



Integrated Water Management Report

Axis Development – Stages 1 & 1a

6 Australia Avenue

Sydney Olympic Park

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1 Introduction

1.1 Background

Insync Services Pty Ltd have been engaged by Capital Corporation Pty Ltd, to provide an Integrated Water Management Report in association with the Section 75W Application for the proposed Axis Stages 1 & 1a commercial development at 6 Australia Avenue, Sydney Olympic Park.

The aim of this Integrated Water Management Report is as follows;

- To determine Site Stormwater Management requirements in association with the proposed development.
- To determine Water Sensitive Urban Design requirements in association with the proposed development.

1.2 Site Description

The proposed Axis Development is located on SOPA Masterplan 2030 nominated development sites 43 & 44, bounded by Herb Elliott Avenue to the west, Australia Avenue to the north, and existing sites to the east and south. The overall development site (43 & 44 combined) has an area of 12,050m², and will be divided into three separate parcels of and to accommodate the staged Axis development construction as follows;

- Stage 1 (site 44) – being located on the northern section of the existing site bounded by Herb Elliott Avenue to the west, Australia Avenue to the north, a new road to the east (currently nominated as Road 10) and a new road through the Axis site (currently nominated as Road 16). The stage 1 development site will include the stage 1a development, and have a total site area of 5,055m².
- Stage 2 (site 43) – being located on the southern section of the existing site bounded by Herb Elliott Avenue to the west, a new road through the Axis site (currently nominated as Road 16) to the north, a new road to the east (currently nominated as Road 10) and the existing development to the south. The stage 2 development site will have a total site area of 3,170m².
- Road Reserves – being road reserve allocations for the proposed Road 10 and Road 16 with a total site area of 3,825m².

The integrated water management strategies detailed within this report are made with reference to Stages 1 & 1a of the Axis development only. Information with regard to integrated water management strategies for Stage 2 of the Axis development has been provided under a separate report.

1.3 Development Description

The Axis Stages 1 & 1a commercial development will include approximately 33,885m² of gross floor area, and provide the following facilities;

- 9,567m² of basement parking over 2 levels for 223 vehicles.
- 1,540m² of retail tenancy area at ground floor.
- 22,778m² of commercial tenancy area over 7 levels.
- roof level plant facilities.

1.4 ESD Targets

Environmentally Sustainable Design targets for this development have been outlined in the ESD Strategies report as prepared by Green Planning Australia Pty Ltd. In summary the Environmentally Sustainable Design objectives of the Axis development include;

- 5 Star Green Star Office V3 Design Rating.
- 5 Star Green Star Office V3 As-Built Rating.
- 5 Star Nabers Energy Rating.
- High Performance in Energy, Water, Waste and Indoor Environment Quality.

1.5 Briefing Documents

The engineering elements considered in this report have based or taken into consideration the following documents:

- Sydney Olympic Park Authority Policy – DRAFT Stormwater Management and Water Sensitive Urban Design Policy
- ESD Strategies Report prepared by Green Planning Australia Pty Ltd.
- Architectural drawings prepared by Architectus Pty Ltd.

2 Policy Requirements

2.1 Development Control Plan

Stormwater controls described herein have been extracted from the DRAFT Stormwater Management and Water Sensitive Urban Design Policy provided by Sydney Olympic Park Authority.

2.2 Policy Statement:

Development within Sydney Olympic Park must;

- Comply with best practice water sensitive urban design objectives and performance targets as identified in Table 1: Stormwater management and Water Sensitive Urban Design Requirements.
- Manage stormwater from construction sites in accordance with the requirements of Table 2: Stormwater Management Requirements for Construction Sites.

2.3 Location Classification

The DRAFT Stormwater Management and Water Sensitive Urban Design Policy provided by Sydney Olympic Park Authority identifies sites within the Sydney Olympic Park local government area under two classifications;

1. Those sites which are located within the WRAMS stormwater harvesting catchment area.
2. Those sites which are located outside of the WRAMS stormwater harvesting catchment area.

The WRAMS stormwater harvesting catchment area is identified by MAP 1 within the policy document.

2.4 Design Requirements

Table 1 of the DRAFT Stormwater Management and Water Sensitive Urban Design Policy provided by Sydney Olympic Park Authority details the design requirements for various developments as follows;

Element	Performance Requirement
SOPA Environmental Guidelines	<ol style="list-style-type: none">1. All developments must be consistent with the Environmental Guidelines for Sydney Olympic Park 2008. Provisions of particular relevance to stormwater management are:<ul style="list-style-type: none">• Minimise overall public domain water use (potable and non- potable) using best practice environmental design principles, innovative technology, water sensitive urban design, water efficient landscaping and other demand

Masterplan 2030	<p>management practices.</p> <ul style="list-style-type: none"> • All new developments required to maximise opportunities in building and infrastructure design to incorporate water collection and recycling systems. • Avoid adverse impacts on water quality or quantity in local streams, wetlands and groundwater from operations, development and major event activities.
	<p>2. All development must be consistent with Masterplan 2030. Provisions of particular relevance to stormwater management are:</p> <ul style="list-style-type: none"> • Ensure there is sufficient deep soil on each site and throughout the township to retain stormwater, manage the water table and water quality, and support the growth of medium and large trees: <ul style="list-style-type: none"> - A minimum of 20 per cent of the site's open space area is to be deep soil. Areas included as deep soil are to have a minimum dimension of 2 m. Consolidate areas of deep soil within sites and between adjacent sites to increase the benefits. • Minimise the impact of stormwater from communal open space on the health and amenity of nearby waterways: <ul style="list-style-type: none"> - Retain stormwater on site by: collecting and storing water from roofs and hard surfaces; maximising porous surfaces and deep soil; draining paved surfaces to appropriate adjacent vegetation. - Protect stormwater quality by providing for: sediment filters, traps or basins for hard surfaces; treatment of stormwater collected in sediment traps on soils; containing dispersive clays.
Water Conservation	<p>3. Maximise use of non-potable water for suitable applications on individual development sites.</p> <ul style="list-style-type: none"> - Sources of non-potable water may include WRAMS recycled water, stormwater, rainwater and wastewater. <p>4. The water must be fit for purpose and satisfy national and state legislation for water recycling (Australian Guidelines for Water Recycling) including provision of risk management plans and recycled water management plans. Suitable applications for non-potable water may include:</p> <ul style="list-style-type: none"> - Toilet flushing - Car washing - Washdown

	<ul style="list-style-type: none"> - Irrigation of gardens and landscaping - Water features - Fire fighting - Construction and dust suppression - Cooling towers - Filter backwash <p>5. All developments must connect to the WRAMS recycled water supply, where available.</p> <p>6. Where WRAMS supply is available, all outdoor water use demand must be met from non-potable water sources. Where such connections are not available, 80% of outdoor water use demand must be met from non-potable water sources.</p> <p>7. New dwellings including residential components within mixed use building and serviced apartments, are to comply with SEPP BASIX or better.</p> <p>8. Individual water metering must be provided where possible to all residential and commercial units within a development.</p>
<p>Stormwater Harvesting</p>	<p>9. Developments outside the WRAMS stormwater harvesting catchment (as shaded red on Map 1, plus development within parklands areas) must:</p> <ul style="list-style-type: none"> - Provide an on-site or other decentralised approach to stormwater quality and quality management, including local collection, treatment and utilisation of stormwater as part of an integrated treatment system. - Maximise rainwater and stormwater harvesting and re-use, and minimise runoff to the Park’s wetlands and waterways. - Source at least 80% of outdoor water use from locally-generated non-potable sources such as roof water, stormwater or waste water.
<p>WSUD Strategy</p>	<ul style="list-style-type: none"> - WRAMS supply may be used for top-up for non potable demands. <p>10. Application for the following types of development must be accompanied by a Water Sensitive Urban Design (WSUD) Strategy prepared by a suitably qualified practitioner with WSUD experience,</p> <ul style="list-style-type: none"> - All new commercial, retail, residential, & mixed use development, entertainment and sporting facilities, roads, and public domain hardstand - All alterations and additions to existing commercial, retail, residential, mixed use and other development with a

	<p>total site area greater than 2000m² and which results in a building footprint or gross floor area of greater than 50%. WSUD is to be applied on the <u>whole</u> site</p> <ul style="list-style-type: none"> - Any development which involves the construction or designation of ten or more additional car parking spaces, whether covered or uncovered <p>11. The WSUD strategy must include as appropriate:</p> <ul style="list-style-type: none"> - An Integrated Water Cycle Management Plan including a water balance report - A site layout plan showing the location of the proposed stormwater treatment measures - Assessment of the impact of flows on the receiving environment, the capacity of downstream infrastructure to manage such flows, and any required enhancement works proposed to be implemented - A report, prepared by a suitably qualified professional such as a civil engineer, outlining water quality and stormwater flow improvements achieved by the WSUD strategy for the development, using the MUSIC tool or equivalent, with reference to stormwater quality targets for Sydney Olympic Park (Attachment 1) - Design details to assess the technical effectiveness of the proposed stormwater treatment measures - Design details for proposed measures to capture gross pollutants - A site management plan which details how the site will be managed through construction and which sets out future operational and maintenance requirements - If policy requirements or stormwater quality targets are not met, an application must include justification for how the development meets the objectives of this policy
<p>WSUD Asset Maintenance</p>	<p>12. An establishment, handover and operation and maintenance plan must be developed for all WSUD assets and included in an application for an Occupation Certificate, with a copy provided to the Authority. An annual statement of maintenance activities conducted under this Plan must be provided to the Authority by 30 June each year.</p>
<p>Oil & Grease From Carparks Riparian Protection</p>	<p>13. All open and basement carparks over ten spaces must include oil and grease traps.</p> <p>14. All development must have regard for the 'Guidelines for riparian corridors on waterfront land' (dated July 2012, or subsequent revisions) issued by NSW Office of Water. Any necessary approvals required under the NSW Water Management Act must be obtained.</p> <p>15. Developments must not contribute to scouring of outlets to wetlands <u>or waterways during storm events</u></p>

2.5 Stormwater Quality Targets

Attachment 1 of the DRAFT Stormwater Management and Water Sensitive Urban Design Policy provided by Sydney Olympic Park Authority details the stormwater quality targets for various developments as follows;

Pollutant	Baseline Targets – Sites Within WRAMS Catchment	Baseline Targets – Sites Outside WRAMS Catchment
Total Nitrogen	45% reduction in the mean annual load	65% reduction in the mean annual load
Total Phosphorus	65% reduction in the mean annual load	85% reduction in the mean annual load
Total Suspended Solids	85% reduction in the mean annual load	90% reduction in the mean annual load

2.6 Rainfall Intensity

The Sydney Olympic Park local government area, is subject to the following rainfall intensities;

- 5 Year ARI storm of 5 minutes duration with a rainfall intensity of 144mm/h
- 20 year ARI storm of 5 minutes duration with a rainfall intensity of 184mm/h
- 100 Year ARI storm of 5 minutes duration with a rainfall intensity of 236mm/h

3 Stormwater Management Proposal

3.1 Development Assessment

The Axis – Stages 1 & 1a development has been assessed as follows with regard to the requirements of the DRAFT Stormwater Management and Water Sensitive Urban Design Policy provided by Sydney Olympic Park as follows;

1. Site Area	5,055m ²
2. Development Type	Commercial
3. Location	Outside WRAMS catchment
4. Stormwater Detention	Not Required
5. Rainwater Storage	Required
6. Water Quality	Required

3.2 Overland Flow

The site is located on grade relative to the immediate local catchment area, bounded on three sides by existing roadways and on the remaining side by an existing building. As such there is no significant overland flow entering the site that would require any dedicated capture and transfer pipework system.

3.3 Site Stormwater Connection

A site stormwater connection for the development will be facilitated by a new 450mm direct connection into the existing SOPA 825mm stormwater main that will be diverted outside of the development site, via a new easement along the sites western boundary and then along the eastern side of new road 10.

3.4 On-Site Stormwater Detention

In accordance with the SOPA DRAFT Stormwater Management and Water Sensitive urban Design Policy, on-site stormwater detention is not required for this development.

3.5 Rainwater Harvesting

In accordance with the SOPA DRAFT Stormwater Management and Water Sensitive urban Design Policy, a rainwater harvesting system will be provided for this development.

The rainwater harvesting system will collect rainwater runoff from roof areas of the development only, and transfer this rainwater to the rainwater storage tank via a syphonic stormwater drainage system installed throughout the building.

Due to the possibility of contamination, rainwater runoff from balcony areas will not be collected for the rainwater harvesting system. Rainwater runoff from balcony areas will be transferred directly to the gravity stormwater drainage system.

Harvested rainwater will be used to supply non-potable cold water for toilet flushing, landscape irrigation and cooling towers on the project. The rainwater harvesting system does not have adequate capacity to supply these uses on its own, but will instead be used in a hybrid system whereby recycled water from the WRAMS recycled water scheme is used to top up any shortfall in non-potable water supply from the rainwater harvesting system.

The rainwater harvesting system has been designed with regard to the following design parameters;

- Bureau of Meteorology rainfall data from the Macquarie Park weather station.
- Minimum catchment area of 4,429m² (total roof area)
- Minimum Tank Volume 70.843m³

The total available rainwater supply with these parameters has been calculated at 92.728kL/week, or 4,821.856kL/annum.

3.6 Water Quality

In accordance with the SOPA DRAFT Stormwater Management and Water Sensitive urban Design Policy, stormwater water quality measures are required for this development.

Stormwater quality will be addressed via a three stage treatment process as follows;

- Roof water from the development will discharge into the rainwater storage tank, which will provide for a reduction in total suspended solids by settlement over time as well as tank inlet screening.
- Overflow from the rainwater storage tank together with surface run-off will be directed through a sand filter prior to final discharge into the stormwater drainage system.
- Vehicular pollution will be dealt with via a Gross Pollutant Trap installed to treat run-off from all carpark areas, prior to final discharge into the stormwater drainage system.

Stormwater quality has been modelled using the MUSIC program with regard to the above mentioned parameters, and found to achieve the following overall system performance;

Treated Outlet	Flow (ML/yr)	Total Nitrogen (kg/yr)	Total Phosphorus (kg/yr)	Total Suspended Solids (kg/yr)	Gross Pollutants (kg/yr)
Untreated Pollutant Loads	6.47	18.40	2.69	1330	145
Treated Pollutant Loads	3.20	5.51	0.381	129	0
Target Reduction	NA	65%	85%	90%	NA
Actual Reduction	50.5%	70.1%	85.8%	90.3%	100%

4 Water Sensitive Urban Design Proposal

4.1 Base Building Water Consumption

Potable water consumption has been estimated throughout the entire development for the base building case to be used as a benchmark against which to compare the efficiency of various potable water consumption reduction strategies that have been proposed.

BASE BUILDING EVALUATION

Water consumption estimates for the base building benchmark have been prepared with regard to the following base data;

WATER SUPPLY

Toilet Flushing	100% potable cold water (towns main)
Urinal Flushing	100% potable cold water (towns main)
Tapware	100% potable cold water (towns main)
Showers	100% potable cold water (towns main)
Heat Rejection	100% potable cold water (towns main)
Irrigation	100% potable cold water (towns main)

FIXTURE EFFICIENCY

- Water Closets – 3 Star WELS rated, having an average flush volume of 4 litres
- Urinals – 3 Star WELS rated, having an average flush volume of 2 litres
- Tapware – 3 Star WELS rated, having a flow rate of 9 litres/minute
- Showers – 3 Star WELS rated, having a flow rate of 9 litres/minute

CONSUMPTION EVALUATION

Category	Water Consumption (kL/week)	Consumption Reduction (kL/week)	Alternative Water Supply (kL/week)	Total Water Saving (%)
Retail Amenities	10.156	0.000	0.000	0%
Retail Tenancies	2.415	0.000	0.000	0%
Commercial	296.352	0.000	0.000	0%
Heat Rejection	178.240	0.000	0.000	0%
Irrigation	3.233	0.000	0.000	0%
Totals	490.396	0.0	0.0	0%

4.2 Axis Development Water Consumption

Potable water consumption has been estimated throughout the entire development for the water efficiency case to identify the efficiency of the proposed Axis development against the base building benchmark potable water consumption evaluation.

WATER EFFICIENCY EVALUATION

Water consumption estimates for the water efficiency evaluation have been prepared with regard to the following base data;

WATER SUPPLY

Toilet Flushing	100% non-potable cold water (towns main)
Urinal Flushing	100% non-potable cold water (towns main)
Tapware	100% potable cold water (towns main)
Showers	100% potable cold water (towns main)
Heat Rejection	100% non-potable cold water (towns main)
Irrigation	100% recycled rainwater (on-site tank)

FIXTURE EFFICIENCY

- Water Closets – 4 Star WELS rated, having an average flush volume of 3.5 litres
- Urinals – 6 Star WELS rated, having an average flush volume of 1 litres
- Tapware – 6 Star WELS rated, having a flow rate of 4.5 litres/minute
- Showers – 3 Star WELS rated, having a flow rate of 9 litres/minute

CONSUMPTION EVALUATION

Category	Water Consumption (kL/week)	Consumption Reduction (kL/week)	Alternative Water Supply (kL/week)	Total Water Saving (%)
Retail Amenities	3.169	3.132	3.855	69%
Retail Tenancies	2.415	0.000	0.000	0%
Commercial	142.884	68.796	84.672	52%
Heat Rejection	0.000	0.000	178.240	100%
Irrigation	0.000	0.000	3.233	100%
Totals	148.468	71.928	270	70%

4.3 Description

The water efficiency measures proposed for Stages 1 & 1a of the Axis development will achieve a potable cold water consumption reduction of 70% when compared to the base case benchmark. The improvement in water efficiency is achieved via the installation of more water efficient fixtures and tapware, as well as the substitution of a non-potable water supply for flushing purposes, heat rejection and irrigation requirements. The non-potable water supply would need to be provided from two supplies as follows;

1. Rainwater Harvesting (Irrigation) – requiring a rainwater storage tank, a booster pump and filtration system, and a recycled rainwater reticulation system to the planters. The cost of a rainwater harvesting system has been assessed at \$45,000. (Infrastructure \$35,000 + Reticulation \$10,000). A rainwater harvesting system has no ongoing cost for the provision of non-potable water apart from general system maintenance.
2. Recycled Water (Flushing & Heat Rejection) – requiring a mains supply, booster pump, and a non-potable water reticulation system throughout the development. The cost of a recycled water system has been assessed at \$95,000. (Infrastructure \$25,000 + Reticulation \$70,000). A recycled water system will have ongoing water supply charges in addition to general system maintenance. The cost of water supply requires further investigation with the supplier.

4.4 Summary

Option	Description	Potable Cold Water Reduction	Cost
Base Case	Base building used for benchmark potable cold water consumption	0%	\$0
	Water Efficiency Inclusion of water efficient fixtures and tapware, non-potable water supply (recycled water) to 100% of all flushing requirements and 100% of all heat rejection requirements. Non-potable water supply (rainwater harvesting) to 100% of irrigation requirements.	70%	\$140,000

NOTE: recycled water supply rates are yet to be clarified and included.

5 Base Case - Water Consumption Evaluation

5.1 Retail Amenity Water Requirements

Base case retail amenity water consumption for the Axis development, has been modelled based upon following information;

- 5 days of building operation per week.
- 3 Star WELS rated water closets, having an average volume per flush of 4 litres.
- 3 Star WELS rated urinals, having an average volume per flush of 2 litres.
- 3 Star WELS rated tapware, having a flow rate of 9.0 litres per minute.
- 3 Star WELS rated showers, having a flow rate of 9.0 litres per minute.

A summary of the estimated base case retail amenity water consumption for the parameters listed above is as follows;

Base Building Assessment	Water Closet	Urinal	Tapware	Showers	Totals
Area	1112	1112	1112	1112	1112
Male - Staff	11	11	11	11	11
Female - Staff	11	11	11	11	11
Male - Visitor	185	185	185	185	185
Female - Staff	185	185	185	185	185
Fixture Efficiency	3 Star	3 Star	3 Star	3 Star	
Consumption Per Use	4	2	3	45	
Male - Staff	44	44	100	100	289
Female - Staff	133	0	100	100	334
Male - Visitor	148	148	334	0	630
Female - Visitor	445	0	334	0	778
Total Consumption (L/day)	771	193	867	200	2031
Efficiency (L/m2/day)	0.69	0.17	0.78	0.18	1.83
Days Of operation Per Week	5	5	5	5	5
Total Consumption (kL/week)	3.855	0.964	4.337	1.001	10.156

The total base case retail amenity water consumption with these parameters has been estimated at 10.156kL per week throughout the development.

5.2 Retail Tenancy Water Requirements

Retail tenant water consumption for the Axis development, has been modelled based upon actual metered consumption data from similar retail centres. Specifically the base model has been developed upon following information;

- 5 days of building operation per week.
- Non-food tenants having an average water consumption rate of 0.11kL/m² per annum.
- Food tenants having an average water consumption rate of 5.23kL/m² per annum.
- Supermarkets having an average water consumption rate of 0.21kL/m² per annum.
- Majors and Mini Majors having an average water consumption rate of 0.11kL/m² per annum.

A summary of the estimated retail tenancy water consumption for the parameters listed above is as follows;

Base Building Assessment	Specialty	Restaurants	Supermarkets	Majors	Totals
Area	572	0	540	0	1112
Consumption Rate	0.11	5.23	0.21	0.11	
Total Consumption (L/day)	172	0	311	0	483
Efficiency (L/m ² /day)	0.30	#DIV/0!	0.58	#DIV/0!	0.43
Days Of operation Per Week	5	5	5	5	
Total Consumption (kL/week)	0.862	0.000	1.553	0.000	2.415

The total retail tenant water consumption with these parameters has been estimated at 2.415kL per week throughout the development.

5.3 Commercial Tenancy Water Requirements

Base case commercial tenancy water consumption for the Axis development, has been modelled based upon following information;

- 5 days of building operation per week.
- 3 Star WELS rated water closets, having an average volume per flush of 4 litres.
- 3 Star WELS rated urinals, having an average volume per flush of 2 litres.
- 3 Star WELS rated tapware, having a flow rate of 9.0 litres per minute.
- 3 Star WELS rated showers, having a flow rate of 9.0 litres per minute.

A summary of the estimated medical water consumption for the parameters listed above is as follows;

Base Building Assessment	Water Closet	Urinal	Tapware	Showers	Totals
Area	21168	21168	21168	21168	21168
Male - Staff	1058	1058	1058	1058	1058
Female - Staff	1058	1058	1058	1058	1058
Fixture Efficiency	3 Star	3 Star	3 Star	3 Star	
Consumption Per Use	4	2	3	45	

Male - Staff	4234	4234	9526	9526	27518
Female - Staff	12701	0	9526	9526	31752
Total Consumption (L/day)	16934	4234	19051	19051	59270
Efficiency (L/m²/day)	0.80	0.20	0.90	0.90	2.80
Days Of operation Per Week	5	5	5	5	5
Total Consumption (kL/week)	84.672	21.168	95.256	95.256	296.352

The total base case commercial water consumption with these parameters has been estimated at 296.352kL per week throughout the development.

5.4 Heat Rejection Water Requirements

Water consumption within each mechanical services air conditioning system varies depending upon the location of the building, the type of building construction, and the type of mechanical services systems incorporated. For the Axis development, the heat rejection water demand has been developed using the following information;

- Total Nett Floor Area 22,280m²
- 5 days of building operation per week.
- Average Cooling Tower Water Supply 1.6L/day/m²

A summary of the estimated heat rejection water consumption for the parameters listed above is as follows;

Base Building Assessment	Specialty	Restaurants	Supermarket	Majors	Commercial	Totals
Area	572	0	540	0	21168	22280
Consumption Rate	1.6	1.6	1.6	1.6	1.6	
Total Consumption (L/day)	915	0	864	0	33869	35648
Efficiency (L/m²/day)	1.60	#DIV/0!	1.60	#DIV/0!	1.60	
Days Of operation Per Week	5	5	5	5	5	
Total Consumption (kL/week)	4.576	0.000	4.320	0.000	169.344	178.240

The total base case heat rejection water demand with these parameters is estimated to be 178.240kL per week.

5.5 Outdoor Water Requirements

Water consumption within each landscape irrigation system varies depending upon the nature of the irrigation system, species of planting, and the prevailing climate. For the Axis development, the base case outdoor water demand has been developed using following information;

- Irrigation area of approximately 500m²
- Irrigation rate 25mm/m²

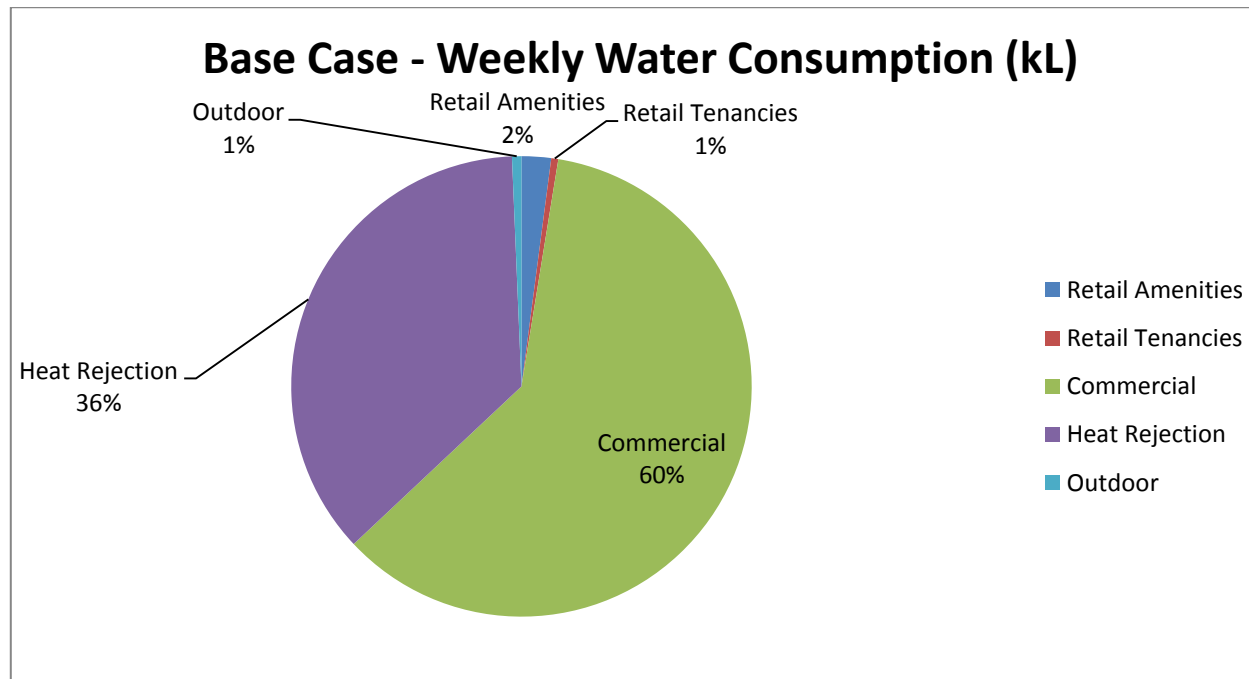
A summary of the estimated irrigation water consumption for the parameters listed above is as follows;

Base Building	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Weeks	4.4	4.0	4.4	4.3	4.4	4.3	4.4	4.4	4.3	4.4	4.3	4.4	52.0
Applications	3	3	2	2	2	1	1	1	2	2	2	3	
Area	500	500	500	500	500	500	500	500	500	500	500	500	
Irrigation Rate	25	25	25	25	25	25	25	25	25	25	25	25	
Requirement	330	300	220	215	220	108	110	110	215	220	215	330	
Rainfall	118.8	144.8	131.9	110.0	86.0	116.2	56.7	55.1	59.9	84.5	95.2	86.9	1148.7
Monthly	105.600	77.600	44.050	52.500	67.000	0.000	26.650	27.450	77.550	67.750	59.900	121.550	727.600
Weekly	24.000	19.400	10.011	12.209	15.227	0.000	6.057	6.239	18.035	15.398	13.930	27.625	168.131

The average base case outdoor water demand with these parameters has been estimated at 3.233kL per week throughout the development.

5.6 Total Base Building Retail Water Consumption

Based on the estimated retail amenity water requirements of 10.156kL per week, the estimated retail tenancy water requirements of 2.415kL per week, the estimated commercial water requirements of 296.352kL per week, the estimated heat rejection water requirements 178.240kL per week and the estimated outdoor water requirements of 3.233kL per week, the total water consumption for this development will be 490.397kL per week.



6 Water Efficiency – Water Consumption Evaluation

6.1 Retail Amenity Water Requirements

Water efficiency retail amenity water consumption for the Axis development, has been modelled based upon following information;

- 5 days of building operation per week.
- 4 Star WELS rated water closets, having an average volume per flush of 3.5 litres.
- 6 Star WELS rated urinals, having an average volume per flush of 1 litre.
- 6 Star WELS rated tapware, having a flow rate of 4.5 litres per minute.
- 3 Star WELS rated showers, having a flow rate of 9.0 litres per minute.
- Non-potable water used for 100% of all flushing requirements. (towns main)

A summary of the estimated water efficiency retail amenity water consumption for the parameters listed above is as follows;

Efficiency Assessment	Water Closet	Urinal	Tapware	Showers	Totals
Area	1112	1112	1112	1112	1112
Male - Staff	11	11	11	11	11
Female - Staff	11	11	11	11	11
Male - Visitor	185	185	185	185	185
Female - Staff	185	185	185	185	185
Fixture Efficiency	4 Star	6 Star	6 Star	3 Star	
Consumption Per Use	3.5	1	1.5	45	
Male - Staff	39	22	50	100	211
Female - Staff	117	0	50	100	267
Male - Visitor	130	74	167	0	371
Female - Visitor	389	0	167	0	556
Total Consumption (L/day)	675	96	434	200	1405
Efficiency (L/m2/day)	0.61	0.09	0.39	0.18	1.26
Days Of operation Per Week	5	5	5	5	5
Weekly Consumption (kL/week)	3.373	0.482	2.168	1.001	7.024
Non-Potable Ratio	100%	100%	0%	0%	
Non-Potable Contribution (kL/week)	3.373	0.482	0.000	0.000	3.855
Total Consumption (kL/week)	0.000	0.000	2.168	1.001	3.169

The total water efficiency retail amenity water consumption with these parameters has been estimated at 3.169kL per week throughout the development.

6.2 Retail Tenancy Water Requirements

Water efficiency retail tenant water consumption for the Axis development, has been modelled based upon actual metered consumption data from similar retail centres. Specifically the base model has been developed upon following information;

- 5 days of building operation per week.
- Non-food tenants having an average water consumption rate of 0.11kL/m² per annum.
- Food tenants having an average water consumption rate of 5.23kL/m² per annum.
- Supermarkets having an average water consumption rate of 0.21kL/m² per annum.
- Majors and Mini Majors having an average water consumption rate of 0.11kL/m² per annum.

A summary of the estimated water efficiency retail tenancy water consumption for the parameters listed above is as follows;

Efficiency Assessment	Specialty	Restaurants	Supermarkets	Majors	Totals
Area	572	0	540	0	1112
Consumption Rate	0.11	5.23	0.21	0.11	
Total Consumption (L/day)	172	0	311	0	483
Efficiency (L/m ² /day)	0.30	#DIV/0!	0.58	#DIV/0!	0.43
Days Of operation Per Week	5	5	5	5	
Total Consumption (kL/week)	0.862	0.000	1.553	0.000	2.415

The total water efficiency retail tenant water consumption with these parameters has been estimated at 2.415kL per week throughout the development.

6.3 Commercial Tenancy Water Requirements

Water efficiency commercial tenancy water consumption for the Axis development, has been modelled based upon following information;

- 5 days of building operation per week.
- 4 Star WELS rated water closets, having an average volume per flush of 3.5 litres.
- 6 Star WELS rated urinals, having an average volume per flush of 1 litre.
- 6 Star WELS rated tapware, having a flow rate of 4.5 litres per minute.
- 3 Star WELS rated showers, having a flow rate of 9.0 litres per minute.
- Non-potable water used for 100% of all flushing requirements. (towns mains)

A summary of the estimated water efficiency commercial water consumption for the parameters listed above is as follows;

Efficiency Assessment	Water Closet	Urinal	Tapware	Showers	Totals
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Area	21168	21168	21168	21168	21168
Male - Staff	1058	1058	1058	1058	1058
Female - Staff	1058	1058	1058	1058	1058
Fixture Efficiency	4 Star	6 Star	6 Star	3 Star	
Consumption Per Use	3.5	1	1.5	45	
Male - Staff	3704	2117	4763	9526	20110
Female - Staff	11113	0	4763	9526	25402
Total Consumption (L/day)	14818	2117	9526	19051	45511
Efficiency (L/m2/day)	0.70	0.10	0.45	0.90	2.15
Days Of operation Per Week	5	5	5	5	5
Weekly Consumption (kL/week)	74.088	10.584	47.628	95.256	227.556
Non-Potable Ratio	100%	100%	0%	0%	
Non-Potable Contribution (kL/week)	74.088	10.584	0.000	0.000	84.672
Total Consumption (kL/week)	0.000	0.000	47.628	95.256	142.884

The total water efficiency commercial water consumption with these parameters has been estimated at 142.884kL per week throughout the development.

6.4 Heat Rejection Water Requirements

Water consumption within each mechanical services air conditioning system varies depending upon the location of the building, the type of building construction, and the type of mechanical services systems incorporated. For the Axis development, the water efficiency heat rejection water demand has been developed using the following information;

- Total Nett Floor Area 22,280m²
- 5 days of building operation per week.
- Average Cooling Tower Water Supply 1.6L/day/m²
- Non-potable water used for 100% of all heat rejection requirements.

A summary of the estimated water efficiency heat rejection water consumption for the parameters listed above is as follows;

Efficiency Assessment	Specialty	Restaurants	Supermarket	Majors	Commercial	Totals
Area	572	0	540	0	21168	22280
Consumption Rate	1.6	1.6	1.6	1.6	1.6	
Total Consumption (L/day)	915	0	864	0	33869	35648
Efficiency (L/m2/day)	1.60	#DIV/0!	1.60	#DIV/0!	1.60	
Days Of operation Per Week	5	5	5	5	5	
Weekly Consumption (kL/week)	4.576	0.000	4.320	0.000	169.344	178.240
Non-Potable Ratio	100%	100%	100%	100%	100%	

Non-Potable Contribution (kL/week)	4.576	0.000	4.320	0.000	169.344	178.240
Total Consumption (kL/week)	0.000	0.000	0.000	0.000	0.000	0.000

The total water efficiency heat rejection water demand with these parameters is estimated to be 0.000kL per week.

6.5 Outdoor Water Requirements

Water consumption within each landscape irrigation system varies depending upon the nature of the irrigation system, species of planting, and the prevailing climate. For the Axis development, the water efficiency outdoor water demand has been developed using following information;

- Irrigation area of approximately 500m²
- Irrigation rate 25mm/m²
- Non-potable water used for 100% of all irrigation requirements.

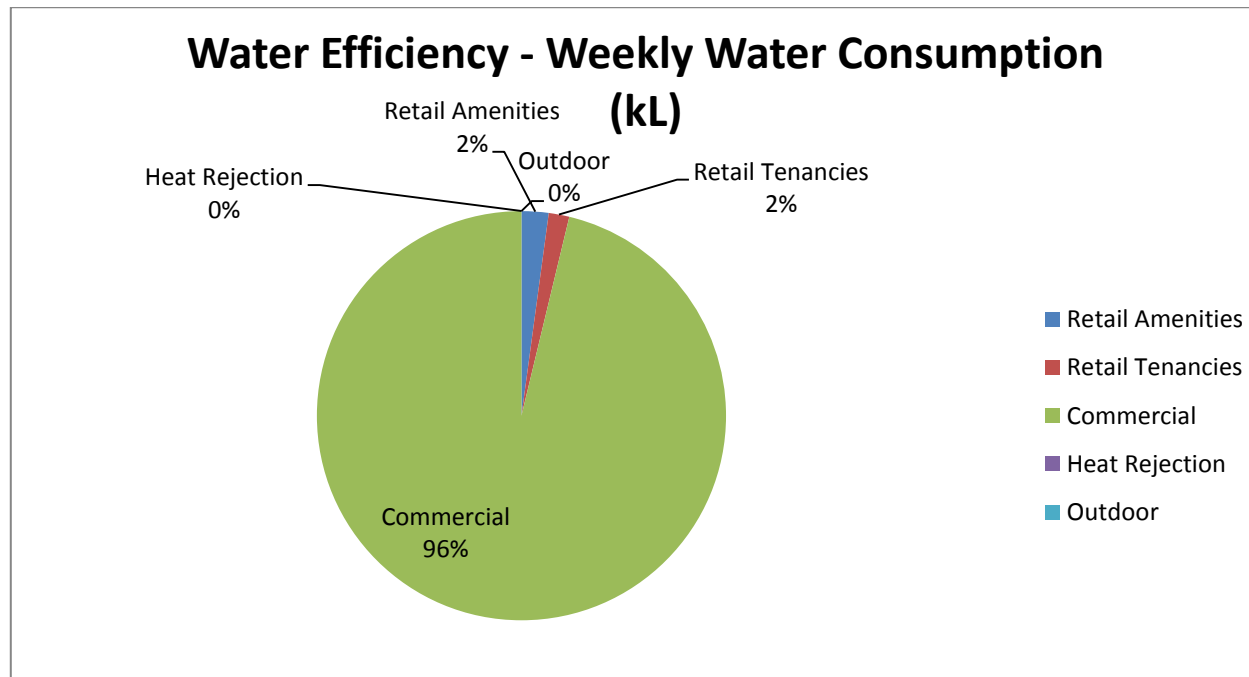
A summary of the estimated water efficiency irrigation water consumption for the parameters listed above is as follows;

Water Efficiency	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Weeks	4.4	4.0	4.4	4.3	4.4	4.3	4.4	4.4	4.3	4.4	4.3	4.4	52.0
Applications	3	3	2	2	2	1	1	1	2	2	2	3	
Area	500	500	500	500	500	500	500	500	500	500	500	500	
Irrigation Rate	25	25	25	25	25	25	25	25	25	25	25	25	
Requirement	330	300	220	215	220	108	110	110	215	220	215	330	
Rainfall	118.8	144.8	131.9	110.0	86.0	116.2	56.7	55.1	59.9	84.5	95.2	86.9	1148.7
Monthly	105.600	77.600	44.050	52.500	67.000	0.000	26.650	27.450	77.550	67.750	59.900	121.550	727.600
Weekly Consumption (kL/week)	24.000	19.400	10.011	12.209	15.227	0.000	6.057	6.239	18.035	15.398	13.930	27.625	168.131
Non-Potable Ratio	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Non-Potable Contribution (kL/week)	24.000	19.400	10.011	12.209	15.227	0.000	6.057	6.239	18.035	15.398	13.930	27.625	168.131
Total Consumption (kL/week)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The average water efficiency outdoor water demand with these parameters has been estimated at 0.000kL per week throughout the development.

6.6 Total Water Efficiency Water Consumption

Based on the estimated retail amenity water requirements of 3.169kL per week, the estimated retail tenancy water requirements of 2.415kL per week, the estimated commercial water requirements of 142.884kL per week, the estimated heat rejection water requirements of 0.000kL per week and the estimated outdoor water requirements of 0.000kL per week, the total potable cold water consumption for this development will be 148.469kL per week.



7 Appendix

7.1 Rainwater Tank Calculations

7.2 Water Efficiency Calculations