

ADVERTISED COPY

PROPOSED STUDENT HOUSING DEVELOPMENT

1494-1496 North Road, Clayton

SUSTAINABLE MANAGEMENT PLAN

&

WATER SENSITIVE URBAN DESIGN RESPONSE

FOR

THE NORTH ROAD PROJECT PTY LTD

27 April 2020

File 1223B



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1. Executive Summary

The proposed student housing development at 1494-1496 North Road, Clayton has been designed to meet the objectives of the Monash City Council's Sustainability Policy Clauses 19-03-3S and 22.13 (Environmentally Sustainable Development Policy) of the Monash Planning Scheme. This report demonstrates how the development meets policy objectives of Clause 22.13-2 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 Design & As Built** performance standard. The standard achieved is defined as Australian 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 City of Monash's Stormwater Management objectives.

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

2. Introduction

Ark Resources has been engaged by The North Road Project Pty Ltd to provide advice in relation to environmentally sustainable development outcomes from the proposed residential development at 1494-1496 North Road, Clayton.

This report contains a summary of:

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

Performance outcomes in this report are based on:

- Architectural plans prepared by Alta Architecture set out below:

Description	Drawing No.	Revision	Date
3D Views	TP-01	-	27/03/2020
Site Analysis	TP-02	-	27/03/2020
Streetview & Demolition Plan & Massing Diagram	TP-03	-	27/03/2020
Design Response & Precedent Images	TP-04	-	27/03/2020
Section Diagram & Precedent Images	TP-05	-	27/03/2020
Basement Plan	TP-06	-	27/03/2020
Ground Floor Plan	TP-07	-	27/03/2020
Level 1 Plan	TP-08	-	27/03/2020
Level 2 Plan	TP-09	-	27/03/2020
Level 3 Plan	TP-10	-	27/03/2020
Level 4 Plan	TP-11	-	27/03/2020
Level 5 Plan	TP-12	-	27/03/2020
Roof Plan	TP-13	-	27/03/2020
Elevations 01	TP-14	-	27/03/2020
Elevations 02	TP-15	-	27/03/2020
Sections 01	TP-16	-	27/03/2020
Sections 02	TP-17	-	27/03/2020
Shadow Diagrams 01	TP-18	-	27/03/2020
Shadow Diagrams 02	TP-19	-	27/03/2020
Shadow Diagrams 03	TP-20	-	27/03/2020
Shadow Diagrams 04	TP-21	-	27/03/2020
Typical Floor Plans 01	TP-22	-	27/03/2020
Typical Floor Plans 02	TP-23	-	27/03/2020

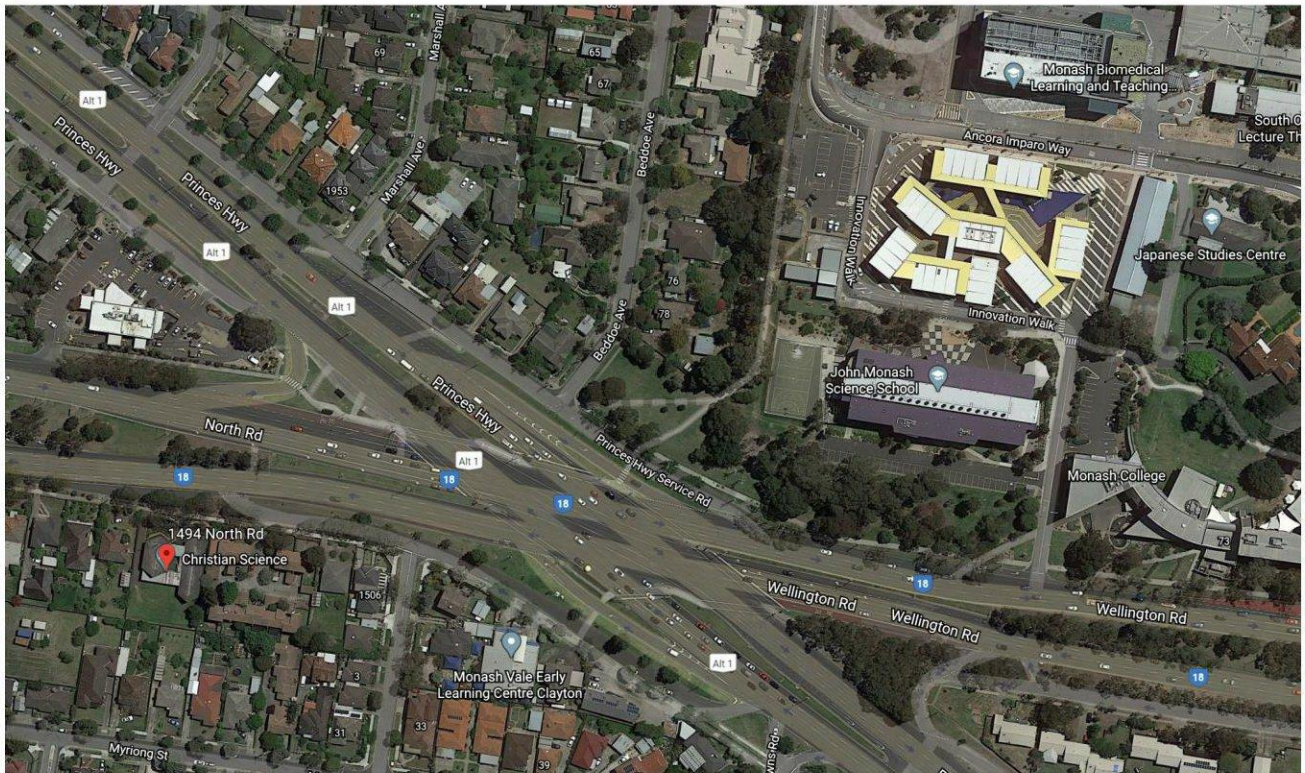
3. Site Description

The proposed development comprises 106 student apartments.

The site is located within the Monash City Council.

The development site has an area of approximately 1576m² and currently contains a single-storey brick building. The surrounding buildings are a mix of residential and commercial use.

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



4. Summary of Key ESD Initiatives

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

- Rainwater harvesting system for toilet flushing and irrigation;
- 12kWp rooftop solar photovoltaic system;
- Deep planting areas;
- High-performance glazing and energy efficient building services, appliances and fixtures; and
- Environmentally preferable internal finishes.

An assessment of sustainable design outcomes of the proposed development has been undertaken with *Green Star Design & As Built* and *STORM* benchmarking tools based on the proposed architectural design and the building services and materials initiatives considered feasible at this stage of the design process.

The information presented in this report demonstrates that:

- The development will achieve a 4 star Green Star Design & As Built rating;
- The development will achieve an overall energy performance of the building 10% better than the minimum permitted by NCC 2019;
- The development meets the *Best Practice* standard for stormwater quality.

5. Green Star

The Green Star Design & As Built (Version 1.3) 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 standard¹.

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 rating are detailed in Section 5.1 below.

¹

5.1. Green Star 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 Design & As Built v1.3 Technical Manual.

Further information in relation to key performance outcomes is provided in the Appendices to this report as referenced in the right hand column of the table.

Green Star Element	Design Attribute	Reference
Management	<ul style="list-style-type: none"> • Design Intent Report prepared • Provide floor-by-floor metering; plus independent metering for all loads >5% of annual building energy use or 100kW; and metering for common water use consuming 10% of development's water use • Comprehensive project-specific environmental management plan implemented during construction 	Conditional Requirements
	<ul style="list-style-type: none"> • Green Star Accredited Professional involved from outset to completion • Services and Maintainability Review undertaken during design stage • Comprehensive commissioning and tuning of building systems • Comprehensive tuning of building systems • Detailed Operations and Maintenance Manual prepared • Monitoring systems in accordance with CIBSE TM39 including metering schedule with load estimates • Head contractor to have current ISO 14001 certification • Operational Waste Management Plan prepared including targets and monitoring 	
Indoor Environmental Quality	<ul style="list-style-type: none"> • Lighting systems comprise flicker free luminaires and a Colour Rendering Index (CRI) greater than 80 • Strategies to reduce glare incorporated into the design 	Conditional Requirements
	<ul style="list-style-type: none"> • Ventilation systems to comply with ASHRAE 62.1, and pre-cleaned prior to handover • Exhaust systems to directly exhaust pollutants to exterior • Reverberation times in nominated areas must be below maximum stated in Table 1 of AS/NZ 2107:2016 • General fixed lighting provides illumination for the entire room and fittings (excluding decorative fittings) have a rated colour variation not exceeding 3 MacAdam Ellipses • Studios to have wall mount or wall wash fittings to one wall • Lighting systems designed for task lighting and brightness control 	

Green Star Element	Design Attribute	Reference
	<ul style="list-style-type: none"> • Specification of low VOC paints, adhesives, sealants and carpets • Specification of low formaldehyde engineered wood products • Requires PMV between -1 & +1; OR ASHRAE 55 - 80% acceptability 	
Energy	<ul style="list-style-type: none"> • NCC J1 and J2 performance requirements to improve by 5% <hr/> <ul style="list-style-type: none"> • Ceiling and floor construction to exceed minimum R-Values specified in J1.3 and J1.6 by 10% and roofs to have a solar absorptance less than 0.40 • Facade allowances and calculated air conditioning energy value to be less than 90% of total as determined by Specification J1.5a for U-Value and Solar Admittance • Energy efficient lighting systems with 10% improvement on NCC Table 6.2a requirements • Lift energy efficiency is class A or B and idle energy and standby energy is Level 1 according to ISO 25745-2 • 12kWp photovoltaic system <ul style="list-style-type: none"> ○ Embodied ecological impacts of PV array and support racking will be reduced by over 20% through use of 300Wp 60-cell modules with efficiency over 20% greater than standard PV modules. ○ Embodied impacts of PV modules will be further reduced by procurement from a manufacturer with an <i>above average</i> rating on the current version Silicon Valley Toxics Coalition Solar Scorecard. 	<p>Conditional Requirement</p> <p>Appendix A</p> <p>Appendix B</p>
Transport	<ul style="list-style-type: none"> • Reduced car parking provided • Local amenities within walking distance • 53 bike racks for residents located in the basement and 4 horizontal spaces at ground level for visitors 	

Green Star Element	Design Attribute	Reference
Water	<ul style="list-style-type: none"> • Water efficient fixtures (WELS 5 star taps, 4 star toilets, 3 star showers) • Water efficient dishwashers • Water efficient sub-soil drip irrigation system with moisture sensors and timers • Rainwater harvesting from all roof areas <ul style="list-style-type: none"> ○ Total storage volume of 20kL rainwater tanks ○ Re-use of captured water for toilet flushing to ground floor and level 1 studios ○ Re-use of captured water for irrigation • Cooling towers not used • Water-efficient sub-soil drip irrigation system with moisture sensors and timers • Fire test system water storage and re-use 	Appendix C
Materials	<ul style="list-style-type: none"> • Specification of common use PVC products that meet Best Practice Guidelines for PVC in the Built Environment • Documentation provided on product sustainability credentials for 3% of materials used on the project • Concrete mixes to incorporate at least 30% reduction in Portland cement • Concrete mixes to incorporate at least 50% reclaimed water • Concrete mixes to incorporate at least 40% replacement of coarse aggregate with slag • 5% reduction in mass of steel reinforcement • 60% of steel reinforcement manufactured using energy reducing process • Divert 90% of demolition and construction waste from landfill. Waste contractors to have compliance measures audited 	
Land Use & Ecology	<ul style="list-style-type: none"> • No endangered or vulnerable species on site at time of purchase • Site does not contain old growth forest or wetland of High National Importance 	Conditional Requirements
	<ul style="list-style-type: none"> • Native planting used on at least 2½% of the site • Site has been previously developed • At least 75% of the total project site area comprises building or landscaping elements that reduce impact of heat island effect. 	
Emissions	<ul style="list-style-type: none"> • All outdoor lighting to comply with AS4282:1997 for light spill to inhabited boundaries. 	Conditional Requirement

Green Star Element	Design Attribute	Reference
	<ul style="list-style-type: none"> • STORM modelling has been undertaken to confirm the development attains the Best Practice standard for urban stormwater quality • No increase in stormwater discharge to result from re-development • External lighting design to have an upward light output ratio <5% • Strategies to minimise Legionella impacts from cooling systems implemented • Refrigerants to have Ozone Depletion Potential of zero and a Global Warming Potential of 10 or less 	
Innovation	<ul style="list-style-type: none"> • Credit 30A: The objective of this initiative is to stimulate transformation of PV market through incentivising best-practice manufacturing practices, marketing and CSR reporting and promoting procurement of higher-efficiency modules. Embodied ecological impacts of PV array and support racking will be reduced by 20% through use of 300Wp 60-cell modules with efficiency 20% or greater than conventional PV modules. • Credit 30C: Improving Green Star Benchmarks – 50% of internal paints to be ultra-low VOC type (<5g/litre). Innovation point targeted for Exceeding Green Star Benchmarks – Ultra Low VOC Paints (refer to Credit 13: Indoor Pollutants for further details) • Credit 30C: Improving Green Star Benchmarks – Air tightness testing of representative spaces before handover, including a sample of apartments. Air tightness testing to be carried out in accordance with the requirements set out in AS/NZS ISO 9972:2015 Thermal performance of buildings – Determination of air permeability of buildings – Fan pressurisation method. 	

5.2. Green Star Preliminary Design Rating

Based on the design attributes and performance outcomes set out above, the following Green Star pathway has been prepared which confirms that the development has the preliminary design potential to achieve a 4 star Green Star standard.

Green Star - Design & As Built Scorecard v1.3

Project:	1494-1496 North Road, Clayton	Round:		TP Application REV A	Points Available	Total Score Targeted
Targeted Rating:	4 Star - Best Practice	1			100	45
				14/04/2020		

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	Points Available	4* pathway
Management				14	
Green Star Accredited Professional	Appointment and active involvement of a Green Star AP to ensure that the rating tool is applied effectively and as intended.	1.1	Accredited Professional	1	1
Commissioning and Tuning	To encourage and recognise commissioning, handover and tuning initiatives that ensure all building services operate to their full potential.	2.0	Environmental Performance Targets	-	Complies
		2.1	Services and Maintainability Review	1	1
		2.2	Building Commissioning	1	1
		2.3	Building Systems Tuning	1	1
Building Information	Info facilitating understanding of systems, O&M requirements and targets to optimise performance.	4.1	Building Information	1	1
Metering and Monitoring	To recognise the implementation of effective energy and water metering and monitoring systems.	6.0	Metering	-	Complies
		6.1	Monitoring Systems	1	1
Responsible Construction Practices	To reward projects that use best practice formal environmental management procedures during construction.	7.0	Environmental Management Plan	-	Complies
		7.1	Environmental Management System	1	1
Operational Waste (PCA requirement)	A. Performance Pathway	8A	Performance Pathway: Specialist Plan	1	1
Total				14	8

Indoor Environment Quality				17		
Indoor Air Quality	To recognise projects that provide high air quality to occupants.	9.1	Ventilation System Attributes	1	1	
		9.3	Exhaust or Elimination of Pollutants	A. Removing the Source of Pollutants B. Exhausting the Pollutants Directly to the Outside	1	1
Acoustic Comfort	To reward projects that provide appropriate and comfortable acoustic conditions for occupants.	10.2	Reverberation	1	1	
Lighting Comfort	To encourage and recognise well-lit spaces that provide a high degree of comfort to users.	11.0	Minimum Lighting Comfort	-	Complies	
		11.1 General Illuminance and Glare Reduction	11.1.1 General Illuminance	A. Non Residential Spaces B. Residential Spaces	1	1
			11.1.2 Glare Reduction	A. Prescriptive Method 1 B. Prescriptive Method 2 C. Performance Method		
		11.2	Surface Illuminance	A. Prescriptive Method B. Performance Method C. Residential Spaces (Prescriptive Method)	1	1
11.3	Localised Lighting Control		1	1		
Visual Comfort	To recognise the delivery of well-lit spaces that provide high levels of visual comfort to building occupants.	12.0	Glare Reduction	A. Fixed Shading Devices B. Blinds or Screens C. Daylight Glare Model	-	Complies
Indoor Pollutants	To recognise projects that safeguard occupant health through the reduction in internal air pollutant levels.	13.1 Paints, Adhesives, Sealants and Carpets	13.1.1 Paints, Adhesives and Sealants	A. Product Certification B. Laboratory Testing C. No Paints, Adhesives or Sealants	1	1
			13.1.2 Carpets	A. Product Certification B. Laboratory Testing C. No Carpets		
		13.2	Engineered Wood Products	A. Product Certification B. Laboratory Testing	1	1
Thermal Comfort	To encourage and recognise projects that achieve high levels of thermal comfort.	14.1	Thermal Comfort	A. Naturally Ventilated Spaces B. Mechanically Ventilated Spaces C. Residential Spaces	1	1
Total				17	9	

Energy				22	
Greenhouse Gas Emissions	A. Prescriptive Pathway	15A.0	Conditional Requirement: Prescriptive Pathway	-	Complies
		15A.1	Building Envelope	1	1
		15A.2	Wall-Glazing Construction and Retail Display Glazing	1	1
		15A.3	Lighting	1	1
		15A.9	Vertical Transportation	1	1
Total				11	4

Transport				10	
Sustainable Transport	B. Prescriptive Pathway	17B.2 Reduced Car Parking Provision		1	1
		17B.5 Walkable Neighbourhoods	A. Proximity to Amenities	1	1
Total				7	2

Water				12	
Potable Water	B. Prescriptive Pathway	18B.1 Sanitary Fixture Efficiency		1	1
		18B.3 Heat Rejection		2	2
		18B.4 Landscape Irrigation		1	1
		18B.5 Fire Protection System Test Water		1	1
Total				6	5

Materials				14		
Life Cycle Impacts	B. Prescriptive Pathway - Life Cycle Impacts	19B.1 Concrete	19B.1.1 Portland Cement Reduction	2	1	
			19B.1.2 Water Reduction	0.5	0.5	
			19B.1.3 Aggregates Reduction	A. Course Aggregate Reduction	0.5	0.5
		19B.2 Steel	A. Reduced Mass of Steel Framing	B. Reduction in Mass	1	1
		19B.4 Structural Timber	19B.4.0 Responsible Sourcing	-	Complies	
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	20.1.0 Responsible Steel Maker	-	Complies	
			B. Energy-Reducing Processes in Steel Reinforcement Production	1	1	
		20.3 Permanent Formwork, Pipes, Flooring, Blinds and Cables	A. Products That Do Not Contain PVC	1	1	
Sustainable Products	To encourage sustainability and transparency in product specification.	21.1 Product Transparency and Sustainability	A. Reused Products	3	1	
			B. Recycled Content Products			
			C. Environmental Product Declarations (EPDs)			
			D. Third Party Certification			
			E. Stewardship Programs			
Construction and Demolition Waste	A. Fixed Benchmark	22.0 Reporting Accuracy	A. Compliance Verification Summary	-	Complies	
		22A Fixed Benchmark	1	1		
Total				12	7	

Land Use & Ecology					6	
Ecological Value	To reward projects that improve the ecological value of their site.	23.0	Endangered, Threatened or Vulnerable Species	A. EPBC	-	Complies
		23.1	Ecological Value		3	1
Sustainable Sites	To reward projects that choose to develop sites that have limited ecological value, re-use previously developed land and remediate	24.0	Conditional Requirement		-	Complies
		24.1	Reuse of Land	A. Previously Developed Land	1	1
Heat Island Effect	To encourage and recognise projects that reduce the contribution of the project site to the heat island effect.	25.1	Heat Island Effect Reduction		1	1
Total					6	3

Emissions					5	
Stormwater	To reward projects that minimise peak stormwater flows and reduce pollutants entering public sewer infrastructure.	26.1	Stormwater Peak Discharge		1	1
		26.2	Stormwater Pollution Targets		1	1
Light Pollution	To reward projects that minimise light pollution.	27.0	Light Pollution to Neighbouring Bodies		-	Complies
		27.1	Light Pollution to Night Sky	A. Control of Upward Light Output Ratio (ULOR)	1	1
Microbial Control	Minimising impacts associated with harmful microbes in building systems.	28	Legionella Impacts from Cooling Systems	B. Waterless Heat Rejection Systems	1	1
Total					5	4

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	1
Improving on Green Star Benchmarks	Demonstrates a substantial improvement on the benchmark required to achieve full points on existing credit.	30C	Improving on Green Star Benchmarks			2
Total					10	3



	4* pathway	Potential points
CORE POINTS	100	42.0
INNOVATION POINTS	10	3.0
TOTAL SCORE TARGETED	45.0	45.0

Green Star rating

4 Star - Best Practice

6. Conclusion

This report provides details of a comprehensive package of sustainable design features which will be integrated into the design and specification of the proposed development in order to improve environmental outcomes during occupation.

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

- Attain a 4 star Green Star standard based on the Design & As Built v1.3 rating tool
- Achieves an overall energy performance of the building 10% better than the minimum permitted by NCC 2019;
- Attain the *Best Practice* standard for urban stormwater quality

Accordingly, the performance outcomes achieved by the proposed development considered to be appropriate for a mixed use development of this scale and are consistent with the objectives set out in Clauses 19.03-3S and 22.13 (ESD Policy) of the Monash Planning Scheme.



Jan Talacko
Director

Appendix A. NCC J1.5 Façade Calculator

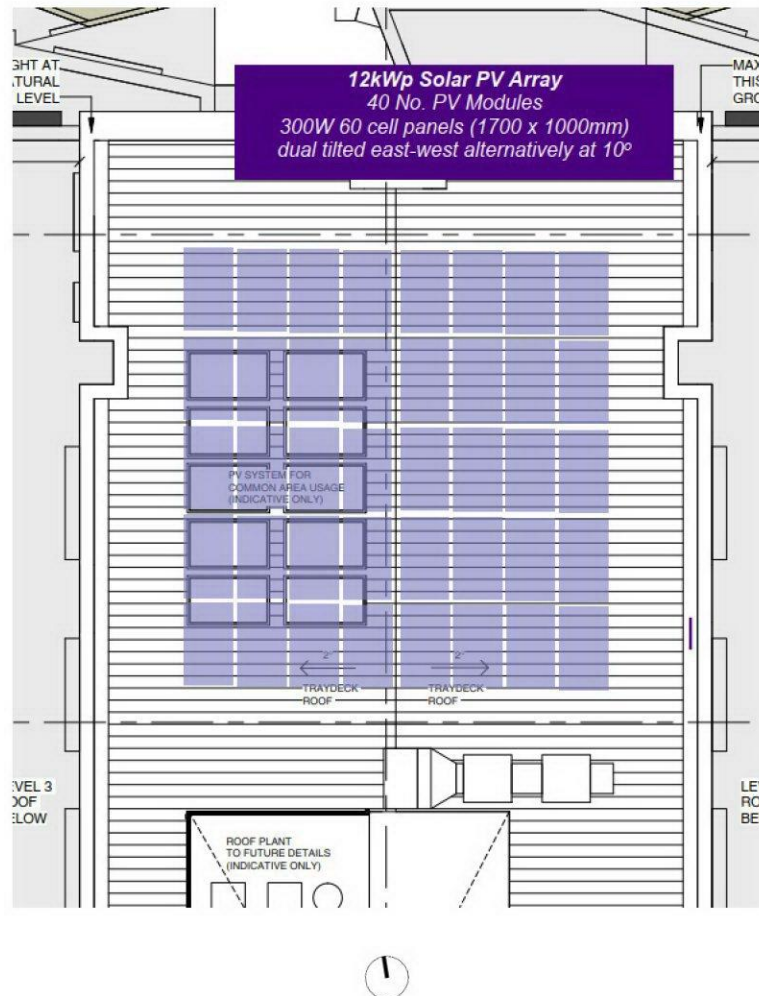
A preliminary façade calculation has been carried out to ensure the project is able to comply with NCC 2019 using WERS rated window products.

NCC 2019 Wall-Glazing Calculator v3.0													
Wall and glazing energy efficiency in Class 2-9 buildings - Method 2 of Specification J1.5a, NCC 2019													
Building name and description					Classification			Climate Zone					
1494-1496 North Road, Clayton					3. 9c or 9a ward			6					
Calculated Area-Weighted U-Value					0.99		Calculated Representative Air-Conditioning Energy Value					168.0	
Allowable Area-Weighted U-Value					1.10		Allowable Representative Air-Conditioning Energy Value					195.1	
Building total U-Value allowance met					90%		Building total SHGC allowance met					87%	
Check Values		Wall Element Requirements			Met			Display Glazing Element Requirements		-			
Visible													
Use of this calculator does not guarantee compliance with the NCC. The disclaimer and a version update check are available at the bottom of the page.													
Element Description					U-Value			SHGC and Shading					
ID	Description (optional)	Element Type	Facing Sector	Area (m ²)	U-Value	U-Value Element share of allowance used	SHGC	Glazing Height (m)	Shading Height (m)	Shading Projection (m)	SHGC Element share of allowance used		
1	Type 1 AWN	Glazing	North	25.20	2.70	3% of building total	0.18	1.8	1.8	0.25	4% of building total		
2	Type 1 AWN	Glazing	East	26.46	2.70	3% of building total	0.18	1.8	1.8	0.25	3% of building total		
3	Type 1 AWN	Glazing	South	13.86	2.70	1% of building total	0.18	1.8	1.8	0.25	0% of building total		
4	Type 1 AWN	Glazing	West	28.98	2.70	3% of building total	0.18	1.8	1.8	0.25	4% of building total		
1	Type 1 AWN	Glazing	North	6.30	2.70	1% of building total	0.18	1.8	1.8	0.45	1% of building total		
2	Type 1 AWN	Glazing	East	12.60	2.70	1% of building total	0.18	1.8	1.8	0.45	1% of building total		
3	Type 1 AWN	Glazing	South	1.26	2.70	0% of building total	0.18	1.8	1.8	0.45	0% of building total		
4	Type 1 AWN	Glazing	West	17.64	2.70	2% of building total	0.18	1.8	1.8	0.45	2% of building total		
5	Type 1 AWN	Glazing	East	16.38	2.70	2% of building total	0.18	1.8	0	0	2% of building total		
6	Type 1 AWN	Glazing	West	13.86	2.70	1% of building total	0.18	1.8	0	0	2% of building total		
7	Type 1 FIX	Glazing	North	64.80	2.00	5% of building total	0.25	1.8	1.8	0.25	13% of building total		
8	Type 1 FIX	Glazing	East	68.04	2.00	5% of building total	0.25	1.8	1.8	0.25	12% of building total		
9	Type 1 FIX	Glazing	South	35.64	2.00	3% of building total	0.25	1.8	1.8	0.25	0% of building total		
10	Type 1 FIX	Glazing	West	74.52	2.00	5% of building total	0.25	1.8	1.8	0.25	13% of building total		
11	Type 1 FIX	Glazing	North	16.20	2.00	1% of building total	0.25	1.8	1.8	0.45	3% of building total		
12	Type 1 FIX	Glazing	East	32.40	2.00	2% of building total	0.25	1.8	1.8	0.45	5% of building total		
13	Type 1 FIX	Glazing	South	3.24	2.00	0% of building total	0.25	1.8	1.8	0.45	0% of building total		
14	Type 1 FIX	Glazing	West	45.36	2.00	3% of building total	0.25	1.8	1.8	0.45	7% of building total		
15	Type 1 FIX	Glazing	East	42.12	2.00	3% of building total	0.25	1.8	0	0	8% of building total		
16	Type 1 FIX	Glazing	West	35.64	2.00	3% of building total	0.25	1.8	0	0	7% of building total		
17	Type 2	Glazing	North	1.92	2.00	0% of building total	0.25	0.6	0.6	0.25	0% of building total		
18	Type 2	Glazing	South	3.84	2.00	0% of building total	0.25	0.6	0.6	0.25	0% of building total		
19	Type 2	Glazing	East	0.96	2.00	0% of building total	0.25	0.6	0.6	0.45	0% of building total		
20	Type 2	Glazing	South	2.88	2.00	0% of building total	0.25	0.6	0	0	0% of building total		
21	Type 2	Glazing	West	0.96	2.00	0% of building total	0.25	0.6	0	0	0% of building total		
22	Type 3	Glazing	North	4.32	2.00	0% of building total	0.25	1.8	0	0	1% of building total		
23	Type 3	Glazing	East	8.64	2.00	1% of building total	0.25	1.8	0	0	2% of building total		
24	Type 3	Glazing	South	12.96	2.00	1% of building total	0.25	1.8	0	0	0% of building total		
25	Type 3	Glazing	West	6.48	2.00	0% of building total	0.25	1.8	0	0	1% of building total		
26	Type 4	Glazing	East	2.88	2.00	0% of building total	0.25	1.8	1.8	0.25	0% of building total		
27	Type 4	Glazing	South	5.76	2.00	0% of building total	0.25	1.8	1.8	0.25	0% of building total		
28	Type 4	Glazing	West	1.44	2.00	0% of building total	0.25	1.8	1.8	0.25	0% of building total		
29	Type 4	Glazing	East	1.44	2.00	0% of building total	0.25	1.8	1.8	0.45	0% of building total		
30	Type 4	Glazing	South	2.88	2.00	0% of building total	0.25	1.8	1.8	0.45	0% of building total		
31	Type 4	Glazing	East	8.64	2.00	1% of building total	0.25	1.8	0	0	2% of building total		
32	Type 4	Glazing	West	8.64	2.00	1% of building total	0.25	1.8	0	0	2% of building total		
33	Type 5	Glazing	South	1.92	2.00	0% of building total	0.25	0.6	0.6	0.25	0% of building total		
34	Type 5	Glazing	East	2.88	2.00	0% of building total	0.25	0.6	0	0	1% of building total		
35	Type 5	Glazing	West	2.88	2.00	0% of building total	0.25	0.6	0	0	1% of building total		
36	Type 6	Glazing	East	16.10	2.00	1% of building total	0.25	2.3	2.3	0.45	3% of building total		
46	Wall	North		408.29	0.60	9% of building total					Not counted		
47	Wall	South		630.37	0.60	14% of building total					Not counted		
48	Wall	East		407.73	0.60	9% of building total					Not counted		
49	Wall	West		634.26	0.60	14% of building total					Not counted		
50	Wall	Internal		0.00	0.60	0% of building total					Not counted		

Appendix B. Solar Photovoltaic System

High-efficiency solar PV modules with a total capacity of 12 kWp will be installed at roof level as per the preliminary layout indicated below.

PV modules will be oriented in pairs to the east and west at 10-15° tilt and have at least 300Wp capacity (i.e. over 20% more efficient than traditional 250Wp 60-cell modules). High-efficiency modules deliver more compact arrays with inherently lower embodied ecological impact per unit of generation than standard efficiency modules.



Indicative Solar Photovoltaic array layout

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.



Total yield of this array will be approximately 16MWh per annum equating to an estimated annual carbon emissions offset of 18 tonnes CO_{2-e} per annum.

1494-1496 North Road, Clayton

		Input	
		Calculated	
		Step Control	
		Copied data	
Data			
Photovoltaic System			
Electricity gas emissions factor, NG [2]	kg_CO2-e/kWh	1.12	Scope 2 and 3
PV Melbourne energy delivery	MWh/y per kWe	1.40	10° tilt, East/West
PV capacity required	kWe	12.0	
Proposed PV module rating	Wp	300	
Efficiency improvement over traditional 250W module		20.0%	
Typical dimensions for 60-cell module	Width (m) x length (m)	1.0 x 1.7	
Number of panels required	rounded up	40	
Expected electricity produced	kWh/day	46.0	
Annual expected electricity produced	MWh/yr	16.8	
Annual expected solar energy contribution	GJ/y	254.1	
Natural gas use reduction from solar	GJ/y	338.8	
Greenhouse gas emissions factor, NG [1]	kg_CO2-e/GJ	55.43	Scope 1 and 3
Greenhouse gas emissions reduction	tonnes_CO2-e/yr	18.78	

[1] National Greenhouse Accounts (NGA) Factors, August 2019, tables 2 and 41

[2] National Greenhouse Accounts (NGA) Factors, August 2019, table 44 "Latest", "Victoria"

Appendix C. STORM Results



STORM Rating Report

TransactionID: 944733
 Municipality: MONASH
 Rainfall Station: MONASH
 Address: 1494-1496 North Road

Clayton
 VIC

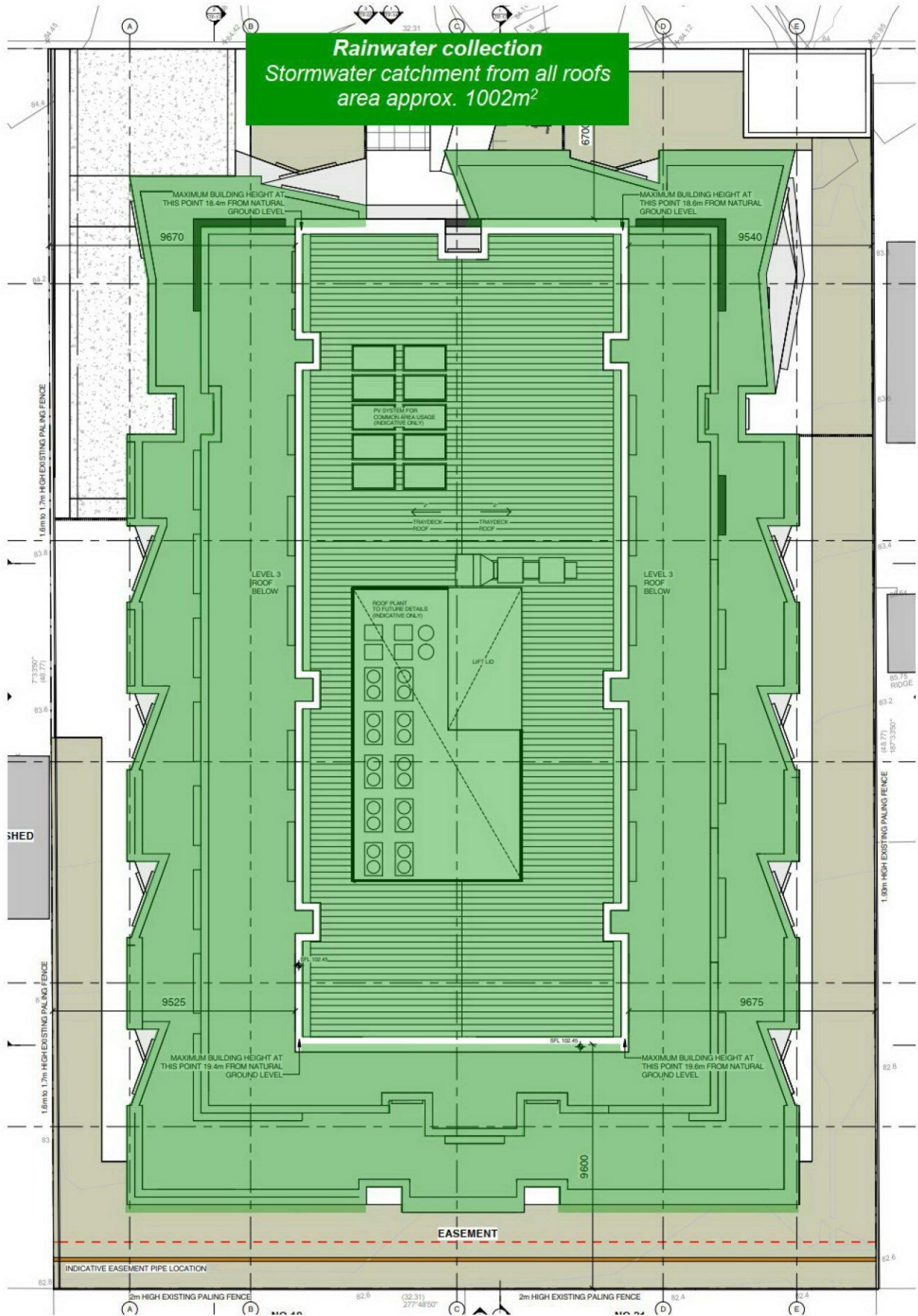
Assessor: Id
 Development Type: Other
 Allotment Site (m2): 1,576.00
 STORM Rating %: 102

Description	Impervious Area (m2)	Treatment Type	Treatment Area/Volume (m2 or L)	Occupants / Number Of Bedrooms	Treatment %	Tank Water Supply Reliability (%)
Roofs	1,002.00	Rainwater Tank	20,000.00	45	132.50	72.00
Remaining impervious	300.00	None	0.00	0	0.00	0.00

Date Generated: 14-Apr-2020

Program Version: 1.0.0

RAINWATER CATCHMENT AREAS



Appendix D. Rainwater Harvesting

Property **1494-1496 North Road, Clayton**
Version

box 1

Inputs

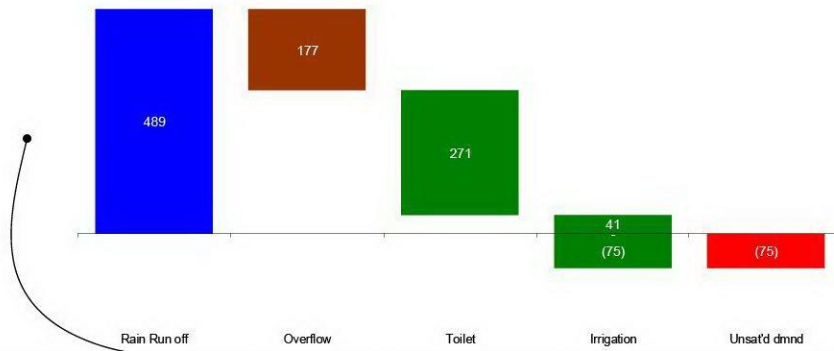
PPL	45	
Flush/Person/Day	5	
Litres/Flush	3.3	
Total Daily usage (litres)	742.5	Recalc. update pivots, table and graphs
Roof area (m2)	1,002	
Collection Evaporation	5%	
Tank Capacity (litres)	20,000	
Irrigation Area (m2)	274	
T'off if Total Rain (mm)	10	
in the last	5 days	

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)												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Rain Run off	32	44	28	45	41	36	33	44	38	49	50	50	489
Overflow	(5)	(20)	(8)	(15)	(15)	(11)	(8)	(15)	(13)	(24)	(23)	(21)	(177)
Rain Water saved	27	24	20	29	26	25	25	29	25	25	27	30	312
Toilet	(23)	(21)	(23)	(22)	(23)	(22)	(23)	(23)	(22)	(23)	(22)	(23)	(271)
(Shortfall)/Surplus before Irrigation	4	3	(3)	7	3	2	2	6	2	2	4	7	41
Irrigation	(20)	(17)	(21)	(4)	(4)	(5)	(5)	(4)	(4)	(5)	(8)	(18)	(116)
Unsatisfied Demand	(16)	(14)	(24)	3	(1)	(2)	(2)	2	(2)	(2)	(4)	(11)	(75)

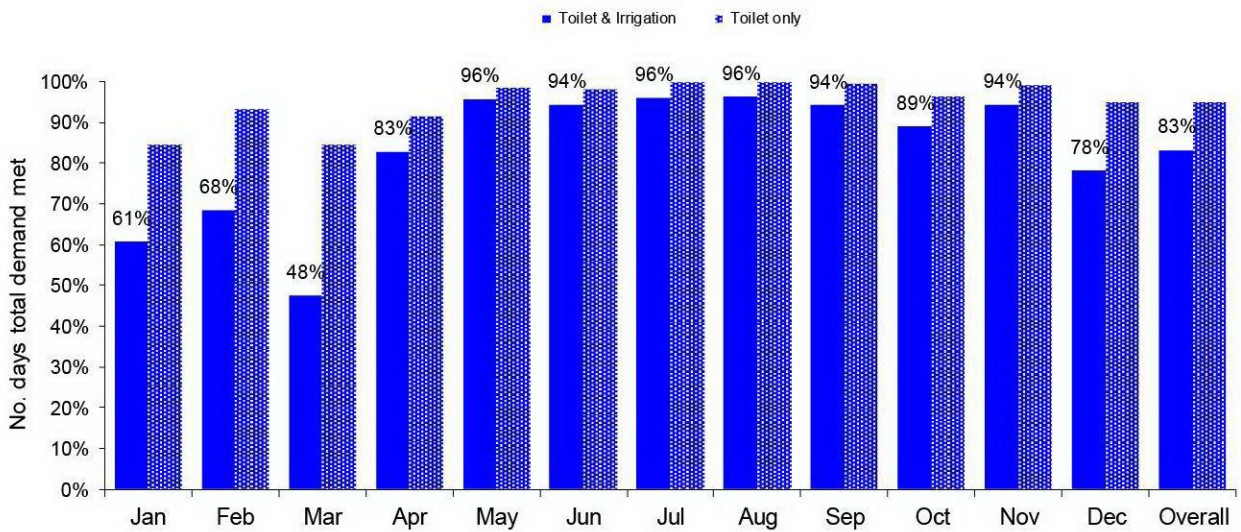
	Actual Years (k l)												Total
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
Rain Run off	342	557	581	599	576	378	469	592	562	417	403	399	5,875
Overflow	(68)	(226)	(231)	(274)	(275)	(52)	(158)	(277)	(270)	(103)	(95)	(99)	(2,128)
Rain Water saved	274	331	350	325	301	325	311	316	292	314	308	300	3,747
Toilet	(271)	(271)	(271)	(271)	(271)	(271)	(271)	(271)	(271)	(271)	(271)	(272)	(3,253)
(Shortfall)/Surplus before Irrigation	3	60	79	54	30	54	40	45	21	43	37	28	494
Irrigation	(130)	(99)	(97)	(108)	(118)	(116)	(122)	(112)	(121)	(104)	(134)	(132)	(1,393)
Unsatisfied Demand	(127)	(39)	(18)	(54)	(88)	(62)	(82)	(68)	(100)	(61)	(98)	(103)	(899)

box 4

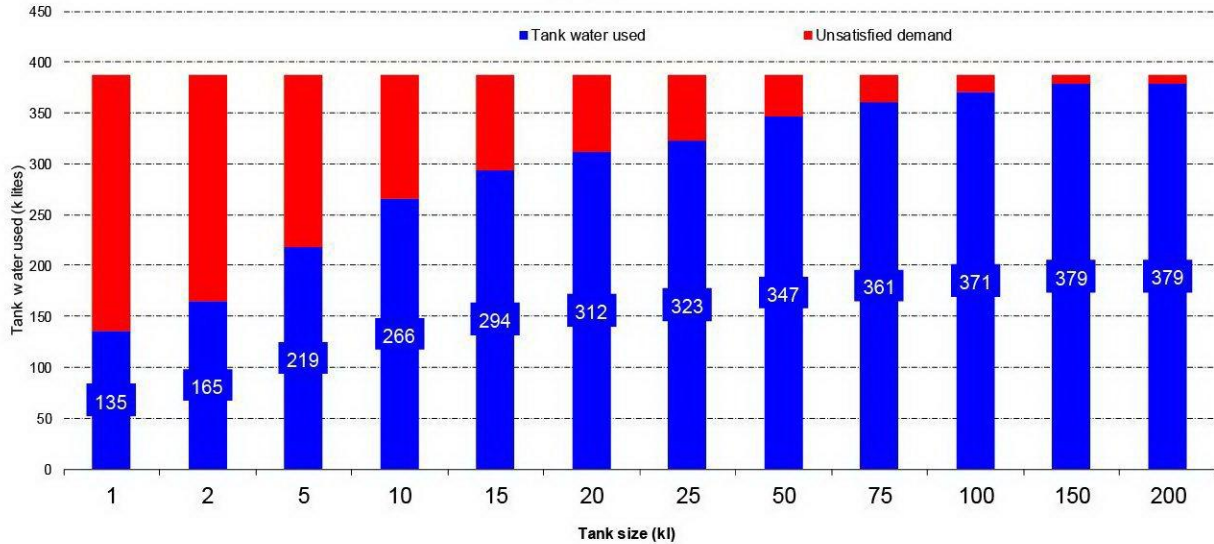
Reliability of supply (daily demand met)- Tank size what ifs

Tank	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
1k	23%	25%	20%	35%	39%	39%	43%	42%	45%	46%	36%	28%	35%
2k	28%	31%	24%	44%	47%	49%	53%	51%	52%	54%	44%	35%	43%
5k	37%	45%	31%	62%	63%	65%	68%	72%	70%	72%	62%	46%	58%
10k	45%	56%	38%	75%	81%	79%	81%	87%	84%	84%	83%	60%	71%
20k	61%	68%	48%	83%	96%	94%	96%	96%	94%	89%	94%	78%	83%
50k	75%	78%	68%	85%	97%	98%	100%	100%	100%	100%	100%	95%	91%
100k	95%	90%	80%	92%	100%	100%	100%	100%	100%	100%	100%	100%	96%
200k	95%	95%	94%	98%	100%	100%	100%	100%	100%	100%	100%	100%	98%

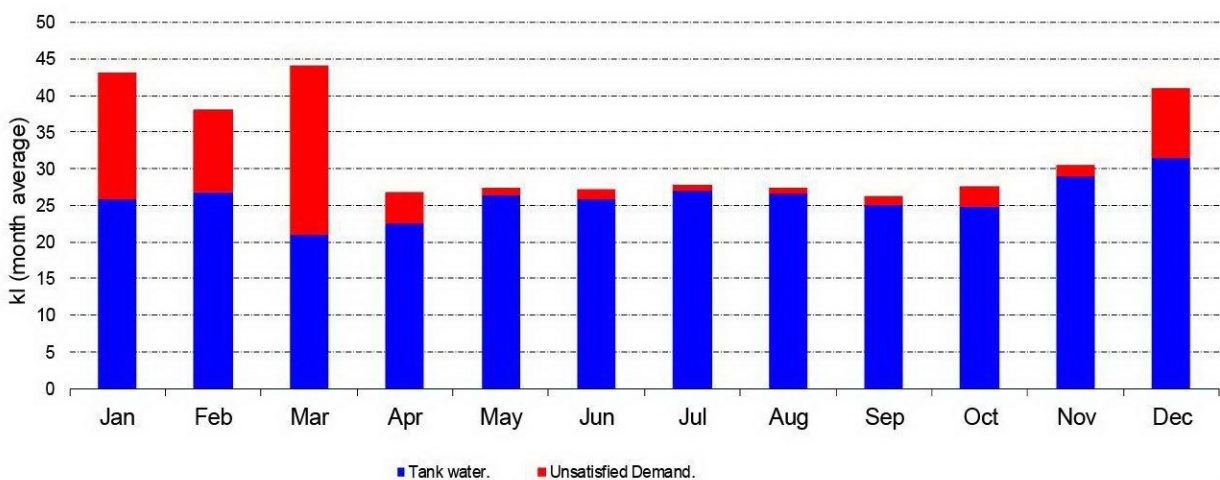
Graph 2 - Reliability of supply from tank (average across 12 years)



**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 E. WSUD Maintenance Program

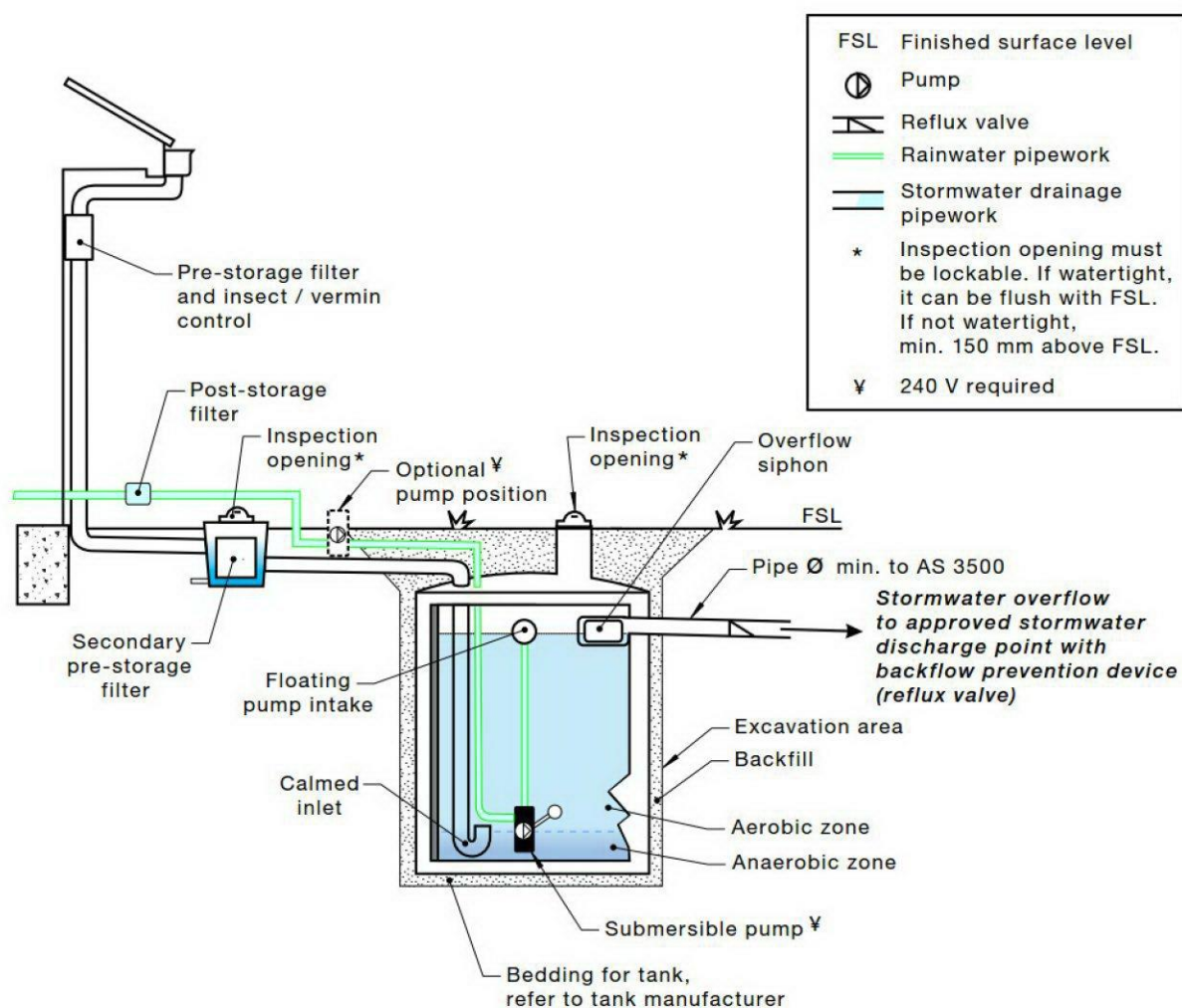
Once installed, a systematic maintenance program will be implemented by the owner's corporation maintenance contractor to ensure the rainwater harvesting system operates as designed and water quality is maintained.

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 Commission². A schematic diagram of the rainwater tank installation is provided below.



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

Maintenance Checklist

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 device. Consider a manual switching device.
Mesh cover	Has the mesh cover deteriorated or have any holes in it?		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		

Appendix F. Site Management Plan

During the construction phase, the key pollutants at risk of entering the stormwater system include:

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

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

In order to mitigate the impacts of the above pollutants on the stormwater system, the following stormwater management strategies will be implemented during the construction phase as appropriate:

- Installation of 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 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 by the head contractor/ builder to make personnel aware of stormwater management measures in place
- Employ suitable 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.
- 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.