Appendix 4.2.1(a) Process Flow Diagram (Sewerage and Recycled Water)

Quality Control Points (QCP) for Water Quality

Bioreactor
- pH
- Dissolved oxygen
- Temperature
- Flow

Chlorine Residual
- Chlorine residual

Reverse Osmosis
- TDS

Stabilisation
- pH
- TDS

Critical Control Points (CCP) for Water Quality

Membranes
- Permeate turbidity

UV
- UV transmissivity
- UV Intensity
- Flow

Chlorine Contact
- Chlorine residual
- Flow

New infrastructure

Minor Flow

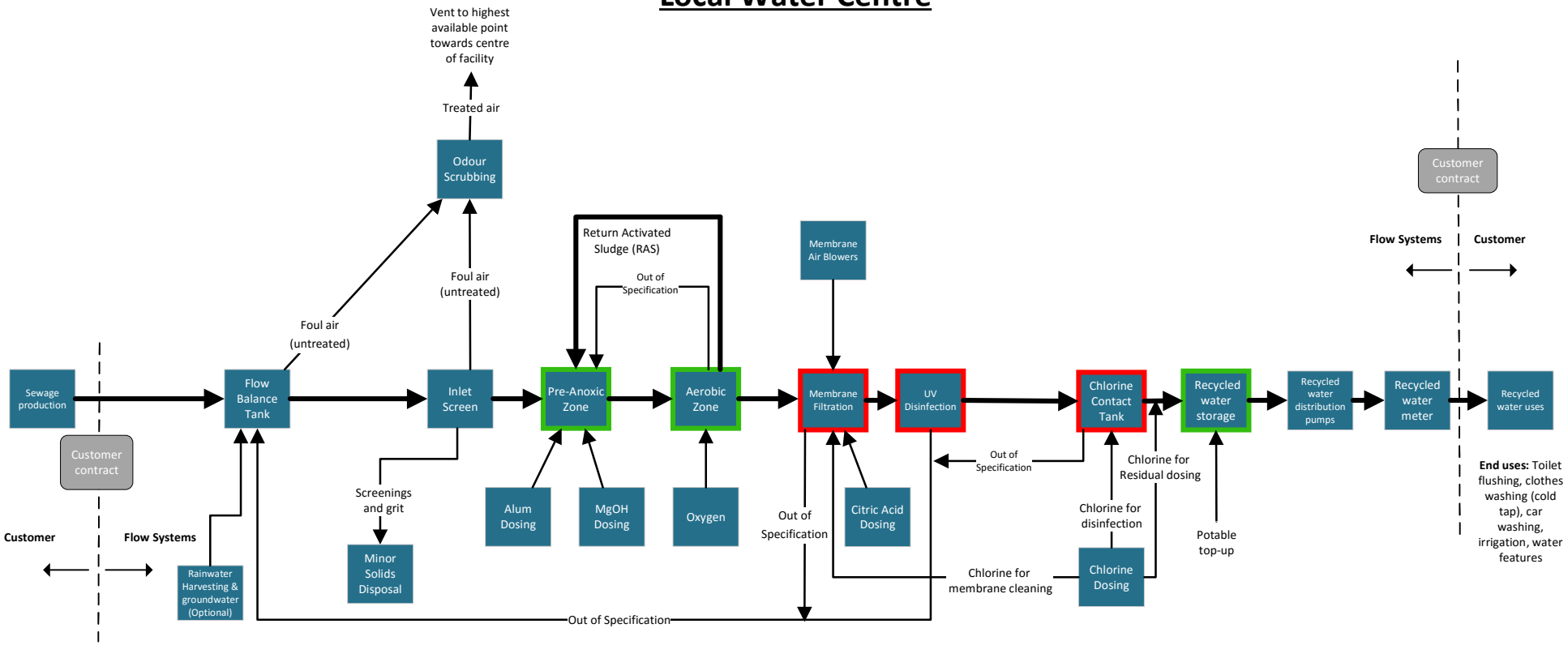
Major Flow

Contract/Agreement

Location of QCP

Location of CCP

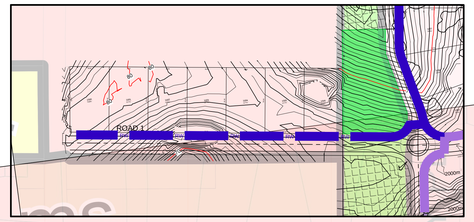
Local Water Centre



Glossodia	Date: 6/04/2016	Sewerage and Recycled Water Process Flow Diagram	Revision C

Glossodia Water

Appendix 4.2.1(b) Recycled Water Reticulation Masterplan



INSET A
SCALE: 1:2000 @ A0

SEE INSET A FOR CONTINUATION

SPINKS RD

ROSE CR

JAMES ST

RE1

R2

R3

R4

R5

R6

ROAD 1
ROAD 2
ROAD 3
ROAD 4
ROAD 5
ROAD 6
ROAD 7
ROAD 8
ROAD 9
ROAD 10
ROAD 11
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ROAD 32
ROAD 33
ROAD 34
ROAD 35

LOCAL WATER CENTRE

LEGEND:

DN150 RECYCLED WATER MAIN

DN100 RECYCLED WATER MAIN

Date: 15/02/2016

Rev: A

Drawing No: SK002

Scale: 0 20 40 60 80 100m
SCALE 1:2000 AT A0

GLOSSODIA - JACARANDA PONDS
RECYCLED WATER FUNCTIONAL DESIGN

flow systems

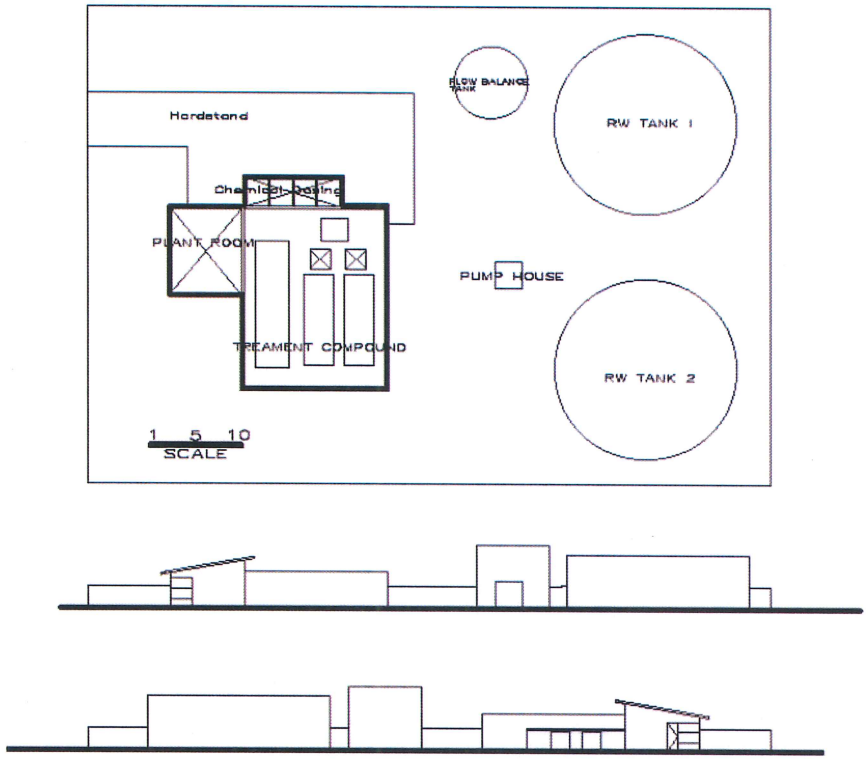
Pressure System Solutions Pty Ltd
PLANNING, DESIGN & IMPLEMENTATION OF WATER & WASTEWATER SYSTEMS
Our Understanding and Experience Provides Certainty
PO Box 630 Jannali NSW 2226
www.pssolutions.net.au
T: +61 2 9584 1177
F: +61 2 9584 1477

Saved: 16.02.2016, By: srust
J:\1700-Projects\800-Preliminary-Tender\Jacaranda Ponds\Street Mains\SK002 Glossodia-Jacaranda Ponds Recycled Water Functional Design.dwg

Glossodia Water

Appendix 4.2.1(c) LWC Concept Layout

Appendix 1 - Utility Works Concept Design



flow systems

Jacaranda Ponds

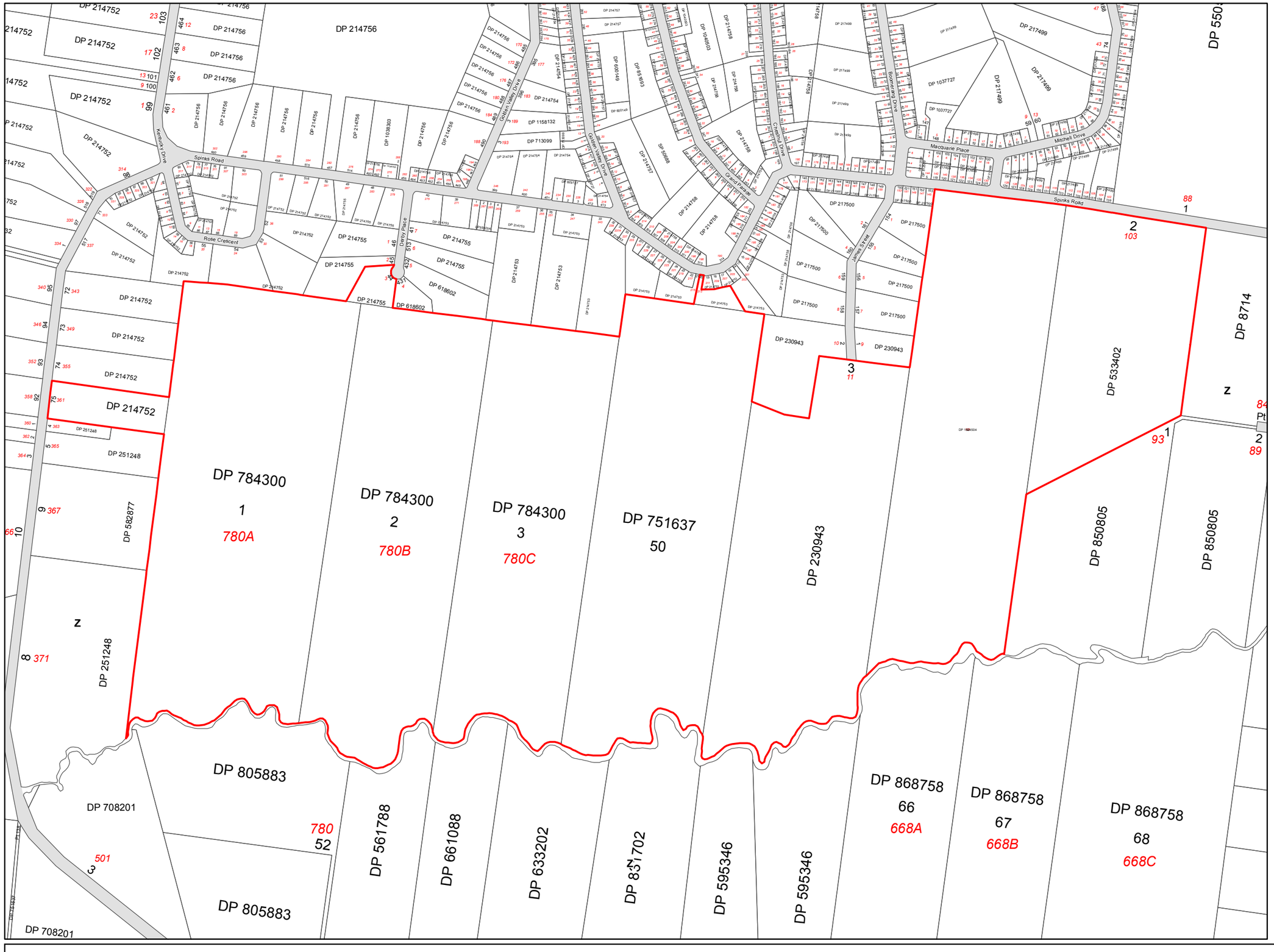
Local Water Centre Concept

Glossodia Water

Appendix 4.2.3(a) Scheme Lot and DP References

HAWKESBURY CITY COUNCIL

PO Box 146, Windsor NSW 2756
Website: www.hawkesbury.nsw.gov.au
Email: council@hawkesbury.nsw.gov.au
Hours: Monday to Friday 8.30am - 5.00pm
Phone: 02 4560 4444



Legend

- Land Parcels
- Roads
- Subject Site

N
W E
S

0 100 200 400
Metres
1:8,000 @ A3

Planning Proposal - Jacaranda Ponds at Glossodia - Locality Map

Date: 24/06/2013

Glossodia Water

Appendix 4.2.6(a) Glossodia Water Balance Summary Report

KINESIS

Glossodia Water

A local sustainable water utility

GLOSSODIA WATER

WATER BALANCE SUMMARY REPORT

DRAFT – 13 APRIL 2016

V0.3

PREPARED BY KINESIS FOR FLOW SYSTEMS

Prepared by Kinesis
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Sydney, 2000 NSW
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NSW 1230
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Document Version
Final

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David Holden, Associate Director
Tom Watson, Sustainability Analyst
Tu Tu, Senior Analyst

Cover Image Credits
City of Sydney, 2015

Note: This report is provided subject to some important assumptions and qualifications:

The results presented in this report are modelled estimates using mathematical calculations. The data, information and scenarios presented in this report have not been separately confirmed or verified. Accordingly, the results should be considered to be preliminary in nature and subject to such confirmation and verification.

Energy, water and greenhouse consumption estimates are based on local climate and utility data available to the consultant at the time of the report. These consumption demands are, where necessary, quantified in terms of primary energy and water consumptions using manufacturer's data and scientific principles.

Generic precinct-level cost estimates provided in this report are indicative only based on Kinesis's project experience and available data from published economic assessments. These have not been informed by specific building design or construction plans and should not be used for design and construct cost estimates.

The Kinesis software tool and results generated by it are not intended to be used as the sole or primary basis for making investment or financial decisions (including carbon credit trading decisions). Accordingly, the results set out in this report should not be relied on as the sole or primary source of information applicable to such decisions.

CONTENTS

EXECUTIVE SUMMARY

The Jacaranda Ponds development is a proposed residential development in Glossodia in the local government area of the City of Hawkesbury. Glossodia Water proposes to provide recycled water to **580** houses on **199 ha** of land and include **12.2 ha** of public open space comprising of playing fields, public gardens, public plazas and native parklands.

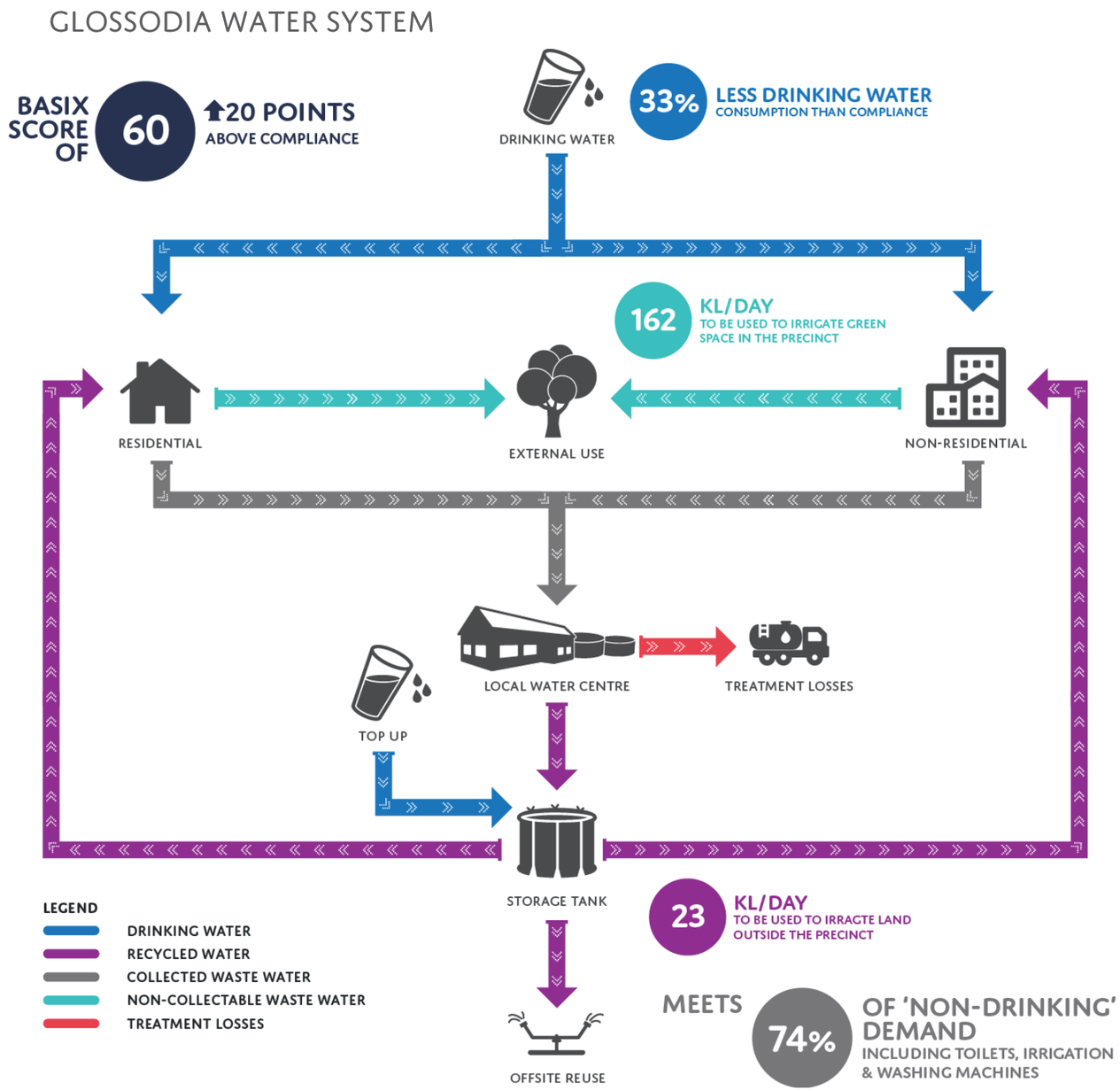
Glossodia Water will operate a recycled water scheme that incorporates a combined membrane bioreactor and ultrafiltration system with a **1.2 ML** storage tank. The system will take inflows from all grey and black waste water in the precinct and provide recycled water for:

- Residential use in
  - Toilets
  - Washing Machines (cold only), and
  - Garden Irrigation.

- Non-residential use in
  - Irrigation

These end-uses will be supplied by **74% recycled water**, with the remainder serviced by drinking water.

With the recycled water scheme, dwellings in the precinct are expected to achieve, on average, a **BASIX Water score of 60**. Furthermore, to achieve BASIX Water targets without the recycled water scheme, dwellings at Jacaranda Ponds would be required to install rainwater tanks connected to both toilet flushing and external use. Sydney water will provide the drinking water and sewerage services to the precinct.



1. PROJECT DETAILS

This report documents the water balance analysis of the Jacaranda Ponds development in order to inform the delivery of a recycled water scheme.

The Jacaranda Ponds development is a proposed residential development at Glossodia in the local government area of the City of Hawkesbury. Ultimately it will comprise 580 houses on 199 ha of land and include 20 ha of public open space comprising of playing fields, public gardens, public plazas and native parklands.

Analysis in this report outlines the results and performance outcomes for Jacaranda Ponds. This analysis is undertaken based on figures provided by Flow Systems (see Figure 1 and Table 1) using Kinesis's C^{CAP} Precinct modelling tool. C^{CAP} Precinct is a land use and planning tool that models key environmental, economic, social and infrastructure implications and requirements for precinct-scale development projects.

The report is structured as follows:

- Water Demands
- Source Water Production
- Recycled Water System Performance

Land Use	Area
Total Development Area	**199 ha**
Public Space	
Public Gardens	2 ha
Playing Fields	2 ha
Public Plazas	1 ha
Native Parklands/Reserves	7.2 ha
Total public space	**12.2 ha**
Residential Dwellings	
5 Bedroom Detached Houses; 4000 m^2 lots	70
5 Bedroom Detached Houses; 2000 m^2 lots	75
5 Bedroom Detached Houses; 1000 m^2 lots	180
4 Bedroom Detached Houses; 2000 m^2 lots	75
4 Bedroom Detached Houses; 1000 m^2 lots	180
Total dwellings	**580**

Table 1: Dwelling yield and floor space for the Jacaranda Ponds Precinct.

JACARANDA PONDS MASTER PLAN

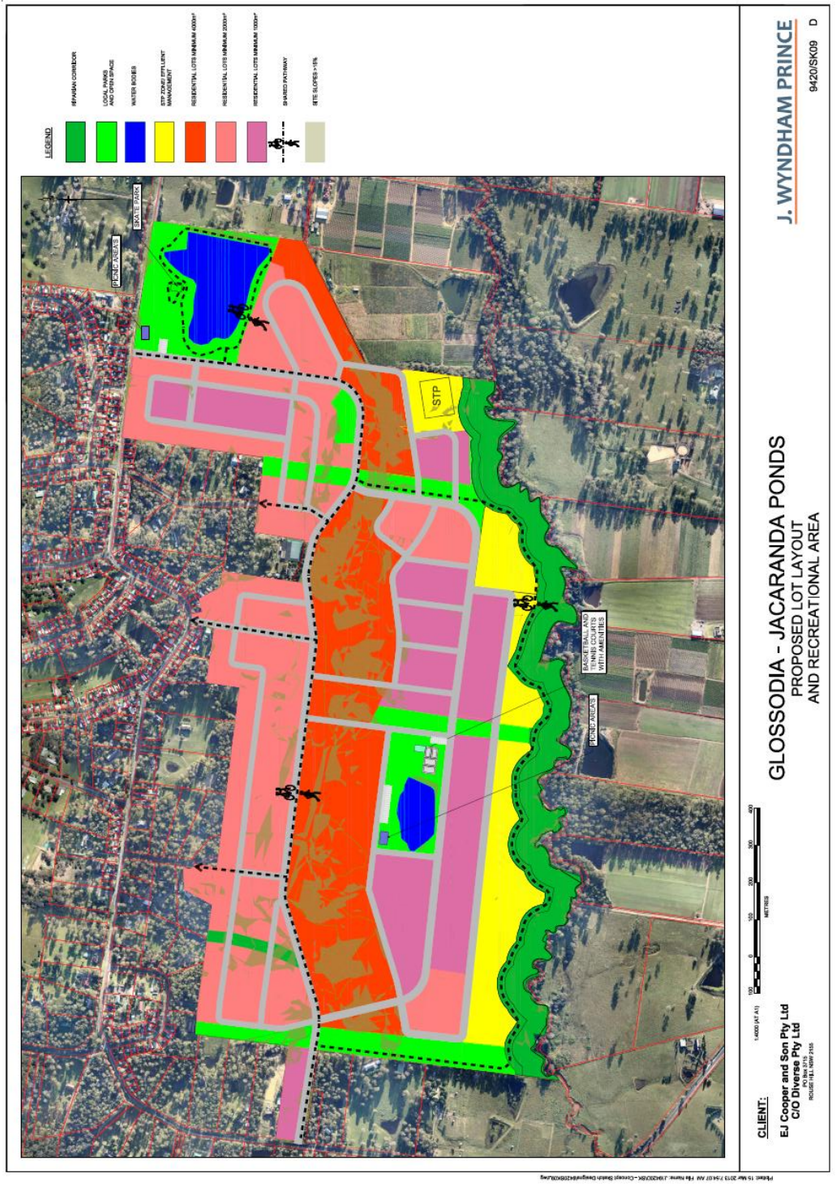


Figure 1: Jacaranda Ponds Master Plan

2. WATER DEMANDS

2.1 RESIDENTIAL WATER DEMANDS

Residential water demands were calculated based on the specific residential building types proposed for the Jacaranda Ponds development. The details of the dwelling type configuration are outlined in Tables 2 and 3. Monthly total and daily average residential water demands by end use are outlined in Figures 3 and 4. Month to month variation is evident due to changes to irrigation water demands based on rainfall and evaporation profiles. Monthly internal total demands vary slightly due to differences in the number of days per month.

SINGLE DWELLING DAILY WATER BALANCE

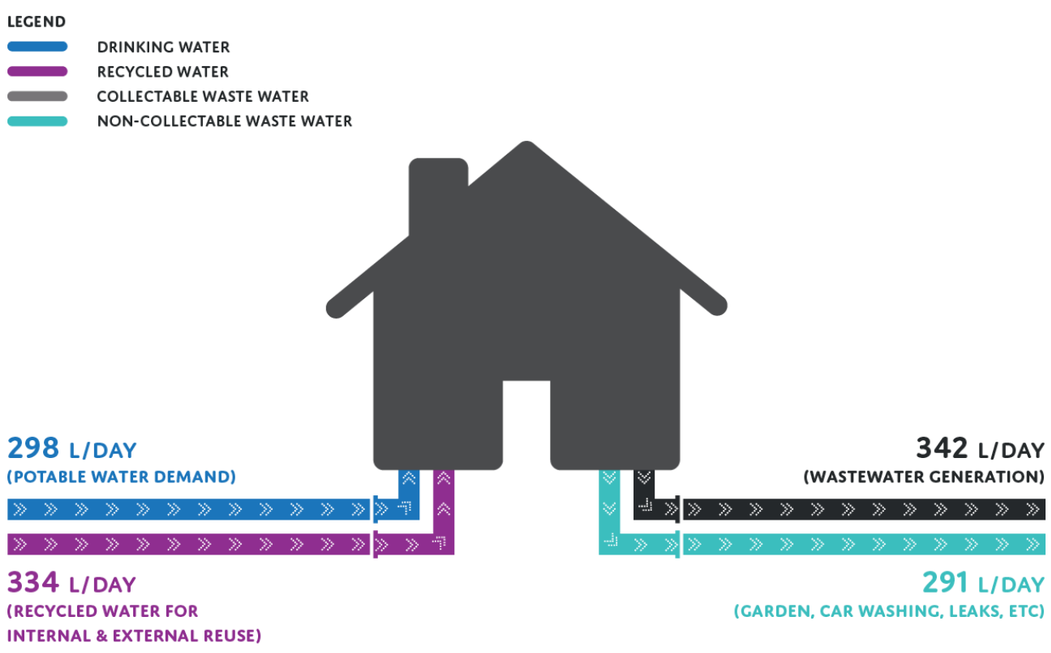


Figure 2: Schematic showing a single house's expected daily drinking and recycled water consumption, including common area and irrigation demands.

RESIDENTIAL DWELLING SPECIFICATIONS

Dwelling type	Number	Bedrooms	Occupancy	EP
Residential Dwellings				
5 Bedroom Detached Houses; 4000 m2 lots	70	5	4.04	282
5 Bedroom Detached Houses; 2000 m2 lots	75	5	4.04	303
5 Bedroom Detached Houses; 1000 m2 lots	75	5	4.04	303
4 Bedroom Detached Houses; 2000 m2 lots	180	4	3.44	618
4 Bedroom Detached Houses; 1000 m2 lots	180	4	3.44	618
TOTAL	**580**	**-**	**-**	**2,125**
AVE. DWELLING		**4.38**	**3.66**	

Table 2: Residential dwelling specifications used in the analysis

RESIDENTIAL END USE SPECIFICATIONS AND AVERAGE DEMANDS

Water End Use	Technology	Per Person Demand L/day			Development Demand kL/day		
		DW	RW	Total	DW	RW	Total
Shower	4 star WELS	28.5	-	28.5	60.4	-	60.4
Kitchen Sink	5 Star WELS	7.0	-	7.0	14.9	-	14.9
Bathroom Basin	5 Star WELS	1.4	-	1.4	2.9	-	2.9
Dishwasher	3+ Star WELS	2.1	-	2.1	4.5	-	4.5
Laundry trough	-	5.0	-	5.0	10.6	-	10.6
Bath	-	8.7	-	8.7	18.5	-	18.5
Leaks & Fire test	-	20.5	-	20.5	43.6	-	43.6
Toilet	4 star WELS	-	17.5	17.5	-	37.2	37.2
Washing Machine	4.5 star WELS	3.5	19.6	23.1	7.3	49.0	56.3
Car Washing		0.7	-	0.7	1.4	-	1.4
Other External	-	4.0	-	4.0	8.5	-	8.5
Irrigation	-	-	54.1	54.1	-	115.0	115.0
TOTAL	**-**	**81.3**	**91.2**	**172.5**	**172.7**	**201.2**	**373.9**
AVE. DWELLING		**297.7**	**334.2**	**632.0**			

Table 3: Residential dwelling end use specifications and average per person daily demands used in the analysis (DW = Drinking water demand, RW = Recycled water demand)

TOTAL RESIDENTIAL WATER DEMANDS

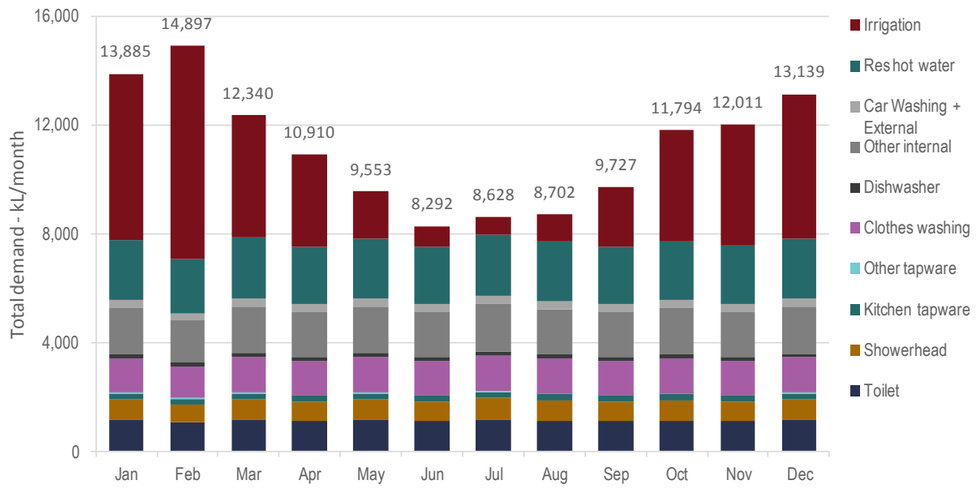


Figure 3: Total residential total water demands by end use, by month

AVERAGE DAILY RESIDENTIAL WATER DEMANDS

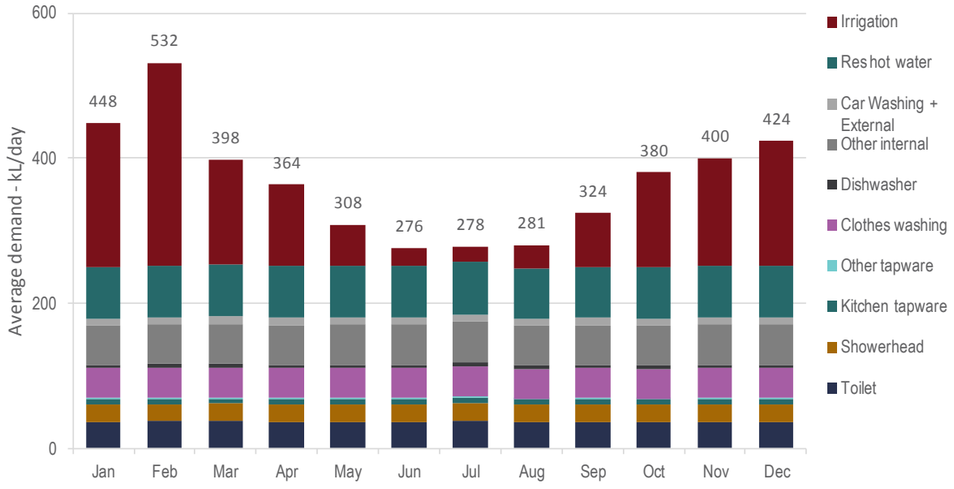


Figure 4: Average daily residential water demands by end use, by month

TEMPERATURE AND RAINFALL EVAPORATION AT JACARANDA PONDS

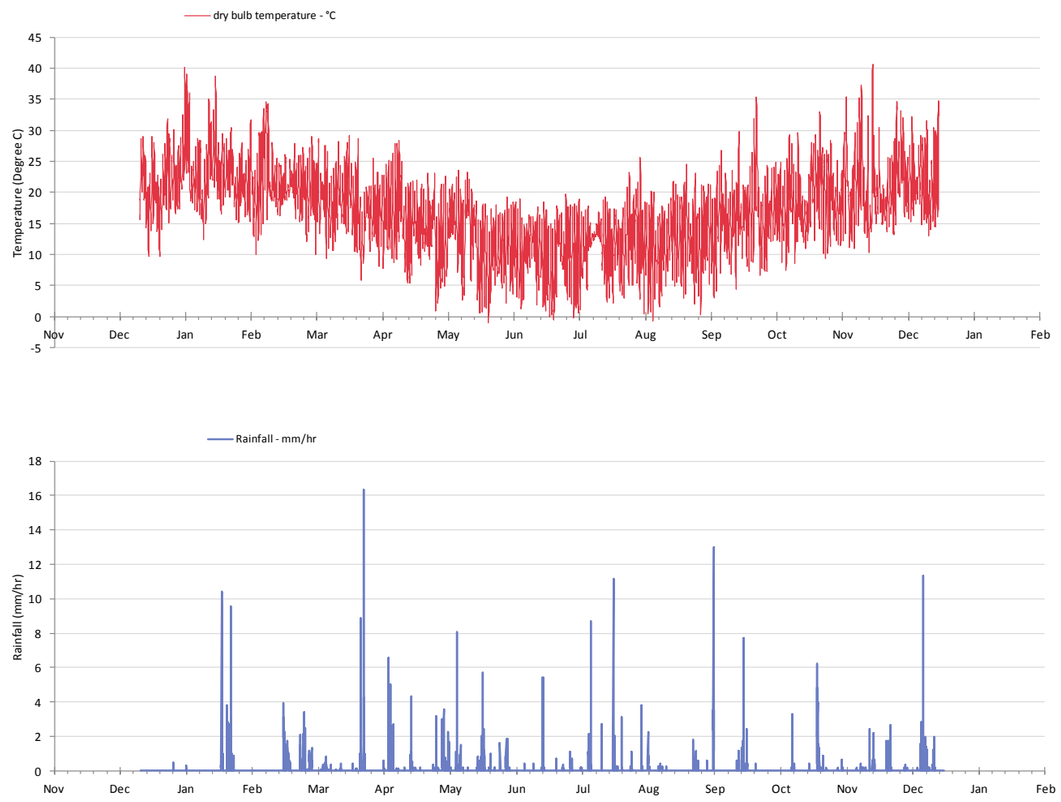


Figure 5: Dry bulb temperature and historic average rainfall for local climate zone.

2.2 NON-RESIDENTIAL WATER DEMANDS

Non-Residential water demand was calculated based on the specific open space proposed for the Jacaranda Ponds development.

Details of the open space configuration are outlined in Table 4. Median Practice is assumed to be current average practice and is derived from various sources, including Sydney Water Best Practice Guidelines for water conservation in commercial office buildings and shopping centres (see Appendix).

Monthly total and daily average non-residential water demands by end use are outlined in Figures 6 and 7. Monthly internal total demands vary due to differences in the number of days per month. Month to month variation is only evident in changes to irrigation water demand based on rainfall and evaporation profiles.

NON-RESIDENTIAL SPECIFICATIONS – TOTAL

Demand Hierarchy	Water End Use	Area (m2)	Per m2 demand L/day			Development Demand kL/day		
			DW	RW	Total	DW	RW	Total
1	Playing Fields	20,000	-	0.6	0.6	-	11.9	11.9
1	Public Gardens	20,000	-	1.2	1.2	-	24.1	24.1
1	Public Plazas	10,000	-	0.1	0.1	-	0.9	0.9
			TOTAL			**-**	**36.9**	**36.9**

Table 4: Non-Residential specifications and average annual demands used in the analysis
DW = Drinking water demand, RW = Recycled water demand

TOTAL NON-RESIDENTIAL WATER DEMANDS

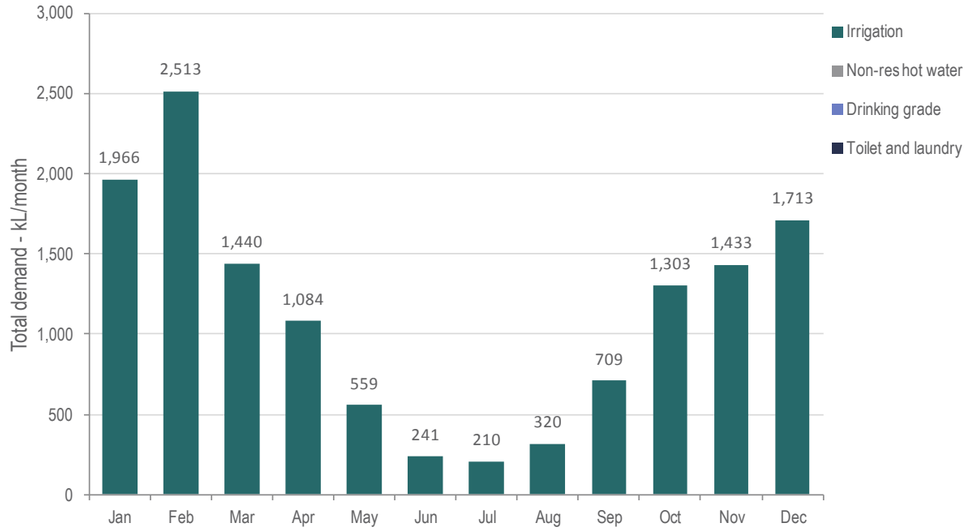


Figure 6: Non-Residential total water demands by end use, by month

AVERAGE DAILY NON-RESIDENTIAL WATER DEMANDS

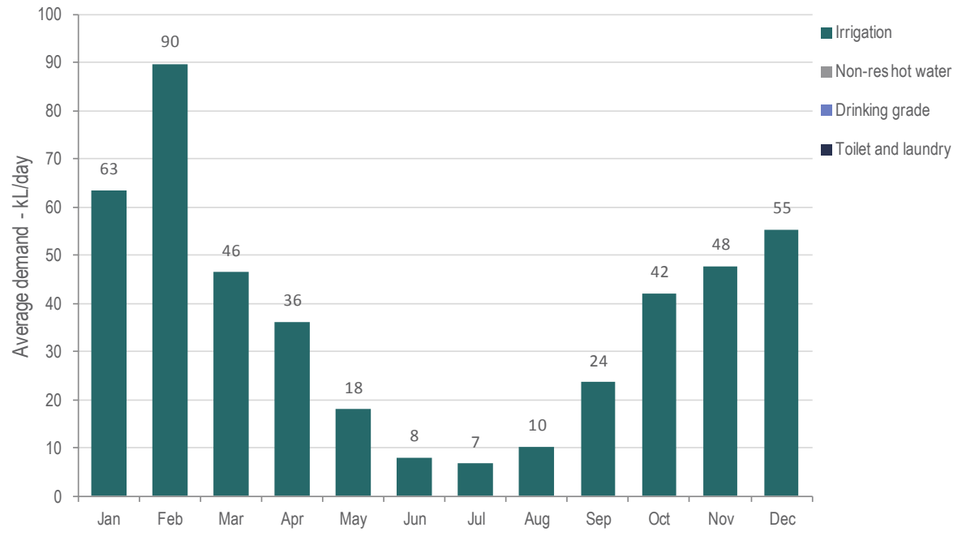


Figure 7: Average daily Non-Residential water demands by end use, by month

2.3 TOTAL AND PEAK WATER DEMANDS

Total water consumption, drinking water demand and recycled water demands are outlined in Tables 5 to 7, showing both total and peak demands for each use.

Total water demands are outlined in Figures 8 to 10 (monthly totals) and Figures 11 to 13 (daily average), summarising the results of the residential and non-residential demands for both drinking and recycled water demands.

As with the individual residential and non-residential demands, month to month variation is predominantly due to changes in irrigation demands. The irrigation demand analysis takes into account hourly rainfall data and cumulative period since the last rain event and irrigation, to predict the time and water use of the next irrigation event. Predictions are also calibrated against real irrigation data for better alignment and accuracy (See Key Data Sources in Appendix).

Peak water demand (kilolitres per hour) for each month is provided in Figure 14. Peak demands for drinking and recycled water are also shown separately in Figures 15 and 16. The peak demand was determined based on the hourly maximum demand for each month, calculated based on the following variables:

- Hourly internal water demands based on a standard hourly internal water demand profile for each end use and building type.
- Hourly irrigation demands based on the irrigation area and local hourly rainfall and evaporation rates.

Due to the fact that internal water demand is relatively consistent over time, in all cases, outdoor irrigation demand is the key contributor towards peak water demands. It should also be noted that peak demands for drinking water and recycled water (Figures 15 and 16) do not necessarily add up to the total peak demand (Figure 14) as the individual peak demands may occur at different times.

TOTAL WATER DEMAND PROFILE

FACTOR	RESIDENTIAL	NON-RESIDENTIAL	TOTAL
Average Daily Demand - kL/d	367	37	404
Peak day - kL/d	920	195	1116
Peak hour – kL/hr	80	17	95

Table 5: Demand profile for the Jacaranda Ponds development

DRINKING WATER DEMAND PROFILE

FACTOR	RESIDENTIAL	NON-RESIDENTIAL	TOTAL
Average Daily Demand - kL/d	173	0	173
Peak day - kL/d	249	0	249
Peak hour – kL/hr	26	0	26

Table 6: Demand profile for the Jacaranda Ponds development

RECYCLED WATER DEMAND PROFILE

FACTOR	RESIDENTIAL	NON-RESIDENTIAL	TOTAL
Average Daily Demand - kL/d	194	37	231
Peak day - kL/d	706	195	902
Peak hour – kL/hr	61	17	77

Table 7: Demand profile for the Jacaranda Ponds development

TOTAL WATER DEMAND

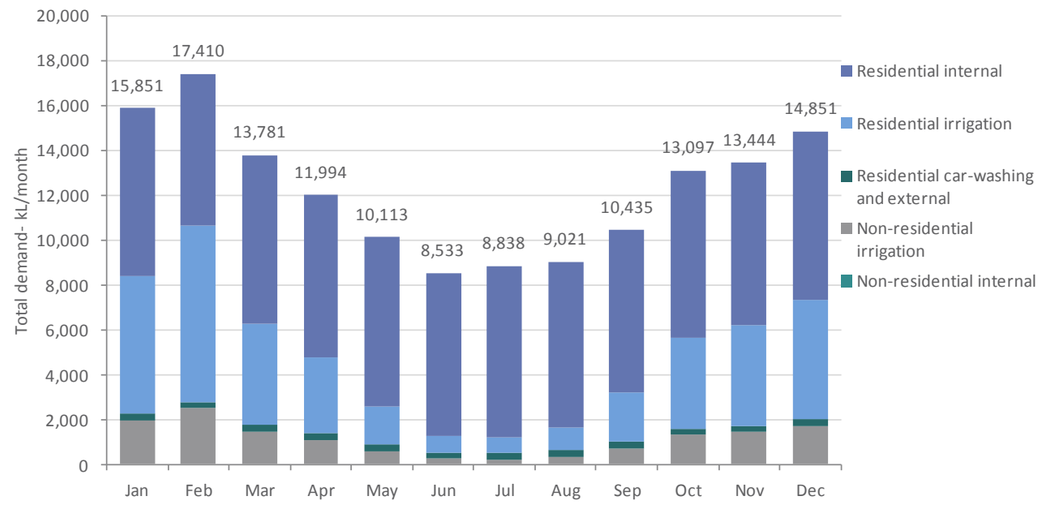


Figure 8: Total water demand by month

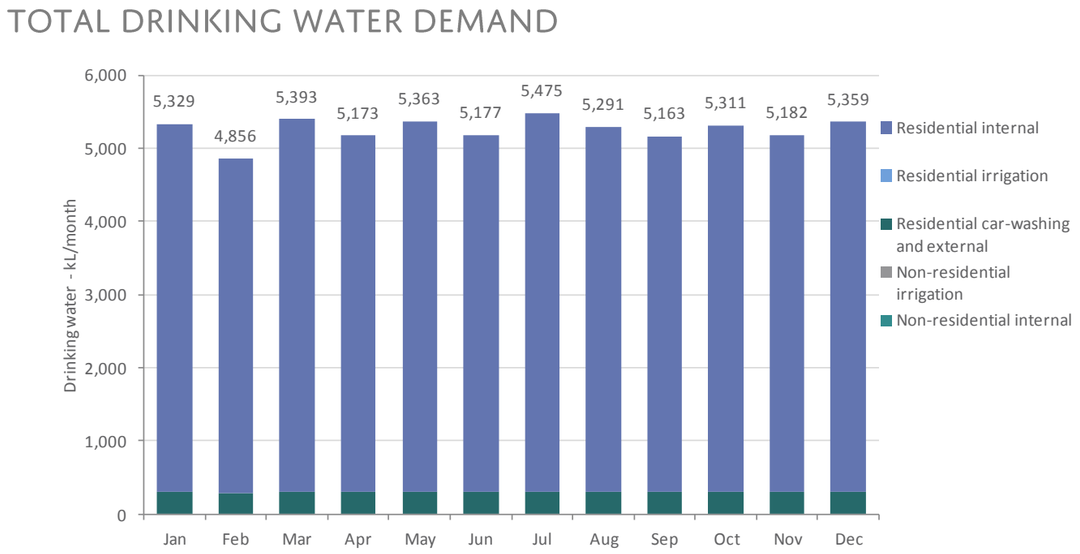


Figure 9: Total drinking water demand by month

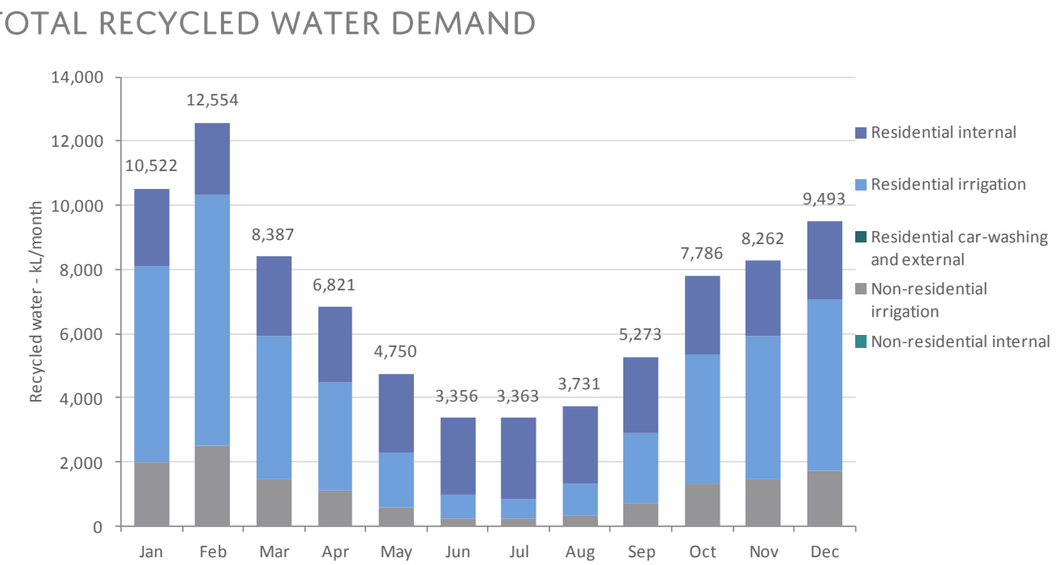


Figure 10: Total recycled water demands by month

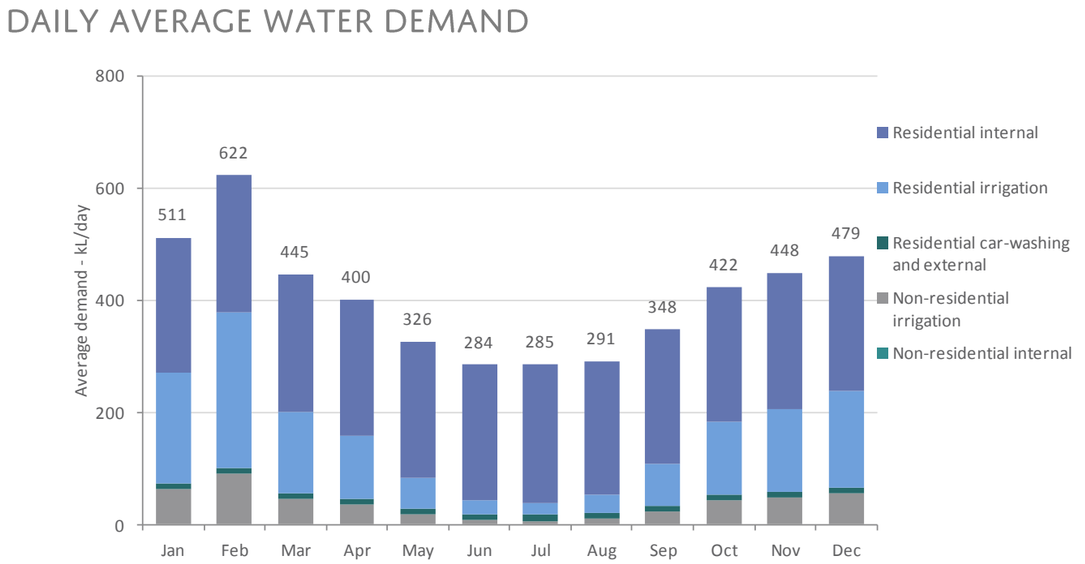


Figure 11: Daily average total water demands by month

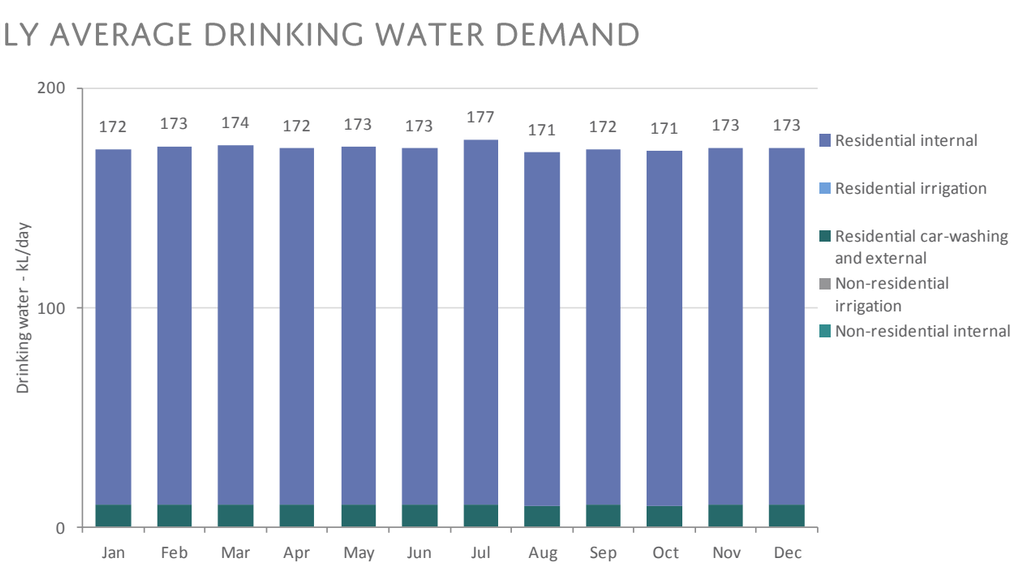


Figure 12: Daily average drinking water demand by month

DAILY AVERAGE RECYCLED WATER DEMANDS

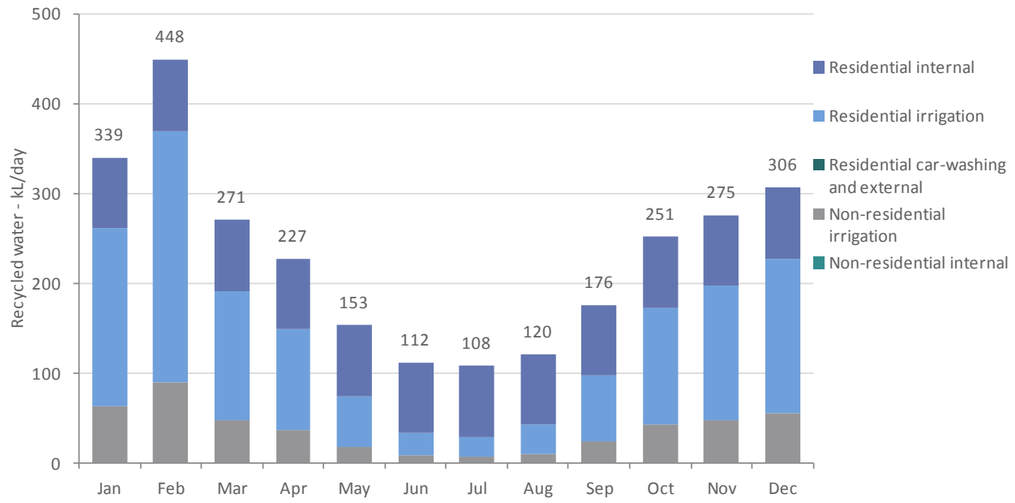


Figure 13: Daily average recycled water demand by month

PEAK RECYCLED WATER DEMANDS

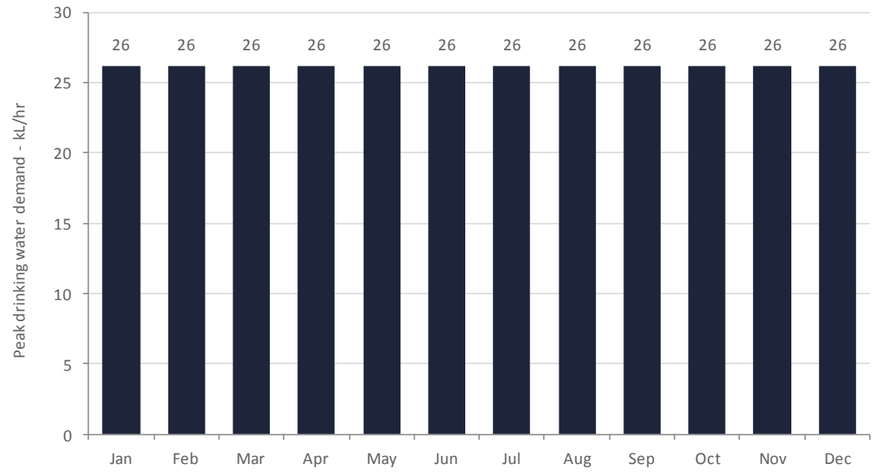


Figure 15: Peak recycled water demands by month

PEAK TOTAL WATER DEMANDS

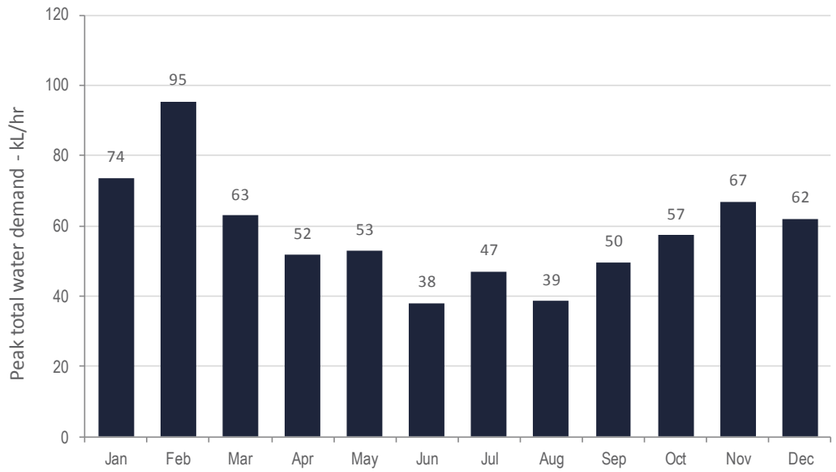


Figure 14: Peak total water demand by month

PEAK DRINKING WATER DEMANDS

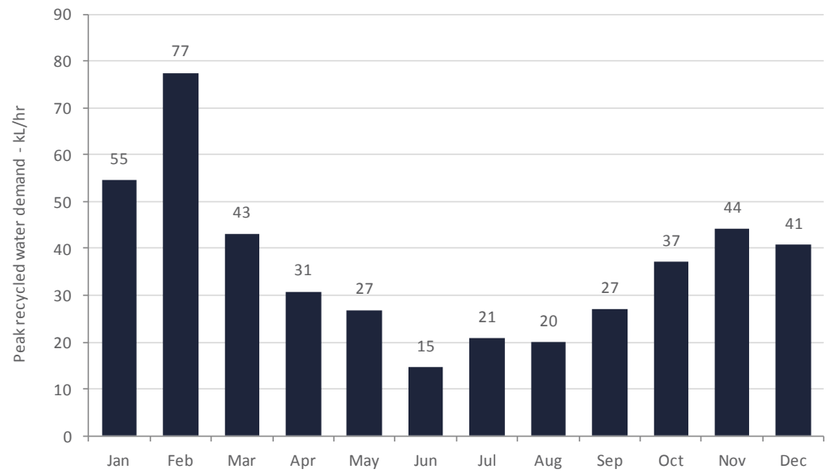


Figure 16: Peak drinking water demand by month

NOTE: Peak demands for drinking water and recycled water (Figures 15 and 16) do not necessarily add up to the total peak demand (Figure 14) as the individual peak demands may occur at different times.

3. SOURCE WATER PRODUCTION

3.1 SOURCE WATER PRODUCTION

Source water for the recycled water scheme is sourced from sewage production. Residential and non-residential sewage production is calculated based on the specific building types proposed for the Jacaranda Ponds development (as shown previously in Tables 3 and 4).

Table 9 outlines the average daily and peak sewer production for the residential and non-residential components of the development. Source water production from the residential and non-residential buildings is broken down further in Tables 8 and 10.

RESIDENTIAL SEWAGE PRODUCTION

Water End Use	Per Person Sewage Production L/day	Development Sewage Production kL/day
Shower	28.5	60.4
Kitchen Sink	7.0	14.9
Bathroom Basin	1.4	2.9
Dishwasher	2.1	4.5
Laundry trough	5.1	10.9
Bath	8.6	18.2
Leaks & Fire test	-	-
Toilet	17.5	37.2
Washing Machine	23.1	49.0
Car Washing	-	-
Other External	-	-
Common Area Irrigation	-	-
TOTAL	**93.2**	**198.1**
AVE. DWELLING	**341.6**	-

Table 8: Residential dwelling end use specifications and per person daily sewage production used in the analysis

SOURCE WATER PRODUCTION PROFILE

FACTOR	RESIDENTIAL	NON-RESIDENTIAL	TOTAL
Average Daily Production - kL/d	198	0	198
Peak day - kL/d	286	0	286
Peak hour – kL/hr	30	0	30

Table 9: Demand profile for the Jacaranda Ponds development

NON-RESIDENTIAL SEWAGE PRODUCTION

Water End Use	Sewage Production (L/m2/day)	Development Sewage Production kL/day
Public Open Space	0.0	0.0
TOTAL	**TOTAL**	**0.0**

Table 10: Non-Residential specifications and average annual demands used in the analysis

4. RECYCLED WATER SYSTEM PERFORMANCE

4.1 RECYCLED WATER SYSTEM CONFIGURATION

The recycled water system for Jacaranda Ponds was configured as follows:

- Connection to all dwellings for toilet and washing machine (cold tap) and garden irrigation
- Connection to all open space for irrigation
- Storage tank is sized at 1.2 ML
- Volume losses of 2% are considered for the UF and membrane bioreactor processes

4.2 WATER BALANCE

The average daily performance of the recycled water system at full build out of Jacaranda Ponds is in Figure 17 and the key water results are shown in Table 11.

Water Source	ML per year
Total Precinct Water Demand	147
Sewage Production	72
Recycled Water Demand	84
Recycled Water Demand Met	63
Water Import for Recycled Water Use	22
Drinking Water Demand for Drinking Water Uses	63
Water available for off-site use	9

Table 11: Estimated development average water balance with recycled water system at full build out

Water Import for Recycled Water Use

The model shows that, at full build out, 22 ML/yr of potable water top-up (water import) will be required to service non-drinking water uses. This occurs primarily over the summer months when irrigation demand is above average and outpaces source water production.

ANNUAL AVERAGE DAILY FLOWS IN KL/DAY

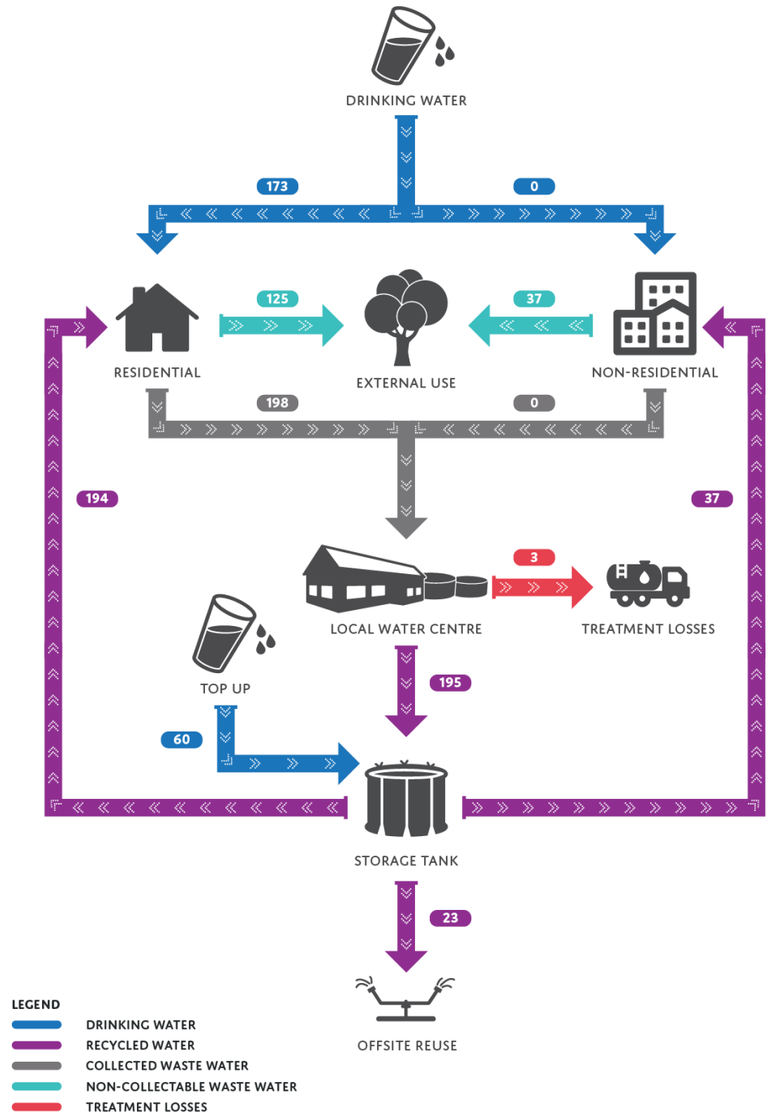


Figure 17: Schematic of the recycled water system showing annual average daily flows and treatment losses in kL/day.

Note - The sum of monthly recycled water use and discharge to sewerage does not always equal the total sewage production, due to the hourly analysis run by CCAP Precinct and the storage tank actively accepting and supplying water in order to minimize top-up, e.g. sewage production in excess of the recycled water demand is kept in the flow balance or recycled water is kept in the recycled water storage tanks, for periods where sewage production cannot meet the recycled water demand.

RECYCLED WATER SYSTEM PERFORMANCE AT FULL BUILD OUT

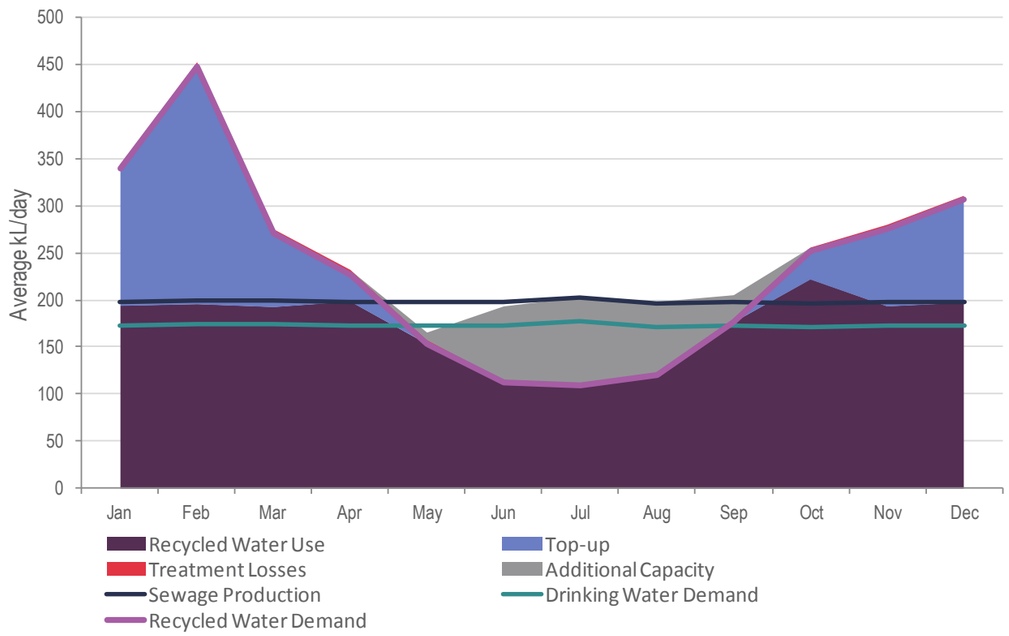


Figure 18: Recycled water system performance showing monthly recycled water use, demand and exported sewer.

Recycled Water System Stored Volume

Figure 20 outlines the hourly recycled water storage volume over the year, reflecting the high variability in recycled water use throughout the year. On average, the daily stored volume in the recycled water system tanks is about 40% capacity or 0.49 ML.

4.3 BASIX COMPLIANCE

With connection to the recycled water system, residential dwellings at Jacaranda Ponds are estimated to achieve an average **BASIX water score of approximately 60**.

RECYCLED WATER STORED VOLUME

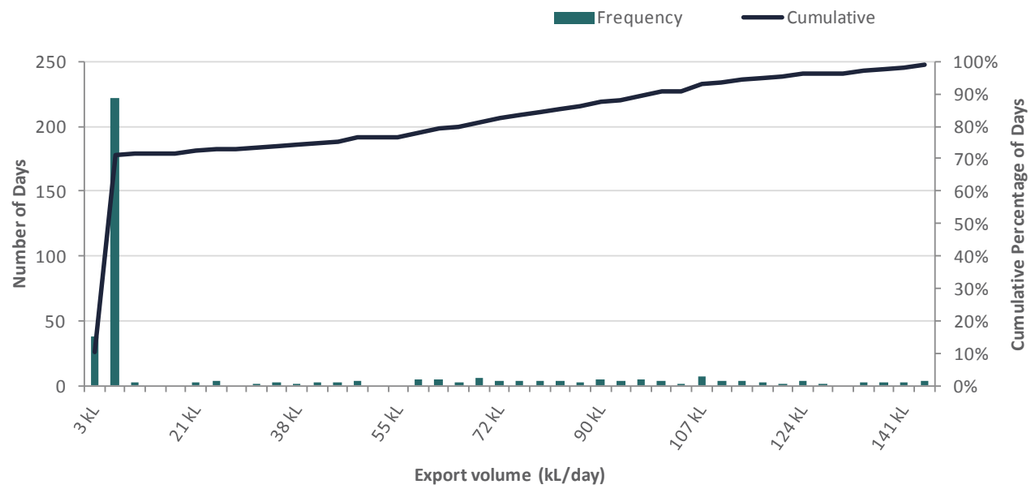


Figure 19: Frequency distribution of daily sewer export

RECYCLED WATER STORED VOLUME

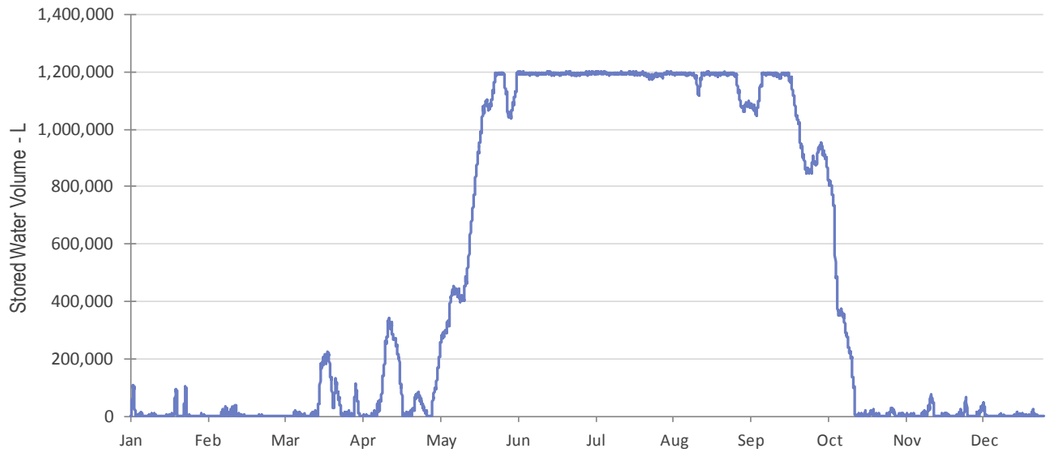


Figure 20: Hourly recycled water stored volume for the recycled water system

APPENDIX

Date	Version No.	Change Summary
15/2/2016	0.1	
18/2/2016	0.2	Storage tank corrected to 1.2 ML Dwelling mix diversified to mix of 4/5 BR houses
13/4/2016	0.3	Native parklands lowered to 7.2 ha from 15 ha Name change to Glossodia Water from Jacaranda Ponds Water

KEY DATA SOURCES

- ACADS-BSG Australian Climatic Data (Reference Meteorological Year, RMY) for hourly temperature, insulation and humidity.
- Bureau of Meteorology local rainfall and evaporation data (station 67021 – Richmond – UWS Hawkesbury, 140 km from development, synthesized RMY)
  - Data is from the representative weather station for the local climate zone (NatHERS zone 28)
  - The RMY (Representative Meteorological Year) is synthesized from a composite of 12 typical meteorological months that best represent the historic average of the specified location using post-1986 data in addition to the earlier weather data for each of the 69 climate zones in Australia. The total rainfall and evaporation for this climate zone is:

    Annual rainfall (mm) - 728
    Annual evaporation (mm) – 1,391

- Department of Resources, Energy and Tourism, 2010, Energy in Australia – 2010, ABARE, Canberra
- Kinesis 2014, Additional water end use breakdowns derived from first principle analysis of residential and non-residential building types.
- National Water Commission, 2011, National performance report 2009-2010: urban water utilities, National Water Commission, Canberra
- NSW Department of Planning, BASIX Residential Water Consumption Data (2010)
- Sydney Water Best Practice Guidelines for water conservation in commercial office buildings and shopping centres (2007), http://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdu0/~edisp/dd_054580.pdf
- Sydney Water Best Practice Guidelines for holistic open space turf management (2011), https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf

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Appendix 4.2.10(a) Preliminary Risk Assessment Overview

Preliminary Risk Assessment Overview

Purpose

The purpose of undertaking the preliminary risk assessment was to:

- Identify potential risks that may impact the safe and reliable operation of the facility (and associated components), specifically focussed on risks associated with the following:
    - Potential impacts to public health and/or water quality
    - Environmental impacts including noise, odour and general environmental impacts
    - Operational reliability and process performance
    - Financial viability
    - Customer Service
- Identify early, potential risk mitigation/control measures that can be incorporated in the design, construction and operation of the facility in order to sufficiently mitigate these risks.
- Facilitate further dialogue with all key stakeholders to ensure all key risks associated with the project are identified and effectively controlled.

Methodology

The risk assessment approach adopted for conducting the preliminary risk assessment for the project was consistent with the recommendations in the Australian Guidelines for Recycled Water Management (AGRW). The process included the following activities:

- Risk Identification – The identification of a range of risk related to the project *(what might happen?)*
- Risk Categorisation – The categorisation of the risks into various types to aid understanding and to provide context
- Risk Assessment – determination of the likelihood and consequence of the unmitigated/uncontrolled risk, see Attachment A for details of the assessment criteria *(what is the likelihood and impact/consequence?)*
- Managing the Risk / Risk Mitigation – the identification of appropriate controls to be further developed and implemented as appropriate should the project be approved to proceed *(what can be done to stop it happening?)*
- Post Mitigation Risk Assessment – the reassessment of the risk following implementation of appropriate controls to ensure that the risk is sufficiently mitigated *(how effective do we anticipate the controls to be?)*

Outcomes

<u>Identification</u>

In undertaking the preliminary risk assessment a total of 71 key risks were identified across the following areas:

Area	Descriptions
The Catchment	Risks associated with the catchment area including consideration of items such as contamination, volume changes, public health incidents, storage requirements, illegal discharge to sewers etc.
The Sewer Network	Risks associated with the network itself including blockages, pipe or equipment failure, loss of power etc.
Local Water Centre	Consideration of the potential risks associated with the operation of the treatment facility including tank and/or equipment failure, odour, noise, process risks, capacity, power failure, telemetry, vandalism, operator error, flooding etc.
Recycled Water Reticulation and use	Risks associated with the transfer of recycled water from the facility to the users and covered areas such as equipment failure, demand, unauthorised usage, water quality, power failure etc.
Management	General operations management issues risks that may impact operational reliability or supply surety.

Risks have been summarised at Attachment B as the detailed preliminary risk assessment contains information that is commercial in confidence.

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ATTACHMENT A: RISK ASSESSMENT QUALITATIVE CRITERIA

QUALITATIVE MEASURES OF LIKELIHOOD		
Level	**Descriptor**	**Example description**
A	Rare	May occur only in exceptional circumstances. May occur once in 100 years.
B	Unlikely	Could occur within 20 years or in unusual circumstances.
C	Possible	Might occur or should be expected to occur within a 5 to 10 year period.
D	Likely	Will probably occur within a 1 to 5 year period
E	Almost certain	Is expected to occur with a probability of multiple occurrences within a year.

QUALITATIVE MEASURES OF CONSEQUENCE		
Level	**Descriptor**	**Example description**
1	Insignificant	Insignificant impact or non-detectable.
2	Minor	Health - Minor impact for small population.
		Environment - Potentially harmful to local ecosystem with local impacts contained to site.
		Financial - Cost of event and / or rectification is less than $10K.
3	Moderate	Health - Minor impact for large population.
		Environment - Potentially harmful to regional ecosystem with local impacts primarily contained to site.
		Financial - Cost of event and / or rectification is greater than $10K but less than $100K.
4	Major	Health - Major impact for small population.
		Environment - Potentially lethal impact to local ecosystem, predominantly local, but potential for off-site impacts.
		Financial - Cost of event and / or rectification is greater than $100K but less than $1,000K.
5	Catastrophic	Health - Major impact for large population.
		Environment - Potentially lethal to regional ecosystem or threatened species; widespread on-site and off-site impacts.
		Financial - Cost of event and / or rectification is greater than $1,000K.

QUALITATIVE RISK ESTIMATION					
	Consequence				
Likelihood	1- Insignificant	2 - Minor	3 - Moderate	4 - Major	5 - Catastrophic
A - Rare	Low	Low	Low	High	High
B - Unlikely	Low	Low	Moderate	High	Very High
C - Possible	Low	Moderate	High	Very High	Very High
D - Likely	Low	Moderate	High	Very High	Very High
E - Almost certain	Low	Moderate	High	Very High	Very High

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ATTACHMENT B: PRELIMINARY RISK ASSESSMENT SUMMARY

Item	Component	Potential Hazard	Pre-mitigation Risk	Controls	Post-mitigation (Residual) Risk
1	Catchment	Low flow in reticulation generates odour	High	– Regular flushing of reticulation – Interim, staged servicing strategy	Moderate
		Out of specification feed water for treatment process	Very High	– Testing and monitoring – Disinfection barriers – Education of customer base – Utility approval of new connections – Buffering tank	High
2	Sewage Local Water Centre	Sewage overflow in community	Very High	– Monitoring – Ability to isolate reticulation built into design – Tankering company on emergency callout contract – Allow adequate storage in collection tanks	High
		Sewage overflow at household	Very High	– Installation of pumps by authorised personnel – Monitoring of network – Proactive maintenance regime – Plumbing checks for infiltration prior to occupancy	High
		Odour	Very High	– Design to minimise air entrainment – Odour control on air valves – Regular replacement of cartridges	High
3	Recycled Water Local Water Centre	Inability to treat water due to process unit failure	High	– Duty / standby of equipment – Inlet and product water buffer storage – Spares of critical equipment on site – Monitoring and controls – Proactive maintenance regime – Experienced operators – Maintain Asset Protection Zones – Maintain access around LWC for fire fighting – Access to water for fire fighting – Located above 1 in 100 year flood level – Backup generator	Moderate
		Product water out of specification due to process failure	High	– Production shut down – Duty / standby of equipment – Inlet and product water buffer storage – Monitoring and controls – Proactive maintenance regime – Experienced operators	Low
		Noise and odour	Very High	– Odour and noise modelling at planning phase – Odour scrubbing – Noise mitigation in building design	High
		Environmental spill from tank rupture	High	– Quality assurance processes in construction – Isolation from stormwater drainage – Experienced construction contractors and operators – Monitoring of tank levels	Low
4	Recycled water reticulation and use	Compromise of public health through consumption of recycled water	Very High	– Plumbing inspections prior to occupancy – High treatment quality – Education – Signage in public areas	High
		Interruption to household recycled water supply due to breakage in reticulation	High	– Monitoring – Ability to isolate reticulation built into design – Registration on DBYD	Low
		Recycled water supply exceeds demand	Moderate	– Buffer storage – System monitoring – Evaluation of offsite uses as the development progresses	Low
		Recycled water demand exceeds supply	Moderate	– Buffer storage – Top up with drinking water	Low
		Compromise of public health due to poor water quality	Very High	– High treatment quality – Monitoring in distribution network – Education	High
5	Management	Unable to provide services due to business failure	Very High	– Ongoing auditing of the business in accordance with the network operator's licence – Internal governance regime – Water Industry Competition Act's Operator of Last Resort provisions and step in rights	High

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Appendix 4.2.11(a) Flow Systems Recycled Water Quality Plan (TOC)

Recycled Water Quality Plan (RWQP)

Document Issue Record

Issue Date	Revision	Changes	Issued To	Prepared By	Approved By
24/10/14	1	First revision	Flow	Kirsten Evans	Andrew Horton
12/12/14	2	Minor formatting corrections	Flow	Kirsten Evans	Andrew Horton
30/1/15	3	Added AMP to: Figure 1 Table 1	Flow	Kirsten Evans	Andrew Horton
05/05/15	4	Added TDS figures for HR & LH to: Table 6	Flow	Marcelo Sales	Andrew Horton

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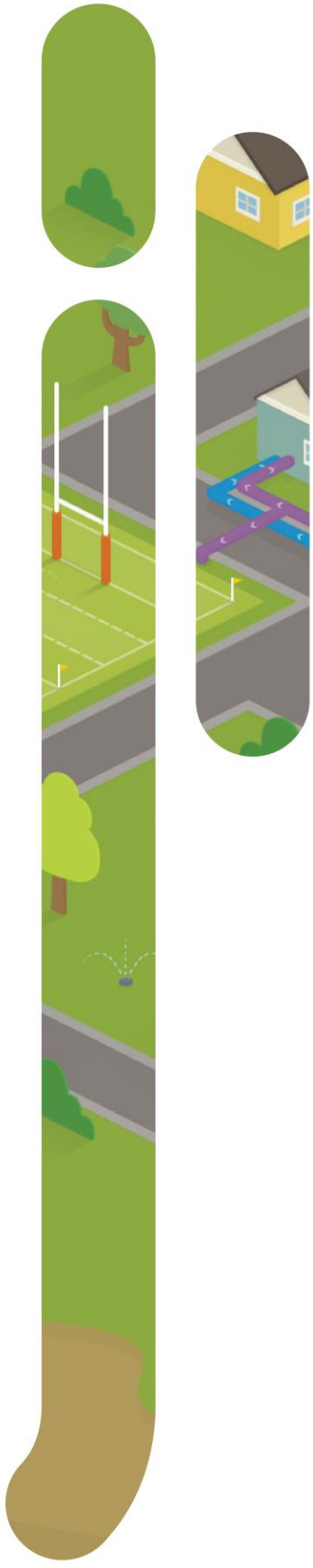
Appendix 4.2.11(b) Glossodia Scheme Management Plan (TOC)

flow systems

Glossodia Water Scheme Management Plan (Scheme MP)



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Document Issue Record

Revision	Date	Changes	Prepared By	Approved By
1	20/04/16		Ned Campbell	Darren Wharton

1 Executive Summary

1.1 Purpose of the Scheme Management Plan

This document is the Glossodia Water scheme-specific Scheme Management Plan (Scheme MP) which outlines the scheme-specific details referenced by the Flow Recycled Water Quality Plan, Drinking Water Quality Plan, Sewage Management Plan and others. It therefore forms part of Flow's conformance to the requirements of the Water Industry Competition Regulations 2008 (WICR) Schedule 1 clauses 7, 13 and 14 and forms part of Flow's:

- Commitment to compliance with the Water Industry Competition Act 2006 (WICA)
- Overall management plan framework for the provision of sewage, drinking and recycled water services.

The purpose of this document is to supplement the following Flow management plans with scheme specific information:

- Recycled Water Quality Plan
- Sewage Management Plan
- Infrastructure Operating Plan
- Asset Management Plan
- Incident Management Plan
- Operations Environmental Management Plan.

1.2 Scheme Summary

Table 1: Scheme Summary Details

Scheme Summary Details		
Location:	**Region**	**State**
Glossodia	Hawksbury, Sydney	NSW
Ultimate Residential	**Ultimate size**	
580	199ha	
Development Type:	**Development Precinct**	**Development Marketing Name**
Housing Supply	Glossodia South	Jacaranda Ponds
Utility Name	**Network Operator**	**Retailer**
Glossodia Water	Flow Systems Operators P/L	Flow Systems P/L
WICA NOL No.	**WICA RSL No.**	
TBC	13_001R	
Services	☐ Drinking water ☒ Sewage services ☒ Recycled water ☐ Electricity ☐ Hot water ☐ Gas	

Recycled water	
Source	Sewage from residential dwellings and retail connections
Treatment	MBR, UV Disinfection and Chlorination

Further Treatment	Chemical dosing, dewatering, odour control
End Uses	Toilet flushing, washing machines, general purpose wash-down, carwash use, irrigation, treatment plant service water
Drinking Water	
Source	N/A
Treatment	N/A
Further treatment	N/A

1.3 Critical Control Points

Table 2 Process Critical Control Points

Critical Control Point	Treatment Process	Criteria
1	Membrane Bioreactor	Turbidity (NTU)
2	Ultraviolet (UV) Disinfection	UV transmissivity (mJ/cm2)
3	Chlorination	Free chlorine (mg/L) Chlorine contact (mg.min/L) pH

1.4 High Level Program

The high-level program shows the approximate staging of infrastructure development over the life of the Glossodia Water development. Refer to the following documents listed in Section 2.1.4 Supporting Documents:

- Glossodia Water High Level Program.

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Appendix 4.2.12(a) Flow Systems Infrastructure Operating Plan (TOC)

Infrastructure Operating Plan (IOP)

flow systems

Document Issue Record

Issue Date	Revision	Issue	Issued To	Prepared By	Approved By
24/10/14	1	First revision	Flow	Kirsten Evans	Andrew Horton
12/12/14	2	Minor formatting corrections	Flow	Kirsten Evans	Andrew Horton
30/1/15	3	Added AMP to: Figure 1 Table 1 Added: Section 3.4	Flow	Kirsten Evans	Andrew Horton
22/5/15	4	Added reference to AMP in Section 7 Added information regarding water meters to 2.5.1	Flow	Kirsten Evans	Andrew Horton
8/9/15	5	Amended to include interim drinking water supply system	Flow	Kirsten Evans	Andrew Horton

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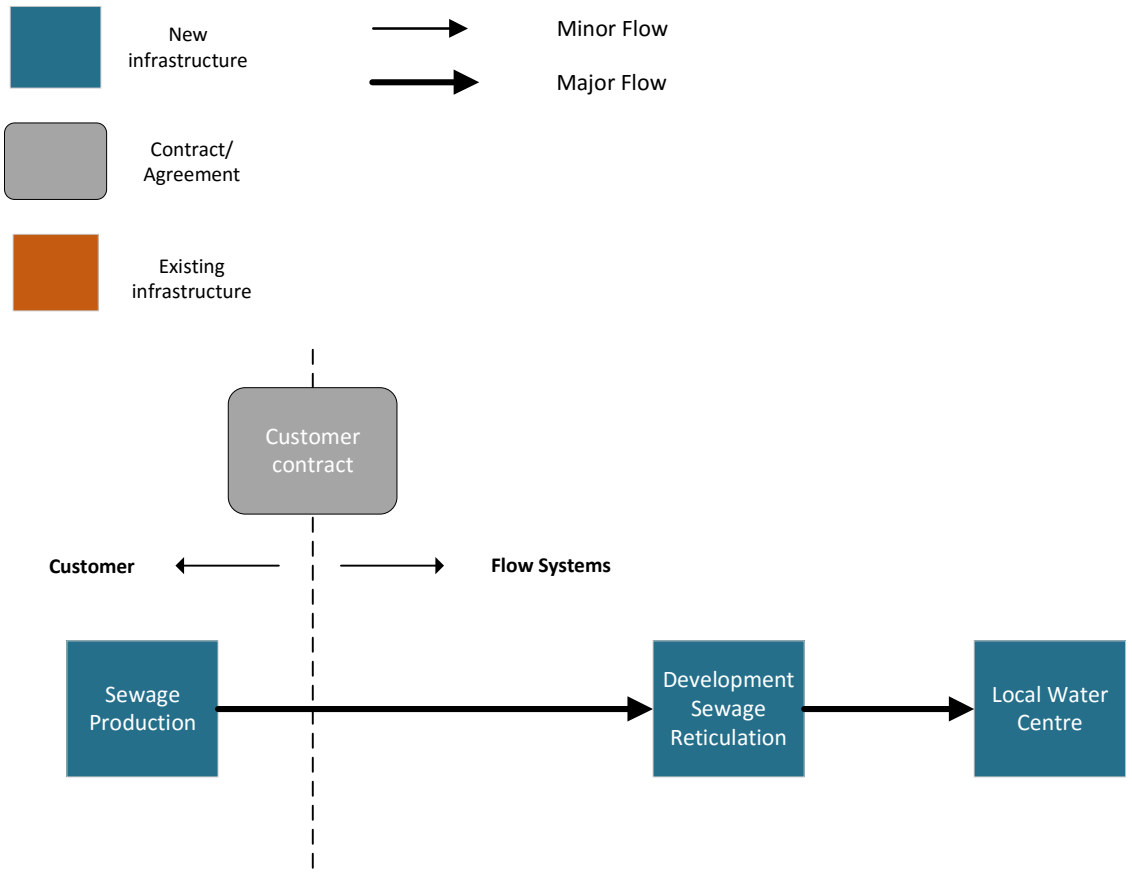
Appendix 4.3.1(a) Process Flow Diagram (Interim Sewer)



Glossodia	**Date: 6/04/2016**	**Interim Sewerage Process Flow Diagram**	**Revision C**

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Appendix 4.3.1(b) Sewerage Reticulation Masterplan

INSET A
SCALE: 1:2000 @ A0

SEE INSET A FOR CONTINUATION

LOCAL WATER CENTRE

LEGEND:

- PRESSURE SEWER SPINE MAIN
- PRESSURE SEWER MAIN
- LINK MAINS (NORMALLY VALVED CLOSE)
- Z 1 | 50Ø — ZONE NUMBER/PIPE SIZE
- ZONE/PIPE SIZE CHANGE; FLOW DIRECTION
- A — AIR VALVE
- PV — PINCH VALVE

Date: 15/02/2016

Rev: A

Drawing No: SK001

Scale: 0 20 40 60 80 100m
SCALE 1:2000 AT A0

GLOSSODIA - JACARANDA PONDS
PRESSURE SEWERAGE COLLECTION SYSTEM FUNCTIONAL DESIGN

flow systems
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Glossodia Water

Appendix 4.3.10(a) Flow Systems Sewage Management Plan (TOC)

Sewage Management Plan
(Sewage MP)

flow systems

Document Issue Record

Issue Date	Revision	Issue	Issued To	Prepared By	Approved By
24/10/14	1	First revision	Flow	Kirsten Evans	Andrew Horton
30/1/15	2	Added AMP to Table 1	Flow	Kirsten Evans	Andrew Horton
23/2/16	3	General review	Flow	Andrew Horton	Andrew Horton

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