOTOVOLTAIC SYSTEM

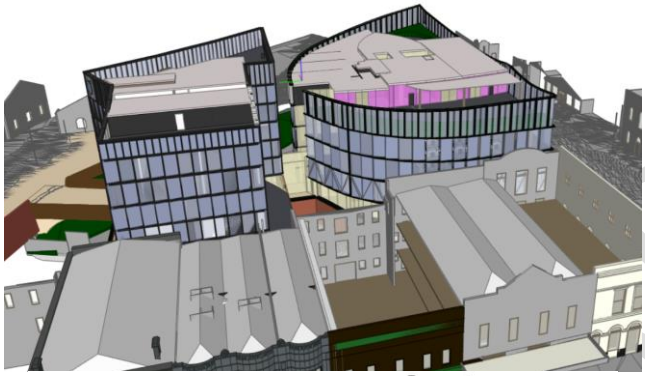
Rooftop solar PV systems will be configured as indicated below:



Indicative Solar Photovoltaic array layout

Façade integrated solar PV systems will be configured generally as per architectural elevations by Plus Architecture, subject to further design analysis and optimisation. 3D model perspective views are shown below:





High-efficiency solar PV modules with a total capacity of 115kWp will be installed as summarised below.

Hotel building

Aspect	Quantity	Module capacity (W)	Dimensions (mm)	Array capacity (kW)	Azimuth (°)	Tilt (°)	Yield (kWh/kWp)	Annual yield (MWh.pa)
Rooftop (E/W)	24	400	1100 x 1800	9.6	90°	13°	1.28	12.3
North	29	570	1134 x 2278	16.5	15°	90°	0.98	16.2
NNW	24	570	1134 x 2278	13.7	355°	90°	0.97	13.3
NE	49	570	1134 x 2278	27.9	45°	90°	0.99	27.7
West	20	570	1134 x 2278	11.4	255°	90°	0.72	8.2
Total	146			**79**				**77.6**

Office building

Aspect	Quantity	Module capacity (W)	Dimensions (mm)	Array capacity (kW)	Azimuth (°)	Tilt (°)	Yield (kWh/kWp)	Annual yield (MWh.pa)
Rooftop (E/W)	14	400	1100 x 1800	5.6	90°	13°	1.28	7.2
NNE	12	570	1134 x 2278	6.8	35°	90°	0.99	6.8
NE	20	570	1134 x 2278	11.4	45°	90°	0.98	11.2
NW	7	570	1134 x 2278	4.0	315°	90°	0.95	3.8
West	14	570	1134 x 2278	8.0	255°	90°	0.72	5.7
Total	67			**36**				**34.6**
Site Total	213			**115**				**112**

Total yield of this array will be approximately 112MWh per annum equating to an estimated annual carbon emissions offset of 112 tonnes $CO_{2\text{-}e}$ per annum.

Rooftop PV modules will be oriented in pairs to the east and west at 10-15° tilt and have at least 400Wp capacity (i.e. over 20% more efficient than conventional 330Wp 60-cell modules). High-efficiency modules deliver more compact arrays with inherently lower embodied ecological impact per unit of generation than standard efficiency modules.

The undulating east-west configuration prevents self-shadowing of the array, and provides a low-profile installation with maximised packing factor. It also helps maximise self-consumption due to its flatter and broader power output yield profile.

APPENDIX E. SITE MANAGEMENT PLAN

It is important to protect waterways into which stormwater systems drain into from various pollutants. The key pollutants at risk of entering the stormwater system during construction phase include:

- Sediments (e.g. soil, sand, gravel, concrete washings); and
- Litter, debris etc.

These pollutants result from several factors such as dirt from construction vehicles, erodible stockpiles located close to surface runoff flow paths, and surface runoff from disturbed areas during earthmoving and construction works. It is therefore important to integrate measures that minimise the pollutant loads entering stormwater system during construction.

The following stormwater management strategies will be implemented during the construction phase to mitigate the impacts of the pollutants above on the stormwater system:

- A project specific Erosion and Sediment control plan will be prepared in accordance with the guidelines set out in:
- Best Practice Erosion and Sediment Control (International Erosion Control Association Australasia, 2008); and
- Reducing Stormwater Pollution from Construction Sites (*EPA Victoria, 2005*).
- The Erosion and Sediment plan will form part of the Environmental Management Plan described in section 6.1 of this report. This initiative will reduce the impacts of sediments on the stormwater system during construction works upon implementation.
- Installation of appropriate onsite erosion and sediment control measures. All installed control measures shall be regularly inspected & maintained to ensure their effectiveness. Such measures may include (but not limited to):
- Silt fences
- sediment traps
- hay bales
- geotextile fabrics
- Where possible, litter bins with a lid or cover will be used to prevent litter from getting blown away and potentially entering stormwater drains.
- Additionally, the following work practices shall be adopted to reduce stormwater pollution:
- Site induction to make personnel aware of stormwater management measures in place;
- Employ measures to reduce mud being carried off-site into the roadways such as installing a rumble grid/ gravel/ crushed-rock driveway (or equivalent measure) to provide clean access for delivery vehicles, removing mud from vehicle tyres with a shovel etc.;
- Safe handling and storage of chemicals, paints, oils and other elements that could wash off site to prevent them from entering stormwater drains; and
- Where practicable, stockpiles will be covered, located within the site's fence and away from the lowest point of the site where surface runoff will drain to. This initiative will minimise erosion.

Accordingly, the measures presented above are considered appropriate for the proposed development at this stage of the project. The measures will reduce the pollutants entering stormwater system from the site during construction works thereby protecting waterways.

Furthermore, the initiatives above are consistent with the Application Requirements set out in the WSUD Policy of the Ballarat Planning Scheme.

APPENDIX F. DAYLIGHT ANALYSIS

F.1 RESULTS

This report assesses the daylight performance of the commercial spaces and hotel rooms within the proposed commercial development at 116-122 Lydiard St North & 8-10 Mair St, Ballarat Central.

The daylight assessment set out in this report is based on:

- Architectural drawings set by Plus Architecture Pty Ltd issued on the 4th of October 2022 and updated elevations issued on the 20th of October 2022 (Town Planning Issue).

Results of the daylight assessment are based on the daylight standard in the BESS sustainability rating tool.

The BESS tool sets the following minimum performance standards for internal daylight within habitable rooms of:

Residential:

- At least 80% of dwellings achieve a daylight factor greater than 0.5% to 90% of the floor area in all bedrooms.
- Additional points are allocated in the BESS tool if 100% of each room type achieve the daylight factor thresholds above however a 'best practice' outcome in BESS is achieved when 80% of rooms meet these thresholds.

*Due to there being no clear definition of minimum performance standards for internal daylight amenity within hotel guest rooms, we consider that the minimum performance standards for internal daylight amenity within residential bedrooms as established by BESS (CASBE) represents a reasonable best practice standard for hotel guest rooms.

Commercial:

- At least 33% of regular use areas (by floor area) achieve a daylight factor greater than 2%.
- Additional points are awarded where a higher proportion of regular use areas (by floor area) achieves a daylight factor of 2%
- Maximum points are awarded where 100% of regular use areas (by floor area) achieves a daylight factor of 2%.

*Commercial spaces within the existing buildings at 116-122 Lydiard St North have been omitted from the daylight assessment due to the intention to maintain the heritage façade.

Commercial Areas:

Room	Zone	Level	Floor Area (m²)	DF % > 2.0
Retail 1	2	LG	88	44.3
Retail 2	2	LG	315	27.7
Café	1	UG	62	100
Commercial 1	2	UG	95	30.2
Commercial 2	2	UG	96	24.9
Commercial 3	2	UG	211	9.4
Commercial 4	2	UG	332	26.6
Commercial 5	2	UG	447	44.2
Commercial 1	2	L1	453	29.8

Commercial 2	2	L1	890	41.6
Commercial 1	2	L2	1493	37.1
Commercial 1	2	L3	1494	37.9
Activity Room 1	2	L4	55	100
Activity Room 2	2	L4	52	19.2
Activity Room 3	2	L4	52	100
Activity Room 4	2	L4	52	100
Meeting Room 1	2	L4	59	9.8
Meeting Room 2	2	L4	47	52.9
Meeting/Break Out Space	2	L4	231	79.5
Hospitality	2	L4	136	64.4
Hospitality/Amenity	1	L7	136	66
Overall Weighted Average				**40.2**

Hotel Rooms:

Room	Level	DF % > 1.0
Hotel Room 1	UG	100
Hotel Room 2	UG	100
Hotel Room 3	UG	100
Hotel Room 1	L1	100
Hotel Room 2	L1	100
Hotel Room 3	L1	100
Hotel Room 1	L2	88.9
Hotel Room 2	L2	99.7
Hotel Room 3	L2	100
Hotel Room 4	L2	99.7
Hotel Room 5	L2	100
Hotel Room 6	L2	100
Hotel Room 7	L2	100
Hotel Room 8	L2	100
Hotel Room 9	L2	100
Hotel Room 10	L2	99.6
Hotel Room 11	L2	99

Room	Level	DF % > 1.0
Hotel Room 12	L2	100
Hotel Room 13	L2	100
Hotel Room 14	L2	64.9
Hotel Room 15	L2	89
Hotel Room 16	L2	96.2
Hotel Room 17	L2	100
Hotel Room 18	L2	100
Hotel Room 19	L2	100
Hotel Room 20	L2	100
Hotel Room 1	L3	88.2
Hotel Room 2	L3	100
Hotel Room 3	L3	100
Hotel Room 4	L3	100
Hotel Room 5	L3	100
Hotel Room 6	L3	100
Hotel Room 7	L3	100
Hotel Room 8	L3	100
Hotel Room 9	L3	100
Hotel Room 10	L3	100
Hotel Room 11	L3	100
Hotel Room 12	L3	100
Hotel Room 13	L3	100
Hotel Room 14	L3	79.9
Hotel Room 15	L3	93.4
Hotel Room 16	L3	100
Hotel Room 17	L3	100
Hotel Room 18	L3	100
Hotel Room 19	L3	100

Room	Level	DF % > 1.0
Hotel Room 20	L3	100
Hotel Room 1	L4	100
Hotel Room 2	L4	100
Hotel Room 3	L4	100
Hotel Room 4	L4	100
Hotel Room 5	L4	100
Hotel Room 6	L4	100
Hotel Room 7	L4	100
Hotel Room 8	L4	100
Hotel Room 9	L4	100
Hotel Room 10	L4	100
Hotel Room 11	L4	100
Hotel Room 12	L4	100
Hotel Room 13	L4	81.4
Hotel Room 14	L4	95.9
Hotel Room 15	L4	100
Hotel Room 16	L4	100
Hotel Room 17	L4	95
Hotel Room 18	L4	100
Hotel Room 19	L4	100
Hotel Room 20	L4	99.3
Hotel Room 1	L5	100
Hotel Room 2	L5	100
Hotel Room 3	L5	100
Hotel Room 4	L5	100
Hotel Room 5	L5	100
Hotel Room 6	L5	100
Hotel Room 7	L5	100

Room	Level	DF % > 1.0
Hotel Room 8	L5	100
Hotel Room 9	L5	100
Hotel Room 10	L5	100
Hotel Room 11	L5	100
Hotel Room 12	L5	100
Hotel Room 13	L5	100
Hotel Room 14	L5	100
Hotel Room 15	L5	100
Hotel Room 16	L5	100
Hotel Room 17	L5	83.9
Hotel Room 18	L5	100
Hotel Room 19	L5	100
Hotel Room 1	L6	100
Hotel Room 2	L6	100
Hotel Room 3	L6	100
Hotel Room 4	L6	100
Hotel Room 5	L6	100
Hotel Room 6	L6	100
Hotel Room 7	L6	100
Hotel Room 8	L6	100
Hotel Room 9	L6	100
Hotel Room 10	L6	100
Hotel Room 11	L6	100
Hotel Room 12	L6	100
Hotel Room 13	L6	100
Hotel Room 14	L6	100
Hotel Room 15	L6	100
Hotel Room 16	L6	100

Room	Level	DF % > 1.0
Hotel Room 17	L6	100
Hotel Room 18	L6	80.9
Hotel Room 19	L6	100

F.2 ASSUMPTIONS

The following assumptions have been made for the Visible Light Transmittance (VLT) values for all glazing applicable to this analysis:

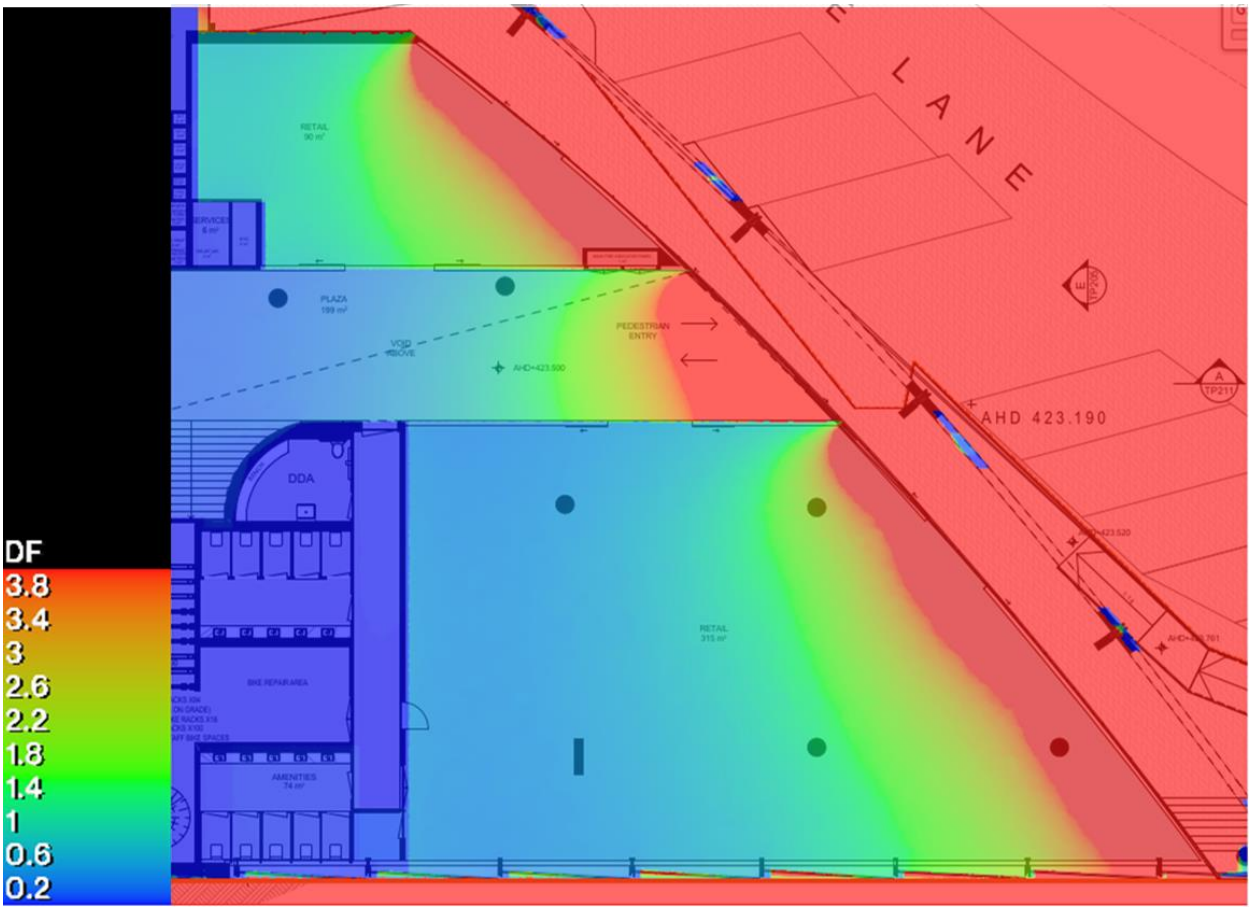
ASSUMED GLAZING VISUAL LIGHT TRANSMITTANCE

Glazing Type	Visible Light Transmittance (VLT)
	%
Grey-hued frosted glass (G1)	40
Grey-hued clear glass (G2)	50
Gold/Champagne-hued glass (G3)	30
Transparent clear low-e glass (G4)	60

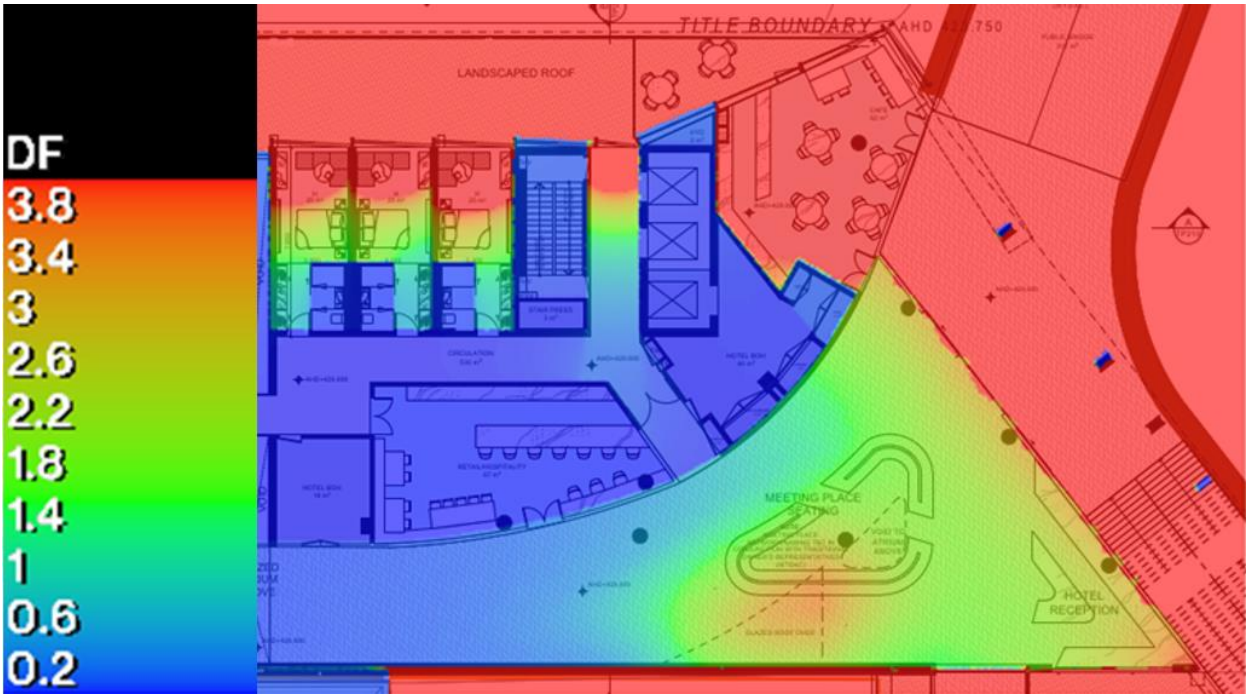
ASSUMED SURFACE REFLECTANCES

Construction Element	Reflectance (%)	Description
Floors	30	Assumes a medium-coloured carpet/timber/vinyl
Internal Walls	70	Assumes white paint
Internal Ceilings	80	Assumes white paint
External Fabric 1 (BR1)	30	Emperor Brick – Aged Natural Brick
External Fabric 2 (BR2)	30	Natural Blue Stone
External Fabric 3 (MT1)	5	Black Metal finish
External Fabric 4 (MT2)	5	Dark Bronze Metal finish
External Fabric 5 (AF1)	20	Light Bronze – Applied finish
External Fabric 6 (AF2)	10	Dark Grey – Applied finish
External Fabric 7 (PF1)	13	Welsh Slate (Porter's) – Paint finish
External Fabric 8 (PF2)	5	Darker Welsh Slate (Porter's) – Paint finish
External Fabric 9 (PF3)	11	Toy Soldier (Porter's) – Paint finish
External Fabric 10 (PF4)	4	Darker Toy Soldier (Porter's) – Paint finish
External Fabric 11 (S1)	15	Spandrel
Photovoltaics (PV1)	15	Dark Glass
External Ground 1	10	Assumes asphalt
External Ground 2 (PAV1)	30	Rammed Earth Paving – Herringbone Pattern

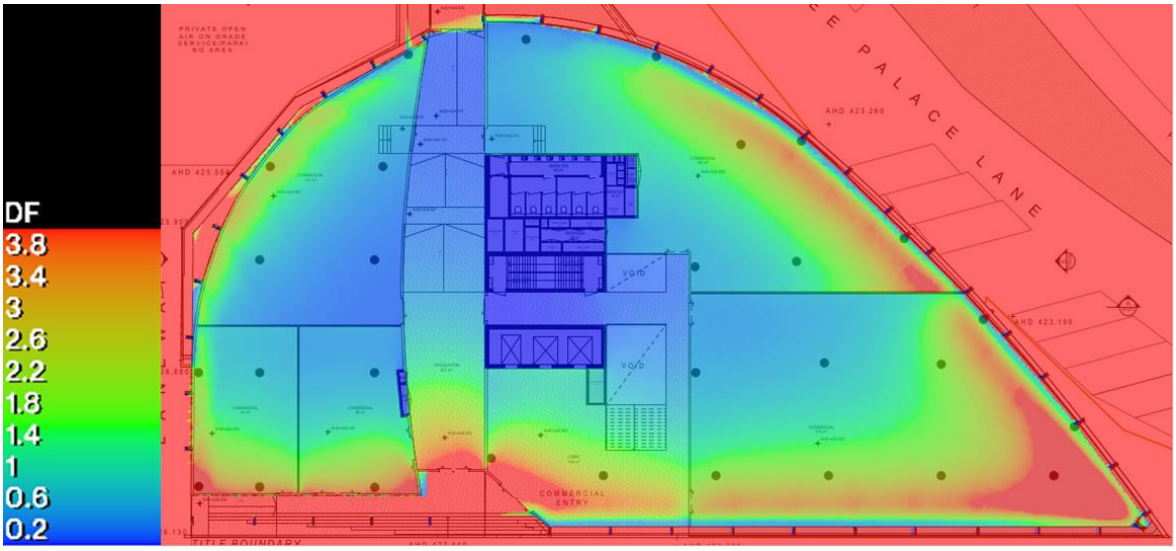
F.3 DAYLIGHT FACTOR CONTOUR PLOTS



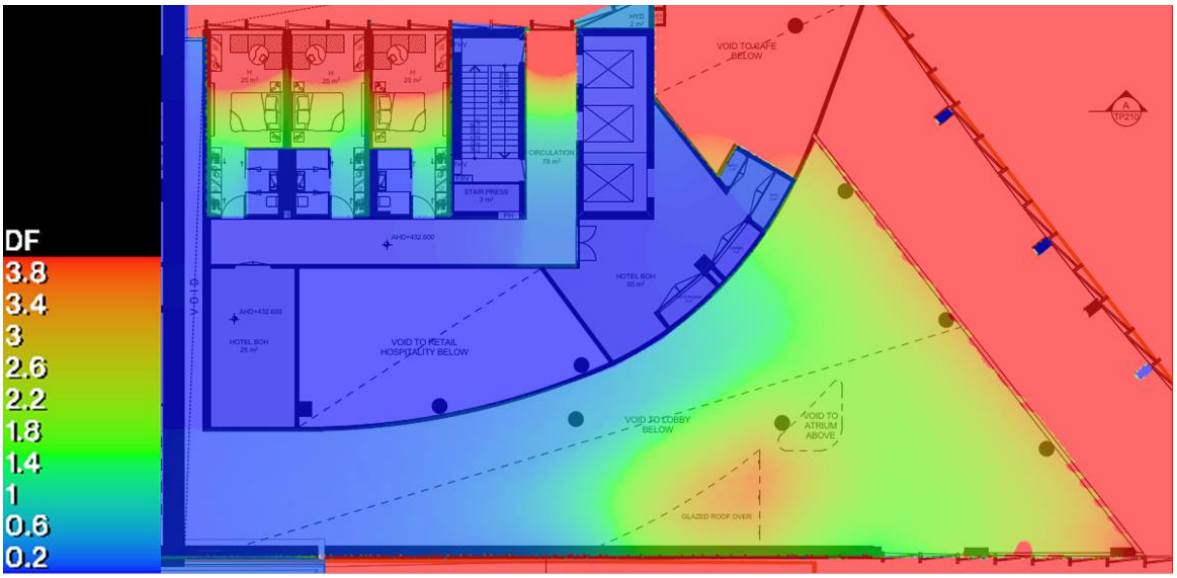
Lower Ground Zone 2 Daylight Factor Contour Plot



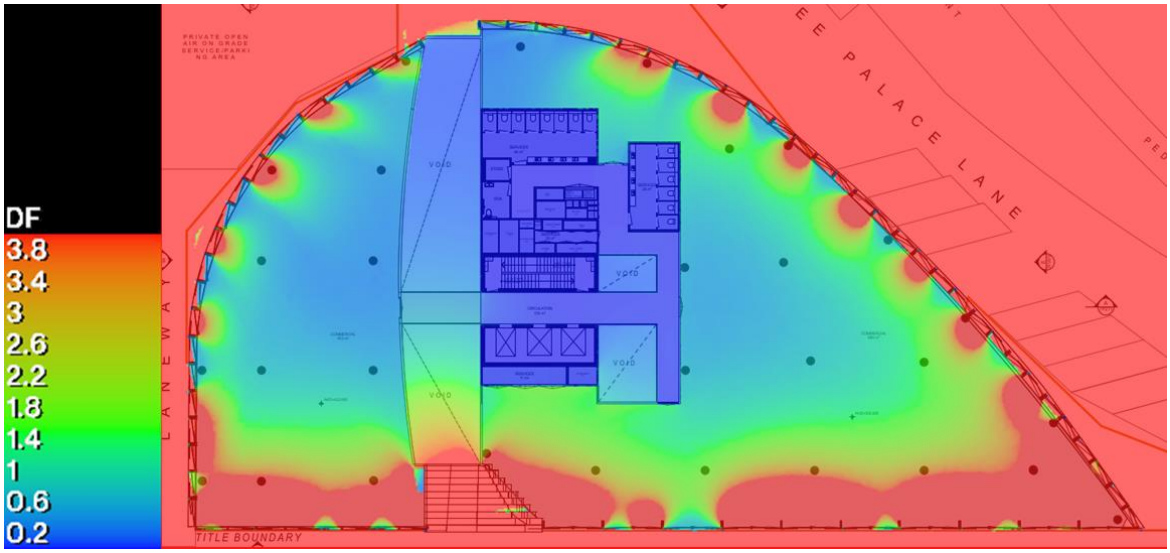
Upper Ground Zone 1 Daylight Factor Contour Plot



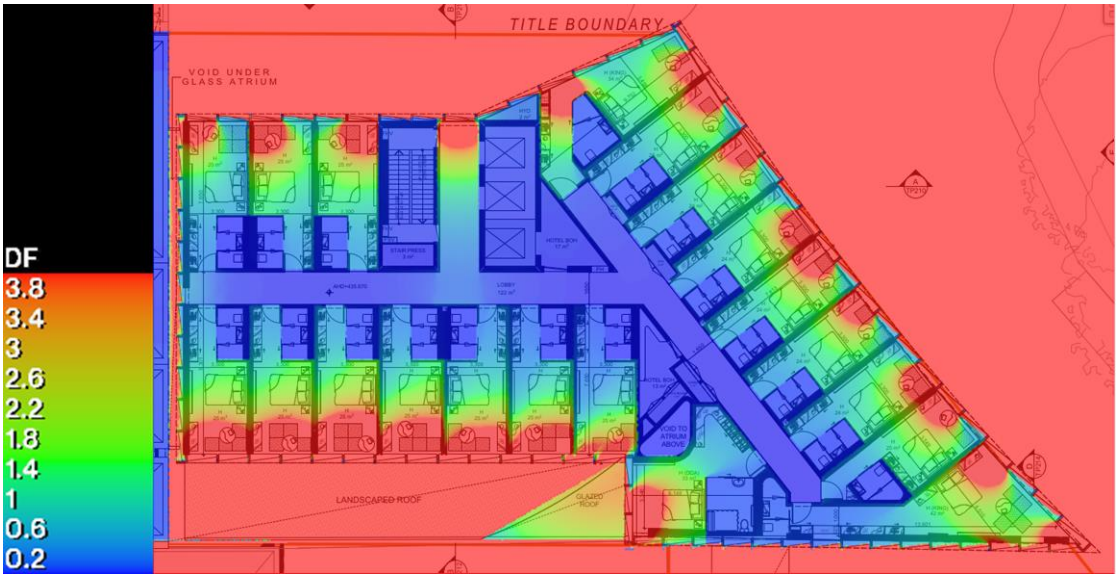
Upper Ground Zone 2 Daylight Factor Contour Plot



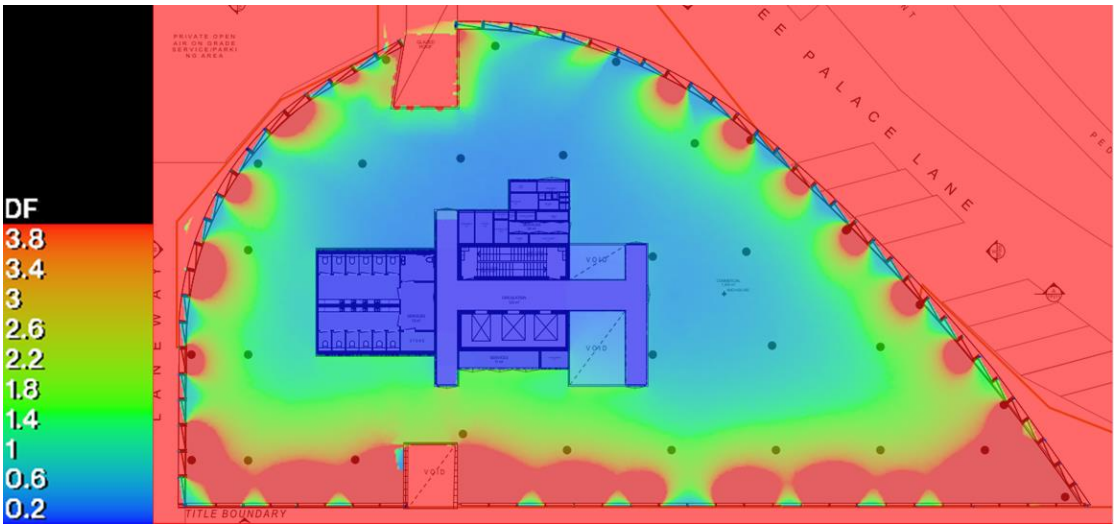
Level 1 Zone 1 Daylight Factor Contour Plot



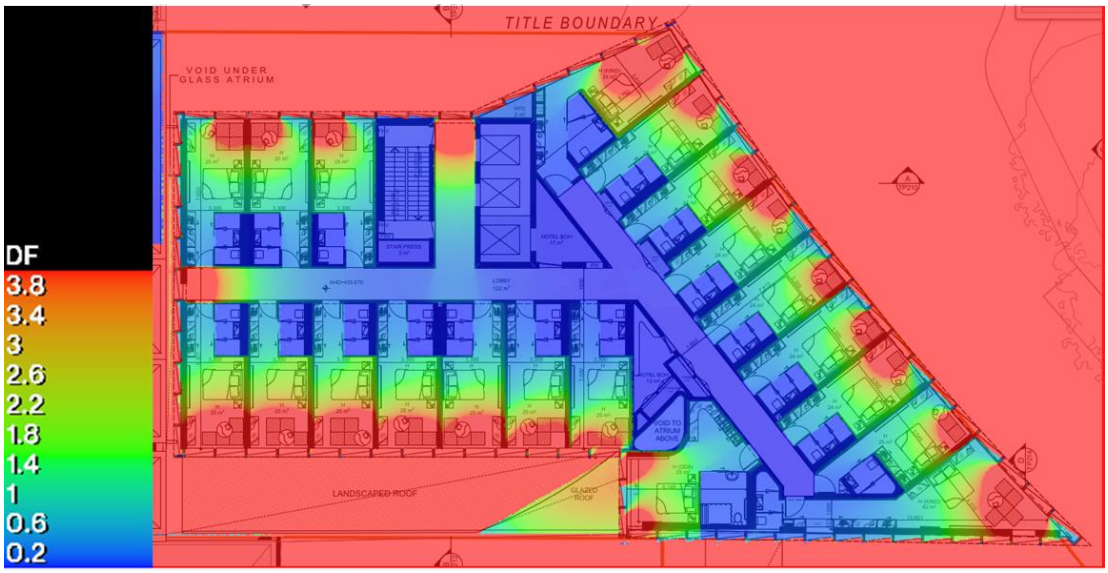
Level 1 Zone 2 Daylight Factor Contour Plot



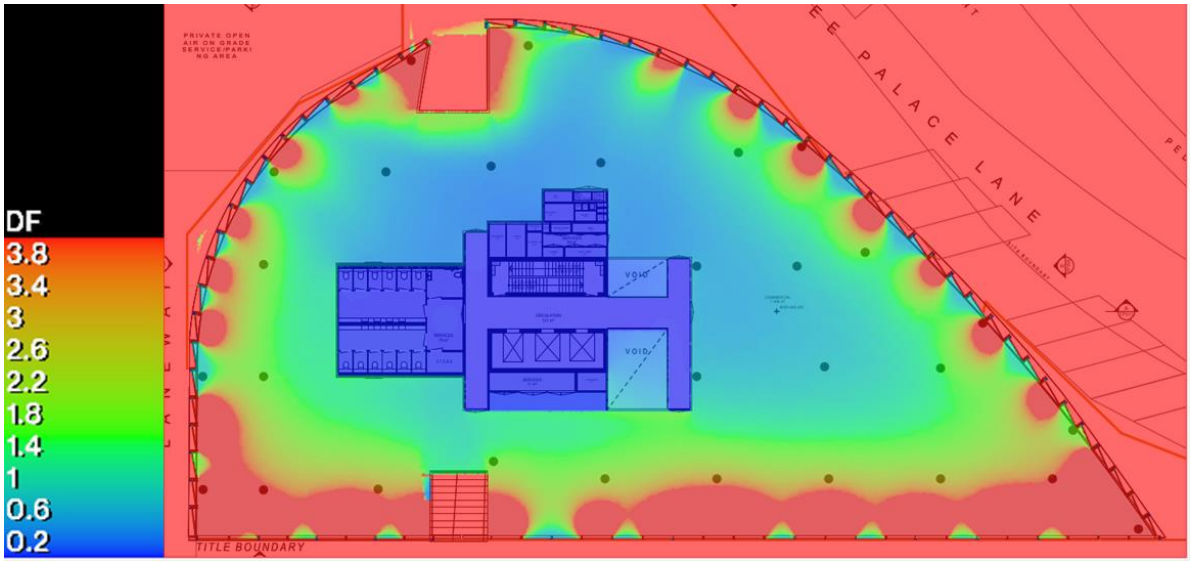
Level 2 Zone 1 Daylight Factor Contour Plot



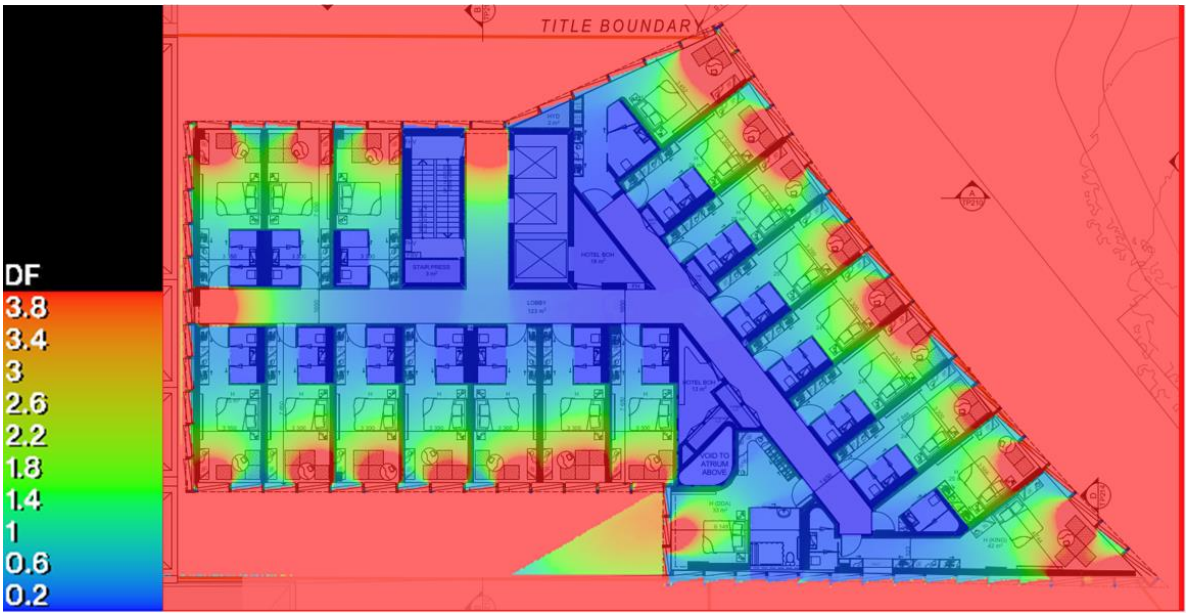
Level 2 Zone 2 Daylight Factor Contour Plot



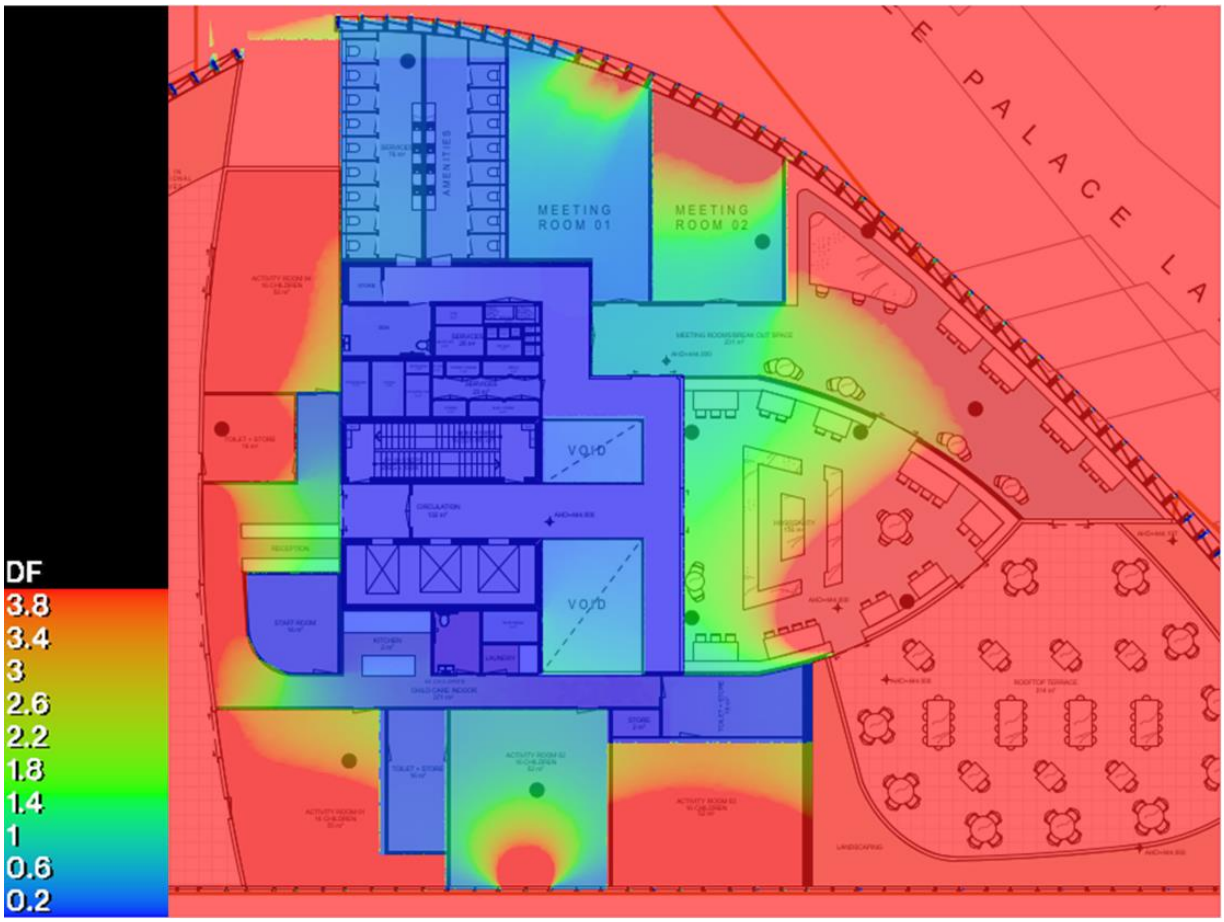
Level 3 Zone 1 Daylight Factor Contour Plot



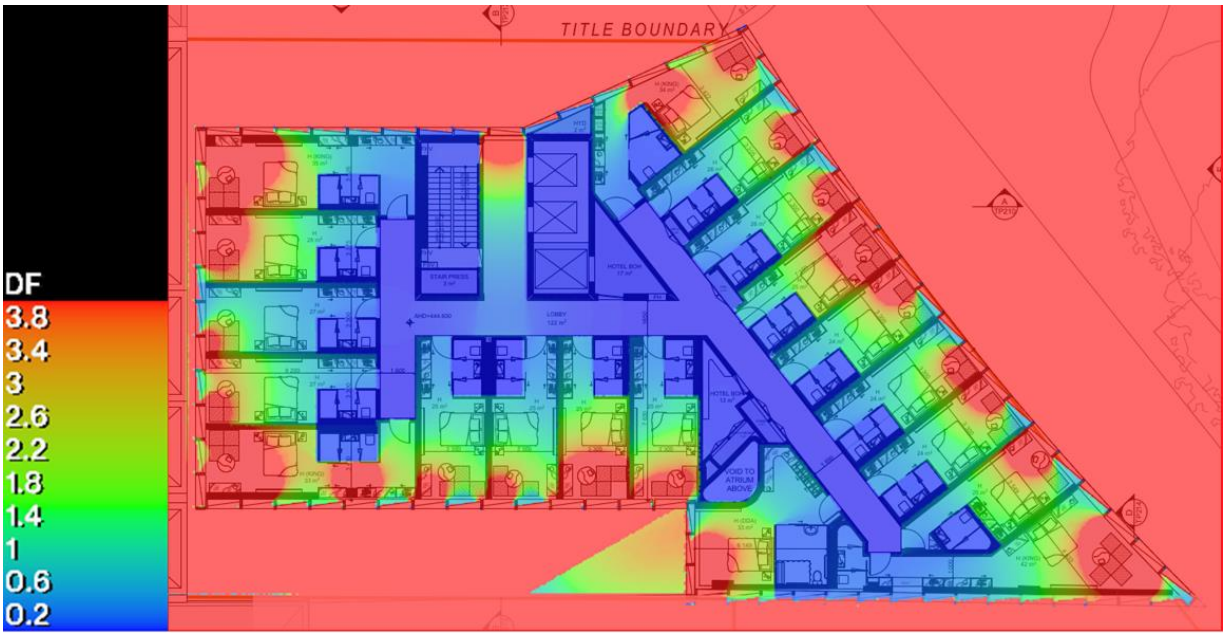
Level 3 Zone 2 Daylight Factor Contour Plot



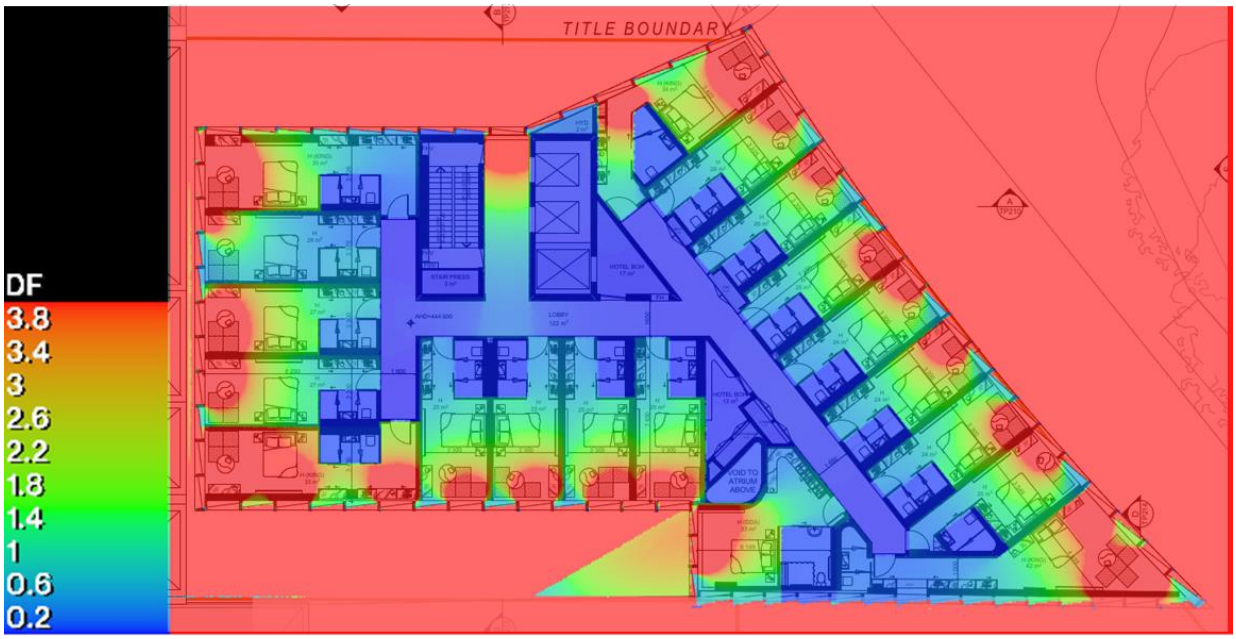
Level 4 Zone 1 Daylight Factor Contour Plot



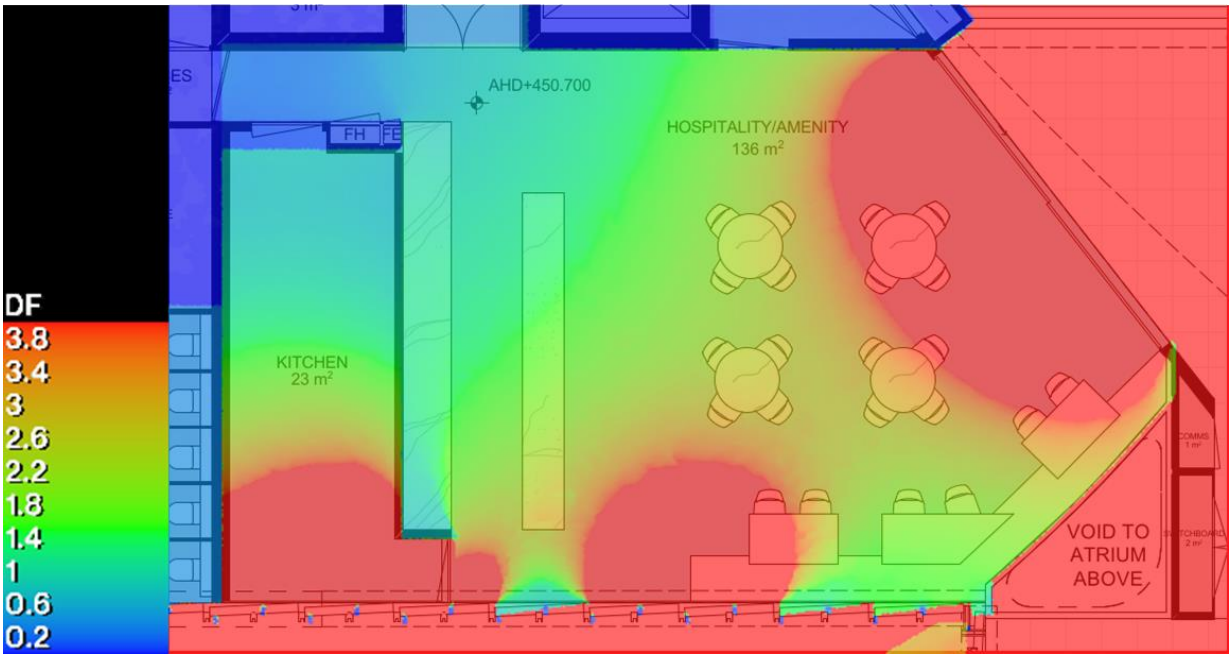
Level 4 Zone 2 Daylight Factor Contour Plot



Level 5 Zone 1 Daylight Factor Contour Plot



Level 6 Zone 1 Daylight Factor Contour Plot



Level 7 Zone 1 Daylight Factor Contour Plot