

Appendix Q12.0 Proposed Area of Operations

Aquacell's Onsite Sewage Management (OSSM) treatment plant will be located within the Alspec Industrial Business Park (AIBP) at 221-227 and 289-317 Luddenham Road, Orchard Hills, NSW. The proposed area of operations is the entire development. Please refer to Appendix Q12.1 for the map showing the scheme boundary.

The AIBP development will ultimately comprise 100 lots, distributed across the main AIBP site, Southern Parcel, and Eastern Parcel (which are all located within the scheme boundary). However, the whole site will be developed in two stages. In stage - 1, the AIBP site will be developed and in stage – 2 the Eastern and Southern Land Parcel site will be incorporated as shown in the map in Appendix Q12.1.

The proposed OSSM plant will be located at ground level, at the northern end of the AIBP site, adjacent to Warehouse Lot 2. The OSSM plant will be constructed during Stage 1 and will supply recycled water for non-potable uses including toilet flushing and cooling tower make-up across the site. Additionally, recycled water will be used for landscape irrigation at various locations throughout the development. The irrigation master plan is available in Appendix Q12.2. During Stage 1, the schemes area of operation will be confined to the main AIBP site. In Stage 2, the operational area will be extended to include the Eastern and Southern Parcels.

The shapefiles for the Areas of Operations for Stage 1, Stage 2, and the combined developable area are provided in Appendices Q12.3, Q12.4, and Q12.5, respectively. The corresponding coordinate data for the proposed Areas of Operations for each stage are included in Appendices Q12.6, Q12.7, and Q12.8.

Wastewater generation and recycle water demand of the site are described in Appendix Q12.9 and Q12.10, which demonstrate that the proposed system is appropriately sized for the sewage service requirement and recycle water needs of the defined area of operation.

Appendix Q14.0 Proposed Staging of Scheme

The Alspeg Industrial Business Park (AIBP) at 221-227 and 289-317 Luddenham Road, Orchard Hills, NSW will ultimately comprise 100 lots, distributed across the main AIBP site, Southern Parcel, and Eastern Parcel. Lot sizes range from 1,000 m² to 100,000 m², with over 70 lots having a site area of less than 2,500 m². In the context of wastewater servicing, the development will be split into two distinct stages. These stages are highlighted on “*Appendix Q14.1_AIBP_Area of operations_Map_v0.1*” and summarised below:

Stage 1 comprises 32 individual lots, with total building areas ranging from approximately 300 m² to 48,000 m². The first warehouse (Cope) is scheduled for completion in June 2026, with the final warehouse due for completion in Q3 2028. The estimated maximum daily total flow is approximately 193 kL/day.

Stage 2 comprises 68 individual lots, with total building areas ranging from approximately 900 m² to 1,100 m². The first warehouse is expected to be completed in Q4 2028, with the final warehouse due for completion in Q2 2029. The estimated maximum daily total flow is approximately 245 kL/day.

The Aquacell system is designed to treat up to 300kL of wastewater per day, making it capable of servicing the full development at maximum capacity, with contingency. The plant will be configured as two identical 150kL/day treatment trains, which can be commissioned and operated independently. This staged approach allows the system to be brought online with lower initial wastewater volumes. The first train will be commissioned during the early stages of the development, with the second train brought online once additional capacity is required. As shown in “*Appendix Q14.2 - AIBP Draft Construction Programme*”, Stage 1 commissioning is due for completion in November, 2026, with Stage 2 commissioning complete in November 2027.

Whilst most treatment processes are duplicated across two identical treatment trains, there are a number of common elements to the plant, including inlet works, sludge handling and storage. There will also be a single main control cabinet and a single PLC program. Given the amount of common equipment, and relatively short time between completion of Stage 1 commissioning and commencement of Stage 2 commissioning, the treatment plant will be constructed in one phase, but commissioned in two.

Stage 1 process proving period is anticipated to be complete around December 8th, 2026. This is after the anticipated completion of the first two warehouses (Cope and Alspeg). As such, a temporary pump out solution is proposed to service the development until Stage 1 of the OSSM facility is operational.

Both reticulation network and irrigation area will be completed on an ongoing basis, as required, to service the warehouses as they are brought online.

Although the scheme has been defined in two stages, Aquacell intends to apply for a single scheme approval covering both Stages 1 and 2. Upon award of the scheme approval, Aquacell also intends on submitting a single operational approval to cover both stages.

Appendix Q12.1



COVER SHEET - SHEET 00
ALSPEC BUSINESS PARK - IRRIGATION WATER REUSE
MASTER PLAN

Sheet -01

Sheet -02

Sheet -03

Sheet -04

Sheet -05

Sheet -06

LEGEND:

AREAS TO BE IRRIGATED AND WATER SOURCE .



AREAS TO BE IRRIGATED FROM RECLAIMED WATER RESOURCED VIA THE (OSSM) ON SITE SEWER MANAGEMENT FACILITY. - PROPOSED LOCATION OF MAIN SUPPLY PIPE, CONTROL CABLE AND VALVES AS SHOWN OR TO FUTURE STAGE LANDSCAPE DETAIL.



HARVESTED RAINWATER FROM WAREHOUSE ROOF TOPS - WITH POTABLE BACK UP AS NECESSARY. MINIMUM 80% OF THE ANNUAL WATER TO BE FROM RAINWATER HARVESTING.- TO FUTURE DETAILED LANDSCAPE DESIGN.



OTHER SITE STORMWATER CATCHMENTS VIA BIO-RETENTION AND STORAGE PONDS. - TO FUTURE LANDSCAPE DESIGN.

90/12.5

75/12.5

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DC/1

DC/1

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P2

CONTROL CABLE JUNCTION PITS - MINIMUM VISCOUNT P2 PIT WITH CONCRETE COVER.

➤

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➤

ISOLATION VALVES - 80mm STAINLESS STEEL ISOLATION BALL VALVES OR WHERE SHOWN 50mm STAINLESS STEEL OR "PHILMAC" BALL VALVES IN A 1419 VALVE PIT AS FOR THE SOLENOID VALVES.

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INDEPENDENT IRRIGATION DESIGNERS:
ASIC MATTHEW WILSON
PROFESSIONAL MEMBER AMERICAN SOCIETY OF IRRIGATION CONSULTANTS



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Sheet 02

Sheet 03

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Sheet 05

Sheet 06

Sheet 07



B 26-07-2024 FOR REVIEW AND COUNCIL SUBMISSION- RECLAIMED REUSE: WH
A 18-07-2024 DRAFT: WH

REV. DATE: AMENDMENT: BY:

CLIENT:



PROJECT:
ALSPEC INDUSTRIAL BUSINESS PARK ORCHARD HILLS

TITLE:
IRRIGATION STRATEGY RECLAIMED & WATER REUSE SITE MASTER PLAN

CAD BY: DESIGN BY: CHECKED BY:
M.W. M.W.

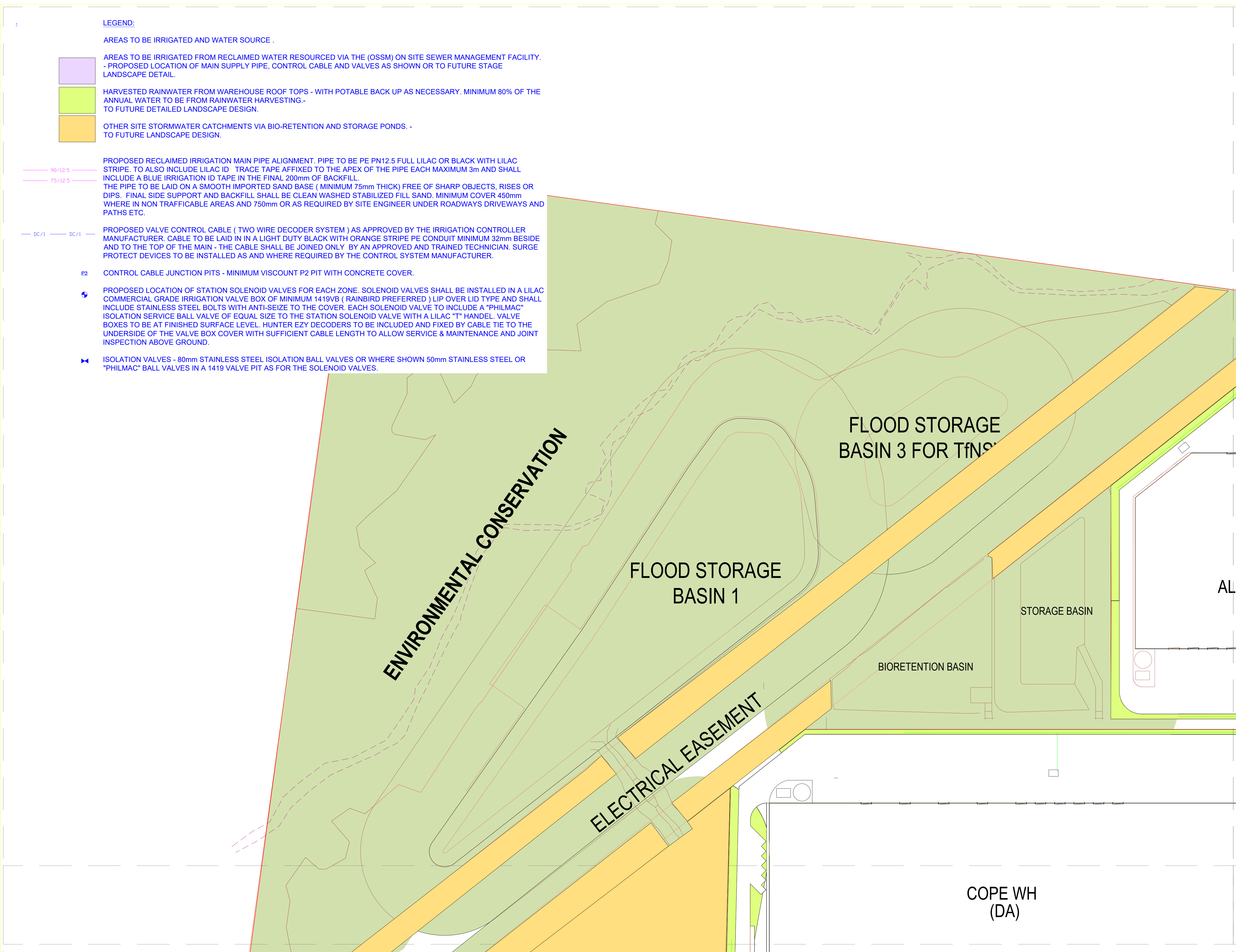
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TOTAL IRRIGATION DESIGNERS
P.O. BOX 577
BATHURST, NSW, 2795
PH: 0415 672204
email: admin@irrigationdesign.com.au



LEGEND:

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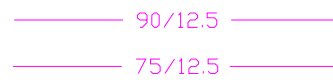
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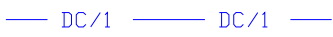
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Sheet 07



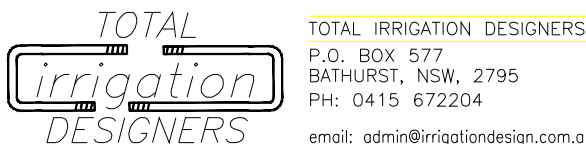
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B	26-07-2024	FOR REVIEW AND COUNCIL SUBMISSION- RECLAIMED REUSE	WM
A	18-07-2024	DRAFT	WM
CLIENT:			



PROJECT:
ALSPEC INDUSTRIAL BUSINESS PARK ORCHARD HILLS

TITLE:
IRRIGATION STRATEGY RECLAIMED & WATER REUSE SITE MASTER PLAN

CAD BY:	DESIGN BY:	CHECKED BY:
M.W.	M.W.	
DATE:	DATE:	DATE:
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RECLAIMED WATER

- IRRIGATION PUMP STATION AND IRRIGATION CONTROLLER TO BE LOCATED AT THE REAR OF THE ON SITE SEWER WATER MANAGEMENT FACILITY.

THE REUSE IRRIGATION PUMP STATION TO BE TRIPLEX (2 DUTY AND ONE STAND BY) VERTICAL MULTISTAGE PUMP SYSTEM WITH REMOTE ACCESS - EQUAL TO LOWARA eSV WITH INCA COLOUR TOUCH SCREEN PANEL. PANEL TO INCLUDE TANK LEVEL INDICATION. COMBINED (2 PUMPS)

PUMP DUTY TO BE MINIMUM 5LT/SEC @ 600kPa. -PUMPS TO BE EQUAL TO LOWARA eSV 10-07 EACH 3kw.

PUMP STATION TO INCORPORATE 80mm 316 STAINLESS STEEL HD MANIFOLDING AND ALL ISOLATION VALVES TO INCLUDE LILAC COLOURED HANDLES. - PUMP SYSTEM TO BE "TURN KEY" FROM BROWN BROS ENGINEERING AND INCLUDE SITE COMMISSIONING.

A STAINLESS STEEL "FILTAWORX" 80mm SELF CLEANING SCREEN ANGLE "CHECK" FILTER IS TO BE INSTALLED DOWN STREAM FROM THE IRRIGATION PUMPS MODEL"FW080F-EL" COMPLETE WITH LILAC ISOLATION VALVES BEFORE AND AFTER THE FILTER.

IRRIGATION CONTROLLER TO BE HUNTER ACC2 - 2 WIRE DECODER TYPE COMPLETE WITH A DESKTOP PC LOADED WITH HUNTER 360 SOFTWARE, SECURE MODEM AND INTERNET ACCESS FOR WEATHER DATA (OR LOCAL HUNTER SUPPLIED WEATHER STATION) , SELF ADJUSTING BASED ON WEATHER DATA PARAMETERS, DELAY, CANCEL, SUSPENSION & ACTIVATE OF THE IRRIGATION PROGRAMING SUBJECT TO CURRENT CONDITIONS AND OR WRITTEN "IF/THEN" CONDITIONS, REPORTING FAULTS AND ALARMS AND REMOTE ACCESS CONTROL OF THE IRRIGATION IN REAL TIME. USER ACTIVITY LOG AND HISTORY OF EVENTS.

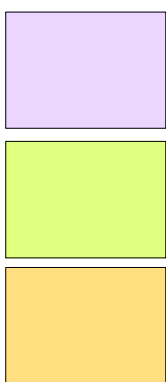
THE IRRIGATION CONTROLLER IS TO REPORT FAULTS WITHIN THE SYSTEM TO THE OPERATORS VIA EMAIL OR SMS. AND BE CAPABLE OF PROVIDING HISTORICAL SYSTEM OPERATIONAL DATA.

THE IRRIGATION SYSTEM SHALL BE CAPABLE TO AUTOMATICALLY SUSPEND IRRIGATION IN THE EVENT OF RECENT PAST HEAVY RAINFALL (UP TO SELECTABLE UP TO 7 DAYS IN THE PAST. FINAL APPLICATION RATES AND OPERATIONAL TIMES TO BE DETERMINED ON SITE GIVEN THE FINAL CONDITIONS, SOIL, SLOPE, PLANTING AND SPRINKLER TYPES FOR EACH STATION.

THE IRRIGATION SYSTEM DOWNSTREAM FROM THE PUMP SHALL INCLUDE A COMPATIBLE PULSE FLOW METER WITH MAXIMUM 10LT PER PULSE AND THE METER TO INCLUDE A REAL TIME LCD DISPLAY OF CURRENT FLOW RATE AND TOTAL CUMULATIVE FLOW. EQUAL TO BERMAD EUROMAG WITH 608 READER AND DISPLAY WITH OUTPUTS TO AND TO DISPLAY ON THE PUMP PANEL REAL TIME FLOW AND CUMULATIVE FLOW.

LEGEND:

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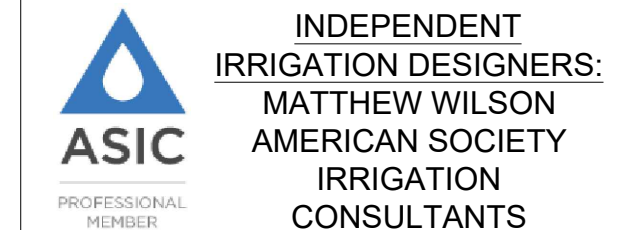
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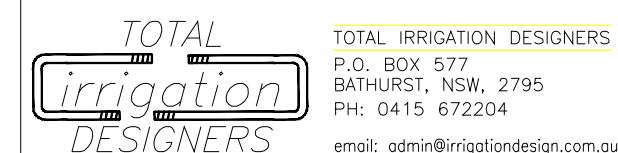
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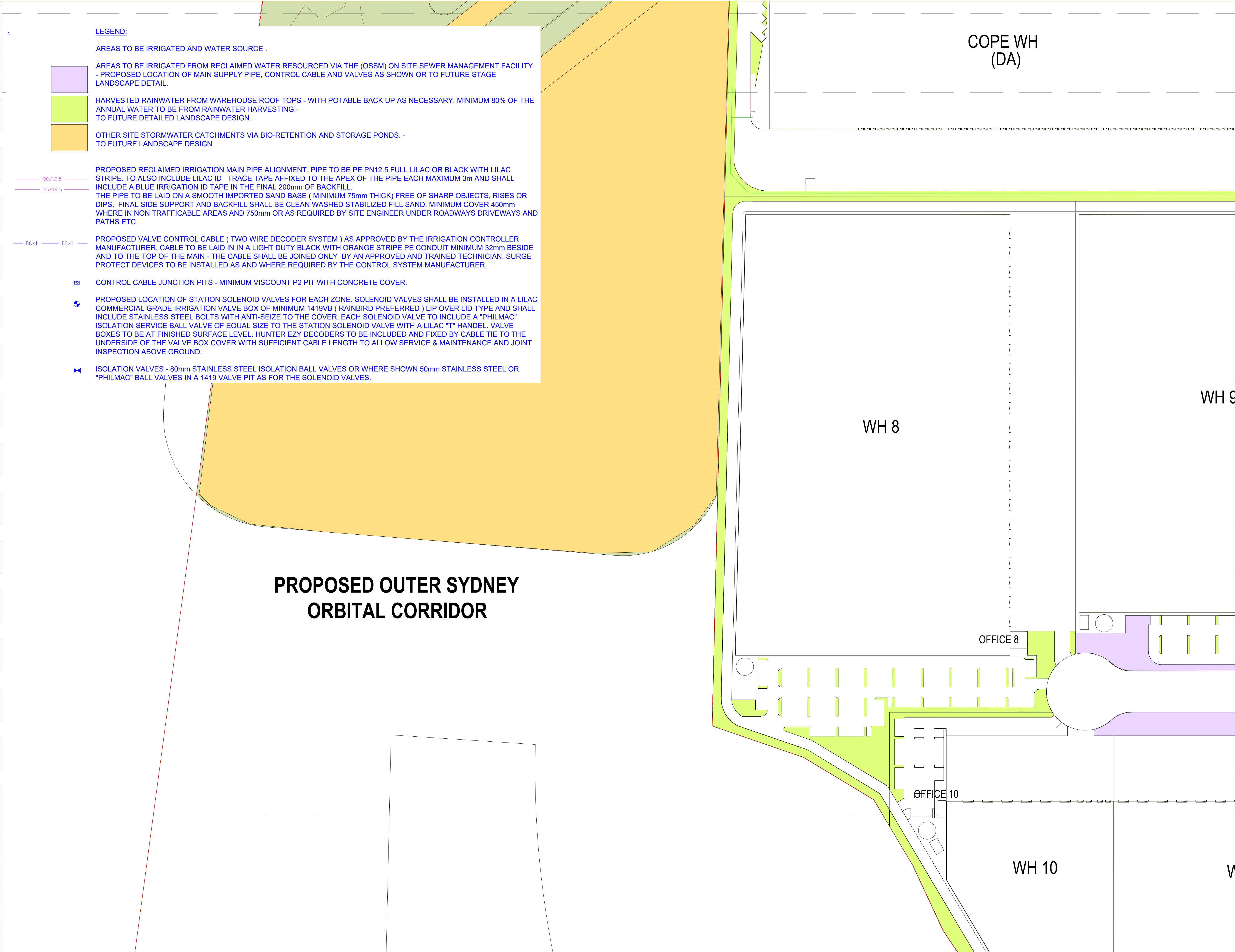
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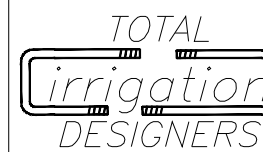
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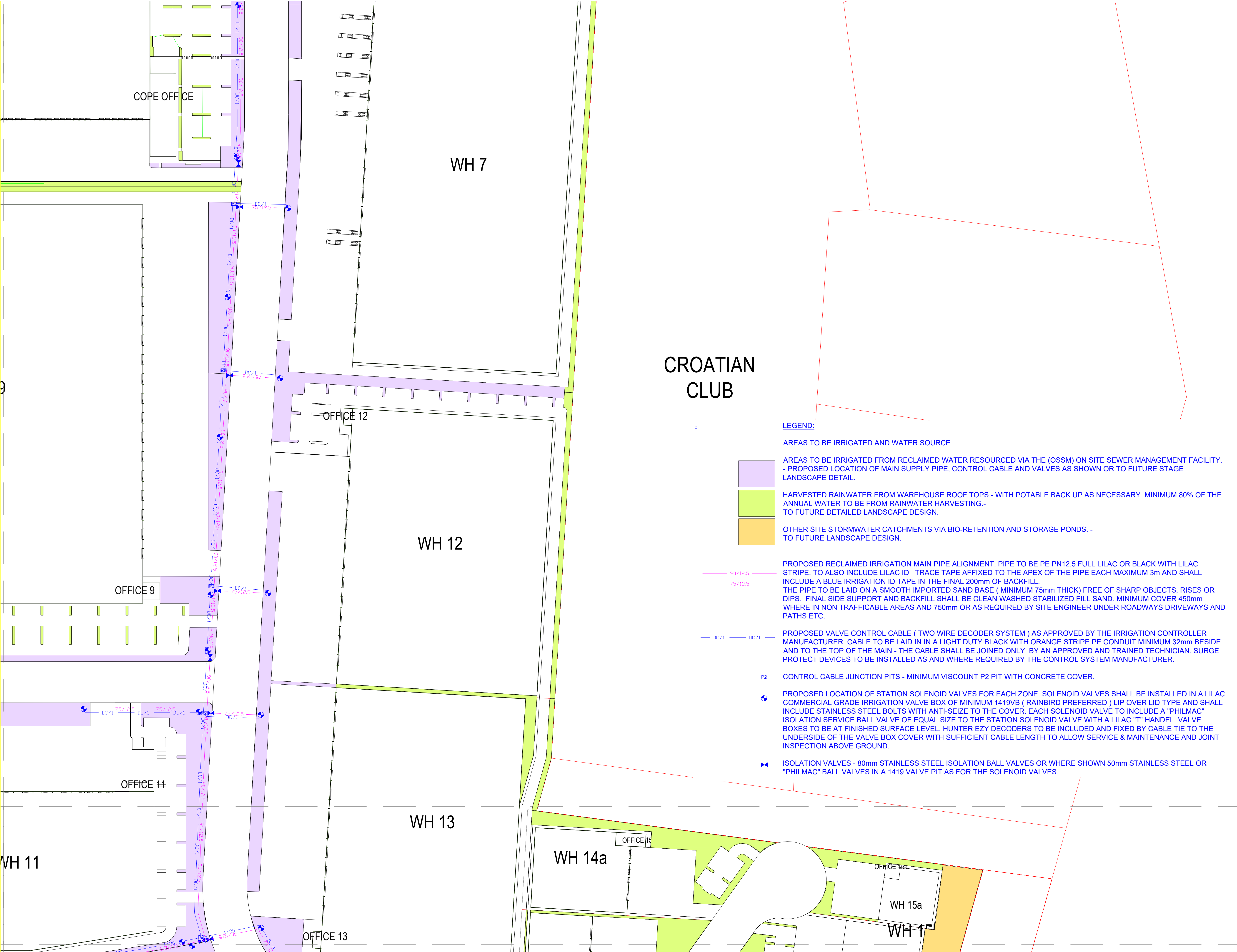
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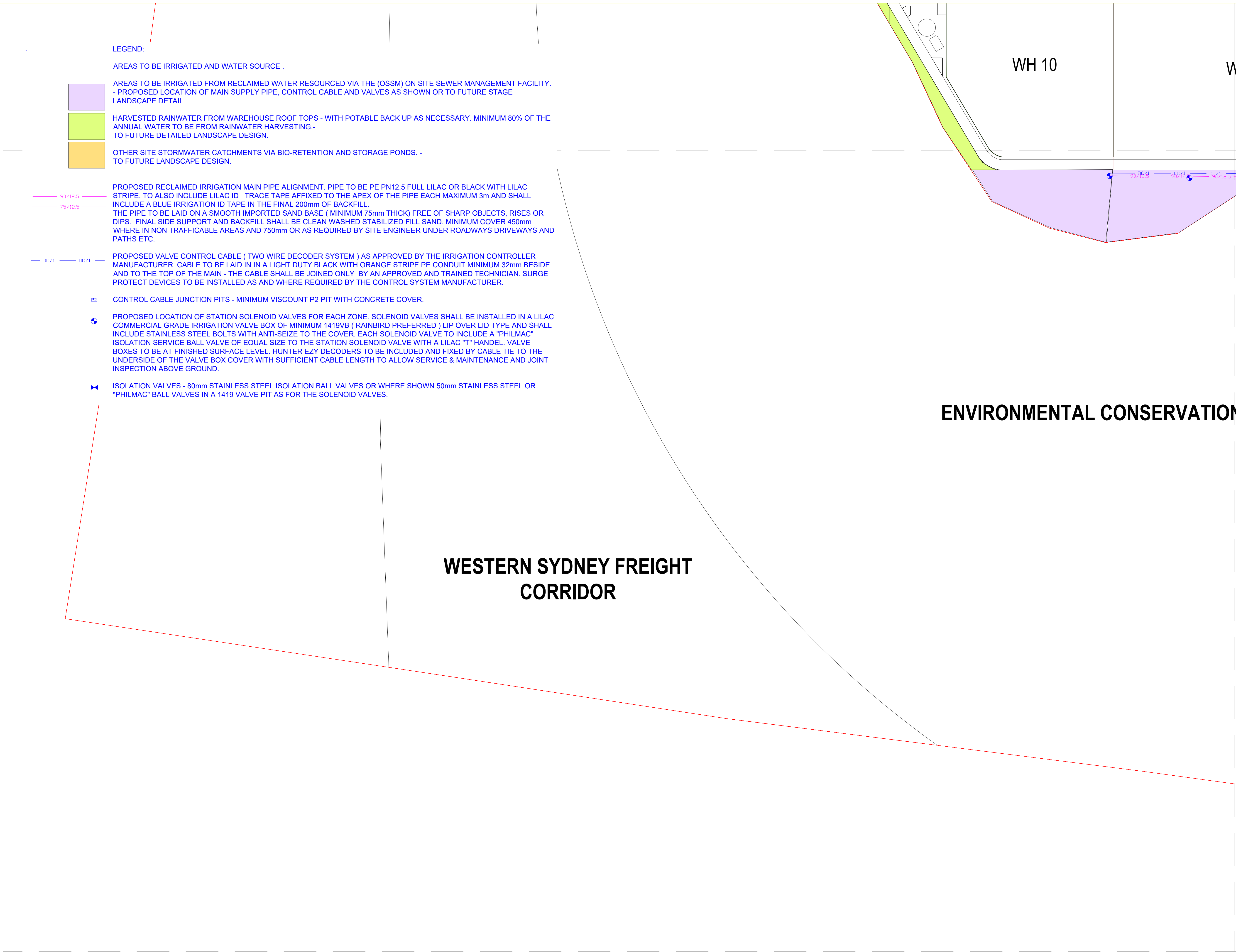


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ALSPEC INDUSTRIAL BUSINESS PARK ORCHARD HILLS

TITLE:
IRRIGATION STRATEGY RECLAIMED & WATER REUSE SITE MASTER PLAN

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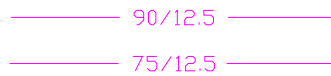
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PROJECT:
**ALSPEC INDUSTRIAL
BUSINESS PARK
ORCHARD HILLS**

TITLE:
**IRRIGATION STRATEGY
RECLAIMED &
WATER REUSE
SITE MASTER PLAN**

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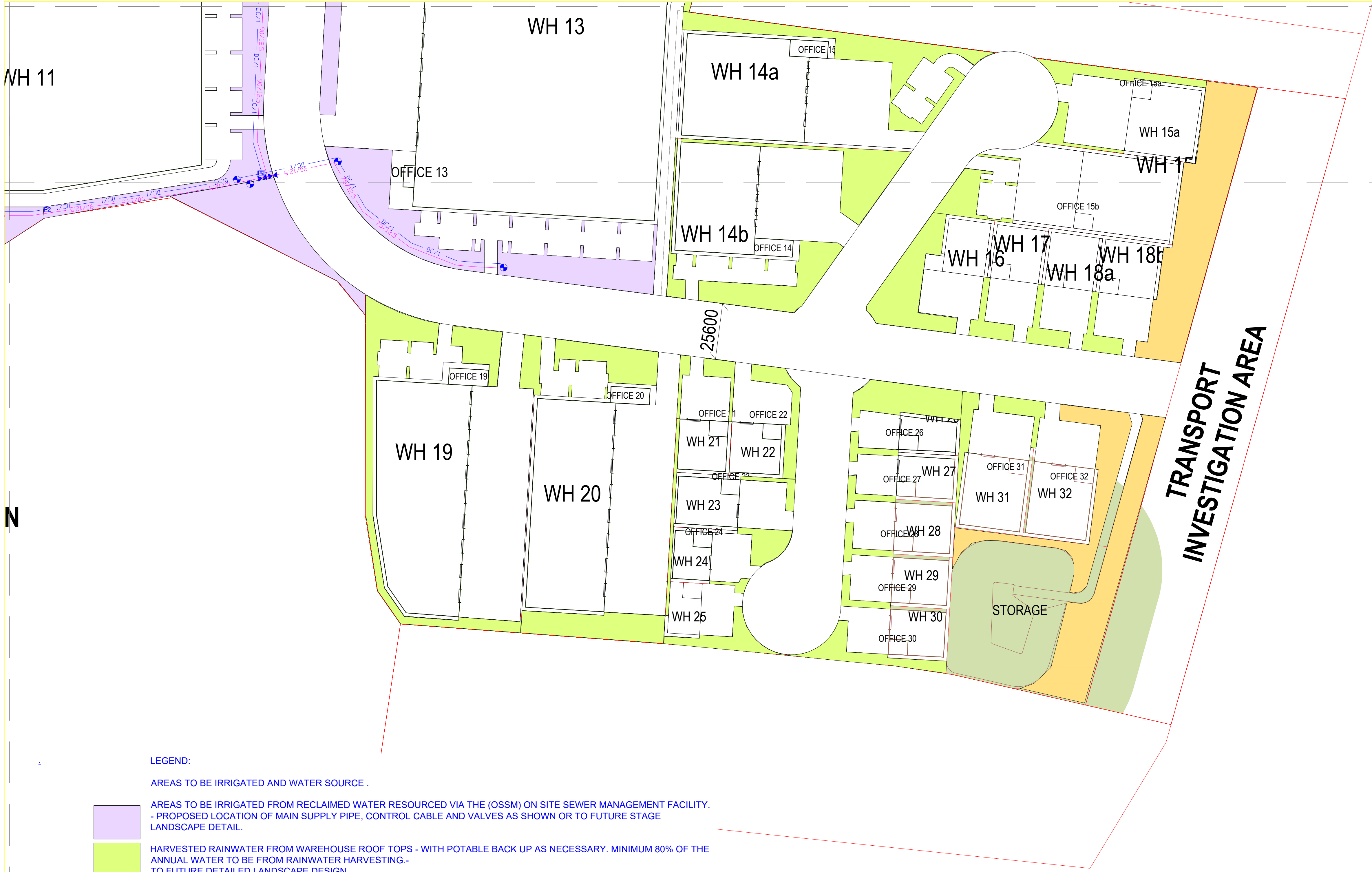
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PROJECT: **ALSPEC INDUSTRIAL BUSINESS PARK ORCHARD HILLS**

TITLE: **IRRIGATION STRATEGY RECLAIMED & WATER REUSE SITE MASTER PLAN**

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Wastewater Flow Assessment

Aquacell Pty Ltd

**Alspec Industrial Business Park
Onsite Sewage Management System
Luddenham Rd, Orchard Hills**

June 2025, Revision 7



Revision	Date	By	Checked	Document Status	Amendments
1	14 th June 2024	WTJ		Initial Issue	
2	30 th July 2024	JJ	WTJ	For Review	Minor Amendments throughout
3	22 nd August 2024	JJ	WTJ	For Review	Minor amendments to Alspec 2
4	27 th November 2024	JJ	WTJ	For Review	Amended in line with council RFI
5	19 th May 2025	JJ	WTJ	For Review	Assumptions amended around showers
6	10 th June 2025	JJ	WTJ	For Review	Storage and Distribution Warehouse incorporated
7	19 th June 2025	SMA	WTJ	For Review	Wastewater quality, Sensity analysis and climate change impacts



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1. Purpose

This document summarises the approach taken to verifying the expected wastewater flows and characteristics that will need to be handled by the Onsite Sewage Management (OSSM) plant located at the Alspec Industrial Business Park (AIBP) on Luddenham Road, Orchard Hills.

2. Method

Information was provided through several sources to assist in estimating potential wastewater flow quantity and quality. The sources used include the following:

- Survey of tenants: A water and wastewater survey were developed by Aquacell and distributed to Alspec and Cope by HBB. The survey sought information on water usage, staffing, and any on-site processes that could generate wastewater.
- Development warehouse and office areas: The site masterplan was used to identify the number of lots and the area set aside for warehouses on each lot.
- Specific information on key water users: Alspec provided information on the layout of the warehouse, staffing levels, and a two water bills from other Alspec sites in Australia.
- To characterise the quality of the estimated wastewater, mass loadings of key pollutants—namely, total suspended solids (TSS), biological oxygen demand (BOD), chemical oxygen demand (COD), and total nitrogen (TN)— were calculated based on values reported in a published article [\[1\]](#).

The information was combined to develop the expected wastewater generation in litres per square metre of combined office and warehouse areas. Specific contributions from processes in Alspec's facility were considered in developing the generation rate. The calculated generation rate was then compared with the other Alspec sites, the wastewater estimate provided by Arcadis, and water estimates from Sydney Water guides [\[2\]](#). The plant has been designed ultimately based on a conservative assumption of wastewater generation, expressed in litres per square metre of combined office and warehouse floor area.

Finally, a sensitivity analysis was conducted to assess the variability and robustness of the wastewater quantity and quality estimates. The analysis considered both temporal and operational factors, including:

1. Development and operation staging: Wastewater flows were assessed under different stages of site occupancy and development progression to capture incremental loading impacts.
2. Hydraulic load variability: Scenarios representing both average and peak flow conditions were evaluated to understand design implications for flow equalisation and treatment performance.
3. Seasonal variability: The influence of altered rainfall patterns on inflow and infiltration, as well as seasonal demand-driven fluctuations in water use and wastewater generation.
4. Changing water demands: Projected shifts in irrigation demand, which could affect overall water balance and effluent discharge or reuse requirements.



3. Assumptions

The water balance assessment is based on a set of defined assumptions regarding wastewater generation, quality, development staging, and the potential impacts of peak flow conditions and climate change. These are detailed in the following sections.

3.1 Wastewater Generation Assumptions

The staffing numbers included a breakdown of the ratio of male to female staff. The volume generated from toilets and showers was estimated by assuming the following:

- Males: Urinal used three times per day and toilet once per day
- Females: Toilet used three times per day (half flush) and once per day full flush.
- Shower: Used once per day by 25% of drivers and 5% of all remaining staff.

Volumes per usage of toilets, urinal, handbasin and shower are assumed as follows:

- Volume per flush (urinal): 2.5 L
- Volume per flush (toilet): 11 L
- Volume per flush (toilet) half flush: 4.5 L
- Volume per use of handbasin: 3 L
- Volume per shower: 100 L

3.2 Wastewater Quality Assumptions

The quality of the wastewater generated from the toilet flush and urinals were estimated based on the following assumptions [1]:

Table 1 Composition of urine and faeces

Mass loading (g/person/day)	Urine	Faeces
TSS	0.8	48
BOD	8.5	64.1
COD	5	34.1
TN	11	1.5



3.3 Sensitivity Analysis Assumptions

The proposed scheme will be developed in multiple stages. The sensitivity analysis of the water balance has been carried out based on the development phases and different operational scenarios. Assumptions are provided below:

Development phases:

- Stage 1: Alspec, Cope, Spec, storage and distribution (lot 11), and other tenants excluding the Eastern and Southern Land Parcels
- Stage 2: Full development of the site including Eastern and Southern Land Parcels

Operational scenarios:

- Scenario A: Alspec, Cope, Spec, and storage and distribution (lot 11) operating
- Scenario B: Alspec, Cope, Spec, and storage and distribution (lot 11) operating (excluding Alspec cooling tower)
- Scenario C: Full site operation (all tenants)
- Scenario D: Full site operation excluding Alspec cooling tower

Climate change impacts:

For the climate change sensitivity assessment, the following assumptions were made:

- Rainwater infiltration: Considered negligible due to the relatively short and contained nature of the site's wastewater collection network compared to conventional systems.
- Hydraulic load variability: To account for variability in flow due to peak usage periods and potential rainwater ingress into the sewer network, the design conservatively assumes that the peak flow may reach up to three times the average daily flow following Sydney Water's wastewater treatment planning guidelines [3].
- Irrigation demand: Assumed to vary seasonally in response to fluctuations in rainfall, with increased demand during dry periods.

4. Results

This section outlines the major findings of the water balance analysis of the proposed onsite sewage management (OSSM) facility. Detailed calculations of the wastewater flow assessment can be found in section 7 of this document.

4.1 COPE

The tenant survey yielded information on staffing numbers for the COPE site, and the presence of a truck wash that will operate using a potable water feed.

Applying these rates to the staffing numbers and including the truck wash generated an average wastewater generation of 13,018 L/day (0.34 L/m²/day). The corresponding average wastewater quality is Total Suspended Solids (TSS): 708 mg/L, Chemical Oxygen Demand (COD): 1,040 mg/L, Biochemical Oxygen Demand (BOD): 559 mg/L, and Total Nitrogen (TN): 151 mg/L. These results indicate that the wastewater generated at the site contains higher concentrations of organic matter and nitrogen compared to typical municipal wastewater. This is likely due to the limited use of showers and the absence of laundry facilities, which results in reduced dilution of the wastewater stream.

4.2 Alspec

The Alspec site is the largest of the sites and also contains some material processing with associated water usage.



The same assumptions around staff ratios (male to female) that were provided for COPE were adopted for Alspec on the basis that the uses are similar and the ratios are likely to be comparable.

The Alspec 1 site will incorporate both an extrusion press, a paint line and truck wash though it is understood that the paint line process is a closed loop and will not require a water supply. To estimate the contribution to wastewater flow from the processing (cooling tower blowdown), water usage information was obtained from the manufacturer of the extrusion press.

The resulting calculation indicates a wastewater generation of 57,470 L/day (1.43 L/m²/day) and an average wastewater quality of TSS: 181 mg/L, COD: 235 mg/L, BOD: 123 mg/L, and TN: 30 mg/L.

4.3 Spec Warehouse

The spec warehouse is an office, warehouse and truck wash facility, with no special processes or wastewater contributions. Staffing numbers were provided by Alspec and incorporated within the calculations, using the same assumptions were used as with COPE.

The resulting calculation indicates a wastewater generation of 9,391 L/day (0.59 L/m²/day) and wastewater quality of TSS: 639 mg/L, COD: 1046 mg/L, BOD: 559 mg/L and TN: 217 mg/L.

4.4 Storage and Distribution Warehouse Lot 11

The storage and distribution warehouse to be located on 11 is an office and warehouse only, with no special processes or wastewater contributions. Staffing numbers were provided and incorporated within the calculations, using the same assumptions were used as with COPE.

The resulting calculation indicates a wastewater generation of 6,305 L/day (0.16 L/m²/day) and the quality of the wastewater are as follows TSS: 627 mg/L, COD: 982 mg/L, BOD: 528 mg/L and TN: 221 mg/L.

4.5 Remaining Sites

The remaining site contributions were estimated using the applicable wastewater generation rate applied to the total site developed area. A figure of 0.8 L/m²/day was adopted as a conservative figure based on the three sites above.

4.6 Design Capacity

Based on the combined estimates of wastewater generation from all site tenants, the total projected daily wastewater flow is approximately 245 kL/day. However, the treatment plant's design capacity is based on a conservative generation rate of 0.8 litres per square metre per day across the whole site. Given the total combined office and warehouse area of 339654 m², the estimated daily wastewater volume of 272 kL/day. Accordingly, the treatment plant has been designed with a capacity of 300 kL/day to accommodate this conservative estimate. Additionally, the plant is designed with two equal treatment trains, each with a capacity of 150 kL/day, allowing for effective treatment performance at low initial flows, with capacity increasing as the site is progressively developed and occupied.

4.7 Development Stages

The following table summarises the results of the water balance analysis undertaken to evaluate the wastewater generation and characteristics at various stages of site development:



Table 2 Water balance for different stages of the scheme

Scenarios	Wastewater Volume (kL/day)	Wastewater Quality			
		TSS (mg/L)	COD (mg/L)	BOD (mg/L)	TN (mg/L)
Stage-1*	193	352	508	271	85
Stage-2**	245	352	508	271	85

* Development Stage-1: Alspec, Cope, Spec, storage and distribution (lot 11), and other tenants excluding the Eastern and Southern Land Parcels

** Development Stage-2: Full development of the site including Eastern and Southern Land Parcels

These results confirm that at completion of any stage of the development, the proposed 300 kL/day wastewater treatment plant (2 × 150 kL/day treatment trains) will have sufficient capacity to treat the wastewater generated on site.

4.8 Sensitivity Analysis

A sensitivity analysis was conducted to evaluate potential variations in wastewater flow and quality under different operational scenarios, recognising that not all warehouses will begin their operation simultaneously. The outcomes of this analysis are summarised below:

Table 3 Sensitivity analysis of the water balance

Scenarios	Wastewater Volume (kL/day)	Wastewater Quality			
		TSS (mg/L)	COD (mg/L)	BOD (mg/L)	TN (mg/L)
Scenario-A*	88	352	508	270	85
Scenario-B**	39	672	1027	550	193
Scenerio-C***	245	352	508	271	85
Scenario-D****	196	672	1027	551	193

* Scenario A: Alspec, Cope, Spec, and storage and distribution (lot 11) operating

** Scenario B: Alspec, Cope, Spec, and storage and distribution (lot 11) operating (excluding Alspec cooling tower blow down)

*** Scenario C: Full site operation (all tenants)

**** Scenario D: Full site operation excluding Alspec cooling tower



These scenarios indicate that the maximum daily wastewater volume will be approximately 245 kL/day under Scenario C. Wastewater quality parameters, vary significantly depending on the availability of Alspec's cooling tower blowdown, with COD levels ranging from 508 mg/L (with blowdown) to 1027 mg/L (without blowdown). As the treatment plant comprises two 150 kL/day treatment trains, lower flows can be managed by operating a single train, ensuring operational flexibility and energy efficiency. In all evaluated scenarios, the wastewater quality remains within the treatment capabilities of the proposed Aquacell S150 Blackwater Treatment System, which integrates biological treatment, membrane filtration, ozonation, biologically activated carbon filtration, UV disinfection, and chlorination. However, to manage flow and quality fluctuations, a 1 ML buffer tank is proposed at the plant inlet. This buffer will provide hydraulic and pollutant load equalisation, ensuring stable plant performance during peak or variable inflow conditions.

The influence of climate change on influent wastewater flow is considered negligible due to the relatively short and contained nature of the wastewater collection network, especially when compared to conventional municipal sewer networks. Nonetheless, to ensure robustness, the inlet infrastructure (pre-screen and buffer tank) has been conservatively designed to accommodate peak flows up to 900 kL/day—equivalent to three times the average daily flow. This accounts for potential increases from seasonal rainfall events and peak wastewater generation from peak usage of toilets and urinals. While the quantity of wastewater generated is not expected to be significantly affected by climate change, recycled water demand for irrigation purposes will likely vary. A comprehensive Land Capability Assessment (LCA) and Irrigation Management Plan (IMP) have been developed to estimate irrigation demand under varying climatic conditions. To accommodate these fluctuations, a 1 ML treated water storage tank has been included in the design. For further details, refer to Appendix Q8.3_AIBP LCA and IMPA.

5. Conclusions

Based on the assumptions of toilets and urinal usage and process waste from the developments the estimated wastewater generation quality and quantity are summarised in the table below:

Table 4 Summary of water flow assessment

	Wastewater Generated (kL/day)	Rate (L/m ² /day)	Wastewater Quality (mg/L)	Percentage Recycled
Alspec	57.5	1.43	COD: 235, TN: 30	9%
Spec Warehouse	9.4	0.59	COD: 1046, TN: 217	69%
COPE	13.0	0.34	COD: 1040, TN: 151	47%
Storage and Distribution (Lot 11)	7.9	0.16	COD: 982, TN: 221	82%
Other sites	105	0.8	COD: 1206, TN: 277	50%
Total – Stage 1	193		COD: 570, TN: 85	



Remaining Sites	52.2	0.8		
Combined Total	245		COD: 570, TN: 85	
Design Capacity (@0.8 L/m²/day)	272	0.8		

This water flow assessment confirms that the proposed Onsite Sewage Management (OSSM) system has been appropriately sized and designed to accommodate the anticipated wastewater flows and pollutant loadings from the development. The design ensures that the facility will be fit for purpose and capable of operating safely, reliably, and in compliance with regulatory requirements.



6. References

1. Jönsson H, Baky A, Jeppsson U, Hellström D, Kärrman E. Composition of urine, faeces, greywater and biowaste for utilisation in the URWARE model. Urban Water report 2005:6. Gothenburg, Sweden: Urban Water, Chalmers University of Technology; 2005
2. Sydney Water, Non-residential water usage, Doc no. SWIM 3078898 / Publish no SW 66 03/25, version. 3, Issue date: 25/03/2025
3. Alex R., William W., Wastewater Treatment Planning Guidelines, Sydney Water, Engineering and Technical Services (ETS), Asset Lifecycle. Version 1.0, 2 July 2021, BMIS Number: D0001891



7. Appendix - Detailed summary of flow calculations

Appendix 1 – Detailed summary of flow calculations

Appendix 2 – Alspec-1 wastewater flows

Appendix 3 – Spec warehouse wastewater flows

Appendix 4 – COPE warehouse wastewater flows

Appendix 5 – Storage & Distribution (Lot 11) wastewater flows



Appendix 1 – Detailed summary of flow calculations

Project: A0144 AIBP OSSM

Prepared by: Warren Johnson

Date: 6/08/2025

Revision: 6

Applied WW loading rate: 0.80 L/d/m2

TSS	COD	BOD	TN
352	509	271	85

Site Areas (m2)			
Site	Office	Warehouse	Combined
1 - Alspec	2534	37687	40221
2 - Spec WH-2	872.6	15075	15947.6
3 - Cope	1460	37000	38460
4	2000	15600	17600
5	2000	17263.58	19263.58
6	2000	13990	15990
7	800	12401	13201
8	300	2475	2775
9	136	1113	1249
10	1570	39465	41035
11 - Storage and Distrubution	1843	46314	48157
12	136	1153	1289
13	60	933.4	993.4
14	60	1500	1560
15	60	470	530
16	60	476.6	536.6
17	60	478	538
18	60	550	610
19	134	4123	4257
20	134	3445.14	3579.14
21	60	451	511
22	60	470	530
23	60	557	617
24	60	319	379
25	60	238	298
26	60	320	380
27	60	422	482
28	60	509	569
29	60	468	528
30	60	462	522
31	60	812	872
32	60	862	922

Wastewater Volume (kL/day)			Stage 1 (kL/day)		
Office	Warehouse	Combined	Office	Warehouse	Combined
2.03	30.15	32.18	2.03	30.15	32.18
0.70	12.06	12.76	0.70	12.06	12.76
1.17	29.60	30.77	1.17	29.60	30.77
1.60	12.48	14.08			
1.60	13.81	15.41			
1.60	11.19	12.79			
0.64	9.92	10.56			
0.24	1.98	2.22			
0.11	0.89	1.00			
1.26	31.57	32.83			
1.47	37.05	38.53			
0.11	0.92	1.03			
0.05	0.75	0.79			
0.05	1.20	1.25			
0.05	0.38	0.42			
0.05	0.38	0.43			
0.05	0.38	0.43			
0.05	0.44	0.49			
0.11	3.30	3.41			
0.11	2.76	2.86			
0.05	0.36	0.41			
0.05	0.38	0.42			
0.05	0.45	0.49			
0.05	0.26	0.30			
0.05	0.19	0.24			
0.05	0.26	0.30			
0.05	0.34	0.39			
0.05	0.41	0.46			
0.05	0.37	0.42			
0.05	0.37	0.42			
0.05	0.65	0.70			
0.05	0.69	0.74			

Based on site data	
Combined (kL/day)	L/d/m2
57.5	1.43
9.4	0.59
13.0	0.34
14.1	0.8
15.4	0.8
12.8	0.8
10.6	0.80
2.2	0.80
1.0	0.80
32.8	0.80
7.9	0.16
1.0	0.80
0.8	0.80
1.2	0.80
0.4	0.80
0.4	0.80
0.4	0.80
0.5	0.80
3.4	0.80
2.9	0.80
0.4	0.80
0.4	0.80
0.5	0.80
0.3	0.80
0.2	0.80
0.3	0.80
0.4	0.80
0.5	0.80
0.4	0.80
0.4	0.80
0.7	0.80
0.7	0.80

Totals	16999.6	257402.72	274402.32	13.6	205.9	219.5	3.9	71.8	75.7
Eastern Land Parcel	2687	53745	56432	2.1	43.0	45.1			
Southern Land Parcel	420	8400	8820	0.3	6.7	7.1			
Totals	20106.6	319547.72	339654.32	16	256	272			

193.1
45.1
7.1
245

Appendix 2 – Alspec-1 wastewater flows

Male/female ratio assumed same as Cope

	People	Male/female	Toilets	Showers/Handbasins/kits	Volume (L/day)
Main office	70	60%	2303	350	2653
Warehouse office	8	75%	256	40	296
Drivers	10	95%	220	310	530
Warehouse	70	95%	2156	350	2506
Visitors	5	50%	34	15	49
Office amenities				732	732
	163		4969	1797	6766 L/day

	TSS	COD	BOD	TN
	755	1190	645	293
	775	1221	662	300
	984	1379	743	111
	801	1263	684	311
	1801	2626	1411	381
	679	1213	577	0
Average	790	1246	666	254

0.17 L/day/m2 of floor area (office + warehouse)

Other Site Activities

Extrusion Line - Quenching cooling tower

Evaporation Loss (@1%) L, Blowdown @0.5% (L/day)

69120 34560

Extrusion Line - Cooling oil cooling tower

29088 14544

Truckwash

1600

Total

98208 50704

Other?

Estimated

50704 L/day

Based on L

	TSS	COD	BOD	TN
	100	100	50	0
Average (est.)	100	100	50	0

TOTAL

57470 L/day

1.43 L/day/m2 of floor area (office + warehouse)

Average	181	235	123	30
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Alspec-1 Excluding Cooling Tower

8366

Average	658	1027	548	206
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Recycled Water

4969 L/day Assumed 0% of factory process water is recycled water

Potable Water

52501

% Recycled

9%

Fixtures: From plans March 2024

Toilets 19

Urinals 6

Kitchenettes 2

Assume 1x dishwasher loads per day @ 16L/load.

Lunch room sink 2

Assume 5 L/person/day

Utilities 1

Showers 4

Appendix 3 – Spec warehouse wastewater flows

	People	Male/female	Toilets	Showers/Han	Volume (L/day)
Main office	70	60%	2303	350	2653
Warehouse office	8	75%	256	40	296
Drivers	10	95%	220	1060	530
Warehouse	100	95%	3080	500	3580
Visitors		50%	0	0	0
Office amenities				732	732

5859 2682 7791 L/day

0.49 L/day/m2 of floor area (office + warehouse)

Other Site Activities

Truckwash

1600 L/day

1600 L/day

TOTAL

9391 L/day

0.59 L/day/m2 of floor area (office + warehouse)

% Recycled

69%

Fixtures: From plans March 2024

Toilets	19
Urinals	6
Kitchenettes	2
Lunch room sink	2
Utilities	1
Showers	4

TSS	COD	BOD	TN
755	1190	645	293
775	1221	662	300
984	1379	743	111
801	1263	684	311
1801	2626	1411	381
679	1213	577	0
Average	785	1240	664

Average (est.)

TSS	COD	BOD	TN
100	100	50	0

Average

669	1046	559	217
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Appendix 4 – COPE warehouse wastewater flows

	People	Male/female	Toilets	Showers/Handbasins	Volume (L/day)		TSS	COD	BOD	TN			
Main office	71	60%	2336	355	2690.9		755	1190	645	293			
Warehouse office	5	75%	160	25	185		775	1221	662	300			
Drivers	98	95%	2156	3038	5194		984	1379	743	111			
Warehouse	47	95%	1448	235	1682.6		801	1263	684	311			
Visitors	5	50%	34	15	48.75		1801	2626	1411	381			
Office amenities				726	726		343	611	291	0			
					6133	4394	10527	L/day	Average	852	1262	679	186

0.27 L/day/m2 of floor area (office + warehouse)

Other Site Activities

Truck wash (internal recycle)

2491 L/day	Revised (with Average (est.))	100	100	50	0
13018 L/day	Average	708	1040	559	151

0.34 L/day/m2 of floor area (office + warehouse)

Fixtures: From plans March 2024

OFFICE	
Toilets	13
Urinals	4
Kitchenettes	1
Lunch room sink	2
Utilities	2
Showers	4

Recycled Water
Potable Water
% Recycled

6133 L/day Assumes truck wash is topped up with potable water
6885 L/day
47%

Assume 1x dishwasher loads per day @ 16L/load.
Assume 5 L/person/day

Appendix 5 – Storage & Distribution (Lot 11) wastewater flows

	People	Male/female	Toilets	Showers/Handbasins	Volume (L/day)
Main office	35	60%	1152	175	1326.5
Dock office	10	50%	335	50	293.75
Warehouse office	14	90%	435	70	479.85
Drivers			0	0	0
Warehouse	100	60%	3290	500	3790
Visitors	5	50%	34	15	48.75
Office amenities				366	366
			5246	1176	6305 L/day

	TSS	COD	BOD	TN
	755	1190	645	293
	741	1169	633	287
	795	1253	679	308
	984	1379	743	111
	755	1190	645	293
	1801	2626	1411	381
	679	1213	577	0
	Average	761	1206	649

Other Site Activities

Truckwash

1600 L/day

TSS	COD	BOD	TN
100	100	50	0

1600 L/day

TOTAL

7905 L/day

Average	627	982	528	221
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0.16 L/day/m2 of floor area (office + warehouse)

% Recycled

82%

Fixtures: Estimated

OFFICE

Kitchenettes

1 Assume 1x dishwasher loads per day @ 16L/load.

Lunch room sink

2 Assume 5 L/person/day

Potable Water Make-up and Irrigation

Aquacell Pty Ltd

**Alspeg Industrial Business Park
Onsite Sewage Management System
Luddenham Rd, Orchard Hills**

July 2025, Revision 1



Revision	Date	By	Checked	Document Status	Amendments
1	23 rd July 2024	SMA	WTJ	Initial Issue	



1. Introduction

The proposed Alspec Industrial Business Park (AIBP) On-Site Sewage Management (OSSM) Scheme is designed as a closed-loop wastewater treatment system, in which dissolved salts are retained within the system due to the absence of a sewer network for effluent discharge. This closed-loop configuration requires careful control of water recycling and effluent disposal to prevent salt accumulation over time.

While high water recycling rates can enhance resource efficiency by maximizing reuse, they also result in the increased concentration of dissolved solids (measured as Total Dissolved Solids, or TDS) and non-biodegradable substances. These elevated concentrations may inhibit biological treatment processes, corrode system components, and degrade effluent water quality. Since conventional treatment processes are ineffective at removing TDS, a balanced water reuse strategy, incorporating both water recycling and controlled effluent discharge through irrigation, is essential to maintain system stability and prevent long-term salinity build-up.

This document presents a mass and flow balance framework to evaluate the optimal potable water make up, recycled water reuse, and treated water disposal through irrigation. These parameters are optimized with the objective of maintaining TDS concentrations within the acceptable limits, especially for irrigation, thus ensuring compliance with environmental and reuse standards.

2. Methodology

Non-potable water demand within the AIBP can be satisfied using two main sources:

- Potable water
- Recycled water generated by treating wastewater from the site warehouses

However, using 100% recycled water for non-potable applications is not feasible due to the resultant TDS accumulation in the system. This is primarily because the recycled water carries concentrated salts that are not removed during treatment. To maintain a sustainable TDS level in the system, a proportion of the non-potable water demand must be fulfilled using potable water, and the surplus treated water must be discharged via irrigation as shown in Figure 1.

The TDS concentration of irrigation water is constrained by the land's capacity. According to the Land Capability Assessment (Appendix Q8.4), the maximum allowable TDS for irrigation is 1,500 mg/L. The methodology herein focuses on estimating the minimum potable water requirement while maximizing the use of recycled water, ensuring that effluent TDS remains below this threshold.

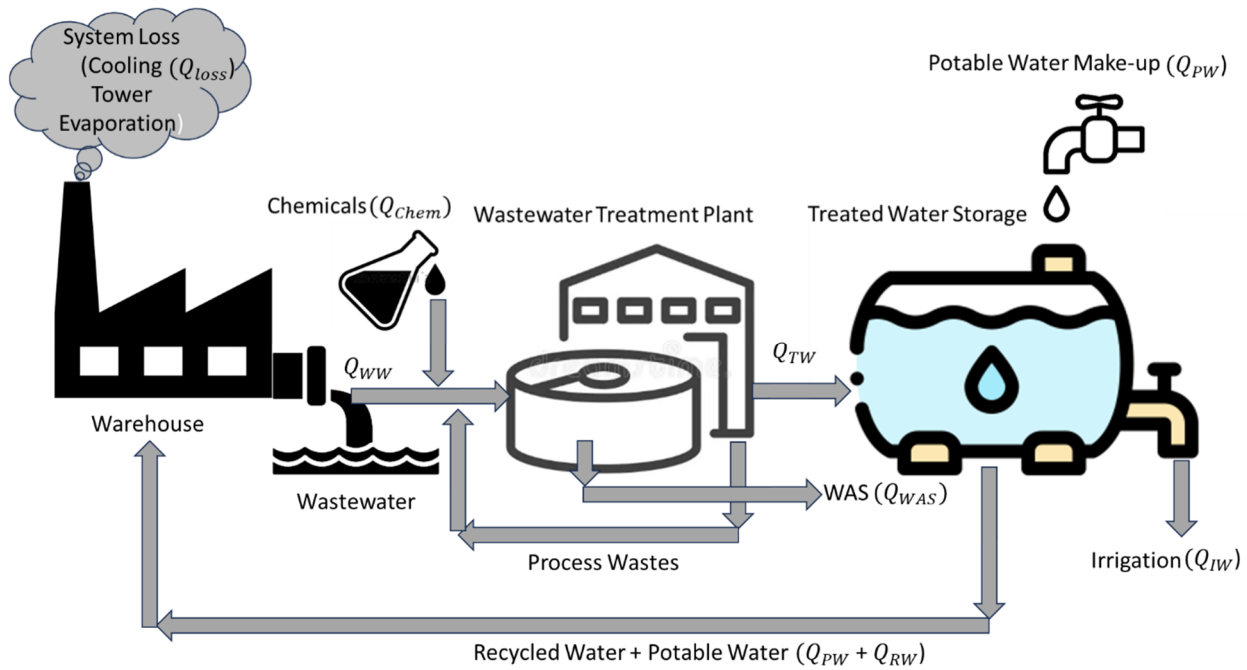


Figure 1 Process flow schematic of AIBP On Site Sewage Management Scheme

The effluent TDS concentration is estimated by applying mass and flow balance principles to the treatment system. Figure 1 illustrates the process flow schematic of the OSSM scheme. Inlet and outlet streams of the systems for analysis are identified as below:

a. Inflow streams

- I. Potable water make-up (Q_{PW})
- II. Wastewater generated within the warehouse (Q_{WW})
- III. Chemicals added to the process (Q_{chem})

b. Outflow streams

- I. Treated water for irrigation (Q_{IW})
- II. Activated sludge wasted from the system (Q_{WAS})
- III. Cooling tower evaporation (Q_{loss})

Flow balance of the plant is presented by the following equations,

$$Q_{PW} = Q_{IW} + Q_{WAS} + Q_{loss} \quad (1)$$

$$Q_{WW} = Q_{PW} + Q_{RW} - Q_{loss} \quad (2)$$



$$Q_{TW} = Q_{WW} + Q_{chem} - Q_{WAS} \quad (3)$$

$$Q_{IW} = Q_{TW} - Q_{RW} \quad (4)$$

Mass balance of the plant is expressed by the following equations

$$Q_{WW}C_{TDS}^{WW} = Q_{RW}C_{TDS}^{RW} + Q_{PW}C_{TDS}^{PW} + Q_{ww}C_{TDS}^{Wint} - Q_{loss}C_{TDS}^{loss} \quad (5)$$

$$Q_{TW}C_{TDS}^{TW} = Q_{WW}C_{TDS}^{WW} + Q_{chem}C_{TDS}^{Chem} - Q_{WAS}C_{TDS}^{WAS} \quad (6)$$

$$C_{TDS}^{WAS} = C_{TDS}^{TW} = C_{TDS}^{IW} = C_{TDS}^{RW} \quad (7)$$

Nomenclature of the symbols used in equation (1) to (7) are described in Table 1.

Table 1 Nomenclature of the symbols used in mass and flow balance equations

Sl. No.	Symbol	Description	Unit
1	Q_{WW}	waste water generated from the warehouses per day	kL/day
2	Q_{PW}	potable water demand of the site per day	kL/day
3	Q_{RW}	recycled water used per day	kL/day
4	Q_{IW}	Treated water irrigated per day	kL/day
5	Q_{TW}	wastewater treated per day	kL/day
6	Q_{chem}	chemical volume used per day	kL/day
7	Q_{WAS}	Activated sludge wasted per day	kL/day
8	Q_{loss}	System loss (cooling tower water evaporated per day)	kL/day
9	C_{TDS}^{WW}	Site warehouse TDS concentration	mg/L
10	C_{TDS}^{Wint}	TDS concentration of the waste generated inside the warehouse contributed by faeces and urine	mg/L
11	C_{TDS}^{PW}	Potable water TDS concentration	mg/L
12	C_{TDS}^{RW}	Recycle water TDS concentration	mg/L



13	C_{TDS}^{IW}	Irrigation water TDS concentration	mg/L
14	C_{TDS}^{TW}	Treated water TDS concentration	mg/L
15	C_{TDS}^{Chem}	TDS concentration of the chemicals added	mg/L
16	C_{TDS}^{WAS}	TDS concentration of activated sludge wasted	mg/L
17	C_{TDS}^{loss}	TDS concentration of evaporated water from cooling tower	mg/L

3. Assumptions

The potable water and irrigation requirements are determined based on estimated non-potable water demand and wastewater generation rates, as well as assumed TDS concentrations:

- $C_{TDS}^{PW} = 200$ mg/L [1]
- $C_{TDS}^{Wint} = 500$ mg/L [2, 3]
- $C_{TDS}^{loss} = 0$ mg/L

Non-potable water demand and wastewater generation volumes by warehouse are detailed in Appendix Q8.2, and summarized in Table 2.

Table 2 Water source, demand and loss of the proposed AIBP OSSM system

Warehouse	Water Demand (L/day)	Wastewater Produced (L/day)	System Loss (L/day)
Alspec-1	6,766	6,766	
Alspec-1 (cooling tower make-up)	147,312		
Alspec-1 (cooling tower evaporation)			98,208
Alspec-1 (cooling tower blowdown)		49,104	
Alspec-1 (truck wash)	1,600	1,600	
Spec Warehouse	7,791	7,791	
Spec Warehouse (truck wash)	1,600	1,600	
COPE	10,527	10,527	
COPE (truck wash)	2,491	2,491	



Storage and Distribution (Lot 11)	6,305	6,305	
Storage and Distribution (Lot 11) – truck wash	1,600	1,600	
Others (lots 4-10, 12-32)	105,293	105,293	
Eastern Land Parcel	45,146	45,146	
Southern Land Parcel	7,056	7,056	
Total	343,487	244,649	98,208

4. Results

The Total Dissolved Solids (TDS) concentration of treated water, along with the corresponding volumes of potable water make-up, recycled water required and irrigation water were calculated and are presented in Figure 2. The recycled water usage rate was varied from 0% to 80%, which represents the upper limit of recycled water usage for most warehouses within the site. Alspec-1 cooling tower make-up demand was assumed to be completely met by the potable water, as this demand is almost 50% of the total plant capacity. Additionally, it was decided that the water demand for the truck wash will also be met by potable water. The analysis indicates that increasing the proportion of recycled water used for non-potable demands reduces the reliance on potable water and the volume of effluent requiring irrigation. However, this increased recycling also leads to a higher TDS concentration of the irrigation water, potentially exceeding acceptable thresholds. Based on land capability constraints, a maximum TDS concentration of 1500 mg/L for irrigation water is permissible. Accordingly, the optimal water recycling rate has been determined to be 50%, as this ensures compliance with irrigation water quality limits.

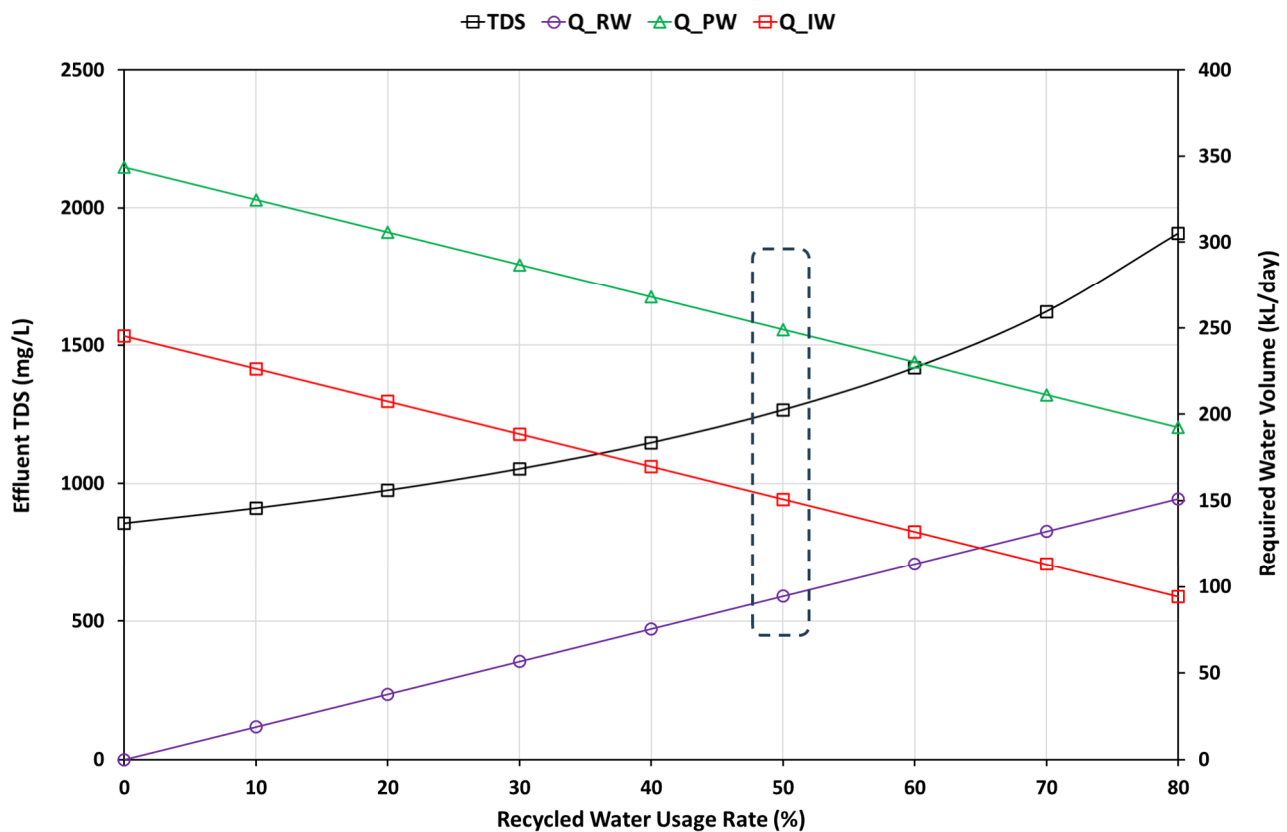


Figure 2 Optimization of recycled water usage rate

At 50% recycled water usage rate, the system requires 249 kW/day of potable water make-up with 151 kW/day of treated water to be discharged for irrigation and a resulting effluent TDS of approximately 1266 mg/L. In contrast, if no recycled water is used, the potable water demand increases to 343 kW/day, and the total volume of treated wastewater (245 kW/day) must be disposed via irrigation.

5. Conclusions

The analysis concludes that a maximum water recycle rate of 50% is feasible for the AIBP OSSM scheme, based on the land capability limit of 1,500 mg/L TDS for irrigation. This level of recycling reduces the potable water demand to 249 kW/day, while ensuring that effluent salinity remains within acceptable bounds.

If no recycled water is utilized, the system would require 343 kW/day of potable water, and all treated effluent (245 kW/day) would need to be discharged via irrigation. This would maintain a lower TDS but at the cost of increased potable water consumption. Therefore, the 50% recycle strategy represents an optimal balance between water reuse, salinity control, and irrigation constraints.



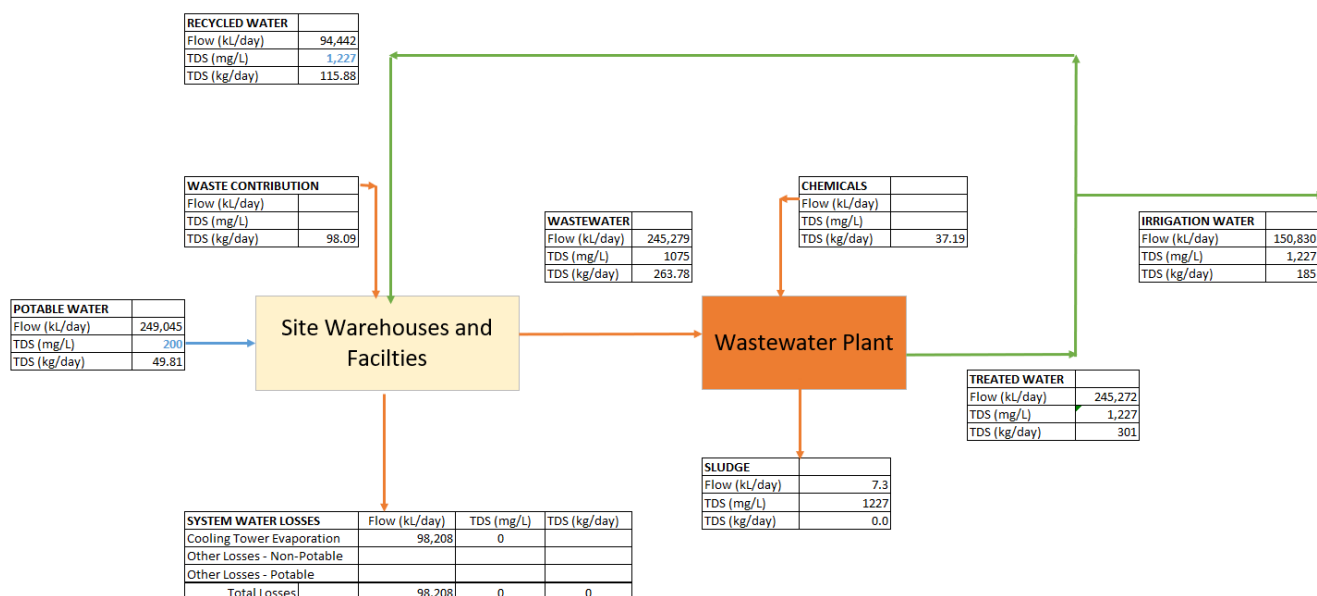
6. References

1. Sydney Water, Quarterly Drinking Water Quality Report: Prospect North Delivery System, 1 January 2024 to 31 March 2024, Sydney Water Corporation, 26 April 2024, p. 8.
2. Sydney Water, Industrial Customers: Acceptance Standards and Charging Rates 2024–25, Sydney Water Corporation, p. 2.
3. Daniel B. Stephens & Associates, Inc., Study to Evaluate Long-Term Trends and Variations in the Average Total Dissolved Solids Concentration in Wastewater and Recycled Water, Southern California Salinity Coalition, Mar. 2018, p. 27.



7. Appendix- Detailed summary of Flow and Mass Balance

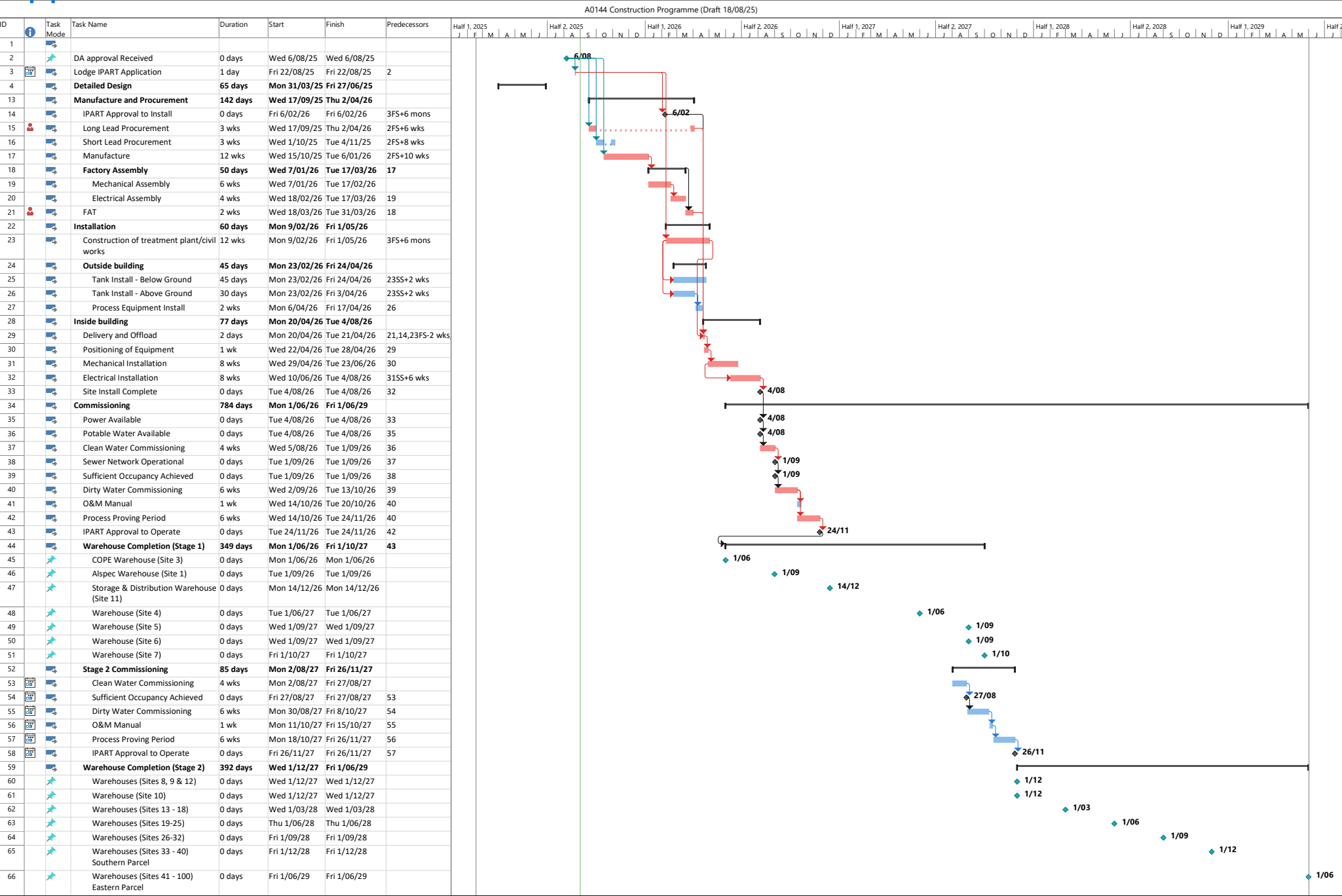
	Demand	% recycled water	Water Source		Wastewater TDS		500 mg/L	
			Potable	Recycled Water	Wastewater Volume Produced	Source water TDS (kg/day)	TDS added (kg/day)	Resulting Wastewater TDS (mg/L)
Alspeg-1	6,766	50%	3,383	3,383	6,766	4.83	3.38	1214
Alspeg-1 (Cooling tower m/up)	147,312	0%	147,312	0		29.46		
Alspeg-1 (Cooling tower blowdown)					49,104			600
Alspeg-1 (Truckwash)	1,600	0%	1,600	0	1,600	0.32	0.80	700
Spec Warehouse	7,791	50%	3,896	3,896	7,791	5.56	3.90	1214
Spec Warehouse (Truckwash)	1,600	0%	1,600	0	1,600	0.32	0.80	700
COPE	10,527	50%	5,264	5,264	10,527	7.51	5.26	1214
COPE - Truck wash	2,491	0%	2,491	0	1,861	0.50	1.25	937
Storage and Distribution	6,305	50%	3,153	3,153	6,305	4.50	3.15	1214
Sotrage and Distribution - Truckwash	1,600	0%	1,600	0	1,600	0.32	0.80	700
Others (lots 4-10, 12-32)	105,293	50%	52,647	52,647	105,293	75.13	52.65	1214
Eastern Land Parcel	45,146	50%	22,573	22,573	45,146	32.21	22.57	1214
Southern Land Parcel	7,056	50%	3,528	3,528	7,056	5.03	3.53	1214
Wastewater Plant Chemicals								
- Mg(OH) ₂ @150mg/L							36.70	
- Hypo @2ppm							0.49	
TOTALS	343,487		249,045	94,442	244,649		135.27	
			Overall recycled %		39%			



Appendix Q14.1



Appendix Q14.2



Appendix Q16.4 Fee Structure - Alspeg Industrial Business Park

Sewer Access Fee

A sewer access fee will be calculated based on GFA of each lot. This fixed price is based on \$0.75/m², with a minimum charge of \$800/annum. This cost is a contribution towards ongoing treatment plant infrastructure costs, ensuring network availability and ongoing compliance.

Waste Water Usage Charge

Waste water usage will be charged at \$1.36/kL, which is comparable with Sydney Water.

Recycled Water Usage Charge

Recycled water usage will be charged at \$2.52/kL, which is comparable with Sydney Water's Olympic Park rates.

Electricity Costs

Electricity will be charged proportionately to each lot within the development, based on the quantity of wastewater that they discharge. A power consumption rate of 7.1kWh/kL has been calculated for this treatment plant. The cost of electricity has been estimated based on a figure of \$0.30/kWh and will be charged based on wastewater demand. This rate will be adjusted once a rate has been confirmed with the chosen electricity provider.

Application and Connection Fee

The occupant of each lot will be required to pay a one off, initial application fee. This covers costs associated with the initial review of each lot to gain an understanding of the expected quantity and quality of wastewater that is likely to be developed by each lot. Larger lots will typically require a much more comprehensive assessment, involving potable and wastewater demand figures, an assessment of any specific process related water uses and a trade waste review. As such, a fee structure will be set up based on GFA, as follows:

- <1,000m² = \$1,046.54 (Aquacell's current standard connection fee for small retail customers)
- <10,000m² = \$4,186.16
- <30,000m² = \$7,325.78
- ≥30,000m² = \$10,465.40



High strength Surcharge Fee

It is assumed that all wastewater discharged to the OSSM facility will comply with the acceptance criteria as outlined in Table 1 below. It will be the responsibility of each individual lot to ensure that appropriate pretreatment is in place if discharge limits are expected to be exceeded. In the event that discharged wastewater exceeds the acceptance criteria, a High Strength Surcharge fee will apply.

PARAMETER	ACCEPTANCE LIMIT	COMMENT
PH	6.5 – 8.5	Must be within range to prevent corrosion and protect treatment processes
BOD ₅	< 300 mg/L	High levels affect oxygen demand and treatment capacity
TSS	< 300 mg/L	Protects pumps and prevents blockages in sewers
OIL & GREASE (NON-POLAR)	< 50 mg/L	Can cause blockages and interfere with treatment
TOTAL DISSOLVED SOLIDS (TDS)	< 300 mg/L	High TDS can affect effluent reuse and treatment efficiency
AMMONIA (AS N)	< 10 mg/L	Toxic to aquatic life and impacts nitrogen removal
TOTAL KJELDAHL NITROGEN (TKN)	< 20 mg/L	Excess nitrogen impacts nutrient balancing
PHOSPHORUS (TOTAL)	< 5 mg/L	Can contribute to eutrophication
SULPHATE	< 300 mg/L	High levels can produce hydrogen sulphide gas
CHLORIDE	< 300 mg/L	Corrosive to infrastructure
METALS - ZINC	< 2 mg/L	Toxic to biological treatment processes
METALS - COPPER	< 2 mg/L	Also toxic to biological systems
CYANIDE	< 1 mg/L	Highly toxic, must be tightly controlled
PHENOLS	< 1 mg/L	Toxic and odorous compounds
TEMPERATURE	< 38°C	High temperature affects microbial processes

Table 1: Aquacell Trade Waste Acceptance Criteria

Appendix Q17.0 Utility Interconnections

The proposed Onsite Sewage Management (OSSM) Plant will have a single utility interconnection with an external service provider. Potable water will be supplied to the OSSM facility by Sydney Water Corporation. All process waste streams generated within the OSSM system—excluding screenings of the prescreens and dewatered waste activated sludge from the biological treatment tanks—will be recycled to the plant's inlet for subsequent treatment. The locations of the utility connection points are shown in the process flow diagram provided below (Figure 1).

Potable water will be connected to the OSSM plant for two primary purposes:

- Treated water storage tank make-up:
Potable water will be used as makeup water to supplement the treated water storage tank. This ensures that sufficient treated water is available to meet demand within the development under all operating conditions.
- Operational and safety requirements: A separate potable water connection will be provided to the Aquacell treatment plant room for the following uses:
 - a. Preparation of membrane cleaning solutions
 - b. Supply to safety showers for emergency use

To protect the potable water supply from potential contamination, a Reduced Pressure Zone (RPZ) backflow prevention device will be installed at the potable water inlet. In addition, an air gap will be provided upstream of the treated water storage tank and filtrate tank as an added safeguard against backflow.

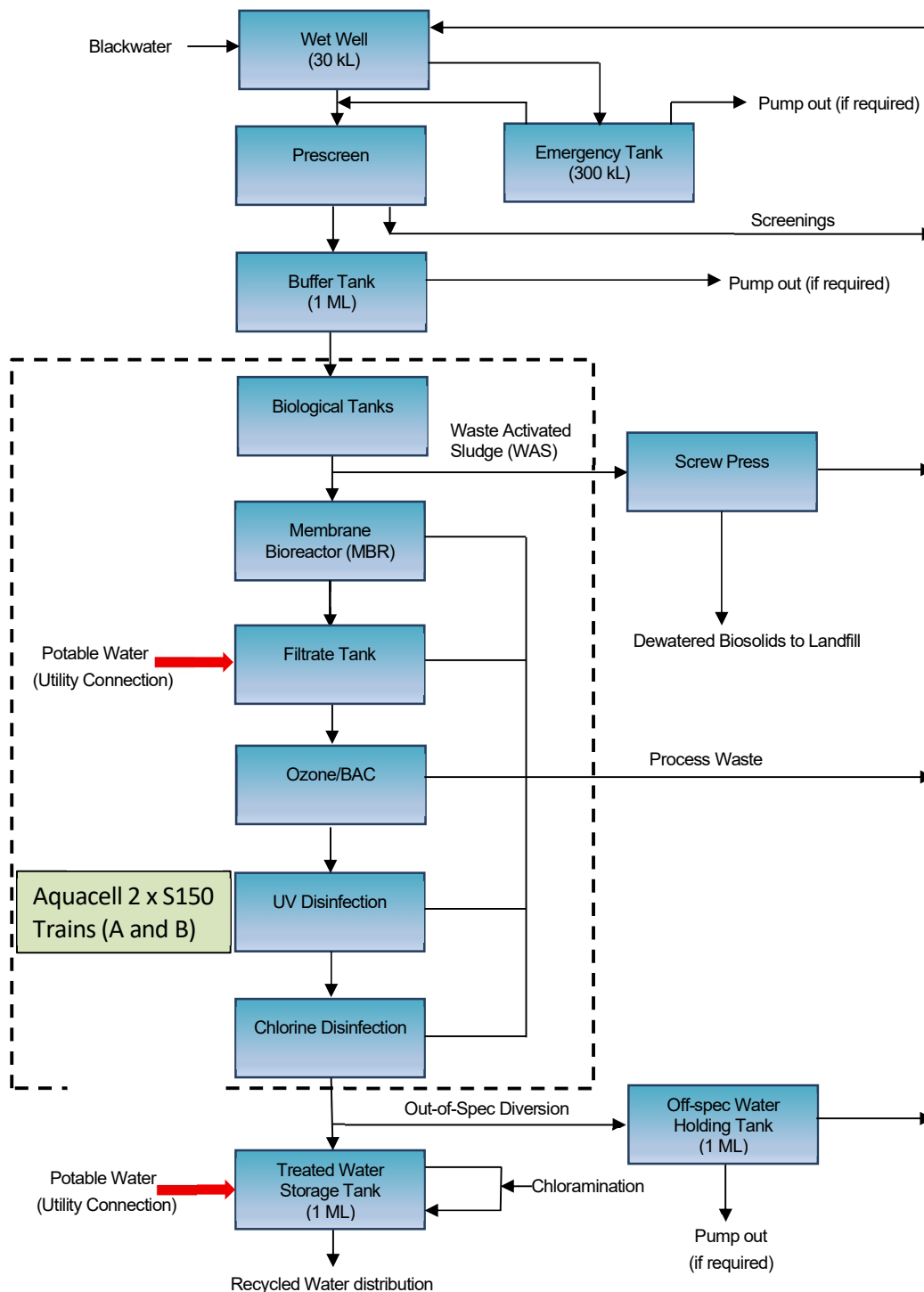


Figure 1 Process flow diagram

Recycled Water Quality Management Plan

Aquacell Pty Ltd

**Alspec Industrial Business Park Blackwater
Treatment Plant
Luddenham Rd, Orchard Hills**

June 2025, Revision 4



Revision	Date	By	Checked	Document Status	Amendments
1	14/06/2024	AE/WJ	WTJ	Initial Issue	
2	30/07/2024	JJ	WTJ	For Review	Minor amendments throughout
3	4/12/2024	JJ	WTJ	For Review	Minor amendments in line with council RFI.
4	13/06/2025	SMA		For Review	Minor amendments in QCP1, PFD and layout, updated for WICA application



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1. Introduction

1.1 Purpose of the RWQMP

This Recycled Water Management Plan (RWQMP) has been prepared by Aquacell Pty Ltd in relation to the operation of the Blackwater Water Treatment Plant (BWTP) that will be located at the Alspec Industrial Business Park (AIBP) on Luddenham Road, Orchard Hills.

It states the microbial quality objectives for the scheme and describes how implementation of the management plan will ensure those objectives are achieved and maintained. The document contains:

- Responsibilities of the recycled water supplier;
- Description of the recycled water process, including composition of the source and end use applications for which the treated water is fit-for-purpose;
- Detailed validation of the treatment processes; and
- A detailed process control and monitoring program to ensure the treated water meets the required quality for end use.

1.2 Description of the scheme

1.2.1 Site Description

The Alspec Industrial Business Park will be located at 221-227 and 289-317 Luddenham Road, Orchard Hills. The proposed location of the BWTP is shown in Figure 1 below.

The blackwater to be used for recycle will be sourced from onsite toilets, showers, basins and drains (other than stormwater drains).

Recycled water will be supplied to the site for:

- Cooling tower make-up water
- Toilet flushing
- Irrigation

Additional demand beyond the available recycled water will be met using potable water.

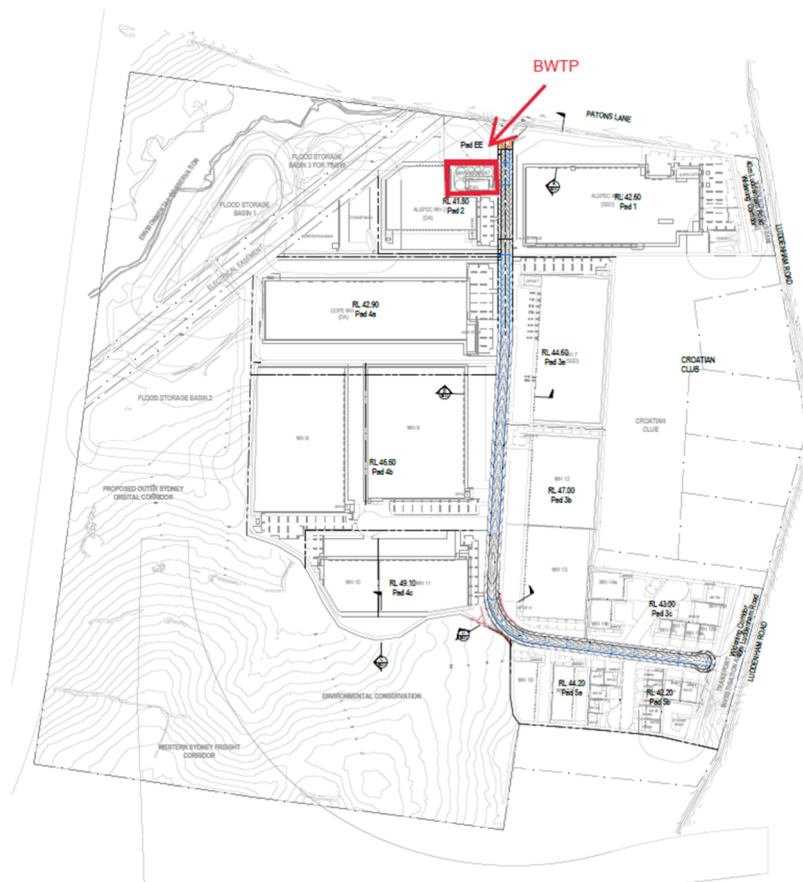


Figure 1: Proposed location of Blackwater Treatment Plant

1.2.2 System Process Design

A flow diagram of the plant showing the key unit operations is provided in Appendix 1, and a general arrangement drawing showing the physical layout of equipment is provided in Appendix 2.

Blackwater from the site is directed to a wet well adjacent to the treatment plant. Effluent from the wet well is pumped to a prescreen and the directed to 1000 kL buffer tank. The BWTP draws water from the buffer tank based on treated water demand, storing the final treated water in a 1000 kL treated water storage tank.

Referring to the flow diagram located in Appendix 1, the system consists of the following units:

- Wet Well (30 kL)
- Emergency Tank (300 kL)
- Prescreen
- Buffer tank for collection of blackwater (1000 kL)
- Two identical process trains with the following process units:
 - Anoxic Tank



- Aerobic Tank
- Membrane bioreactor treatment system (MBR)
- Filtrate tank
- Ozonation
- Biological activated carbon filter (BAC)
- Ultraviolet light disinfection (UV)
- Chlorine disinfection
- Off-spec water holding tank (1000 kL)
- Treated water storage tank (1000 kL)
- Treated water chlorination
- Screw press
- Vents connected to an odour scrubber for odour control
- Overflows and drains to wet well
- Chemical dosing systems

1.3 Management commitment

The scheme manager of the on-site recycling scheme at the AIBP is yet to be determined. They will be committed to ensuring the system is maintained and operated in compliance with relevant guidelines, regulations and standards at all times.

The scheme manager will engage Aquacell Pty Ltd (Aquacell), as the contracted provider of maintenance and operation services for the blackwater treatment plant. Both Aquacell and the scheme manager will provide the same commitment to maintain and operate the system in compliance with relevant guidelines, regulations, and standards at all times.

Under the agreement, the scheme manager will have maintenance personnel on site to undertake all daily, weekly and emergency response tasks associated with the running of the plant. Aquacell will provide initial training and ongoing technical support. Aquacell will be responsible for the majority of the technical and operational activities including on-site servicing, calibrations, regulatory reporting and remote operation as will be detailed in the service contract.

It should be noted that recycled water is treated to a high quality and suitable for human contact. As such, the water is suitable for the purpose of irrigating in the landscaped areas on each of the warehouse lots. Further information can be found within Whitehead & Associates' Land Capability Assessment.

A copy of the Aquacell Recycled Water Policy is provided in Appendix 3.

Comprehensive site management systems for the facility form part of this management plan. These describe the processes and procedures that will be in place to ensure the responsible use and management of recycled water.

1.4 Roles and responsibilities

The scheme manager will be responsible for both the recycled network for the collection and supply of blackwater to the BWTP, and the BWTP itself, which produces recycled water for the scheme. The scheme manager (or designated sub-contractor) will be responsible for the treated water storage and the delivery systems in which the recycled blackwater will be used.



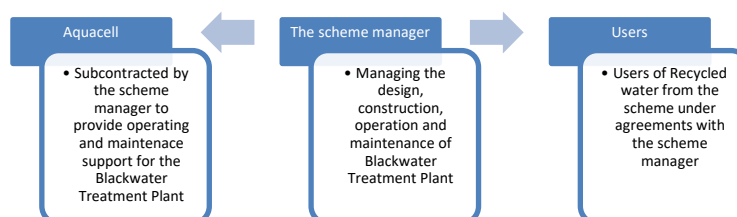
Aquacell provides operation and maintenance support for the BWTP.

In general terms, the scheme manager is responsible for:

- the production and supply of recycled water that is fit for purpose, ensuring that water quality complies with regulated standards and supply agreements up to designated transfer points defined in the RWQMP and supply agreements
- implementation of communication and reporting protocols if water quality does not meet required standards
- operation and maintenance of infrastructure for the production and supply of recycled water up to designated transfer points
- compliance with relevant regulatory requirements for recycled water
- using recycled water only in the manner and for the purposes for which it has been supplied, in accordance with supply agreements
- operation and maintenance of recycled water infrastructure after the designated transfer point
- implementation of control measures and compliance with usage restrictions defined in supply agreements.

The responsibilities and relationships between key roles are outlined in the figure below.

Figure 2. Blackwater Treatment Plant Responsibilities and Relationships



1.5 Scheme Owner

The owner of the development where the BWTP will be installed is to be confirmed.

Business Entity: TBA
Address: TBA
Phone (Business): TBA
Email: TBA

1.6 Responsible entity and scheme manager

The scheme manager is to be confirmed.

Business Entity: TBA
ABN: TBA
Address: TBA
Phone (Business): TBA



Email: TBA

1.7 Scheme operator and recycled water supplier

The scheme operator and supplier of recycled water is Aquacell Pty Ltd (Aquacell).

Business Entity: Aquacell Pty Ltd.

ABN: 79 072 487 015

Address: Suite 6.02, 6A Glen Street,
Milsons Point NSW 2061

Phone (Business): (02) 4721 0545

Email: info@aquacell.com.au

1.8 Users

The users of the recycled water are the staff, tenants and visitors at the AIBP.

2. Water quality objectives

2.1 Microbial

The proposed recycled water quality objectives have been derived based on the application of the principles described in the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks Phase 1 (AGWR) (NRMMC, 2006).

2.1.1 Assumptions

In order to arrive at pathogen log reduction values for the treatment process, assessments must be made of the potential risk of ingestion and frequency of these events for the different exposure routes present in the reuse scheme. The following outlines the assessments made in order to calculate the required treated water quality and hence the associated Log Removal Value (LRV) for the treatment process.

The possible exposure to treated water at this site are:

- Ingestion from cross connections between the drinking and recycled water systems
- Aerosol ingestion from toilets
- Ingestion from cooling towers
- Ingestion of water used for irrigation

2.1.2 Ingestion from cross connections between the drinking and recycled water systems.

Guidance on typical exposure rates and ingestion volumes for cross connection of dual reticulation systems are provided in Table 3.3 of the AGWR. These figures have been adopted for the purposes of calculating performance targets.

There are a number of steps that have been taken to ensure that the risk of cross-connection is low. These include:

- The dual reticulation system will be installed according to AS/NZ 3500 and NSW Health Guidelines for recycled water, including lilac pipe and/or markings.
- Testable reduced pressure zone devices will be provided at all interconnection points between the treated water and the potable water supply.



- Signage to warn of the use of recycled water will be installed.
- The dual pipe system will undergo a full cross connection audit prior to commercial operation. If any cross connections are detected, these will be repaired prior to commercial operation. Cross-connection audits will be carried out at a frequency to be determined by Scheme Owner, in consultation with Aquacell and other stakeholders under the pending recycled water scheme approval to operate under WICA Act. The detailed plan for carrying out cross-connection tests will be documented in the maintenance plan.
- Any maintenance or modification to the reticulation system will occur under strict supervision of the responsible entity and Scheme Manager and in accordance with the site management processes.
- All maintenance workers and plumbing contractors will be fully inducted to the site and made aware of the dual reticulation system and the consequences of cross connections.

2.1.3 Aerosol ingestion from toilets

Table 3.3 of the AGWR provide a guidance on typical exposure rates and ingestion volumes for toilet flushing. These figures have been used for calculating performance targets.

2.1.4 Ingestion from cooling towers

The exposure for those operating the cooling towers (occupational) is considered to be higher than those for the general public. Both of these risks have been considered in the analysis provided in section 2.1.6.

Occupational exposure is mitigated by various means:

- Access to cooling towers restricted to authorised staff only
- The normal practises for maintenance and servicing cooling towers to minimise risk to legionella are applied (e.g., as detailed in the NSW Health document *Legionella control in cooling water systems* (August 2018).
- New construction with modern, low drift design.

2.1.5 Ingestion of water used for irrigation

The proposed irrigation includes drip and spray irrigation for landscaped areas. Table 3.3 of the AGWR provide a guidance on typical ingestion volumes for garden irrigation which have been used for calculating performance targets.

2.1.6 Performance target calculations

The project specific ingestion risks have been considered in order to determine the pathogen removal targets (using sewage as source) required to meet the minimum tolerable health risk of 10^{-6} DALY as recommended by the AGWR. The exposure risks considered, along with associated assumptions, are summarised in Table 1.

Based on the dose equivalent to a DALY of 10^{-6} for each organism (DALYd), the LRV required can be calculated as described in Appendix 2 of the AGWR and shown below as:

$$LRV = \log (raw\ water\ concentration \times exposure\ (L) \times N / DALYd)$$

Where “exposure (L) x N” is the weighted total calculated in Table 1 below:



Table 1: Exposure risks for determining health based LRV targets based on AGWR

Use	Ingestion (L)	Frequency (/person/year)	Prop. of population affected (%)	Weighted total (L/yr)	Assumptions
Toilet flushing	0.00001	1100	100	0.011	Tenants and visitors - 3 uses per day
X-connect	1	365	0.1	0.365	1 L/day per person; Assume 1 in 1000
Cooling towers – general public	0.00001	728	100	0.00728	2 exposures per visit (coming and going); 7 visits per week for each week of the year
Cooling towers – occupational	0.0001	728	100	0.0728	2 staff per visit each day, one visit per day, 7 days per week
Irrigation – Municipal + Dual Reticulation	0.001	52	100	0.052	Assumes most people use these areas sparingly and not during irrigation. Assume 1/week.
Total				0.503	

Using the AGWR recommended blackwater microbial concentrations (from AGWR Table A2.1) and the DALYd data for *Cryptosporidium*, Rotavirus, and *Campylobacter* (from AGWR Box A2.2), the minimum required and target LRV's (rounded up to the nearest 0.5-log) are determined and presented in Table 2. These values are consistent with the recommended log reduction targets for blackwater as shown in Table 3.8 of the AGWS (for dual reticulation, toilet flushing, washing machine and garden use).

Table 2: Minimum and target LRV's for protozoa, bacteria, and viruses (Blackwater Source)

	Representative family	Concentration in source (organisms/L)	Weighted total (L/yr)	DALYd for DALY of 10 ⁶ (organisms/yr)	LRV required	LRV target
Rotavirus	Viruses	8000	0.503	2.5 x10 ⁻³	6.2	6.5
<i>Cryptosporidium</i>	Protozoa	2000	0.503	1.6 x10 ⁻²	4.8	5
<i>Campylobacter</i>	Bacteria	7000	0.503	3.8 x10 ⁻²	5.0	5



Treatment plant performance objectives are summarised in Table 3. The validation basis for these credits is discussed in section 0.

Table 3: Treatment plant performance objectives for blackwater

	MBR ¹	UV	Chlorination	Total LRV Achieved	Target LRV
Virus	1.5	1	4	6.5	6.5
Protozoa	2	4	0	6	5
Bacteria	4	4	4	12	5
1. Based on WaterVal Tier 1 default for MBR (See section 5.1)					

2.2 Chemical

No major industry is conducted on site as it is mostly warehousing and offices, so this risk is considered low. However, there is some aluminium processing (extrusion), along with milling, product painting and washing in one of the warehouse facilities (Alspec 1). The wastewater from these processes will be managed as trade waste to ensure that it does not contain adverse qualities of oil and grease or solvents.

3. System assessment

A Hazard Analysis and Critical Control Point (HACCP) analysis of the AIBP BWTP is conducted and included in Appendix 4. The methodology used will be in accordance with the AGWR and Aquacell's documented risk procedures.

4. Compliance with Australian Guidelines for Water Recycling

The table below lists the 12 elements of the framework for managing recycled water quality and use (as per the AGWR) and shows how the scheme will meet the various elements.

Table 4: AGWR framework elements

Framework element	Activity	Reference Document
Element 1: Commitment to responsible use and management of recycled water quality		
Components: Responsible use of recycled water	Aquacell will operate and maintain the treatment process and provide support. There is a commitment to ensure correct design installation and management. Aquacell WICA retailer (25_009R) and operator licence (25_008) WICA Scheme approval pending to install and operate the system.	WICA scheme approval (Appendix 5) WICA retailer licence (Appendix 7) WICA operator licence (Appendix 8)
Regulatory and formal requirements	There is a WICA scheme approval application pending to install and operate the system.	WICA scheme approval pending (Appendix 5) WICA retailer licence (Appendix 7) WICA operator licence (Appendix 8)
Engaging stakeholders	Stakeholder engagement is pending and will include the development of an information package to create awareness of the various stakeholders' obligations to achieve high water efficiency. This will include marketing material, contractual obligations and site induction information.	
Recycled water policy	The implementation of a recycled water policy is recommended.	Aquacell Recycled Water Policy exists (IMS Document EM010)
Element 2: Assessment of the recycled water system		
Components:	Uses are for toilet flushing, cooling tower makeup and irrigation.	This RWQMP



Identify intended uses and source of recycled water	The water source is blackwater from the AIBP business park development.	
Recycled water system	The plant receives blackwater from the building. Water is subjected to treatment through a membrane bioreactor, ozone, carbon filter, ultraviolet (UV) disinfection and chlorine disinfection. The treated water is piped to a dedicated storage tank and distributed for use.	Operations and Maintenance Manual pending (Appendix 11)
Assessment of water quality data	Raw wastewater is characterised based on typical values for this application, in addition to adopting the values for pathogen content outlined in the AGWR. Treated water quality from the wastewater treatment plant will be tested in accordance with a specified testing regime.	This RWQMP section 7 and AGWR
Hazard identification and risk assessment	A Hazard Analysis and Critical Control Point (HACCP) analysis of the AIBP scheme have been conducted. The methodology used is in accordance with the AGWR and Aquacell's documented risk procedures.	Aquacell HACCP (Appendix 4)
Element 3: Preventative measures for recycled water management		
Components: Preventative measures and multiple barriers	Human health Preventative measures to manage risks to human health include: Membrane filtration, UV disinfection and chlorine disinfection; Pipework (purple and/or with text) and signage at site of use indicating that recycled water is being used; Educational material to tenants and site managers about avoidance of inappropriate disposal of wastes; Signage at site to alert plumbers to recycled water system and co-ordination of plumbers through site management; Backflow prevention and cross-connection control; Environmental performance Preventative measures to manage risks to the environment include: Education programme for tenants and site managers promoting use of environmentally friendly detergents in the toilets and hand basins and avoidance of disposal of chemicals; A list of detergents considered appropriate for use in the building made available to cleaning staff and updated annually;	This RWQMP AS/NZS 3500:2003 Community page on Aquacell website Employer and contractor induction procedures and records Community page on Aquacell website
Critical control points	Multiple critical control points are confirmed through the HACCP analysis. These are detailed further in section 6.1.	Aquacell HACCP (Appendix 4) This RWQMP section 6.1
Element 4: Operational procedures and process control		
Components: Operational procedures	Operational procedures will be identified for all processes and activities associated with the system, including operation of treatment processes and auditing procedures for cross-connections. Documented procedures must be available to operations personnel and for inspection at any time. Operators are proficient and are able to recognize the significance of changes in the recycled water treatment plant and water quality. They are able to respond appropriately according to established procedures.	Operations and Maintenance Manual pending (Appendix 11) Aquacell Work instructions
Operational monitoring	A number of online monitoring instruments are used to ensure that we always meet the requirements of the Critical Control Points (CCP).	This RWQMP section 6 and 7
Corrective action	Corrective actions include the following: Noncompliance with the CCP's results in the system being stopped or treated water diverted to the Off-spec water holding tank. If cross-connections detected, flow to property stopped until repairs completed. Site switches to potable water backup until cross connection is eliminated.	This RWQMP section 6
Equipment capability and maintenance	Treatment plant and disinfection systems of standard and reliable design. Maintained by qualified supplier.	A service agreement will exist between the scheme manager



		and Aquacell for the maintenance and service of the recycled water treatment plant.
Materials and Chemicals	All plumbing and drainage work is conducted in a manner conforming to AS/NZS standard 3500. All chemical used in the plant are obtained from credible suppliers.	MSDS are supplied for each chemical. Purchasing is in accordance with Aquacell Purchasing and Inventory Procedure (IMS Document PI030)
Element 5: Verification of recycled water quality		
Components: Recycled water quality monitoring (specifically designed for individual systems, taking into account source of water, end uses and receiving environments)	Human health Monitoring of defined parameters is undertaken. Building occupant/customer satisfaction, monitored by the operator; complaints are investigated particularly when clusters of complaints are received.	This RWQMP section 6 and 7 Aquacell "Complaints Handling and Dispute Resolution Policy" (IMS Document CS030) Aquacell website "Community" page
Application and discharge site monitoring	Environmental performance Out of specification water will be recirculated to the start of the treatment process. Screenings and dewatered biosolids will be disposed of in landfill.	
Documentation and reliability	The sampling plan (location, parameters and frequency) will be determined and agreed to by the relevant authorities. The sampling and testing will be performed by an independent, NATA accredited laboratory.	Laboratory NATA certification Chains of Custody Records of results.
Satisfaction of users of recycled water	In this application, comments regarding end user satisfaction are likely to be directed to the site management. Any complaints will be handled as described in the Human Health section of Element 5 above.	Aquacell "Complaints Handling and Dispute Resolution Policy" (IMS Document CS030)
Short-term evaluation of results	The customer is supplied with a monthly report regarding the performance of the plant. The Aquacell recycled water engineer and service technician are in regular verbal and e-mail correspondence with the building management. Results will be provided to the regulator.	Monthly Service Report to the scheme manager regarding plant operation and performance indicators derived from onsite activities, data trending and analysis and water quality results.
Corrective responses	Corrective action depends on the incident. Most corrective actions occur automatically through appropriate PLC logic. As a minimum, it involves investigation of plant performance records to confirm normal operation, and additional testing to confirm the result and identify the source of any issue which arises. If target criteria for environmental parameters are exceeded, preventative measures need to be reassessed and corrective action taken to ensure environmental performance is improved.	Corrective actions are addressed in section 6.2 this RWQMP
Element 6: Management of incidents and emergencies		



Components: Communication	Noncompliance with approval conditions to be reported immediately to regulator.	Notification procedures as described in section 11.3 of this report.
	Noncompliance with approval conditions that affect public health to also be reported immediately to Sydney Local Health District Public Health Unit (NSW Health)	Reporting as required to relevant authorities.
Incident and emergency response protocols	In the case of an incident or emergency that requires a media response, only the CEO is authorized to make any public comment.	
	Employees are trained in emergency response and incident protocols. Training records are kept.	Aquacell "Incident and Emergency Management Procedure" (IMS Document IE010)
	In the event where the water treatment plant is unable to supply treated water, potable water backup is available.	Training records
Element 7: Operator, contractor and end user awareness and training		
Components: Operator, contractor and end user awareness and involvement	Operator of treatment plant to be sufficiently skilled to run the plant and investigate any faults;	Technician induction on commencement of employment, operating manuals, supervision from experienced engineers.
	End users are made aware of the restrictions on the use of recycled water and any practice that could threaten human health.	End user awareness via signage, inductions and tenancy agreements.
	Contractors inducted to site are told of the presence of dual pipe systems and the precautions required.	Induction records for the coming on site to work.
Operator, contractor and end user training	Operator to be aware of approval conditions and instructed on occupational health and safety requirements	
	Aquacell has an induction program for new employees and written procedures for all areas of responsibility.	Induction program
	Training needs for individual employees are identified and adequate resources made available during the induction phase. Annual performance reviews identify additional training requirements and set performance targets. Training records are kept.	Annual reviews
	Any contractors used on site are accredited, qualified and have the appropriate level of training. A site induction includes familiarization with Aquacell's Safe Work Method Statements (SWMS's), which are site specific. Aquacell maintains a partnership with several contractors to ensure continuity of knowledge and technical expertise.	Contractor induction records. Aquacell document "Hourly Rate Contractor Requirements" Aquacell terms of purchase to contractors and suppliers. Aquacell SWMS's
Element 8: Community involvement and awareness		
Components: Community consultation	The existence of water recycling will be a feature of advertising and promotion for the development.	
Communication and education	The site management will have an information package regarding recycled water use and hazards which it will make available to all new tenants or upon request.	Information supplied from the site managers for the tenants
		Undesirable chemical discharges to the recycled water system are listed on



		Aquacell's website community page
Element 9: Validation research and development		
Components: Validation of processes	Ongoing investigations into recycled water quality and treatment plant performance to refine assessments. This may enable less conservative critical control points to be adopted or treatment requirements reduced.	Validation according to section 5 of this RWQMP
Design of equipment	The design of the plant is based on well-documented and validated technologies.	This RWQMP section 5
Investigative studies and research monitoring	As the depth of operational knowledge regarding this and similar water treatment technologies increases, so the understanding of the weaknesses increases. This results in better opportunity to be proactive regarding operational control and maintenance of the plant, thereby improving operating costs and sustainability of the scheme.	This RWQMP will be reviewed in 12 monthly intervals as part of the process of continual improvement.
Element 10: Documentation and reporting		
Components: Management of documentation and records	Design of treatment plant and reticulation system documented; Operating procedures documented; All results to be recorded and stored; Aquacell has developed an in-house Integrated Management System (IMS) that is based on the ISO 9000 system. Included in this RWQMP and the Operations and Maintenance Manual is information pertaining to preventative measures employed, target and critical limits, critical control points, operating and corrective action procedures. These documents, along with the incident and emergency response plans, training programs and reporting protocols ensure that the plant is operating within set limits at all times. The document control system, ensures that only the most current version of any document is available for use. All documents are reviewed on an annual basis.	RWQMP Operations and Maintenance Manual pending (Appendix 11) Incident and Emergency Management Procedure, (IMS document IE010), Performance reviews, Risk Management Procedure (IMS document RM030)
Reporting	Internal reporting consists of verbal communication between the Aquacell engineer and the site service technician and written reports from the technician to the engineer. The owners of this treatment plant receive a monthly report detailing all operational and performance parameters and the maintenance performed during that month. Reports will also be prepared and submitted to the appropriate regulatory authority as required. Non-compliance breaches are reported immediately	Monthly reporting to the building managers regarding the plant performance. Reports as required by regulators
Element 11: Evaluation and audit		
Components: Long-term evaluation of results	Report as required by appropriate regulatory authority on compliance with approval conditions, including test results audited by regulator. This report will be reviewed by senior management prior to distribution and a copy sent to the regulatory authority and the owners of the treated water plant.	Aquacell will generate a report as required by regulators
Audit of recycled water quality management	Internal audits typically occur on an annual basis or as required by regulator and include a review of the management system, operational procedures and monitoring programs. An Independent audit in compliance with an approved third-party auditor occurs at a frequency yet to be determined.	Aquacell will conduct internal audits as required by regulators. Compliance audits by an independent auditor will be conducted. The frequency of these audits is yet to be determined
Element 12: Review and continual improvement		



Components: Review by senior managers	Performance of treatment plant, customer complaints/satisfaction	A senior review of this plant will be conducted as required in combination with the compliance reporting
Recycled water quality management improvement plan	An improvement plan, based upon the results of the internal and external audits and monthly reports which addresses the performance of the plant and end user expectations is prepared as part of the annual review.	In combination with the compliance reporting, an improvement plan will be developed for this treatment plant, based on the monthly reports and any audits performed.

5. Validation of treatment processes

The validation program for the Alspec Industrial Business Park BWTP is outlined within this section of the RWQMP. The validation program has been designed to evaluate the BWTP's ability to achieve the water quality objectives outlined in section 2 of this RWQMP, which acts as a feasibility study of the BWTP design.

5.1 Membrane Bioreactor Validation

The Membrane Bioreactor (MBR) system is used to achieve a 1.5-log virus, 2-log protozoa and 4-log bacteria removal, as specified in Table 3.

The validation for the membrane bioreactor is based on the WaterVal™ Validation Protocol for Membrane Bioreactors (WaterSecure, 2017) (MBR Protocol). Default credits for the MBR can be claimed if the system operates under the WaterVal Tier 1 operating envelope. The table below shows that the AIBP's BWTP MBR system is designed to operate within this envelope.

Table 5: Operating Envelope for Tier 1 Log Reduction Credits for MBR

Parameter	WaterVal Protocol Tier 1 Operating Envelope		Design conditions	Tier-1 condition met
	Minimum	Maximum		
Bioreactor pH	6	8	6 – 8	✓
Bioreactor dissolved oxygen (mg/L)	1	7	1-2	✓
Bioreactor Temperature (°C)	16	30	16	✓
Solids Retention Time (d)	11	-	20	✓
Hydraulic detention time (h)	6	-	32	✓
Mixed liquor suspended solids (g/L)	3	-	7.5	✓
Transmembrane pressure (kPa)	3	-	3-20	✓
Flux (LMH)	-	30	12.2	✓
Turbidity (NTU)	-	0.2	≤ 0.2 Measured continuously online	✓



The default Tier 1 credits proposed by WaterVal and the claimed credits for this project are shown in Table 6 below.

Table 6: Tier 1 Default LRVs and Claimed LRVs

Pathogen type	Tier 1 Default LRV	Claimed LRV
Viruses	1.5	1.5
Protozoa	2	2
Bacteria	4	4

To ensure the MBR filtrate turbidity continuously meets the Tier 1 condition, it will be monitored and controlled via the critical control points as discussed in section 6.2.1.

5.2 UV Validation

Based on the analysis in section 0 and summarised in Table 3, the UV system is required to achieve a minimum pathogen reduction of 4-log for both protozoa and bacteria, and 1-log for viruses.

The selected UV model, a Hallett 1000P, is validated in accordance with the requirements of the US EPA Ultraviolet Disinfection guidance manual for the final long term 2 enhanced surface water treatment rule (UVDGM) (US EPA, 2006).

Table 1.4 of the UVDGM provides the UV dose requirements for pathogens, and is reproduced below in Table 7.

Table 7: Reproduction of the UVDGM UV dose requirements

Target pathogens	Log inactivation							
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
<i>Cryptosporidium</i>	1.6	2.5	3.9	5.8	8.5	12	15	22
<i>Giardia</i>	1.5	2.1	3.0	5.2	7.7	11	15	22
<i>Virus</i>	39	58	79	100	121	143	163	186

A validated dose of 58 mJ/cm² is required for 1-log virus inactivation, and 22 mJ/cm² for 4-log protozoa. Bacteria are more UV sensitive than protozoa and will therefore be reduced by an amount at least equal to protozoa (e.g., E. coli up to 10 mJ/cm² for 4-log inactivation (AwwaRF, 2004)).

The UV reactor must be validated in accordance with the UVDGM at the required operating conditions for the AIBP BWTP.

Aquacell confirms that the UV system was validated in accordance with the UVDGM, and will achieve the required validated dose for virus and protozoa under the conditions shown in Table 8.

Table 8: UV system operating parameters

Operating Parameter	Operating Conditions
Operating Mode	Calculated dose monitoring
Validated UV Dose	≥ 58 mJ/cm ² (virus); ≥ 22 mJ/cm ² (protozoa)
Flowrate	Design: 123 L/min (peak per train)
UVT	≥ 75% (validated min. 34.3%) at 254 nm

An analysis of the proposed UV system and validation of the ability to provide the required dose follows.

5.2.1 UV dose equation

The method of operation chosen for this project to ensure the required UV dose is the calculated dose monitoring approach.



The manufacturer of the UV system has had a validation study carried out by a third party in order to establish the UV performance in accordance with the requirements of the UVDGM. This document is confidential to the UV supplier and has been provided to Aquacell under a non-disclosure agreement for the purpose of validating the suitability of the UV and the required operating parameters.

The design assumptions and associated operating UV reactor design output is summarised in Table 10 below:

Table 9: UV system design assumptions

Parameter	Value	Comment
UVT (%)	75	UV Transmissivity (measured online)
UVA	0.125	UV absorbance (calculated from UVT)
S/S ₀	0.85	Combined sleeve and lamp fouling factor (ratio of actual intensity to the intensity with new lamps and sleeves)
Reflection Aging Factors	0.95	Condition of UV light reflectors (a feature of the reactor design)
Flowrate (L/min)	123	Design flowrate per train
Validated UV Dose - Virus (mJ/cm ²)	64	Per US EPA UVDGM
Validated UV Dose - Protozoa (mJ/cm ²)	58	Per US EPA UVDGM

The data from Table 9 shows the UV will generate a validated UV dose of 64 mJ/cm² for viruses under the conditions shown. This is greater than 58 mJ/cm² and therefore the UV reactor is capable of achieving a 1-log virus reduction (per USEPA).

Similarly, Table 9 shows a validated dose 58 mJ/cm² is obtained for protozoa under the design conditions. This is greater than 22 mJ/cm² and therefore the UV reactor is capable of achieving at least a 4-log reduction in protozoa (per USEPA).

5.2.2 UV validation envelope

The UV validation study indicates a validation envelope extending to a UVT of 34.3% and a minimum flow of 23.5 L/min (1.408 m³/h), and up to a maximum flow of 386.9 L/min (23.05 m³/h) and a UVT of 98.9%. The design peak flowrate of 123 L/min (7.4 m³/h) is within the validated flow range.

UVT and validated UV dose are continuously measured and calculated by the UV controller. This in combination with the UV unit status and lamp age is read to the PLC which monitors the UV operational status. If the flowrate falls below 23.5 L/min, the UV dose calculation defaults to the minimum validated flowrate of 23.5 L/min. Furthermore, the rated capacity of the UV feed pump (PF-DIS-01) is 167 L/min, which is well below the maximum validated flow of 384.2 L/min, thereby mitigating the risk of flow rates exceeding the validated operating envelope.



5.3 Free Chlorine System Validation

The chlorine disinfection system is designed to achieve a 4-log virus and bacteria inactivation, as specified in Table 3. The critical C-T required to achieve this is determined by reference to two separate regulations. [Error! Reference source not found.](#) Table 10 is an extract from the *Guidance Manual for Compliance with Filtration and Disinfection Requirements for Public Water Systems using Surface Water Sources* (USEPA 1991). According to US EPA guidelines, at a temperature of 15 degC and pH range of 6 – 9, the C-T requirement for 4.0-log virus inactivation is 4 mg.min/L.

Table 10: Copied from USEPA 1991 Table E-7 – CT values for Inactivation of viruses by free chlorine

Temperature (°C)	Log inactivation – virus					
	2.0		3.0		4.0	
	6-9 pH	10 pH	6-9 pH	10 pH	6-9 pH	10 pH
0.5	6	45	9	66	12	90
5	4	30	6	44	8	60
10	3	22	4	33	6	45
15	2	15	3	22	4	30
20	1	11	2	16	3	22
25	1	7	1	11	2	15

By comparison, the WaterVal™ Validation Protocol for Chlorine Disinfection (WaterSecure, 2017) — underpinned by the US EPA guidance in the Disinfection Profiling and Benchmarking Guidance Manual (US EPA, 1999a) — prescribes specific C–T values based on recent studies using Coxsackievirus B5, which is recognised as the most chlorine-resistant virus within the pH 6–10 range. These values differ from the original US EPA C–T values and are detailed in Table 11, which presents C–T requirements for 1- to 4-log virus reduction across a range of turbidity, pH, and temperature conditions.

Table 11 CT values for 1 to 4 log reduction values of viruses at a range of turbidity, pH and temperature (WaterVal protocol)

pH	LRV	≤ 0.2NTU					≤ 2NTU					≤ 5NTU				
		5°C	10°C	15°C	20°C	25°C	5°C	10°C	15°C	20°C	25°C	5°C	10°C	15°C	20°C	25°C
≤ 7	1	4	3	2	2	1	4	3	2	2	1	4	3	2	2	1
	2	5	4	3	2	2	5	4	3	2	2	6	4	3	2	2
	3	7	5	4	3	2	7	5	4	3	2	7	5	4	3	2
	4	8	6	4	3	2	9	6	4	3	2	9	7	5	3	3
≤ 7.5	1	7	5	4	3	2	7	5	4	3	2	8	6	4	3	2
	2	10	7	5	4	3	10	7	5	4	3	13	9	6	5	4
	3	13	9	7	5	4	13	9	7	5	4	16	12	9	6	5
	4	16	11	8	6	4	16	11	8	6	4	21	15	11	7	6
≤ 8	1	9	7	5	3	3	10	7	5	4	3	12	9	6	4	3
	2	14	10	7	5	4	15	10	7	5	4	19	13	9	7	5
	3	18	13	9	7	5	19	13	10	7	5	25	18	13	9	7
	4	23	16	12	8	6	23	16	12	8	6	32	23	16	11	8
≤ 8.5	1	11	8	6	4	3	12	9	6	5	4	14	10	7	5	4
	2	17	12	9	6	5	19	13	10	7	5	21	15	11	8	6
	3	23	16	12	9	6	25	17	13	9	7	29	21	15	10	8
	4	29	21	15	10	8	31	22	16	11	8	37	26	18	13	9
≤ 9	1	13	9	6	5	3	14	10	7	5	4	15	10	7	5	4
	2	20	14	10	7	5	22	16	11	8	6	23	16	12	8	6
	3	28	19	14	10	7	30	21	15	11	8	32	23	16	11	8
	4	35	25	17	12	9	38	27	19	13	10	41	29	20	14	10



According to this protocol, for ultrafiltered water (essentially particle-free), a C–T value of 12 mg·min/L is required to achieve a 4.0-log virus reduction at pH ≤ 8 and 15 degC. Applying a conservative design approach, the chlorine contact tank has been sized for a 12 mg·min/L C–T. As bacteria are more susceptible to chlorine than viruses, achieving a 4.0-log virus inactivation will also ensure at least a 4.0-log bacteria inactivation.

5.3.1 Chlorine contact tank design

The Theoretical Detention Time (TDT) required is given as follows:

$$TDT = V/Q$$

Where:

TDT = Theoretical Detention Time (min)

V = minimum volume of chlorinate contact system (L)

Q = flow rate (L/min)

Actual detention time (T) is determined by correcting for the impact of potential bypass by the use of a baffling factor (BF):

$$T = TDT \times BF$$

Where:

T = time that water is contact with chlorine (min)

BF = baffling factor (usually between 0.1 – 1.0)

The design for the contact tank uses a long length of pipe to achieve the chlorine contact time. It is generally considered that a L/D of > 40 approximates plug flow (e.g., *Guidelines for validating treatment processes for pathogen removal (DH, 2013), section 8.1.3*), and that under these conditions contact time (T) is equal to theoretical detention time (TDT). That is, the baffling factor (BF) equals one under these conditions.

The design uses a total pipe length (L) of 36 m at a diameter (d) of 246 mm which gives L/d = 146.3, which is greater than the minimum of 40. The calculated volume for the contact pipe is determined as follows:

$$\begin{aligned} \text{Volume (V)} &= \pi * (246/1000)^2 / 4 * 36 \\ &= 1.711 \text{ m}^3 = 1711 \text{ L} \end{aligned}$$

5.3.2 Chlorine residual calculation

The C-T is defined as:

$$\begin{aligned} C-T \text{ (mg·min/L)} &= C \text{ (mg/L)} * T \text{ (min)} \\ &= C \text{ (mg/L)} * TDT * BF \\ &= C \text{ (mg/L)} * V \text{ (L)} / Q \text{ (L/min)} * BF \end{aligned}$$

As BF =1 for plug flow, V= 1711 L, this equation becomes:

$$C-T \text{ (mg·min/L)} = C \text{ (mg/L)} * 1711 / Q \text{ (L/min)} \quad 5.1$$

Equation 5.1 is programmed into the PLC and used to continuously monitor the instantaneous C-T value. At any flow rate, the free chlorine concentration is automatically adjusted to ensure that the C-T is > 12 mg·min/L, while maintaining the chlorine concentration within the operational range of 0.5 – 5 mg/L.



6. Operational monitoring and process control

A Hazard Analysis and Critical Control Point (HACCP) analysis of the Alspec Industrial Business Park BWTP is conducted after the risk management workshop and is included in Appendix 4. The methodology used will be in accordance with the AGWR and Aquacell's documented risk procedures.

6.1 Operational control

A flow diagram summarising the Quality Control Points (QCP) and Critical Control Points (CCP) is shown in Figure 3. Two identical trains with the same process units and QCP's and CCP's will be installed (each producing 150 kL/day). Detailed monitoring and corrective actions for the QCP's and CCP's are described in the following sections.

6.1.1 Critical control points

If water quality parameters for either train A or train B are exceeded at the CCP's, treated water from that train will either be recirculated (MBR CCP's) or diverted to the Off-spec water holding tank. If the CCP limits continue to be exceeded for an extended period of time, the corresponding train will shutdown.

6.1.2 Process Description

Pre-screen:

The prescreen removes non-degradable solids such as fibers, or rags that can block or damage downstream processes and equipment. It also removes some of the degradable waste which help to lower the organic load to the biological treatment process.

Emergency Tank:

A 300 kL emergency storage tank is integrated at the plant's inlet to provide one day of raw sewage holding capacity in the event of a prescreen failure or shutdown, eliminating the need for immediate pump-out.

Buffer Tank:

A 1 ML buffer tank is provided to capture peak flows from the site. This maximizes the amount of water that can be recovered and enables the plant to operate at an efficient and steady flow. A submersible mixer is employed in these tanks to keep solids suspended and to prevent anaerobic conditions occurring.

Bioreactor:

The biological system consists of both anoxic and aerobic stages.

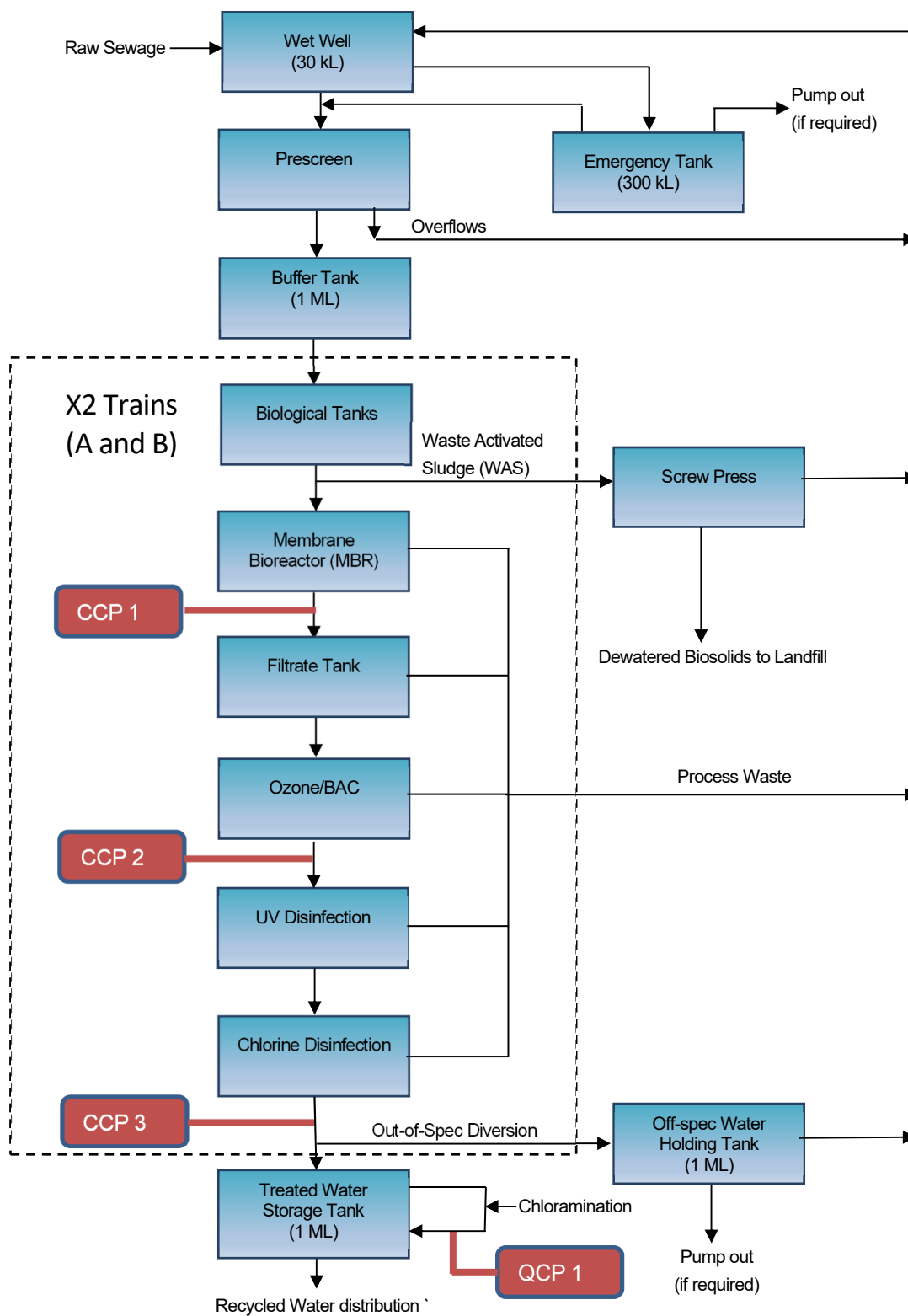
The Anoxic Tank converts nitrate generated by the treatment process to nitrogen gas in order to reduce the nitrogen content of the treated water. Continuous mixing in the anoxic tank ensures that mixed liquor remains homogenous.

The Aerobic Tank carries out further biological treatment of the wastewater to reduce the organic content and convert ammonia nitrogen to nitrate and nitrite. Blowers aerate these tanks to ensure the required air for oxygen transfer is provided.

Mixed liquor suspended solids (MLSS) concentration is monitored continuously and waste activated sludge (WAS) is periodically discharged to maintain the required MLSS level.



Figure 3: Recycled water process flow and critical control points



**Screw Press:**

The screw press receives sludge from the WAS tank and separates the solid and liquid phases. The liquid is sent back to the start of the process train and the dewatered biosolids are collected for transportation to landfill.

Ultrafiltration membranes:

The combination of ultrafiltration and bioreactor is referred to as a membrane bioreactor (MBR). The biomass suspension from the bioreactor is recirculated past hollow fibre membranes, housed in the MBR tank, and returned to the bioreactor. A portion of the recirculated flow is withdrawn through the membranes as filtrate and collected in the filtrate tank for downstream disinfection.

The membranes are polymeric hollow fibres with a nominal pore size of 0.04 μm . The membranes effectively remove essentially all suspended solids and the bulk of any pathogens, including virus, bacteria and protozoa.

Ozone/BAC:

Filtered water then dosed with ozone and passed through an ozone contact pipe followed by Biological Activated Carbon (BAC) filters. This combination is used to remove colour from the feed water. The BAC employs periodic backwashing to control bacteria levels present in the filter and to ensure the filter bed is well distributed.

Ultraviolet light Disinfection (UV):

The UV system consists of two UV units in parallel. It provides the required dose to ensure the required inactivation of virus, bacteria and protozoa.

Chlorine Disinfection:

Following the UV, the water is dosed with sodium hypochlorite before entering a pipe contactor to provide the necessary chlorine contact time for disinfection. The free chlorine residual and pH of the recycled water are monitored at the end of the chlorine contact pipework.

Treated Water Storage Tank and Distribution:

The treated water is stored in a 1ML Treated Water Storage Tank (TWST) which allows the system to account for peak flows. Water in the TWST is recirculated and dosed with chlorine to maintain a free chlorine residual for storage and distribution.

Off-Spec Storage Tank:

Any treated water that cannot be used for distribution will be diverted to the Off-Spec Storage Tank. This water will then be recirculated back through the treatment process.

Odour Scrubber:

The odour scrubber captures and treats emissions from key odour sources within the facility, including the wet well, prescreen, buffer tank, and screw press, to minimise any adverse impacts on the surrounding environment.



6.2 Monitoring and corrective actions

6.2.1 MBR System

Table 12: MBR critical control point

CCP 1	MBR		
	Turbidity	Sample Flow Switch	Instrument Status
Critical limits/alert limits			
Alert	≥ 0.15 NTU		
Critical	> 0.2 NTU	No Flow	Instrument Critical Fault
Monitoring procedures			
What	Turbidity	Flow Switch	Transmitter
How	AIT-MBR-01 (HACH TU5300sc)	FS-MBR-01	AIT-MBR-01 (HACH TU5300sc)
When	Continuous, during MOS FILTRATION		
Where	MBR filtrate line		
Who	Aquacell/Automatic		
Corrective actions			
What	MOS recirculation mode entered, returning filtrate to the MBR tank.		MOS goes to standby
How	Open recirculation valve (AV-306A/B) and close filtrate to filtrate tank valve (AV-302A/B)		Filtration stopped
When	If critical limit is exceeded for > 120 s	No flow for > 120 s	Immediate
Where	PLC		
Who	Automatic		

Turbidity:

If during MOS filtration, the turbidity exceeds the alert level for 120 seconds a warning alarm is generated to warn the operator. If the turbidity exceeds the critical level for more than 120 seconds, an alarm is triggered and the filtrate flow is diverted from the filtrate tank and recirculated back to the MBR tank. During recirculation, if the turbidity drops below the critical level for at least 120 seconds, filtrate is sent to disinfection. However, if after 3 filtration/relaxation cycles, the filtrate turbidity has not fallen below the critical limit for at least 120 seconds, the MOS (Membrane Operating System) will go to standby and a standby alarm will be generated.

Production resumes when the operator resets the turbidity alarm after the cause has been identified and addressed.

Flow switch:

There is a flow switch in turbidity meter sample line to ensure sample flow is present during MOS filtration. If sample flow is lost, the turbidity readings are unreliable. If during MOS filtration, the flow switch turns off for more than 60 seconds an alarm is triggered to warn the operator. If the flow switch is off more than 120 seconds, an alarm is generated and the filtrate flow is diverted from the filtrate tank and recirculated back to the MBR tank. During recirculation, if the sample flow switch turns on for at least 120 seconds, treated water is redirected to storage. However, if after 3 filtration cycles, the sample flow switch has not turned on for at least 120 seconds, the MOS (Membrane Operating System) will go to standby and a standby alarm will be generated.

Production resumes when the operator resets the alarm after the cause has been identified and addressed.



Instrument Status:

If a critical turbidity instrument fault occurs during MOS filtration or recirculation, the MOS (Membrane Operating System) will immediately go to standby and a standby alarm will be generated.

Production resumes when the operator resets the alarm after the cause has been identified and addressed.

Maintenance:

Turbidity tested by handheld turbidity meter monthly, and recalibrated as required.

6.2.2 UV system

Table 13: UV disinfection critical control point

CCP 2	UV disinfection			
	Validated UV Dose – Virus	UVT	Lamp age	UV status
Critical limits/alert limits				
Alert	< 60 mJ/cm ²	< 45%	> 10,000 hours	
Critical	< 58 mJ/cm ²	< 35%	> 12,000 hours	UV Fault
Monitoring procedures				
What	UV Dose	UVT Monitor	Hour monitor	Lamp monitor
How	UV Controller (Hallett 1000P)	UV Controller (Hallett 1000P)	PLC recorded and UV controller (Hallett 1000P)	UV Controller (Hallett 1000P)
When	Continuous, online			
Where	UV Unit	UV Unit	UV Unit and PLC	UV Unit Output
Who	Aquacell/Automatic			
Corrective actions				
What	Flow diverted to Off-spec Water Holding Tank		Disinfection System goes to shutdown	
How	Close AV-461A/B and open AV-462A/B		Flow stopped	
When	If critical limit is exceeded for > 120 s		Immediate	
Where	PLC			
Who	Automatic			

Validated UV Dose – Virus:

The validated UV dose for virus is calculated by the UV controller using the flow rate, measured UVI and measured UVT. The dose is output from the controller to the PLC for monitoring.

If the UV dose drops below the alert level for more than 120 seconds an alarm is triggered to warn the operator that the UV system is approaching the low UV dose limit. The operator can then check the unit operation and rectify before the UV dose reaches the critical level. If the UV dose drops below the critical level for 120 seconds, an alarm is generated and the treated water is diverted to the Off-spec Water Holding Tank. If during diversion to the Off-spec Water Holding Tank, the UV dose increases back above the critical level for 120 seconds, the treated water will be redirected to the Treated Water Storage Tank. However, if after 2 hours the UV dose does not return above the critical limit for a minimum of 120 seconds, the disinfection system will shutdown and a shutdown alarm will be generated.

Production can resume when the operator resets the alarm after the cause has been identified and addressed.

**UVT:**

The UVT is continuously monitored to ensure it remains in the validated range. If the UVT drops below the alert level for more than 120 seconds an alarm is triggered to warn the operator that the UVT is approaching the low limit. If the UVT drops below the critical level for 120 seconds, an alarm is generated and the treated water is diverted to the Off-spec Water Holding Tank. If during diversion to the Off-spec Water Holding Tank, the UVT increases back above the critical level for 120 seconds, the treated water will be redirected to the Treated Water Storage Tank. However, if after 2 hours the UVT does not return above the critical limit for a minimum of 120 seconds, the disinfection system will go to shutdown and a shutdown alarm will be generated.

Production can resume when the operator resets the alarm after the cause has been identified and addressed.

If the UVT exceeds the maximum validated UVT (98.7%) then the calculated UV dose will use the maximum validated UVT to determine the applied UV dose.

Lamp age:

Lamp age is monitored continuously by the UV control module. If the lamp hour alert level is reached, a warning alarm is generated to warn the operator. If the critical hours are exceeded, the disinfection system will immediately go to shutdown and a shutdown alarm will be generated.

Production can resume when the operator resets the alarm after the UV lamps have been replaced.

UV Status:

The UV Status is monitored continuously by the PLC and UV control module. If a critical UV fault occurs, the disinfection system will immediately go to shutdown and a shutdown alarm will be generated.

Production can resume when the operator resets the alarm after the cause of the fault has been rectified.

Maintenance:

UVT is tested by handheld UVT meter monthly, and recalibrated as required.



6.2.3 Chlorine Disinfection

Table 14: Chlorine disinfection critical control point

CCP 3	Chlorine disinfection					Chlorine Contact Time (C-T)
	Free Chlorine Residual (C)	pH	Flow Switch	Temperature	Instrument Status	
	Critical limits/alert limits					
Alert	C < 0.55 mg/L or C > 4.5 mg/L	pH > 8.5 or pH < 6.5	No Flow	< 16 deg C		C-T < 12.6 mg.min/L
Critical	C < 0.5 mg/L or C > 5.0 mg/L	pH > 8 or pH < 6.0	No Flow	< 15 deg C	Instrument Fault	C-T < 12 mg.min/L
	Monitoring procedures					
What	Free chlorine residual	pH	Flow switch	Temperature	Transmitter	PLC
How	AE-CCT-3A/B (E&H CCS51E)	AE-CCT-2A/B (E&H CPS11E)	FS-CCT-1A/B (E&H CYA27)	AE-CCT-1A/B (E&H CCS58D)	AIT-CCT-1A/B (E&H Liquiline CM442)	Calculated in PLC
When	Continuous, online					
Where	End of chlorine contact pipe (CCT)		Disinfection Skid	End of chlorine contact pipe (CCT)	UV-Chlorination Skid	End of chlorine contact pipe (CCT)
Who	Aquacell/Automatic					
	Corrective actions					
What	Flow diverted to Off-spec Water Holding Tank				Disinfection System goes to shutdown	Flow diverted to Off-spec Water Holding Tank
How	Close AV-461A/B and open AV-462A/B				Flow stopped	Close AV-461A/B and open AV-462A/B
When	If critical limit is exceeded for > 120 s				Immediate	If critical limit is exceeded for > 120 s
Where	PLC					
Who	Automatic					

**Free chlorine residual:**

The free chlorine residual at the end of the chlorine contact pipe is continuously monitored. If the free chlorine concentration goes outside the alert range for more than 120 seconds an alarm is triggered to warn the operator. The operator can then check the unit operation and rectify before it reaches the critical level. If the free chlorine concentration goes outside the critical range for 120 seconds, an alarm is triggered and the treated water is diverted to the Off-spec Water Holding Tank. If during diversion to the Off-spec Water Holding Tank, the free chlorine concentration goes back within the critical range for 120 seconds, the treated water will be redirected to the Treated Water Storage Tank. However, if after 2 hours the free chlorine concentration does not return within the critical range for a minimum of 120 seconds, the disinfection system will shutdown and a shutdown alarm will be generated.

Production can resume when the operator resets the alarm after the cause has been identified and addressed.

pH:

The pH measurement at the end of the chlorine contact pipe is continuously monitored. If the pH goes outside the alert range for more than 120 seconds an alarm is triggered to warn the operator. The operator can then check the unit operation and rectify before it reaches the critical level. If the pH goes outside the critical range for 120 seconds, an alarm is triggered and the treated water is diverted to the Off-spec Water Holding Tank. If during diversion to the Off-spec Water Holding Tank, the pH goes back within the critical range for 120 seconds, the treated water will be redirected to the Treated Water Storage Tank. However, if after 2 hours the pH does not return within the critical range for a minimum of 120 seconds, the disinfection system will shutdown and a shutdown alarm will be generated.

Production can resume when the operator resets the alarm after the cause has been identified and addressed.

Flow switch:

There is a flow switch in the temperature and free chlorine sample line to ensure sample flow is present. If sample flow is lost the readings are unreliable.

If the flow switch turns off for more than 60 seconds an alarm is triggered to warn the operator. If the flow switch is off more than 120 seconds, an alarm is generated and the treated water is diverted to the Off-spec Water Holding Tank. During diversion to the Off-spec Water Holding Tank, if the flow switch turns back on for 120 seconds, the treated water will be redirected to the Treated Water Storage Tank. However, if after 2 hours the flow switch has not turned on for a minimum of 120 seconds, the disinfection system will shutdown and a shutdown alarm will be generated.

Production resumes when the operator resets the alarm after the cause has been identified and addressed.

Water temperature:

The chlorine contact system has been designed based on chlorine contact time (C-T) values for a minimum temperature of 15 deg C.

If the temperature drops below the alert level for more than 120 seconds an alarm is triggered to warn the operator. If the temperature drops below the critical level for 120 seconds, an alarm is triggered and the treated water is diverted to the Off-spec Water Holding Tank. If during diversion to the Off-spec Water Holding Tank, the temperature increases back above the critical level for 120 seconds, the treated water will be redirected to the Treated Water Storage Tank. However, if after 2 hours the temperature does not return above the critical limit for a minimum of 120 seconds, the disinfection system will go to shutdown and a shutdown alarm will be generated.

Production can resume when the operator resets the alarm after the cause has been identified and addressed. An increased chlorine residual may be required to allow continued operation at a lower temperature.



Instrument Status:

If there is a CCT instrument critical fault, the disinfection system will immediately go to shutdown and a shutdown alarm will be generated.

Production resumes when the operator resets the alarm after the cause has been identified and addressed.

Chlorine Contact Time:

The chlorine contact time (C-T) is calculated in the PLC using the free chlorine concentration and the flowrate. If the chlorine contact time (C-T) decreases below the critical level for 120 seconds, an alarm is triggered and the treated water is diverted to the Off-spec Water Holding Tank. If during diversion to the Off-spec Water Holding Tank, the C-T increases back above the critical level for 120 seconds, the treated water will be redirected to the Treated Water Storage Tank. However, if after 2 hours the C-T does not return above the critical limit for a minimum of 120 seconds, the disinfection system will shutdown and a shutdown alarm will be generated.

Production can resume when the operator resets the alarm after the cause has been identified and addressed.

Maintenance:

The pH probe is checked against buffer solutions monthly and recalibrated if required.

The free chlorine probe is checked against a DPD photometric free chlorine test monthly and recalibrated as required.

Temperature tested by handheld temperature probe monthly, and recalibrated as required.

6.2.4 Treated Water Storage Chlorination System

Table 15: Treated Water Storage Chlorination quality control point

QCP 1	Total Chlorine Residual (TC)	pH	Sample Flow Switch	Instrument Status
Alert	TC < 0.5 mg/L or TC > 5.0 mg/L	pH < 6.5 mg/L or pH > 9.0 mg/L	No Flow	Instrument Fault
Monitoring procedures				
What	Total chlorine residual	pH	Flow Switch	Transmitter
How	AE-STO-02 (E&H CCS53E)	AE-STO-01 (E&H CPS11E)	FS-STO-01 (E&H CYA27)	AIT-STO-01 (E&H Liquiline CM442)
When	Continuous, when Treated Water Storage Tank recirculation pump is running			
Where	Treated Water Storage Tank recirculation			
Who	Aquacell/Automatic			
Corrective actions				
What	Warning alarm only for < 0.5 mg/L. Stops chloramine dosing pumps if > 5 mg/L		Warning alarm and stop chloramine dosing pumps	
How	PLC triggers alarm		PLC triggers alarm and stops the dosing pumps.	
When	If alert limit is exceeded for > 120 s			Immediate
Where	PLC/HMI			
Who	Automatic			

**Total chlorine residual:**

When the Treated Water Storage Tank recirculation pump is running, the total chlorine level is continuously monitored to ensure that there is a residual in the treated water distribution system. If the total chlorine level is below the alert limits for more than 120 seconds, an alarm is generated to warn the operator. If the total chlorine level is above the alert limit for more than 120 seconds, an alarm is generated to warn the operator and the chloramination dosing pumps are stopped.

The alert is reset after the total chlorine level is within the range for 120 seconds.

Treated water pH:

The pH in the treated water tank is continuously monitored to ensure it is within the range. If the pH is not within the limits for 120 seconds a warning alarm is generated.

Flow switch:

There is a flow switch in the pH and total chlorine sample line to ensure sample flow is present when the Treated Water Storage Tank recirculation pump is running. If sample flow is lost, the pH and total chlorine readings are unreliable. If the flow switch turns off for more than 60 seconds an alarm is triggered to warn the operator. If the flow switch is off more than 120 seconds, an alarm is generated and the chloramine dosing pumps are stopped.

Chemical dosing resumes after the cause has been identified and addressed.

Instrument Status:

If a treated water storage tank instrument fault occurs when the Treated Water Storage Tank recirculation pump is running, chemical dosing pumps will be shutdown and an alarm will be triggered.

Chemical dosing resumes after the cause has been identified and addressed.

Maintenance:

The pH probe is checked against buffer solutions monthly and recalibrated if required.

The total chlorine probe is checked against a DPD photometric total chlorine test monthly and recalibrated as required.



6.3 Standard operating procedures

An operations and maintenance manual will be supplied with the system to explain detailed operation. This includes a description of the CCP's and QCP's and required operator actions.

A summary of the CCP's is provided in Table 16 along with the control response and operator actions. Further details are provided in the operating and maintenance manual.

During shutdown, wastewater is collected in the buffer tank which has been sized to hold a three-day supply of blackwater. If during shutdown the buffer tank reaches full capacity, it will be pumped out.

Table 16: CCP Summary of control system response and operator actions

CCP	Control System Response	Operator Actions
CCP 1 – MBR	The MBR filtrate turbidity, instrument status and flow switch status are continuously monitored. The MBR will go into recirculation mode if the turbidity conditions are not met.	The system will automatically reset when CCP parameters are in spec. However, if this does not occur, the MBR will go into standby and operator intervention will be required. The operator should contact Aquacell for a detailed investigation. The most likely causes are membrane system leaks (seals or membrane integrity), faulty turbidity readings (due to air bubbles), or biogrowth shedding from pipework.
CCP 2 – UV Disinfection	The validated UV dose is continuously calculated and monitored along with UVT, lamp age and UV status. The plant diverts water to the Off-spec water holding tank after the CCT if the UV conditions are not all met.	The system will automatically reset when CCP parameters are in spec. However, if this does not occur, the disinfection system will shutdown and operator intervention will be required. The relevant parameters that affect UV dose are individually monitored and alarmed to guide the operator response. If further troubleshooting is required, contact Aquacell.
CCP 3 - Chlorination	The free chlorine concentration is continuously monitored along with the pH, temperature, flowrate, instrument status and flow switch status. The plant diverts water to the Off-spec water holding tank after the CCT if the chlorine disinfection conditions are not all met.	The system will automatically reset when CCP parameters are in spec. However, if this does not occur, the disinfection system will shutdown and operator intervention will be required. The most likely issues will be around chlorine dose or chlorine demand. If no obvious faults are present, contact Aquacell.



7. Verification and Ongoing monitoring

To provide evidence that the overall system can deliver water of the specified quality, the verification monitoring plan detailed in Table 17 will be used. This will provide a total of 12 samples over 6 weeks.

Influent and treated water samples will be taken as defined below using Aquacell's sampling procedure (Appendix 6). Sample analysis is undertaken at a NATA accredited laboratory.

Table 17: Treated water verification monitoring program

Parameter	Units	Sampling Frequency (per week)	Duration of monitoring program (weeks)	Compliance Value
Influent				
E.coli	cfu/100ml	2	6	NA
FrNA Coliphage	pfu/100mL	2	6	NA
Clostridium perfringens	cfu/100mL	2	6	NA
Biochemical oxygen demand (BOD)	mg/L	2	6	NA
Total suspended solids (TSS)	mg/L	2	6	NA
pH		2	6	NA
Treated Water				
E.coli	cfu/100ml	2	6	< 1
FrNA Coliphage	pfu/100mL	2	6	< 1
Clostridium perfringens	cfu/100mL	2	6	<1
Crypto-sporidium oocysts	oocysts/L	1 sample during monitoring period	6	<1
Biochemical oxygen demand (BOD)	mg/L	2	6	< 10
Total suspended solids (TSS)	mg/L	2	6	< 10
Turbidity (MBR filtrate) (NTU)	NTU	Continuous online	6	≤ 0.2
Validated UV Dose (virus)	mJ/cm2	Continuous online	6	≥ 58
Free Chlorine (FRC – post CCT)	mg/L	Continuous online	6	Target between 0.5 and 5.0
Chlorine Contact Time (C-T)	mg.min/L	Continuous online	6	C-T ≥ 12
pH (CCT)		Continuous online	6	pH ≤ 8
Total Chlorine (Treated Water Storage)	mg/L	Continuous online	6	TC ≥ 0.5 and TC ≤ 5.0



To provide evidence that the overall system can deliver water of the specified quality on an on-going basis, the following on-going monitoring plan is proposed (Table 18).

Table 18: Treated water ongoing monitoring program

Parameter	Units	Monitoring frequency	Compliance Value
Treated Water			
E.coli	cfu/100ml	Monthly	< 1
Turbidity (MBR filtrate) (NTU)	NTU	Continuous online	≤ 0.2
Validated UV Dose (virus)	mJ/cm ²	Continuous online	≥ 58
Chlorine Contact Time (C-T)	mg.min/L	Continuous online	C-T ≥ 12
pH (CCT)		Continuous online	pH ≤ 8
Total Chlorine (Treated Water Storage)	mg/L	Continuous online	TC ≥ 0.5 and TC ≤ 5.0

8. Prerequisite programs

For the effective operation of this RWQMP, prerequisite programs that outline detailed procedures and protocols will be provided.

Operations and Maintenance Procedures:

An operations and maintenance manual in accordance with the AGWR will apply to the scheme and will be attached in Appendix 11. Included in the manual are the Standard Operating Procedures, Maintenance Procedures, Calibration Procedures and Chemical Safety Procedures.

Calibration of Monitoring Instruments:

The calibration of all on-line monitoring instruments will be conducted in accordance with the manufactures' recommendations. The calibration of each instrument is logged and maintained on a standard maintenance record.

Chemical Quality Assurance:

All chemicals required for cleaning, maintenance and water treatment will be supplied by an ISO9001 accredited supplier.

Organisational Quality Management:

Aquacell has developed an in-house management system, IMS (Integrated Management System), which is regularly audited. This system documents Aquacell's regulatory, risk and organisational procedures and protocols.

Inspections:

The plant is under continuous remote supervision by Aquacell as the contracted operator. Data logging of key parameters is a part of this supervision. Weekly inspections are conducted and a checklist is completed by the scheme manager according to the service agreement between the scheme manager and Aquacell. The responsibilities will be clearly delineated in the service agreement. Also, in accordance with the service agreement, monthly maintenance including instrument calibration checks are carried out by Aquacell and records maintained. Quarterly servicing is also carried out by Aquacell and records maintained.



Aquacell will provide the necessary training for the scheme manager's staff to perform the work required. Records of this training will be kept by Aquacell.

9. Incidents and emergencies

Aquacell maintains a community contact and FAQ section of its website with procedures relating to the management of emergencies. This will be updated to include the Alspecc Industrial Business Park BWTP.

In addition, a meeting attended between Aquacell, the scheme manager and its relevant contractors will be held to review emergency procedures that are specific to the recycled water scheme and the precinct.

Table 19 describes emergency response incidents and procedures.

Table 19: Incidents and emergencies

Hazards and events that may lead to emergencies	Immediate Response		Corrective Action		Authorities	
	What	Who	What	Who	What	Who
Non-conformance of water with critical limits	If detected by online instrument, plant automatically shuts off supply	Aquacell	Aquacell diagnose and rectify.	Aquacell	Has non-compliant water been delivered? If yes, Aquacell notify the scheme manager. The scheme manager to notify NSW Health.	The scheme manager
Response to exceedances of water quality targets	If there are any occurrences of positive results for the ongoing water quality monitoring as described in Table 18, supply of recycled water should be stopped, and the cause investigated. Aquacell to notify the scheme manager. The scheme manager to immediately notify NSW Health.	Aquacell/ The scheme manager	Aquacell to investigate cause and rectify. Re-test and achieve compliance before resuming delivery of recycled water.	Aquacell	Aquacell to notify the scheme manager. The scheme manager notify NSW Health.	The scheme manager
Accidents that increase level of contamination in source water	Feed water continuously monitored for pH.	Aquacell	Pause production investigate cause. Production resumed once pH returned to specification (may need manual adjustment)	Aquacell	NA	NA
Equipment breakdown and mechanical failure	Critical equipment alarmed for malfunction. Alarm received by operator. Operator to log in and inspect operation of plant. Disable plant if required.	Aquacell	Repair	Aquacell	NA	NA
Cross-connections	If a cross connection is detected, immediately stop use of treated water, and switch to potable water backup.	The scheme manager	Conduct audit to identify location of cross-connection. Rectify. Preventative measures include signage, labelling, colour-coding,	The scheme manager	Should a cross-connection be identified, notify the scheme manager and Aquacell. The scheme	The scheme manager



			information brochures for plumbers and public. Do not reinstate delivery of treated water until cross connect audit has been completed.		manager in turn notify NSW Health.	
Prolonged power outages	Plant shuts down in a safe state on power failure. Notify Aquacell so that restart procedures and checks can be made and the plant monitored during start-up. Potable water backup will provide water needs automatically.	The scheme manager	Remote operator log-in. Restart operation on return of power.	Aquacell	NA	NA
Leakage, spillage, or runoff of recycled water or greywater on site.	For minor contained spills, notify the scheme manager for repair. If treatment plant is responsible contact Aquacell.	The scheme manager	The scheme manager or site management to respond. Aquacell to action if treatment plant is responsible. Incident report to be prepared and corrective actions implemented.	Aquacell/ The scheme manager	If major spill that contaminates or potentially contaminates the environment also contact NSW Health, Department of Planning and Environment, IPART and the City of Penrith Council.	The scheme manager

10. Employee awareness and training

The scheme manager and Aquacell are responsible for ensuring their respective employees and contractors are familiar with the operation of the scheme and aware of the potential consequences of system failures, and of how their decisions can affect the safety of the scheme.

Aquacell will provide an experienced water recycling engineer to monitor the plant. Any contractors used on site must be accredited, qualified and have the appropriate level of training.

A site induction will be required for anyone doing work related to this scheme. This will be carried out and recorded by the scheme manager for work on the dual pipe system, and by Aquacell for work on the treatment plant. For plant work this includes familiarization with Aquacell's Safe Work Method Statements (SWMS's) which are site specific. Aquacell maintains a partnership with several contractors to ensure continuity of knowledge and technical expertise.

Aquacell has an induction program for new employees and written procedures for all areas of responsibility.

Training needs for Aquacell employees are identified and adequate resources made available during the induction phase. Annual performance reviews identify additional training requirements and set performance targets. Training records are kept.

11. Documentation and reporting

11.1 Documentation

The following records and documents will be maintained by Aquacell as the water recycling plant operator.



- Verification and on-going monitoring results
- CCP monitoring results and analysis
- Plant operation data
- Laboratory testing results and analysis
- Breaches of critical limits and corrective actions taken
- Incidents and emergencies and corrective actions taken
- Inspection and maintenance activities relevant to water quality

CCP results and operation data will be collected by an online data acquisition system and kept as an electronic copy by Aquacell.

Verification results will be collected by Aquacell from a NATA accredited testing laboratory and stored electronically by Aquacell.

A record of any maintenance to the treatment plant will be kept. Any equipment adjusted, repaired, replaced or calibrated will be recorded. Monthly maintenance checks and calibrations are recorded on a monthly maintenance checklist (See Operations and Maintenance Manual (Appendix 11), and stored according to Aquacell's document management procedures.

11.2 Reporting

Aquacell will provide a monthly report to the scheme manager in relation to the operation and maintenance of the water recycling plant.

Separate reports, as required by the relevant authorities will also be prepared. These reports will be signed by the designated Aquacell person and includes:

- a summary of the review and improvement processes, and whether the RWQMP has been complied with,
- a summary of priority areas for improvement and actions to address any non-compliances with the RWQMP,
- an analysis of the monitoring data collected for the management of environmental risks,
- an analysis of the monitoring data collected under the RWQMP,
- a summary of incidents and emergencies, including corrective actions,
- a listing or register of supplied recycling schemes, including quality, quantity and type of use, and
- a summary of audit outcomes.

The reports will also be signed by a person authorised as a representative of the organisation/s receiving the report.

11.3 Notifications

Aquacell, as the operator of the recycled water plant, must immediately notify the scheme manager of any incidents that occur with the treatment process or plant that could affect health. This includes:

- Incidents where recycled water has been supplied that does not comply with the three CCP conditions described in Section 0,
- Any other incident or emergency that could directly or indirectly impact on the health of the end users.

Notification should include details of corrective and future preventive action.



Contact details for various key entities in the project are listed in the table below. These will be updated from time to time as appropriate.

Table 20: Contact details

Entity	Contact	Details
Sydney Local Health District Public Health Unit (NSW Health)	Public Health officer	Phone: 02 9515 9420 Phone (after hours): 02 9515 6111 (to speak with the Public Health Officer on call for environmental health) Email: SLHD-PHUEHO@health.nsw.gov.au
IPART	TBA	TBA
Scheme Manager	TBA	TBA
Aquacell	Colin Fisher, Managing Director	Address: Suite 602, 6A Glen Street, Milsons Point, NSW 2061. Phone: 02 4721 0545 Mobile: 0409 393 389 Email: colinf@aquacell.com.au

12. Review and improvement

The plant operation and RWQMP will be reviewed annually and updated as needed. This is an internal review process with appropriate operating staff. The review and improvement process will include:

- Critical analysis of current improvement procedures
- Identify all known deficiencies that require improvement
- Make comparisons with targets and current practices
- Identification of new and continuous improvement opportunities
- Document success of improvements made
- Overall verification of current improvement practices

Any changes to CCP limits must be endorsed by NSW Health or approved by IPART before being implemented.

13. Commissioning the RWQMP

All operational monitoring, critical alarms and corrective actions within the RWQMP will be tested and verified as part of commissioning. A verification report and cross connection audit will be conducted and submitted to IPART for review and approval before any treated water is delivered for use in the precinct.

14. Plumbing

The Building plumbing and drainage system has been designed in accordance with the Water Supply Code of Australia and in accordance with AS/NZS 3500.1 & AS/NZS3500.2.



15. Appendices

Appendix 1 – Process Flow Diagram

Appendix 2 – General Arrangement

Appendix 3 – Aquacell Recycled Water Policy

Appendix 4 – HAZOP and HACCP Analysis

Appendix 5 – WICA Scheme Approval to Install - pending

Appendix 6 - Aquacell Sampling Procedure

Appendix 7 – WICA Retailer Licence

Appendix 8 – WICA Operator Licence

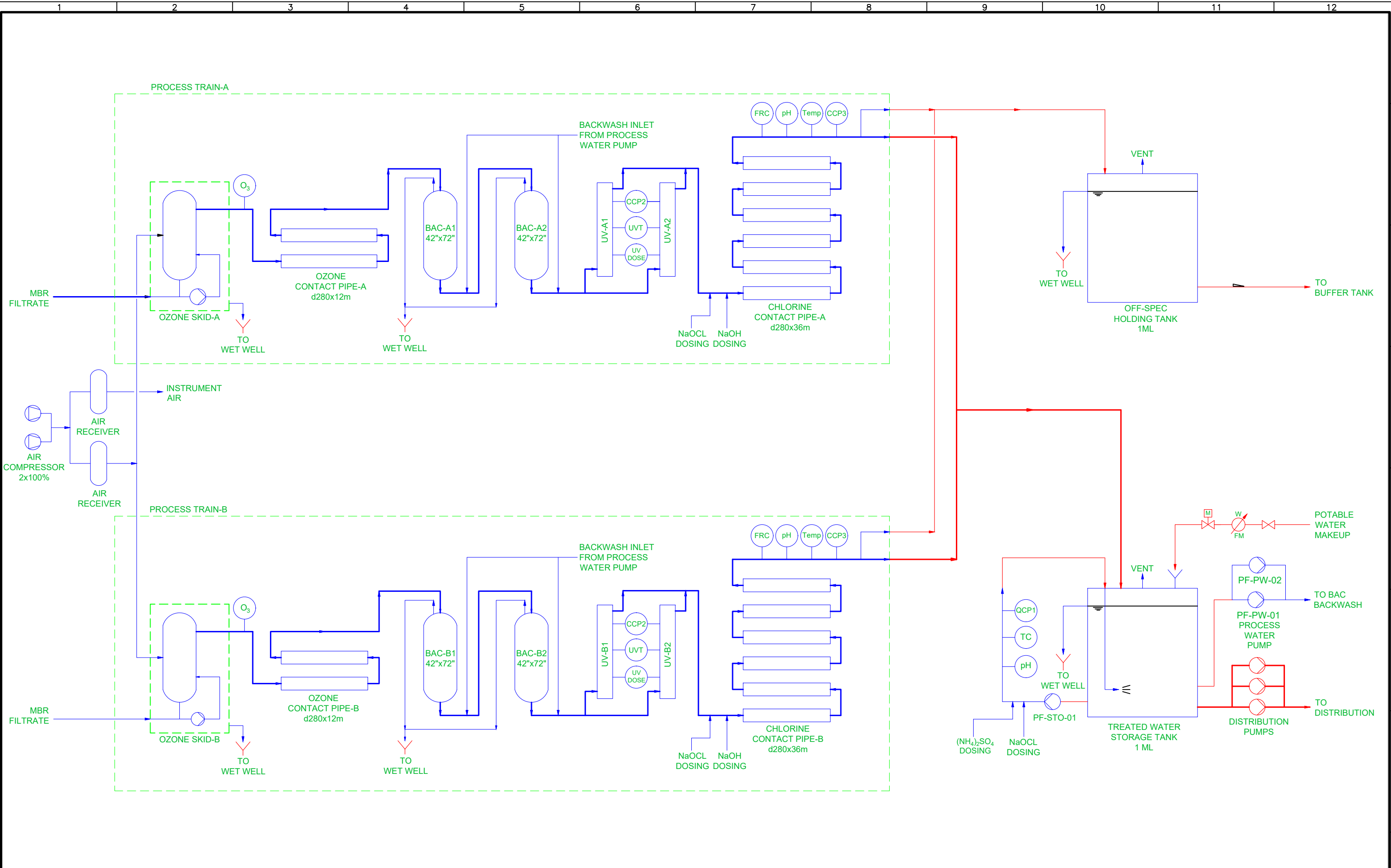
Appendix 9 – Plumbing Audit (Cross Connection Audit) - pending

Appendix 10 – Verification Report - pending

Appendix 11 – Operation and Maintenance Manual - pending



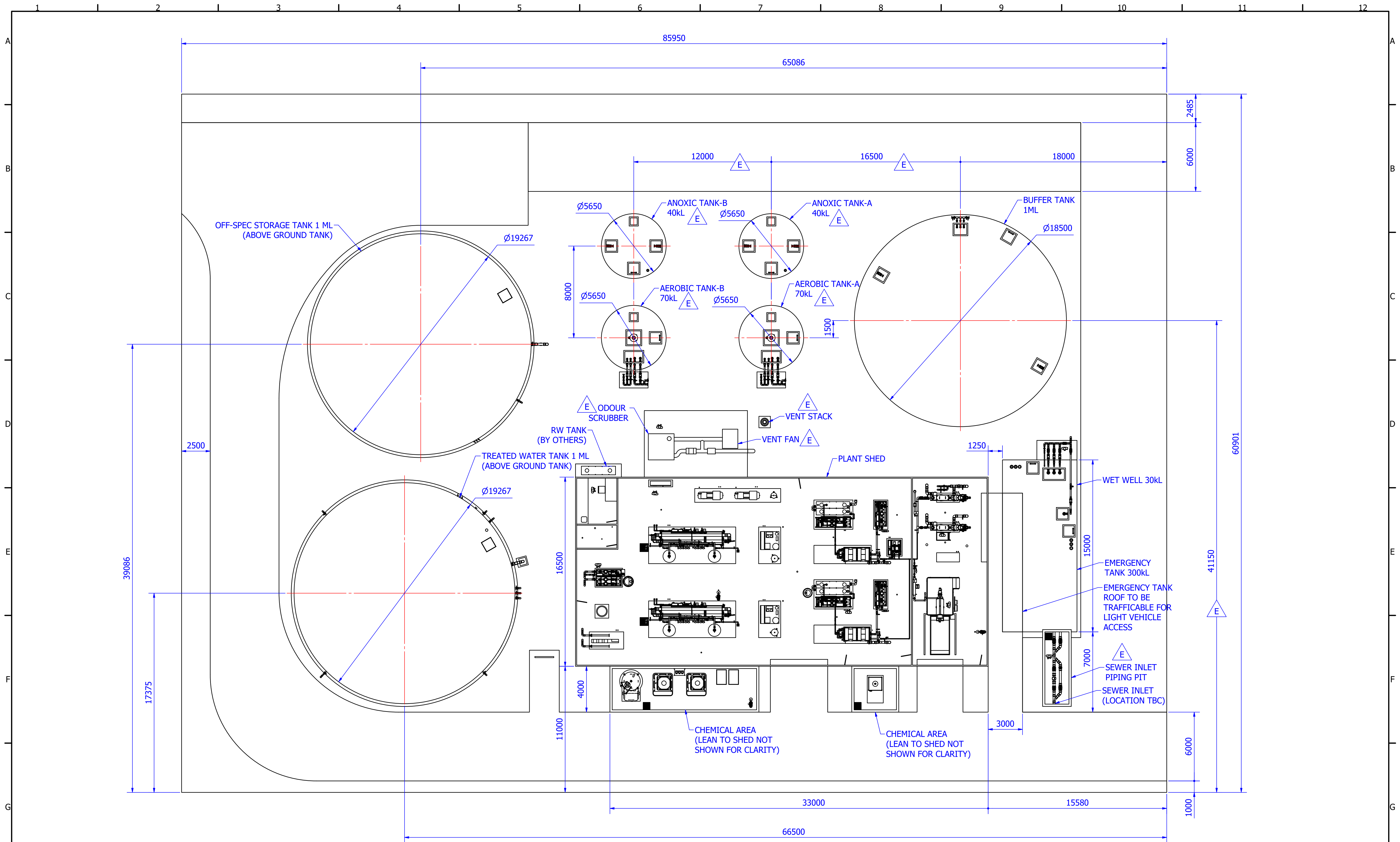
Appendix 1 – Process Flow Diagram



REVISION TABLE												THIS DRAWING IS STRICTLY CONFIDENTIAL AND REMAINS THE PROPERTY OF AQUACELL PTY LTD. IT SHALL NOT BE USED OR REPRODUCED WITHOUT WRITTEN PERMISSION OF THE COMPANY. © 2018 Aquacell Pty Ltd		DRAWN	S.B	DATE	15-Sep-2023	TITLE PROCESS FLOW DIAGRAM BLACKWATER TREATMENT PLANT				
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED			CHECKED	A.E	DATE	15-Sep-2023					
A	15-Sep-2023	INITIAL ISSUE	S.B	E.B	J.J									APPROVED	J.J	DATE	15-Sep-2023					
B	14-Jun-2024	UPDATED	S.B	W.J	W.J									JOB No A0144		DRAWING No A0144-002		PROJECT LUDDENHAM RD ORCHARD HILLS				
C	27-Jun-2025	UPDATED	S.B	S.A	W.J									Suite 602, 6A Glen St Milsons Point NSW 2061 Australia P: 2 4721 0545 Email: info@aquacell.com.au								
D	28-Aug-2025	UPDATED	S.B	S.A	W.J							GENERAL TOLERANCES U.N.O LINEAR : ± 0.5 mm ANGULAR : ± 0.05 deg ALL DIMENSIONS IN mm U.N.O										
																	DRAWING STANDARD AS1100					

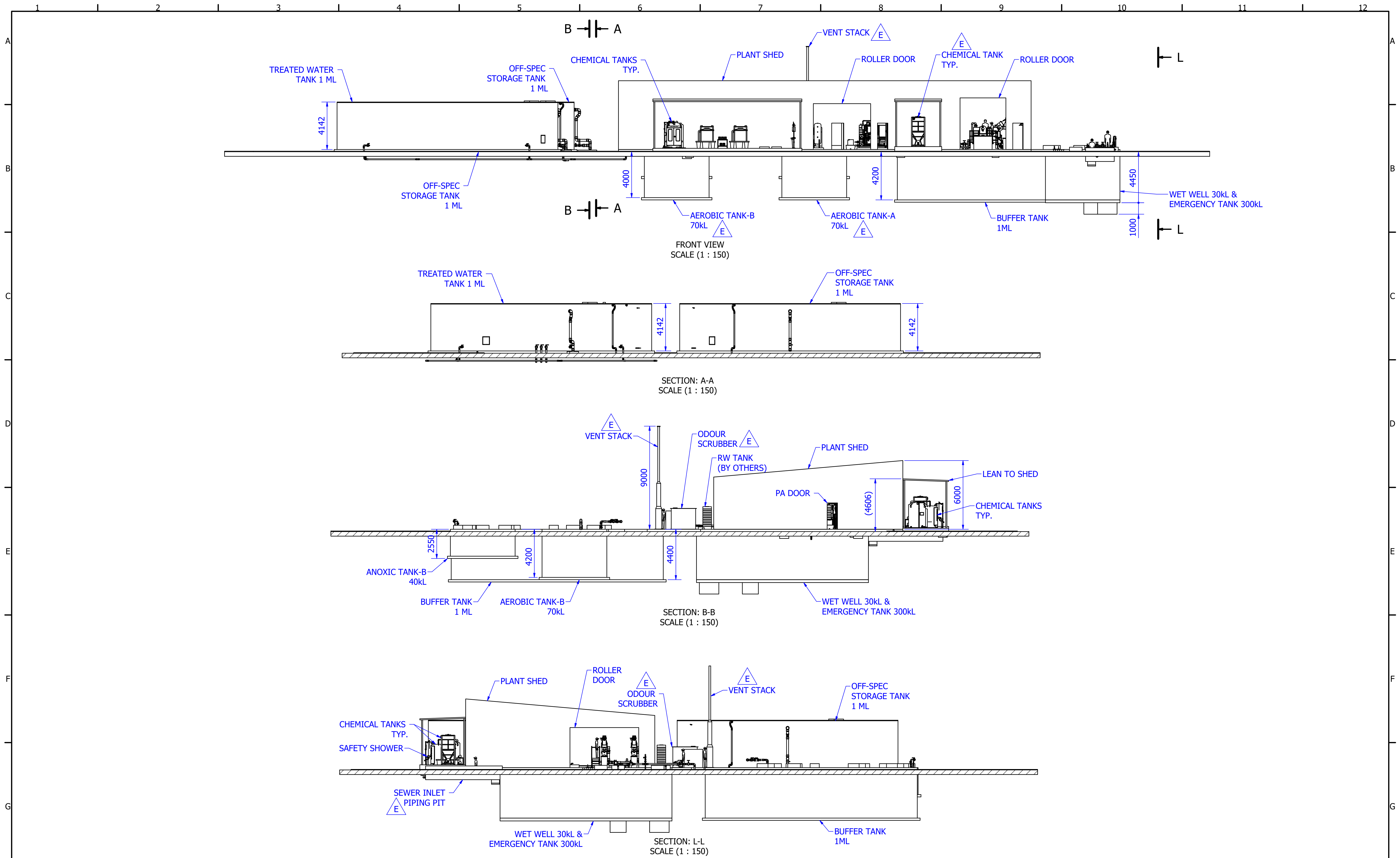


Appendix 2 – General Arrangement



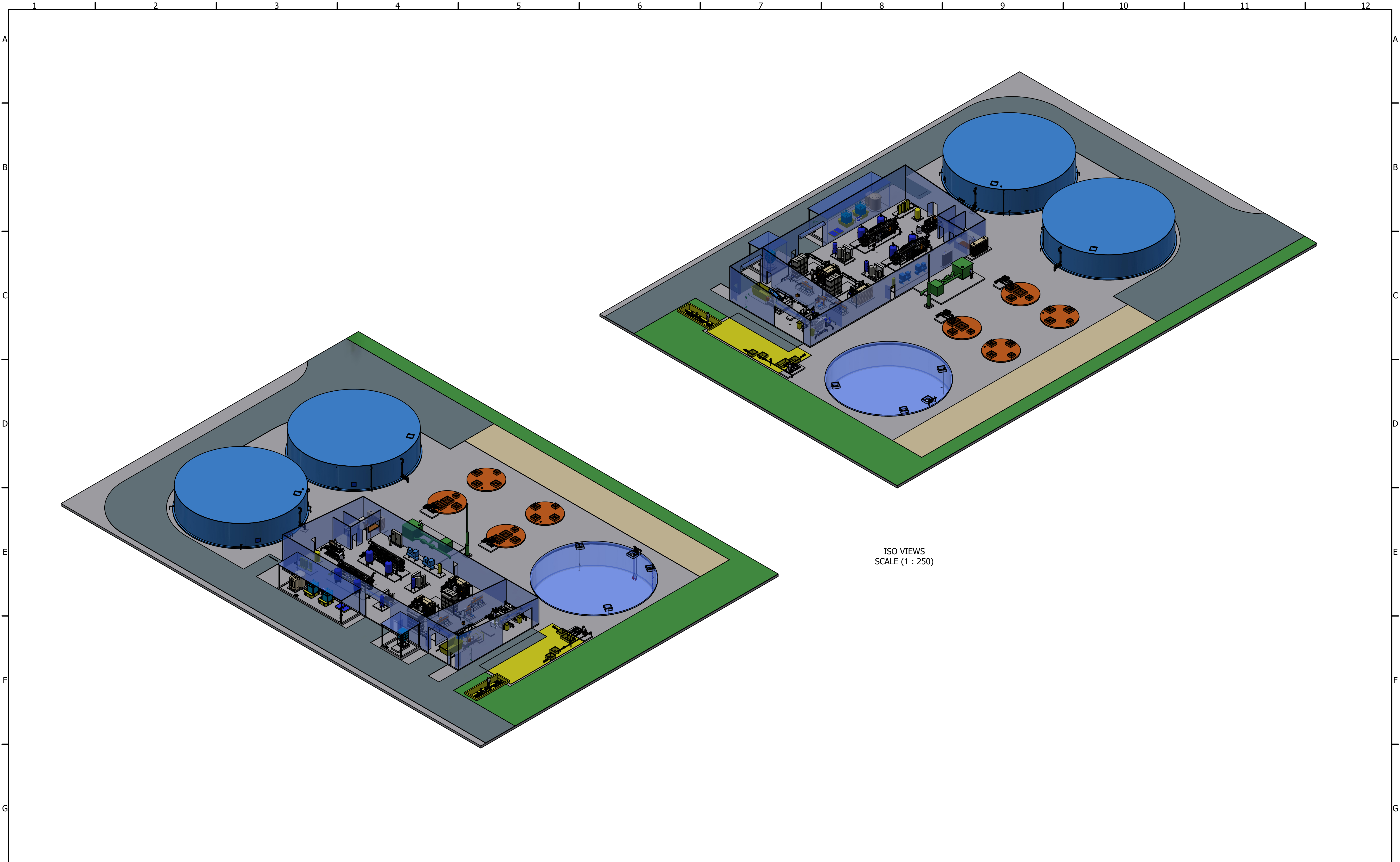
PLAN VIEW
SCALE (1 : 150)

SCALE (1 : 150)					THIS DRAWING IS STRICTLY CONFIDENTIAL AND REMAINS THE PROPERTY OF AQUACELL PTY LTD. IT SHALL NOT BE USED OR REPRODUCED WITHOUT WRITTEN PERMISSION OF THE COMPANY. © 2014 Aquacell Pty Ltd				DRAWN	S.BIABANI	DATE	15/09/2023	TITLE LAYOUT BLACKWATER TREATMENT PLANT						
E	27-Jun-2025	UPDATED		S.BIABANI					J.JENNINGS	CHECKED	A.EISENHAMMER	DATE					15/09/2023		
D	17-Jun-2025	UPDATED		S.BIABANI	J.JENNINGS	APPROVED	J.JENNINGS	DATE	15/09/2023										
C	02-May-2025	UPDATED		S.BIABANI	J.JENNINGS	GENERAL TOLERANCES U.N.O WHOLE : ± 1.0 mm DECIMAL : ± 0.5 mm ANGULAR : ± 0.5 deg ALL DIMENSIONS IN mm U.N.O		Suite 602, 6A Glen St, Milsons Point NSW 2061 Australia P:+61 2 4721 0545 email:info@aquacell.com.au		JOB No		DRAWING No		PROJECT LUDDENHAM RD ORCHARD HILLS					
B	14-Jun-2024	UPDATED		S.BIABANI	W.JOHNSON					A0144		A0144-302							
A	15-Sep-2023	INITIAL ISSUE		S.BIABANI	A.EISENHAMMER														
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1 2 3 4 5 6 7 8 9 10 11 12																			



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C	02-May-2025	UPDATED		S.BIABANI	J.JENNINGS
B	14-Jun-2024	UPDATED		S.BIABANI	W.JOHNSON
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				GENERAL TOLERANCES U.N.O				A0144		A0144-302		LAYOUT			
				WHOLE : ± 1.0 mm		Suite 602, 6A Glen St, Milsons Point		JOB No		DRAWING No		PROJECT			
				DECIMAL : ± 0.5 mm		NSW 2061 Australia P:+61 2 4721 0545		A0144		A0144-302		LUDDENHAM RD ORCHARD HILLS			
				ANGULAR : ± 0.5 deg		email:info@aquacell.com.au		DRAWING STANDARD : AS1100		DO NOT SCALE		Rev: E		SHEET No: 2 OFF 8	
				ALL DIMENSIONS IN mm U.N.O										A1	



ISO VIEWS
SCALE (1 : 250)

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A	15-Sep-2023	INITIAL ISSUE		S.BIABANI	A.EISSENHAMMER
REV	DATE	DESCRIPTION			CHECKED

REVISION HISTORY

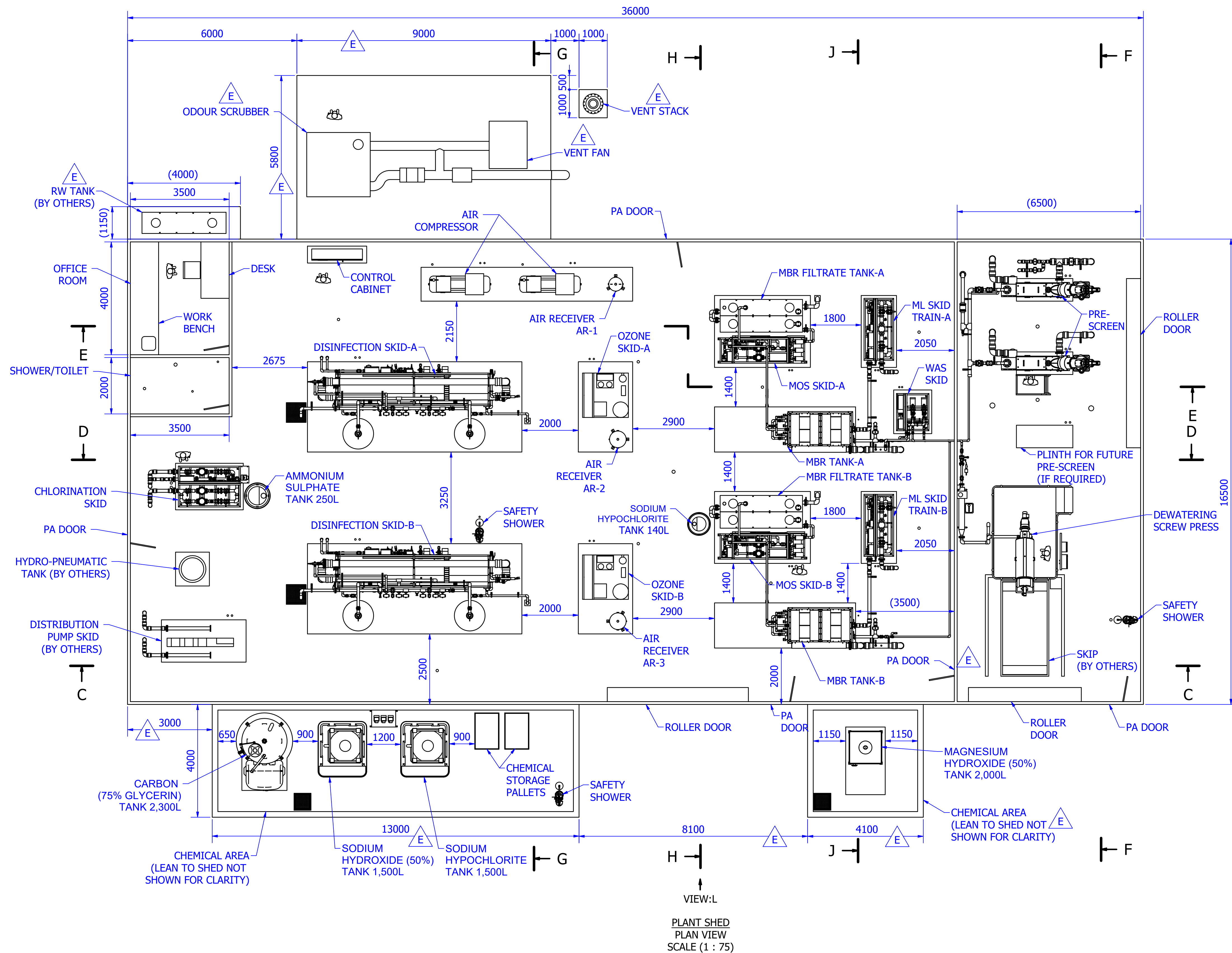
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APPROVED	J.JENNINGS	DATE	15/09/2023		
JOB No A0144		DRAWING No A0144-302		PROJECT LUDDENHAM RD ORCHARD HILLS	
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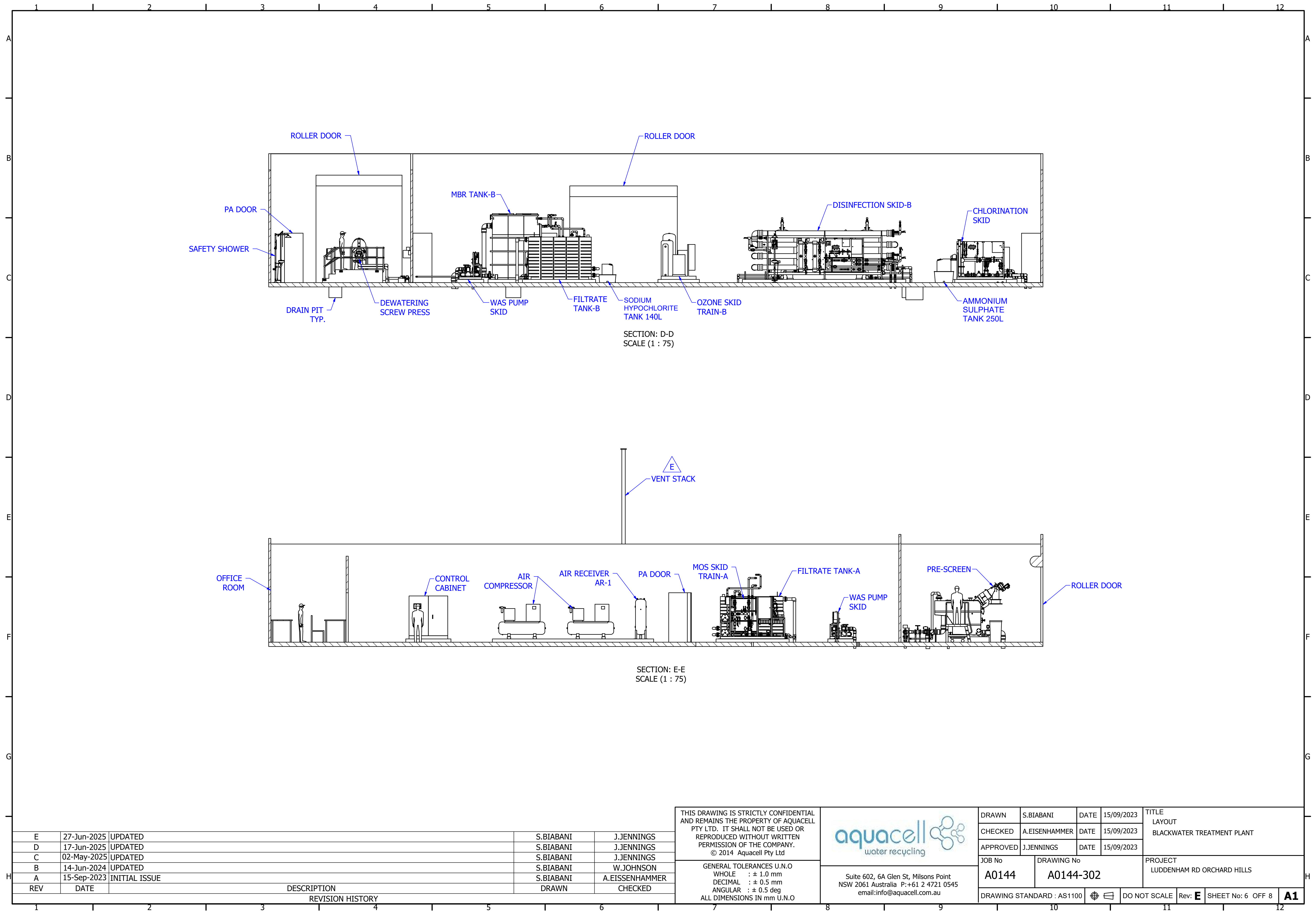
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REV	DATE	DESCRIPTION		DRAWN	CHECKED

REVISION HISTORY

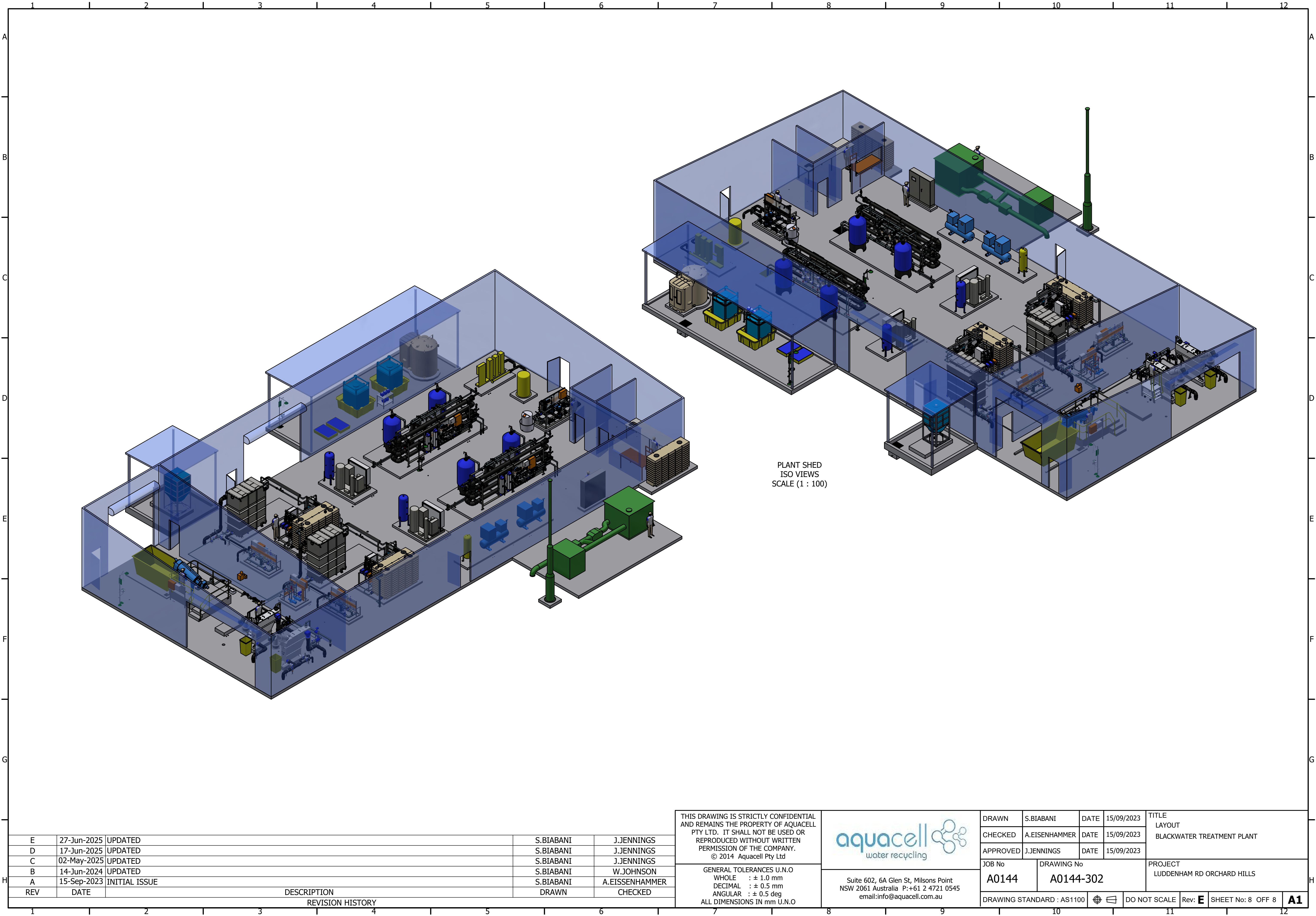
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DRAWING STANDARD : AS1100			 	DO NOT SCALE	Rev: E	SHEET No: 8 OFF 8	A1



Appendix 3 – Aquacell Recycled Water Policy

Aquacell Recycled Water Policy





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Recycled Water Policy.....	4



Document Creation and Review

Revision No	Author	Reviewed By	Approved By	Date
Draft (EM 010-01)	P. Coulton	C. Fisher	C. Fisher	22 July 2011
EM010-2		Annabelle Caspersz		5 December 2011
EM010-3	Edited A. Hidalgo	Colin Fisher		15 July 2025

Document Control

Revision No	Status	Issued To		Date
		Name	Organisation	



RECYCLED WATER POLICY

Aquacell supports and promotes the responsible use of recycled water and the application of a management approach that consistently meets the *Australian Guidelines for Water Recycling*, as well as recycled water user and regulatory requirements.

To achieve this we will:

- Ensure that the protection of public and environmental health is recognised as being of paramount importance.
- Maintain communication and partnerships with all relevant agencies involved in management of water resources, including waters that can be recycled.
- Engage appropriate scientific expertise in developing recycled water schemes.
- Recognise the importance of community participation in decision making processes and the need to ensure the community expectations are met.
- Manage recycled water quality at all points along the delivery chain from source to the recycled water user.
- Use a risk based approach in which potential threats to water quality are identified and controlled.
- Integrate the needs and expectations of our users of recycled water, communities and other stakeholders, regulators and employees into planning processes.
- Establish regular monitoring of control measures and recycled water quality and establish effective reporting mechanisms to provide relevant and timely information and promote confidence in the recycled water supply and its management.
- Develop appropriate contingency planning and incident response capability.
- Participate in appropriate research and development activities to ensure continuous improvement and continued understanding of recycled water issues and performance.
- Contribute to the development of industry regulations and guidelines and other standards relevant to public health and the water cycle.
- Continually improve our practices by assessing performance against corporate commitments and stakeholder expectations.

Aquacell will implement and maintain recycled water management systems consistent with the *Australian Guidelines for Water Recycling* to effectively manage the risks to public and environmental health.

All managers and employees involved in the supply of recycled water are responsible for understanding, implementing, and continuously improving the recycled water management system. Membership and participation in professional associations dealing with management and use of recycled water is encouraged.

Colin Fisher

Managing Director

22nd July 2011



Appendix 4 – HAZOP and HACCP Analysis

DESIGN /			Before Mitigation				After Mitigation				Uncertainty	Decision Tree	CCP/Q CP	Critical Levels		Monitoring	Corrective Action			Records	CONSTRUCTION STAGE HACCP			COMMISSIONING / HANDOVER STAGE HACCP			
Step	Potential Hazard	Preventative Measure	Likelihood	Consequence	Resid. Risk	Risk Rating	Likelihood	Consequ ence	Resid. Risk	Risk Rating				Y or N	Action	How	What	How	Where		Action Checked	By	Date	Action Checked	By	Date	Closed Out
Process unit	Physical Hazard: Biological: other		2 to 5	2 to 5	D + E		2 to 5	2 to 5	D + E				Target	Action													
	Physical Hazard: Aerated liquid reduces ability to float in tank if person falls in	All lids and hatches secured by bolts or locks to prevent accidentally falling in Plant room only accessible to authorised personnel.	3	5	7	Very High	1	5	6	High	± 1	Y	N	N	No												
	Physical Hazard: Electrocution from terminal box	If rating of terminal box is appropriate selected.	4	5	9	Very High	1	5	6	High	± 1	Y	N	N	No		Note this hazard has been added at P.C stage	AQ design team	20-August-2025								
4. UF Membrane Filtration (membrane tank, silt and filtrate tank)	Health Hazard: Membrane integrity is compromised leading to reduced disinfection	Turbidity constantly monitored to determine membrane integrity.	4	4	8	Very High	1	4	5	Moderate	± 1	Y	Y	CCP1	Alert level > 0.35 NTU Critical Level > 0.2 NTU	Operator alarm is alert level triggered if critical level is exceeded, the MCS system recirculates for a period to see if the turbidity reduces. If turbidity does not come back within range, the MCS system generates an alarm and goes into standby state.	Continuous online monitoring of turbidity during filtration and recirculation by PLC and actuated valve when required.	MCS goes into standby if turbidity does not reduce during recirculation. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging.							
	Health Hazard: Turbidity measurement does not reflect the current state of the water because there is no flow through the instrument.	Flow switch installed in the instrument loop upstream of the turbidity meter	4	4	8	Very High	1	4	5	Moderate	± 1	Y	Y	CCP1	No Flow	If no flow is detected, the MCS system recirculates for a period to see if the flow returns. If flow does not return, the MCS system generates an alarm and goes into standby state.	Continuous online monitoring of turbidity during filtration and recirculation by PLC and actuated valve when required.	MCS goes into standby if flow does not return during recirculation. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging.							
	Health Hazard: Turbidity instrument faults	The turbidity instrument has a built in fault relay which is wired to the PLC	4	4	8	Very High	1	4	5	Moderate	± 1	Y	Y	CCP1	Instrument fault	If fault is detected, the MCS system immediately goes into standby state the MCS system generates an alarm.	Continuous online monitoring of turbidity fault relay during filtration.	MCS goes into standby if fault does not rectify during recirculation. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging.							
	Chemical Hazard: CIP requires operators to use chemicals	CIP process is automated. Chemicals are dosed into the system automatically reducing which almost eliminates the requirement for the operator to handle chemicals. Chemicals can be neutralised within the system in a similar manner before they are sent back to the head of the works. Chemicals are common in water treatment plants and can readily be handled with appropriate PPE.	3	3	6	High	1	3	4	Low	± 1	Y	Y	N	No												
	Physical Hazard: Membrane installation requires manual handling	Membranes have a life expectancy of 15 years so the activity is rare. The plant room has been designed to leave space to make installation and replacement safe. Two people are used to replace or install membranes.	3	3	6	High	1	3	4	Low	± 1	Y	Y	N	No												
5. Ozone System	Chemical and Health Hazard: Ozone exposure and insulation of ozone if leakage occurred	Ozone generator equipped with failure / leak detection system that automatically shuts down ozone production if gas is detected. Plant room designed with ventilation system, so a small leak will not cause an issue before the detection system acts to shut down generation	1	3	4	Low	1	2	3	Low	± 1	Y	N	Y	Y	No		Confirming that an ozone destruction unit will be incorporated into the design, meaning that any residual ozone vented from the system will be destroyed before it enters the atmosphere	AQ design team	20-August-2025							
	Health Hazard: Noise exposure from compressors high duty	If practical, enclose compressor in acoustic hood, PPE to be worn by operators if compressors are not enclosed.	3	3	6	High	1	3	4	Low	± 1	Y	N	Y	Y	No		Selected rotary screw compressor as it has a lower noise level	AQ design team	20-August-2025							
6. Biological Inactivated Carbon (BAC) Filter	Physical Hazard: Presence of carbon fines during loading of the carbon vessel.	Operator training and use of dust mask.	3	1	4	Low	1	1	2	Low	± 1	Y	N	N	No		Confirming that appropriate, task specific PPE (gloves, mask, eye protection) will be used and specified within the O&M manual	AQ design team	20-August-2025								
	Physical Hazard: Loading bags of carbon into GAC	Use vacuum or "butter" to remove used carbon. Assign two people to the task if necessary. Use a funnel to make filling the vessel easier.	3	3	6	High	1	3	4	Low	± 1	Y	N	N	No		Confirming that a special loading procedure involving proper to be incorporated	AQ design team	20-August-2025								
7. UV disinfection	Health Hazard: Excessive suspended solids, material interfering with the efficiency of the UV disinfection system	UV is downstream of UF process. See UF membrane filtration section for control measures to ensure membrane integrity etc.	4	4	8	Very High	1	4	5	Moderate	± 1	Y	Y	N	No												
	Health Hazard: Low UV dose leading to poor UV disinfection	UV dose constantly monitored by UV unit using flow rate, measured UV and measured UVT UV unit outputs dose to the PLC so it can be monitored and acted upon	4	4	8	Very High	1	4	5	Moderate	± 1	Y	Y	CCP2	Alert level dose < 60mJ/cm2 Critical Level dose < 58mJ/cm2	Operator alarm is alert level triggered. Plant diverts to off spec if critical level triggered.	Continuous online monitoring and diversion by PLC and actuated valve when required.	Plant automatically diverts to off-spec tank. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging.							
	Health Hazard: UVT is too low meaning the unit is operating outside its validated range.	UV has inbuilt UVT instrument which is used with the device, but also output to the PLC.	4	4	8	Very High	1	4	5	Moderate	± 2	Y	Y	CCP2	Alert level UVT < 45% Critical Level UVT < 35%	Operator alarm is alert level triggered. Plant diverts to off spec if critical level triggered.	Continuous online monitoring and diversion by PLC and actuated valve when required.	Plant automatically diverts to off-spec tank. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging.							
	Health Hazard: UV disinfection not effective due to excessive lamp age.	UV unit monitors lamp age based on actual run time. Other indicators such as UV dose offer a secondary way to monitor poor lamp performance.	4	4	8	Very High	1	4	5	Moderate	± 1	Y	Y	CCP2	Alert level hours > 10,000 Critical Level hours > 12,000	Operator alarm is alert level triggered. Disinfection system goes into shutdown.	Continuous online monitoring and diversion by PLC and actuated valve when required.	Disinfection system goes into shutdown. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging.							

DESIGN /			Before Mitigation				After Mitigation				Uncertainty	Decision Tree	CCP/Q CP	Critical Levels		Monitoring	Corrective Action		Records	CONSTRUCTION STAGE HACCP			COMMISSIONING / HANDOVER STAGE HACCP			
Step	Potential Hazard	Preventative Measure	Likelihood	Consequence	Resid. Risk D = E	Risk Rating	Likelihood	Consequence	Resid. Risk D = E	Risk Rating				Target	Action		How	What		How	Action Checked	By	Date	Action Checked	By	Date
Process unit	Physical, chemical, biological, other		2 to 5	2 to 5	D = E		2 to 5	2 to 5	D = E			Y or N														
	Health Hazard: UV unit malfunctions or faults	UV has inbuilt monitoring that identifies warnings and faults. These outputs are monitored by the PLC so the status of the UV unit is known at all times	4	4	8	Very High	1	4	5	Moderate	± 1	Y	Y		CP2	Instrument Fault	Operator alarm is alert level triggered Disinfection system goes into shutdown	Continuous online monitoring and diversion by PLC and actuated valve when required.	Disinfection system goes into shutdown. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging					
	Health Hazard: Flow rate through UV unit takes the unit outside validated range, or doesn't provide sufficient UV dose	UV feed pump's rated capacity is selected well below the maximum available flow (885 L/min) If the flowrate falls below 23.5 L/min (calculated minimum flowrate), the UV dose calculation defaults to the minimum validated flowrate of 23.5 L/min. Flowmeter downstream of the UV monitors flow.	4	4	8	Very High	1	4	5	Moderate	± 1	Y	Y	N	No											
	Physical Hazard: UV lamps are harmful to humans if viewed directly	UV unit is completely sealed so that no light is visible during operation. UV is designed so that the power cable must be removed to access the lamps. This prevents accidentally accessing the lamps while that are lit.	4	4	8	Very High	1	4	5	Moderate	± 1	Y	Y	N	No											
	Environmental Hazard: UV lamps are harmful if not disposed correctly	Dispose of used UV lamps at an appropriate disposal site.	2	2	4	Low	1	1	1	Low	± 1	Y	Y	N	No											
8. Chlorine disinfection (chlorine, dosing pump)	Health Hazard: Insufficient chlorine or chlorine is too high and may cause harm.	System designed to meet minimum Cl ₂ in relevant legislation Contact tank designed so that minimum Cl ₂ is always achieved Free residual chlorine monitoring	3	2	5	Moderate	1	2	3	Low	± 1	Y	Y		CP3	Alert Level: FEC > 0.55 mg/L, or FEC > 4.5 mg/L Critical Level: FEC > 0.55 mg/L, or FEC > 5.0 mg/L	Operator alarm is alert level triggered Plant shuts to off spec if critical level triggered.	Continuous online monitoring and diversion by PLC and actuated valve when required.	Plant automatically diverts to off-spec tank. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging					
	Biological Hazard: Treated Water outside of target pH range	On-line treated water pH monitoring pH correction installed as part of the plant.	1	3	4	Low	1	2	3	Low	± 1	Y	Y		CP3	Alert Level: pH < 6.5, or pH > 8.5 Critical Level: pH < 6.0, or FEC > 8	Operator alarm is alert level triggered Plant shuts to off spec if critical level triggered.	Continuous online monitoring and diversion by PLC and actuated valve when required.	Plant automatically diverts to off-spec tank. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging					
	Health Hazard: Equipment failure in the chlorine loop means current reported reading of pH or chlorine is not accurate	Monitor the flow through the instrumentation loop to ensure it is continuous. Monitor the instrument status	3	2	5	Moderate	1	2	3	Low	± 1	Y	N	Y	CP3	Flow through recirc. loop must be continuous. Instrument must always be healthy.	Plant shuts to off spec if critical level triggered.	PLC monitors flow switch mounted in instrument cell and fault signal from the field instrument	Plant automatically diverts to off-spec tank. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging					
	Health Hazard: Insufficient disinfection because due to variations in temperature.	On-line temperature monitoring, calculate CT for ambient temperature around storage tanks.	3	2	5	Moderate	1	2	3	Low	± 1	Y	Y		CP3	Alert level T < 16 deg C Critical Level T < 15 deg C	Operator alarm is alert level triggered Plant shuts to off spec if critical level triggered.	Continuous online temperature probe.	Plant automatically diverts to off-spec tank. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging					
	Health Hazard: Required Cl ₂ is not met because flow is too high chlorine is too low	Chlorine contact is in a pipe of fixed volume which flow is variable in the calculation. Flowmeter upstream of the contact tank and chlorine levels allow Cl ₂ to be calculated constantly in the PLC	3	2	5	Moderate	1	2	3	Low	± 1	Y	Y		CP3	Alert level C-T < 12.8 mg.min/L Critical Level C-T < 12.0 mg.min/L	Operator alarm is alert level triggered Plant shuts to off spec if critical level triggered.	Continuous online calculation from flowmeter and chlorine probe.	Plant automatically diverts to off-spec tank. Production resumed once cause is determined and contents in tank are within specification.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging					
9. Distribution System and Storage Tanks (lines, and use, Off-spec tank)	Health Hazard: Improper use of recycled water.	Education program for occupants. Clear coloured pipes and fittings. Signage indicating recycled water usage. No taps accessible to the public.	3	2	5	Moderate	1	2	3	Low	± 1	Y	Y	N	No											
	Health Hazard: Long period until use and all residual chlorine consumed	Chlorine is monitored in the treated water recirculation loop. Plant shuts to off spec tank if chlorine out of range.	3	2	5	Moderate	1	2	3	Low	± 1	Y	N	Y	QC1	Alert Level: TC < 0.5 mg/L, or TC > 0.5 mg/L	Operator alarm is alert level triggered	Continuous online monitoring	Warning alarm only to alert operator for TC < 0.5 mg/L. Warning alarm and dosing pump stops for TC > 0.5 mg/L	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging	Minor amendments to TC alert level (in line with RWAAP). Educators incorporated into the design to homogenise the TC level within the tank	AQ design team	20-August-2025		
	Health Hazard: pHs monitored in the treated water recirculation loop. Plant shuts to off spec tank if chlorine out of range.	pHs monitored in the treated water recirculation loop. Plant shuts to off spec tank if chlorine out of range.	1	3	4	Low	1	2	3	Low	± 1	Y	N	Y	QC1	Alert Level: pH < 6.5, or pH > 9	Operator alarm is alert level triggered	Continuous online monitoring	Warning alarm only to alert operator	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging	Minor amendments to pH alert level (in line with RWAAP)	AQ design team	20-August-2025		
	Health Hazard: Equipment failure in the chlorine loop means current reported reading of pH or chlorine is not accurate	Monitor the flow through the loop to ensure it is continuous. Monitor the instrument status	3	2	5	Moderate	1	2	3	Low	± 1	Y	N	Y	QC1	Flow through recirc. loop must be continuous. Instrument must always be healthy.	Warning alarm and stop chlorine dosing pumps	PLC monitors flow switch mounted in instrument cell and fault signal from the field instrument	Dosing pump stopped. Dosing resumed once cause is determined and issue is resolved.	Identify cause remotely if possible. Otherwise attend site and investigate using hand held instruments and other tools as appropriate.	Service Records, Online datalogging					
	Biological Hazard: Delivery pipes and fittings leaking or burst leading to contamination	Plumbing installed according to AS/NZS 5500.200. Any leaks reported to Building management according to tenement information brochure.	2	3	5	Moderate	1	3	5	Low	± 1	Y	N	N	No											
10. Sludge Handling including WAS Tank	Biological Hazard: Handling of sludge	System is fully automatic and does not require the operator to come into direct contact with sludge. Disposal bins will be designed so they can be handled with appropriate manual handling device.	2	3	5	Moderate	1	2	3	Low	± 1	Y	N	N	No											
	Environmental Hazard: Odour	Waste activate sludge does not typically have a strong odour. Dewatering system is vented through the odour scrubber.	2	2	4	Low	1	2	3	Low	± 1	Y	N	N	No											
	Chemical Hazard: Chemical handling	Chemicals stored and handled appropriately to prevent spills. PPE as per SDS to be used by operators.	3	3	6	High	1	3	4	Low	± 1	Y	N	N	No											
11. Potable Backup Supply	Health Hazard: Contamination from cross connections	Coloured pipe to differentiate recycled water networks. Education of plumbers through site inductions. Cross connection audit by installation plumbers.	3	5	8	Very High	1	5	6	High	± 1	Y	N	N	No											
	Biological Hazard: Reverse flow	RPZ installed on potable tap up supply Airgap between fill point and highest water level in treated water storage tank.	3	4	7	Very High	1	4	5	Moderate	± 1	Y	N	N	No											
12. Climate Change	Biological Hazard: Extreme weather (flooding) causing sewage to mix with stormwater runoff	Site not near known water sources that flood. New development would have considered foreseeable rain events and designed drainage for them.	1	4	5	Moderate	1	4	5	Moderate	± 1	Y	N	N	No											

INITIAL DESIGN STAGE HAZOP												ISSUED FOR CONSTRUCTION STAGE HAZOP				COMMISSIONING / HANDOVER STAGE HAZOP			
Item	Deviation	Consequence	Causes	Safeguards	Actions	Who	Due Date	Status	Action Checked	By	Date	New Actions Identified/ Outstanding	Who	Due Date	Status	Action Checked	By	Date	Closed Out
Equipment, tank, process unit	Condition such as no flow, high flow, pH change	What happens	Why does it happen	Valves, alarms, instrument, design	To be done to mitigate	By	Date												
Section 1 - Inlet works (inclusive of Source water, Wet Well, Emergency Tank, Macerator, Prescreen and Buffer Tank)																			
1a - Source water (Volume, Composition only)	No or low flow	No immediate impact other than limited food for bioreactor	Periods of low population on site, eg, weekends, Christmas	Remote monitoring of plant allows adjustments to be made if required. Do not start plant until sufficient occupancy to supply minimum bio-reactor feed.								Minimum feed volume has been established by design team							
	High influent flow	Wet well and buffer tank fill. No overflow to sewer	Periods of high user demand, rainwater ingress.	Wet well and buffer tanks sized to cope with peak demands. Site is industrial so less prone to diurnal peaks you would see in residential. Wet well and buffer tank have level transducers which allow logged data to be analysed to identify unusual flows during rain events. Pump out connection to buffer tank to allow removal of water off site.								Wet well can now overflow to 300kl emergency tank							
	Reverse Flow	N/A																	
	Low Level	N/A																	
	High level	N/A																	
	High pressure	N/A																	
	Low pressure	N/A																	
	Composition or changing concentration	Plant gets feed which is not designed for and it upsets biological process, foam overs, damage to membranes from FOG's or other chemicals	Occupants dispose of chemicals or other	pH probe warns if pH out of spec, stopping transfer to bio tank. Buffer is mixed to dilute spikes. Pump out point can remove feed if severe contamination. Manual pH correction.	All occupants should be educated to ensure they understand the impacts of disposing of trade waste or other liquid waste streams to the sewer	Client						Rainwater ingress has been considered in the water balance, although impact has been considered insignificant due to smaller collection network and mostly contained.							
	Start up/ shutdown	N/A																	
	Isolation	N/A																	
	Testing	N/A																	
	Maintenance	N/A																	
	Installation	N/A																	
	Cleaning	Spill or overflow of untreated sewage	Uncontrolled flow form process unit failure.	Overflows and drains all feed back to wet well. Control measures specified on process units below such as level switches and transducers.	Ensure floor grading is suitable to direct spills and clean back to floor wastes.	Client						Hose reels included throughout the plant							
1b - Wet Well, Emergency Tank & Macerator	No or low flow	Low inflow to system	No feed from site Blockage at macerator Blockage upstream	Low Level Switch & transmitter to protect pumps. Load sensor in macerator that reverses direction, as well as overload in panel. Bypass line around macerator															
	No or low flow	Low/no flow leaving wet well	Failure of wet well pumps or blockage in line out of	High level switch and transmitter Duty/Standby pump arrangement Overflow to emergency tank -own level instrumentation in emergency tank Macerator reduces likelihood of blockage downstream Emergency tank sized to allow at least 1 day of storage in the event of pump failure. Further allowance for pump out if this is exceeded. Mixing line allowed for to prevent solids build up Valves have been selected appropriately to avoid blockages. Knife gate valves for control, full bore NRVs															
	High influent flow	Receiving more influent than we can treat	More water being received from the network than anticipated. Overflow from treatment plant contributing to level within emergency tank.	High level switch and transmitter Duty/Standby pump arrangement Overflow to emergency tank -own level instrumentation in emergency tank High flow is unlikely to be over a sustained period of time. Short term high flows that exceed capacity will overflow to emergency tank, before being processed by prescreen as capacity allows. Emergency tank sized to allow at least 1 day of storage in the event of pump failure. Further allowance for pump out if this is exceeded. Pumps sized to allow for 3x peak flow															
	Reverse Flow	Gravity flow network, not an issue																	
	Low Level	Pumps run dry and fail to operate	Failure of level transmitter AND level switch	Allowed for both level switch and transmitter															
	High level	Wet well overflows to emergency tank If it persists, emergency tank becomes full	Influent flow exceeds pump rate. Pump failure	Allowed for both level switch and transmitter Duty/stand by pump arrangement Sufficient storage capacity. Allowance for pump outs if ever required.															
	High pressure	Pressure build up in tank Pressure build up in transfer line.	Incorrect closure of valves Blockage	Flowmeter on prescreen inlet will trigger alarm in event of low flow. Gravity flow to macerator Odour scrubber cannot pull enough pressure to impact integrity of concrete storage tank.	Consider adding pressure transducer for on vent line to monitor inlet suction	Aquacell design team	14-Jul-25												
	Low pressure	Low pressure in tank	Vacuum created by odour scrubber	Vent to odour scrubber appropriately sized. Odour scrubber cannot pull enough pressure to impact integrity of concrete storage tank.															
	Composition or changing concentration	Low wastewater strength High wastewater strength High Solids	Foreign object in sewer. Oil/grease creates fat berg Innapropriate disposal of chemicals to sewer	Macerator in line to reduce likelihood of solids build up causing issues. pH sensors incorporated in design. Large volumes in storage tanks should be able to dilute periods of high chemical concentration. Bypass line to allow for maintenance of macerator	All occupants should be educated to ensure they understand the impacts of disposing of trade waste or other liquid waste streams to the sewer Tradewaste agreementrns in place with all occupants.	Aquacell/Client	14-Jul-25												
	Start up/ shutdown	Wet well shutdown	Fault with wet well pumps or routine maintenance	Bypass line allows feed to be diverted from macerator to emergency tank.															
	Isolation	Isolation of macerator. Isolation of wet well.	Routine maintenance or failure of equipment	Isolation and bypasses available. Cutter pumps will assist with reducing solids build up in event of macerator isolation															
	Testing	Requirement to sample influent	Troubleshooting/verification testing	Sample point between wet well and pre screen.															
	Maintenance	equipment offline	Routine servicing or unplanned maintenance	Duty/standby. Able to remove pump by guide rails & level instrumentation from above, means requiring tank access is unlikely. Inlet pit is accesible for maintenance and not deep enough to require confined space permits. Readily accessible for access by lifting equipment	Ensure that sufficient openings are allowed, for both visual inspections, and flushing when required.	Aquacell design team, tank supplier													
	Installation	Issues around Installation of tanks (leak of collapse)	Incorrect design or installation of tank or any process equipment	Engaged third party specialists for design and installation. Inlet works is accessible by crane. Confined space operatives used for initial installation.															
	Cleaning	Build up of solids or grit causing premature pump failure or blokage	Solids passing into wet well, either through macerator or during bypass	Both macerator and cutter pumps incorporated into the design. Mixing line to resuspend any solids. Sloped floors to divert to single point															
1c - Pre Screens	No or Low Flow (into screen)	No impact																	
	High Flow (inflow faster than outflow)	Spill or overflow of untreated sewage. Excess use of process water	Screen is partially or completely blocked which reduces throughput. Failure of solenoid valve on proces water lines.	Screens overflow back to buffer tank so there are no spills. Spray water to screen to assist cleaning. Screen run on time can be tuned to ensure proper cleaning and minimise use of process water. Level transducer will alarm and lock out feed pumps if screen is high. Process water recycles to buffer tank.	Current design shows 3x screens. Design team to investigate alternative screens (2x 100%). We can potentially consider "open channel" design. Details of pump station (by others) to be confirmed by client.	CF SA JJ			Currently working through alternative options. Expecting proposal by 21/03 (Hydroflux)	Design	19-Mar-25	Design calcs that 2x prescreens can keep up with design flow, though space for a third prescreen has been allowed for if required in future		14-Jul-25					
	Reverse Flow	Screens back up because it can't empty. Screen syphons buffer tank to wet well. Outlet or overflow from one screen allows flow to the other screen	Blockage in outlet, wet well lower than screens so gravity flow possible	Wet well pumps have NRV's. Inlet to buffer tank is high level with air gap so syphon through screen to wet well is not possible. Screens gravity flow to buffer tank so not possible to pump back to screen. Screen outlets are 150mm with influent screened to < 2mm so blockage unlikely. Level transmitters in screens meaning they shut down if blocked. Duty/standby screen arrangement.	Confirm levels and pipework design are such that flow from one screen to the other through outlets or overflows is not possible				Cannot be closed out until unit is specified.	Design	19-Mar-25	Design finalised, confirm that prescreens both flow to buffer tank and cannot flow from one to another		14-Jul-25					
	Low Level	No Impact																	
	High Level	As for high flow																	
	Low Pressure	No Impact																	
	High Pressure	Damage to screen or risk of odour escaping	Damper to vent system closed. Vent line blocked	Vent line sized to ensure adequate flow in normal operation. Screens can depressurise through overflow line to wet well. During no flow screens can depressurise through buffer tank															
	Low Temperature	No Impact																	
	High temperature	No Impact																	
	Composition or changing concentration	Screen can block	Foreign objects like wet wipes can bind up screen bruch	Correct selection of wet well pumps. Spray bars and screen run on times to ensure screen clears. Routine maintenance and inspection to clear screen	All occupants should be educated to ensure they understand the impacts of disposing of inappropriate objects to the sewer system	Client						Macerator reduces likelihood of large solids entering prescreen. We now have mixed liquir entering the screens - meaning that when we run at higher MLSS concentration, we need to run at lower flow - Plan is to run mixed liquor processing during night time, or blending it with influent.	AQ design team	14-Jul-25	Closed				

Item	Deviation	Consequence	Causes	Safeguards	Actions	Who	Due Date	Status	Action Checked	By	Date	New Actions Identified/ Outstanding	Who	Due Date	Status	Action Checked	By	Date	Closed Out
Equipment, tank, process unit	Condition such as no flow, high flow, pH change	What happens	Why does it happen	Valves, alarms, instrument, design	To be done to mitigate	By	Date												
	Cleaning	Screens doesn't function due to lack of cleaning. Screenings difficult to dispose of	Screens are difficult to access or clean	Screens are readily accessible. Hose point in treatment plant to allow screen to be cleaned	Ensure bin and system of disposal for screenings is suitable	AQ Design Team			Cannot be closed out until unit is specified.	Design	19-Mar-25	Confirming that disposal system is suitable. Additional roller shutter door added for direct access to prescreens.			Closed				
	Testing	No way of easily testing or getting a representative sample of influent.	No place to take a representative sample.	Sample point on screen inlet															
	Maintenance	Screens can't be maintained	Maintainable parts not accessible	Each screen can be independantly isolated	Ensure ready access to screen to remove screen with lifting device if required	AQ Design Tesm			Space will be maintained, once final unit is determined.	Design	19-Mar-25	Confirming that disposal system is suitable. Additional roller shutter door added for direct access to prescreens.			Closed				
	Installation	Screens cant be installed	Insufficient access									Sufficient access from new side road through roller shutter door for installation			Closed				
	Isolation	Screen can't be isolated. Outlet from one screen flows up other screen outlet if the screen is removed for maintenance.	No isolation points on outlet or overflow	Inlet, process water inlet and vent all have isolation valves. Screens installed at the same level with gravity flow to buffer.	Confirm flow is not possible from one screen to the other via the joined outlets if one screen is removed for maintenance. Similarly for overflows.	AQ Design Team			Since the level for duty & standby is the same, overflow should not be possible. There is no valve between prescreen and buffer to interrupt flow.	Design	19-Mar-25								
1d - Buffer Tank	No or low Flow	No immediate impact other than limited food for bioreactor.	Screen or line blockage. Screen maintenance or failure Pipe failure. Diversion valve failure	Low level in buffer tank is visible on HMI/remote monitoring.															
	High flow	Overflow tank.	Operators running pumps or other equipment in manual. Issue in the plant that prevents processing	Level transducer in buffer tank to generate alarm. Email alarming can be configured. There is a pump out point if waste needs to be removed from site. Buffer tank appropriately sized to take short term interruptions to production.								Buffer tank can overflow to emergency tank if full		14-Jul-25	Closed				
	Reverse flow	Buffer tank drains Anoxic tank.	NRV's on pumped line fail	Feed line to anoxic tank comes in above overflow level so syphoning not possible even if NRV fails.								Feed line now comes in below overflow level. Raise level in anoxic tank to flag warning of reverse flow from anoxic tank to buffer. Alarm to be added to FDS. Consider flow circulation within anoxic tank and best location for mixers		14-Jul-25	Closed				
	High pressure	Tank damage; leakage of wastewater outside tank.	Tank is sealed (odour) with no overflow. Operators run pumps manually. Vent line is blocked at the same time as trying pump waste to the tank.	Gravity flow into tank so pressure is limited to head height of feed liquid. Unlikely to damage undergroundtank. Vent line does not have a damper which could be inadvertently closed. High level transducer with high level switch backup to stop feeds in automatic.	Confirm if level on out of spec tank would push liquid through vent line to odour scrubber.	AQ Design Team			Vent to odour scrubber is sufficiently sized	Design	19-Mar-25								
	Low pressure	Tank collapse.	Pumping out of tank with no way of drawing air in.	Air can be drawn in through the screens if the vent is blocked.															
	Low level	Pump damage. Loss of containment. LTX / LSL failure	Running pumps in manual	Level transmitter for low level protection with level switch as back up.LTX / LSL if one fails, the other device should still read correctly. Buffer transfer pump is interlocked with low level.															
	High level	Overflow tank.	Failed level transmitter. Leaking or manually open valve on off spec tank	Level transmitter has level switch back up in case of failure.	Consider if the tank should have a trapped outlet that diverts tank contents to a specific area if there is ever an overflow event	AQ Design Team			Overflow from buffer tank to emergency tank is to be incorporated	Design	19-Mar-25	Emergency tank has now been allowed for	AQ Design team	14-Jul-25	Closed				
	High temperature	N/A																	
	Low temperature	N/A																	
	Composition or changing concentration	Poor quality water to MBR. Onset of UF fouling and more CIPs than normal	Different activities by client. Surge in alkali cleaners. Anaerobic and pH drops. Chemical dumping.	Buffer tank smooths out peaks. DO monitoringspH alarms on buffer tank. Program PLC to stop/reduce transfer if buffer tank pH high/low.															
	Start up/ shutdown	Low pH Flammable gases.	Could go anaerobic if shutdown for a long time	pH probe. Ventilation to allow gases to be removed. Pump out tank if waste is not appropriate to start plant with.								We have now established that plant cannot be run until 30kL/day is achieved.	AQ Design team	14/07/2025	Closed				
	Cleaning	Hose down needed	Build up of scum, foam and waste inside buffer tank	Sealed tank. Not an aerated tank so foam overs not likely.	Consider sepecifying more than one hose point in the plant	AQ Design Team			Current proposal is that 3x hose points should be allowed. 1x in the main treatment plant, 1x in the sludge room, 1x outside (facing the biotanks)	Design	19-Mar-25								
	Testing	N/A										Add sample line to anoxic feed piping - potentially in valve pit	AQ Design team	14-Jul-25	Closed				
	Maintenance	Pumps and probes in tank need to be serviced	Routine maintenance or failure	Probes/transducers/switches mounted into the top of the tank via flange or similar which allow easy removal. Summersible pumps and mixers on rails or similar that allow them to be removed easily for maintenance.															
	Installation	Incorrectly installed and tank leaks. Pump installation involves a confined space entry.	Inexperienced tank builders Inadequate or undefined quality assurance	Manufacturer to install the tank. Hydrostatic test as part of commissioning. Confined space qualified personnel to be used to install the pumps. Consider using the tank manufacturers to install the pumps.															
	Isolation	Can't shut down tank for confined space entry if ever required	Insufficient isolation points	Manual isolation valves upstream of screens and on the transfer line from the out of spec tank.								Consider additional spectacle plate from treated water storage for isolation. We can isolate inlet to off spec.	AQ Design team	14-Jul-25	Closed				
Section 2 - MBR (inclusive of Anoxic, Aerobic, MOS and Filtrate)																			
2a - Bioreactors - Anoxic (including mixer)	No or low Flow	No or limited food for bioreactor.	Buffer tank pumps failed, empty buffer, or MBR overflow stopped, Bio pumps failed, aerobic tank low level (stops bio pumps), blocked line. Closed valve after maintenance.	Regular monitoring and maintenance by service staff.															
	High flow	Overfill and over pressurise tank causing tank damage or flooding.	Overfeeding from buffer (both pumps on manual). High level switch in Aerobic tank	Piping and overflow is within design capacity for two pumps in parallel.															
	Reverse flow	Overfilling	Foaming in aerobic tank. Anoxic overflow pipe blocked.	Check valves in buffer pumps to stop flow back to buffer tank. Anoxic to MBR tank hydraulically not possible other than foam. Foam from aerobic to tank to anoxic is possible but there are spray bars in the aerobic tank to control foaming.								Check valves on anoxic recirc pumps will also prevent reverse flow							
	High pressure	Tank damage. Leakage of wastewater outside tank.	Overflow blocked.	Overflow sits above inlet level of aerobic tank, so not possible to hydraulically block the line.															
	Low pressure	Tank damage	Blocked vents and bio pumps running	Multiple vent paths - overflow from from aerobic, overflow line from MBR, DN80 vent on tank.								Even if vents were blocked, the pumps would not create sufficient vacuum to damage the underground concrete tanks. Vent dia. increased to 100mm							
	Low level	Mixer gets damaged because water level is low	Tank leaking	Low level switch to protect the mixer. No drain valve on tank. No pumps in tank to empty it in normal operation.															
	High level	Spill from tank	Overflow blocked.	Not possible to hydraulically block the overflow.Spray line in aerobic tank to control foaming. Liquid flow will likely unblock any foaming that may carry over into the overflow line.															
	High temperature	Biology effected	Prolonged exposure to hot climate or high temperature feed	Tank is a large volume. Climate is moderate without prolonged extremes. Influent plant is typical blackwater temperatures.															
	Low temperature	Biology effected	Prolonged exposure to cold climate or low temperature feed.	Tank is a large volume. Climate is moderate without prolonged extremes. Influent plant is typical blackwater temperatures.															
	Composition or changing concentration	Explosion from gases Corrosion of tank Under performance of mixed liquor.	Anaerobic and may produce odour or explosive gases. Improper disposal of CIP waste. Chemicals in wastewater.	DO probe in the aerobic tank. Mixing and aeration in anoxic tank. Design is inherently anoxic. Safeguards for buffer tank. Buffer tank serves to lower peak concentration in w/water.								Explosive gases will be vented through the OCU stack. pH probe in buffer tank to monitor influent characteristics.							
	Start up / shutdown	No issues with start up Mixed liquor turning septic during prolonged shutdown	Lack of aeration during shutdown	During extended shutdown, manually operate pulse burst aerators to supply oxygen from the aerobic tank. If a long period of time then drain the tank.															
	Cleaning	Accumulation of biomass on floor of tank.	Biomass settles over time	Mixer installed. Upstream screening to remove large items.	Consider access for pump out of tank if ever required.	AQ Design Team			Access hatches are to be provided in all tanks. Vehicle access is possible direct to aerobic tanks.	Design	19-Mar-25								

Item	Deviation	Consequence	Causes	Safeguards	Actions	Who	Due Date	Status	Action Checked	By	Date	New Actions Identified/ Outstanding	Who	Due Date	Status	Action Checked	By	Date	Closed Out
Equipment, tank, process unit	Condition such as no flow, high flow, pH change	What happens	Why does it happen	Valves, alarms, instrument, design	To be done to mitigate	By	Date												
	Testing	Underperformance of mixed liquor. Design intent is to remove some nitrogen.	DO of anoxic zone is too high such that anoxic conditions do not exist		Consider access point near the weir to insert DO probe (or visually inspect aeration).	AQ Design Team			Visual inspection is possible through access hatches. Instrument probes can be deployed.	Design	19-Mar-25								
	Maintenance	Can't maintian mixer. Can't inspect tank.	No drain valve on tank.	Mixer and level switch accessible without needing to pumps down tank. Tank inspection rare and it's practical to pump down a 40kL tank if required.								Mixers to be installed on guide rail to allow removal without draining tank.							
	Installation	Leakage	Sub-standard installation leading to a leak	Hydrostatic testing at clean water commissioning.															
	Isolation	High risk if confined space entry of anoxic tank with aerobic tank contains unaerated mixed liquor	Unable to isolate headspace of anoxic tank from aerobic tank. Unable to isolate headspace of MBR tank from anoxic tank.	Able to isolate against inundation at other points.															
2b - Bioreactors - Aerobic (including blower skid)	No or low Flow	Underperformance of biological system. Failure to achieve required DO and MLSS levels	Buffer tank pumps failed, empty buffer, or MBR overflow stopped, Bio pumps failed, blocked overflow from anoxic tank, strainer on bio pump outlet blocks.	Alarms and faults allow service staff to monitor pumps remotely. In line flow meter between bio tank and MBR tank monitors flow. Flow switch on instrumentation side stream alarms if flow is inadequate.															
	High flow	Overflow and/or over pressurise tank causing tank damage or flooding.	Excess flow into anoxic tank	MBR tank can only overflow at the rate the bio pumps remove liquid so no net gain from these pumps, even in manual. Overflow DN150 sized correctly.															
	Reverse flow	MBR and bio tank levels equilibrate and part of membrane exposed.	Loss of power NRV for bio pumps stays open	Bio pumps have NRVs. Bio pumps run almost all of the time. MBR tank has level transducer which will alarm if the level drops.															
	High pressure	Tank damage. Leaks	Blocked overflows. Blocked ventilation for foaming.	Tank can vent through anoxic tank, if aerobic tank vent was blocked. Spray bars keep foaming down.	As per anoxic tank. Confirm with installers that vents for bio and buffer tanks have an uphill gradient, which will avoid water accumulating in the vent system.	AQ Design Team			Confirming an uphill gradient will be applied to the vent from the biotank to odour scrubber.	Design	19-Mar-25								
	Low pressure	Tank damage	Pumps running with vent blocked	Multiple vent paths - vent through anoxic, vent through MBR overflow since overflow is not full bore flow.	As per anoxic tank				Risk of blockage considered to be minimal. No valves or other inline equipment in odour scrubber vent lines.	Design	19-Mar-25								
	Low level	Damage to pumps or aerator	Transducer failure	Level transducer is backed up by level switch															
	High level	Spills	Pumps running manually. Foam "fills" tank above liquid level. Transducer failure. Tanks fills goes high from excess spray water	High level transducer is backed up by level switch. Tank overflows to wet well. Tank sealed for odours so foams will likely go down overflow or back to anoxic tank. Spray bars to reduce foam. Control system allows for sprays to run intermittently to operator settings rather than continuously. System is closed loop - spray water doesn't add to volume in plant since it is process water rather than potable.															
	High temperature	Biology effected	Prolonged exposure to hot climate or high temperature feed	Tank is a large volume. Climate is moderate without prolonged extremes. Influent plant is typical blackwater temperatures.															
	Low temperature	Biology effected	Prolonged exposure to cold climate or low temperature feed	Tank is a large volume. Climate is moderate without prolonged extremes. Influent plant is typical blackwater temperatures.															
	Composition or changing concentration	Explosion from gases. Corrosion of tank. Under performance of mixed liquor.	Inadequate DO control leading to anaerobic conditions. Improper disposal of CIP waste. Chemicals in wastewater. Aerator inlet blocked reducing aerator efficiency	DO and MLSS probe in bio pump sidestream to monitor MLSS. Buffer tank smooths concentration changes up stream. CIP chemicals appropriately neutralised before being introduced into the system.	Ensure aerator pipe is easy to inspect and maintain.				Submersible aerator is considered, which should be easy to raise and inspect.	Design	19-Mar-25	Explosive gases will be vented through the OCU stack. pH probe in buffer tank to monitor influent characteristics. Magnesium hydroxide will be dosed to control pH.							
	Start up / shutdown	No issues with start up Mixed liquor turning septic during prolonged shutdown Pump and/or aerator damage due to operation at low level.	Aerator not submerged. Manual operation overrides level switch Inadequate aeration during prolonged shutdown.	Plant has several stages of shutdown which ensures aerators and pumps run for appropriate periods depending on down time. Level switches and transducers protect pump and aerator	Consider replacing AV-331A & AV-332A with a 3-way valve (waste to sludge settling tank)	AS			Addition of 3 way valve considered in design.	Design	19-Mar-25	Sludge settling tank has been removed from the design, so the three way valve is no longer required.							
	Cleaning	Accumulation of biomass on floor of tank.	Biomass settles over time	Mixer installed. Upstream screening to remove large items.	Consider access for pump out of tank if ever required.	AQ Design Team			Camlock and required isolation valves to be incorporated to allow tank to be drained	Design	19-Mar-25	Access for pump outs confirmed. Design now features an emergency tank transfer system from biotank							
	Testing	Underperformance of mixed liquor	DO, pH, MLSS,	External DO and MLSS on bio pump side stream. Can do grab sample from tank.	Consider inspection points in the aerobic tank (to inspect aeration pattern)	AQ Design Team			Inspection hatch to be included in tank. Submersible aerators to be utilised, no aeration grid.	Design	19-Mar-25	Confirmed inspection hatch included in design							
	Maintenance	Biological system underperformance. Pump or aerator failure.	DO/MLSS probe malfunction	Maintenance of DO and pH probes is easy as it is external. Aerator and pumps can be removed from tank without requirement for confined space entry. Access hatch in tank allows for aerator performance to be assessed.															
	Installation	Leakage	Sub-standard installation leading to a leak	Tank manufacturer to install															
	Isolation	High risk if confined space entry of aerobic tank with anoxic tank containing unaerated mixed liquor	Unable to isolate headspace of anoxic tank from aerobic tank.	Able to isolate against inundation.															
2c - MOS System (Including Magnesium Hydroxide dosing)	No or low Flow	Low inflow to MBR tank leads to biomass concentration increases and blocks membranes. Low flow of air causes fouled membranes. Low backwash flow for maintenance clean causing ineffective membrane cleaning. Low alkalinity chemical flow. Low venturi flow leading to not priming the line. Low flow in instrumentation loop giving false reading. No/Low magnesium hydroxide dosing on overflow line	Blocked recirc pump or pump isolated manually. Blower failure or pipe failure. Loss of pump prime. Low alkalinity caused by loss of pump flow or chemical Blocked dosing line or pump failure	Level transducer in MBR tank that would identify when insufficient mixed liquor feed. MBR overflow is adequately sized. Permeability alarm. Air pressure indicator and alarm. Flowmeter on inlet from biology and after outlet of MBR pump. Level switch on line to confirm priming. Flow switch on instrumentation loop. Selected DN20 magnesium hydroxide dosing line to avoid pipe blockages. Incorporated dosing tank mixer to avoid magnesium hydroxide settling in the system. Selected peristaltic pumps for magnesium hydroxide dosing.															
	High flow	High ML flow has no significant consequence. High air flow could cause membrane damage. High filtrate flow causing rapid fouling. High BW flow damaging membrane. High overflow rate causing high level. High vent flow.	High air flow - both blowers running. Incorrect flow setting on filtrate/BW. High vent flow caused by excessive air.	High flow alarm on filtrate flowmeter. TMP alarm. Air flow limited by aeration rate / size of membrane blower. Overflow rate limited by biology pump flow.								Overflow adequately sized							
	Reverse flow	Reverse flow of MLSS to blowers. Reverse flow of MBR tank to aerobic tank.	MLSS damages blowers. System off for an extended period and slow leak through NRV on ML line, leading to membranes partially exposed.	Non-return valve on blower. Blower pipe line installed so it is higher than the filtrate tank overflow. Non-return valves on all pumps. Level transducer alarms prior to the membrane being exposed.															
	High pressure	High air pressure causes blower failure or low air flow High TMP causes rapid fouling and increases energy consumption High BW pressure for maintenance clean.	Blower isolated or line blocked. Poor mixed liquor quality	Pressure relief valve on blowers. Air pressure monitored and alarmed for high pressure. TMP monitored and alarmed. BW pressure monitored and alarmed. Dead head pressure for backwash pump is less than the design rating for the membranes.	Consider actuated valve on MBR filtrate air relief line for priming	AS			Additional valve to be added onto the line	Design	19-Mar-25	Confirmed actuated valve added on MBR filtrate priming line							
	Low pressure	Low air pressure leading to low air flow and membranes foul faster. Low process water pressure on venturi leading to insufficient vacuum, lead to loss of prime of filtrate pump	Air line or blower line failed.	Blower pressure monitored and alarmed. Level switch on header will detect inadequate venturi operation.								Duty/stand by MOS blower incorporated into the design.							
	Low level	Membranes exposed and may dry out. Could allow air to damage membrane by excessive movement. Air in filtrate line	No inflow or tank drained or valve left open.	Level transducer on MBR tank to monitor level. Low level interlocks blowers and filtrate pump. Low flow through membrane pump detected and alarmed via flowmeter after MBR pump.															
	High level	Tank is designed to overflow to biology tank. If blocked, then level will rise up the vent line.	Blockage in overflow to aerobic tank.	No manual valves on overflow to aerobic tank. DN150 overflow.															
	High temperature	High temperature can damage the membranes	Exothermic chemical reaction diluting or neutralising chemical	Temperature monitored, although only during filtration. Procedure for CIP to prevent mixing of incompatible chemicals. Membrane tanks indoors so not exposed to direct sunlight.															
	Low temperature	Membrane damage	Exposure to low temperature	Temperature monitored. Membrane tanks are indoors and not exposed to prolonged cold temperature. Membranes submerged with tank contents always moving - no risk of freezing.															
	Composition or changing concentration	Damage to membranes by chemicals or other impurities. Damage caused by high MLSS. Damage caused by excessive fibrous materials blocking the membrane modules. Membrane integrity failure leading to poor quality treated water.	Wrong recipe for CIP or inadvertent overdosing of chemicals during CIP. Fibrous material caused by screen failure.	Automated CIP sequence set up at commissioning. See screen failure safeguards. pH probe in buffer tank to detect some impurities. Turbidity monitor and alarm to detect integrity failure. TMP monitoring to detect fouling. MLSS probe to monitor solids concentration. In line strainer between biology pumps and MBR tank.	Consider selection and suitability of MBR recirc strainer. All to investigate rescreening of MLSS from MBRs.	AS			Considering a "pre-pump strainer", which is hydraulically cleaned. Also looking into other options/getting advice from MBR experts.	Design	19-Mar-25	Mixed liquor rescreening has been incorporated to protect membrane failure caused by fibrous material. Basket strainer also added upstream of MBR tank to protect membrane from fibrous material.							
	Start up/ shutdown	Membranes exposed and may dry out. High flow of filtrate due to incorrect VFD setting.	Passing check valve and level equalisation with bio tank. Leaking drain valve. Membrane damage or bio fouling. Position of manual valve on filtrate pump discharge	Non-return valve in biology supply line. Level transducer on membrane tank and a low level alarm. Established procedures for proper storage of membranes (5MB5). Safeguards as per low and high flow scenarios.															
	Cleaning	Membrane fouling/damage	Wrong chemicals and/or concentration or procedure.	Chemical cleaning to be performed only by trained personnel following appropriate procedures.								Sample points added to CIP line to test chemical if required.							

[illegible]

Item	Deviation	Consequence	Causes	Safeguards	Actions	Who	Due Date	Status	Action Checked	By	Date	New Actions Identified/ Outstanding	Who	Due Date	Status	Action Checked	By	Date	Closed Out
Equipment, tank, process unit	Condition such as no flow, high flow, pH change	What happens	Why does it happen	Valves, alarms, instrument, design	To be done to mitigate	By	Date												
	Composition or changing concentration	Residual ozone upsets BAC conditions.	Overdosing ozone upstream. Bio-growth or other contaminant coming from filtrate tank.	Residual ozone measured at the outlet of ozone contact tank. Refer to Filtrate tank maintenance controls.															
	Cleaning	No specific external cleaning requirements. Replacing carbon as per Maintenance controls																	
	Testing	Filters not performing as expected	Carbon exhausted. Upstream process issues	Sample points located uptream and immediately downstream prior to UV units															
	Maintenance	Insufficient colour removal. High HCC count	Filters not backwashed properly	Filters set to backwash on time, differential pressure or manually initiated by operator. High DP is an alarm condition. Unions allow control valve to be disconnected for easy access. "Slurpy" or wet vac's to extract used media.	Ensure adequate height and access for platform ladder when finalising layout	Aquacell Design Team			Mohammad to review access for platform in 3D model	Design	19-Mar-25	Access for platform has been considered.							
	Installation and environment (sun, noise, odour)	Damage to filters from handling or UV	Difficult to handle	Leave vessels on pallet for as long as practically possible. Maintian forklift access to final location if practical. Use at least two people to move filters. Ensure final piping does not impede ability to do initial fill of filter. Filters installed in shed so problem with UV degradation.	Ensure adequate height and access for platform ladder when finalising layout	Aquacell Design Team			as above	Design	19-Mar-25								
	Isolation	Need to replace filter media	Carbon at end of useful life	Each vessel can be isolated to allow the filter to be maintained.															
3c - UV systems	No or low Flow	Overheat the UV	Disinfection pump is off (auto or manual). Downstream valve closed. Air trapped in unit.	Unit has over temperature alarm and shuts down. PLC alarms on low flow for extended period of time. Valves in the high part of the line allow air to be vented															
	High flow	Inadequate disinfection due to short contact time.	High flow from UV pump	Flow from pump is monitored and alarms on high flow.															
	Reverse flow	Not feasible			Add NRV from diversion line to off spec water tank				Confirmed valve added in P&ID	Design	19-Mar-25								
	High pressure	Damage UV by exceeding design pressure	Downstream valve is closed	UV and pipework rated pressure higher than dead head pressure of pump.															
	Low pressure	UV fouling due to lack of wiper functionality.	Low permeate pressure Manual valve closed Drain valve opened	UV controller monitors wiper action and will alarm if it doesn't wipe. Procedures for maintenance of UV.															
	Low level	Damage to unit due to over temperature	Leak, unit drained and left isolated after service.	Unit has over temperature alarm and shuts down. PLC alarms on low flow for extended period of time.															
	High level	N/A																	
	High temperature	Damage to unit. Damage to pipework surrounding the UV	Running with no water or low flow.	Unit has over temperature alarm and shuts down. PLC alarms on low flow for extended period of time. Pipework within line of sight of UV lamp is stainless steel.															
	Low temperature	N/A																	
	Composition or changing concentration	Poor disinfection	Low UVT. Fouled lamps or failed lamps causing low UVI. Pipe material selection incorrect and allows UV light to damage pipework. Valve arrangement used for CIP.	UVT monitor is integral to UV and alarm warns of low UVT. UV dose alarm to warn of low intensity and low dose. Lamp failure alarm. Use stainless steel upstream and downstream of the UV and where there is risk of UV light. CIP solutions not strong enough to damage quartz sleeves.															
	Start up/ shutdown	Inadequate disinfection during start-up. Fouling during extended shutdown	Insufficient lamp warm up time.	Water can be diverted to the off spec tank post CCT contact. UV can be remote started without water flowing if required. UV system has wipers to assist with removing fouling. Manual cleaning of sleeves after prolonged shutdown.															
	Cleaning	Unable to remove lamps for cleaning	Not enough access space provided	Sufficient space around UV unit to open door and perform cleaning. Sufficient space around 130 um and 5 um filters.								Duty/stand by UV arrangement							
	Testing	Need to sample pre or post UV	Troubleshooting, process analysis	Sample points pre and post UV															
	Maintenance	Unable to remove components of UV system, and 130 um and 5 um strainer for cleaning	Not enough access space provided	Sufficient space either side of UV, strainer and cartridge filter.															
	Installation and environment (sun, noise, odour)	No specific issues as unit is indoors																	
	Isolation	Unsafe to work on	No isolation points	Manual valves and electrical isolation provided. UV door cannot be opened without unplugging electrical plug.	Install local isolator on UV (similar to GPO installed at Bankstown). Note in I/O list	AQ Design Team			To be added once IO list is prepared.	Design	19-Mar-25								
3d - Chlorination System (CCT)	No or low Flow	False instrumentation readings, instrument damage if flow cell drains. Inadequate mixing. Overdose of hypochlorite.	UV pump failure. Flow restriction with one or more valves. Flow cell blockage. Flow cell drains. Low level in filtrate tank. Strainer blockage in analysis stream	Flow switch in flow cell. Pump fault alarm. Flow meter upstream of injection point. Flow control using diaphragm valve. Fine adjustment via needle valve in flow cell. Static mixer.															
	High flow	Damage instruments or inaccurate readings. Insufficient contact time.	Valves not set correctly	Flow cell acts as a flow restrictor and has flow indicator with needle valve to control. Adequate volume in CCT to ensure sufficient contact time. Flowmeter in line to monitor flow rates															
	Reverse flow	Backflow to cell causes damage by overpressure	Upstream valves isolated with pump running	NRV after off spec diversion valve to prevent backflow to cell. NRV at disinfection pump prevents backflow through system															
	High pressure	Damage to chlorine probe (max 1bar) or flow cell	Accidently closing a manual valve downstream of cell or closed manual valve at outlet CCT	Pressure regulating valve prevents over pressure for instrument flow. NRV in sidestream prevents overpressure from reverse flow. Pressure gauges for service technicians to set and monitor pressee.								Sufficiently trained operators will maintain the plant. Correct sequences to be outlined in O&M manual.							
	Low pressure	N/a																	
	Low level	Damage to probes by cell draining.	UV Pump stops and line drains.	Treated water tank and off spec holding tank entry points are higher than the remiander of the system. Enter above overflow level so syphon not possible.	Confirm safeguard cited is correct	AQ Design Team			Air gap between pump entry point and overflow to be maintained to avoid siphoning	Design	19-Mar-25	Confirmed air gap has been added.							
	High level	Not an issue - designed to be full																	
	High temperature	Not considered a risk in this installation																	
	Low temperature	Improper disinfection	Lower temperature requires higher chlorine CT									Temperature sensor installed in flow cell. CCT defined. Water diverts below set temperature.							
	Composition or changing concentration	Excessive chlorine level could be a hazard to reuse and irrigation. Inadequate chlorine doesn't ensure adequate disinfection	Chlorine demand is not constant. Dosing failure or incorrect setting. Instrument drift. Inadequate maintenance of chlorine probe. Chlorination affected by pH. Chlorine supplied can vary in strength.	Free chlorine analyser monitors chlorine level. Alarms if too high or too low. Monthly calibration & service checks of probe. Periodic microbial test results. Chlorine dosing rates can be monitored and adjusted remotely. Chlorine dosing control can be made sophisticated if required (eg PID loop). Store chlorine away from direct sunlight. Monitor chlorine inventory to ensure minimum practical time on shelf. Chlorine probe reading is compensated using pH measurement from the same flow cell.								Confirmed PID loop incorporated into chlorine dose control. Chlorine stored under a roof to protect from direct sunlight.							
	Start up / shutdown	Start up - unstable dose control. Shutdown - probe issues over time, fall to calibrate. Chlorine residual drops during shutdown	Incorrect PID loop tuning during commissioning Probe drifts off-spec during storage. Natural decay of chlorine	Free chlorine is a CCP and water will be diverted to off spec tank until chlorine is in target range. Operators service and calibrate probe after extended shutdown.															
	Cleaning	Fouling of piping and equipment	Low residual free chlorine or fault online instrument.	Routine servicing and cleaning of strainer. Strainer union ended.															
	Testing	Can't monitor water quality properly	Inadequate number/location of sample points	Sample point adjacent to instrument sidestream to get representative sample.								Confirmed sample points located before and after CCT							
	Maintenance	Unable to safely remove probes for calibration, or remove strainer for cleaning	Poor access and no isolation	Isolation valves on sidestream, and either side of static mixer (union ended).															
	Installation and environment (sun, noise, odour)	CCT pipe skid doesn't fit though room doors	Skid bigger than opening	Doors on building should be large enough. Could be constructed in situ if it is problematic after final building design is determined. Indoor setting so no issues for probes or pipework.								Skid mounted - fabricated off site. Confirmed door sized adequately to allow for installation							
	Isolation	Can't service easily	No isolation points.	Provision for isolation of CCT, sidestream and static mixer.															
Section 4 - Storage (Inclusive of Treated Water and Off-Spec)																			
4a - Treated Water Storage Tank (including process water pumps and recirc loop)	No or low Flow	No issues for tank. Low potable makeup flow causes tank to run dry. Flow is too low for effective mixing. Flow is too low for process water to service equipment. Low flow doesn't let instrumentation get representative readings. Inadequate chloramine dosing.	Makeup water valve failure. Manual valve closed. Failure of recirc or process water pumps. Multiple process units require water simultaneously. Strainer in instrumentation loop blocked. Dosing pumps under sized	Low level switch and transducer indicate low level. Manual override for auto valve (potable). Physical bypass of automatic valve is possible. Flow switch in instrumentation cell to detect no or low flow. Process units don't use water for extended periods so unlikely to occur concurrently. Pump sized appropriately. Process water pump is duty/standby. Strainer readily accessible and maintainable. Tank needs to maintain minimum volume to protect pumps. Radar level transducer not likely to be affected by swirling motion. Level switches are back ups so minor disturbance acceptable. Mount level switches out of direct line of eductor flow. Dosing pumps adequately sized	Consider limit switches for automatic valve, or alarm in PLC if valve is open and flowmeter doesn't indicate flow. This would allow early detection of valve failure. Depending on end use, refill rate etc. this may not be necessary.	Aquacell Design Team			Potable top up valve to be client scope. We can still request position feedback of valve.	Project delivery	19-Mar-25	Position feedback to be specified.							
	High flow	Process water flow too high at point of intended use. High flow through eductors causes "stirring". Excessive chloramine dosing	Process water pump oversized. High supply water pressure combined with requirement for air gap. Dosing pumps over sized	All points of use for process water have a valve that could be used to throttle flow if required. Dosing pumps adequately sized								Both disinfection pumps and process pumps are adequately sized. Disinfection pumps run on VFD to control flow.							
	Reverse flow	Contamination of potable by recycled water. Contamination of Treated Water tank from sewer (or drain line).	Backup in line Sewer line backs up Drain valve left open and drain line backs up and flows into tank	Air gap between tank and potable top up line. RPZ valve on potable line at plant inlet. Check valves on pumps.	Consider the risk of process water contamination from process s - eg, reverse flow from screen. Need to maintain air gaps. Should there be a RPZ?	Aquacell Design Team			Overflow line is lower than tw entry point to avoid siphoning. Air gap from potable top up maintained. RPZ incorporated (client supply).	Design	19-Mar-25	Confirmed.							
	High pressure	Tank damage and/or rupture. Damage to instrumentation or flow cell. Damage to process units using process water.	Overfilling tank and continuing to pump water into tank faster than it leaves.	Air gap provides a vent pipe when tank filling. Pressure regulators on instrumentation side stream. Presure regulators on process units.	Confirm BAC backwash supply line does not need a pressure regulator on it. Should there be a pressure transducer to alarm low and high pressure on the process pumps?	Aquacell Design Team			Pressure transducer to be incorporated into BAC backwash supply to monitor high & low pressure	Design	19-Mar-25	Overflow line adequately sized. Pressure transducer added to BAC backwash supply line.							

Item	Deviation	Consequence	Causes	Safeguards	Actions	Who	Due Date	Status	Action Checked	By	Date	New Actions Identified/ Outstanding	Who	Due Date	Status	Action Checked	By	Date	Closed Out
Equipment, tank, process unit	Condition such as no flow, high flow, pH change	What happens	Why does it happen	Valves, alarms, instrument, design	To be done to mitigate	By	Date												
	Low pressure	Tank collapse	Pump out faster than air or water can come into tank.	Air gap for makeup provides a vent point.	Confirm the air gap is sufficient venting.	Aquacell Design Team			Confirmed air gap will be sufficient	Design	19-Mar-25								
	Low level	Pump damage. Instrumentation damage. Insufficient supply for process water. Eductors above water line.	Pumping out faster than makeup or incoming treated water.	Low level switch and low level warning on level transmitter. Level set at commissioning to ensure eductors remain covered even at low level.	Confirm with manufacturer is there is a minimum level required to be maintained.	Aquacell Design Team			Low level switch & transducer incorporated to protect equipment.	Design	19-Mar-25	Minimum 100mm of water level to be maintained.							
	High level	Tank backs up and overflows at airgap and/or vent.	Failed level switch and transducer. Potable makeup valves fails open.	Peak flows considered at design stage when sizing overflow and vent lines. Some buffering capacity in buffer tank.	Ensure potable makeup valve fails closed. Limit switches on valve. Manual override on valve. Manual isolation on makeup line. Ensure the overflow line is the first point it overflows from.	Aquacell Design Team			As above, position feedback to be provided on top up valve, manual isolation & a bypass.	Design	19-Mar-25								
	High temperature	Not considered a risk in this location																	
	Low temperature	Not considered a risk in this location.																	
	Composition or changing concentration	Water is out of specification for delivery. Chlorine concentration can vary. Inadequate or excessive total chlorine in treated water	Chlorine out of range . pH out of range. Failure of control system for diversion. Override of CCP. Dosing pump incorrectly sized. Incorrect selection of static mixer.	Upstream diversion to out of spec tank to prevent water reaching tank in first place. Chlorine, Ammonium sulphate to correct chemistry if required. Free chlorine analyser monitors chlorine level. Alarms if too high or too low. Monthly calibration & service checks of probe. Periodic microbial test results. Chlorine dosing rates can be monitored and adjusted remotely. Chlorine dosing control can be made sophisticated if required (eg PID loop). Store chlorine away from direct sunlight. Monitor chlorine inventory to ensure minimum practical time on shelf. Chlorine probe reading is compensated using pH measurement from the same flow cell. Dosing pump correctly sized. Static mixer appropriately selected.															
	Start up / shutdown	Start up -unstable dose control. Pump damage upon start up. Off-spec water	Pumps not primed (air lock). Restoring pump after maintenance and isolations removed.	Treated water tank to be filled with sufficient potable during commissioning to ensure process water pumps can run the plant.															
	Cleaning	Biogrowth over long term	Insufficient free chlorine	Total chlorine residual maintained through QCP's. Periodic inspection to identify bio growth.															
	Testing	Inadequate total chlorine in the treated water.	Failure of some part of treatment process	Critical control points. Monthly microbial lab analysis. Sample point prior to treated water entering tank. Sample point on recirc loop.								Water would be diverted to off spec tank in event of any treatment process failure.							
	Maintenance	Pump can't be removed. Instruments can't be repaired or checked.	Not easily accessible	Pumps are external to tank for easy access. Instrumentation readily accessible	Are eductors installed from the top of the tank so they can be removed?	Aquacell Design Team			Select eductor material as SS316 to minimise the possibility of failure & need for replacement.	Design	19-Mar-25								
	Installation	Tank or liner blows away	Wind		Fill tank with water post installation if required.	Aquacell Installation Team			Filling of tank responsibility of tank supplier	Design	19-Mar-25	100mm of water must be available at time of tank commissioning							
	Isolation	Can't isolate	Lack of isolation valves	Every stream can be isolated															
4b - Off Spec Holding Tank	No or Low Flow	Tank could go stagnant. Algal bloom	Contents of tank not aerated and may not be introduced back into the system	Water in tank has been through biological treatment, and likely at least one other process step, eg. UV, Ozone, chlorination. Water quality is likely to be good.	Confirm tank is covered.	Aquacell Design Team			Confirmed	Design	19-Mar-25								
	High Flow	Out of spec inflow tank overflows faster than buffer tank pups can pump out	UV pump running with water out of spec and bio tank at high level.	High level transducer and switch to stop UV pumps. Buffer tank will have some buffering ability.															
	Reverse Flow	Contamination, odour	Reverse flow from off spec tank to treated water tank. Air from bio tank aeration escapes and enters off spec tank via overflow	Air gap at top of tank where out of spec water drops in. Out of spec tank higher than buffer tank so reverse liquid flow not possible. Out of spec water is being returned to the head of the plant for retreatment anyway.	Confirm P-trap in line between buffer tank and off spec tank to prevent odour	Aquacell Design Team			To be added to P&ID	Design	19-Mar-25	NRV added after CCT							
	Low Level	Tank or liner could blow away.	Drain valve leaking. Large surface area, low weight.	Maintain manufacturers minimum water level. Roof on tank. Low level switch to close drain valve	Confirm with manufacturer if there is a minimum water level that must be maintained after installation. Consider loop or standpipe so the tank cannot drain below minimum level.	Aquacell Design Team			Confirm with supplier minimum required water level	Project delivery	19-Mar-25	100mm of water must be available at time of tank commissioning							
	High Level	Overflow	Tank outlet valve failure, UV pumps running	High level transducer and switch in tank. Some buffering capacity in buffer tank.															
	Low Pressure	Tank collapse	Empty tank faster than air can enter	Tank is emptied via gravity rather than being pumped - slower rate.	Confirm the final tank spec has sufficient venting				Confirmed	Design	19-Mar-25								
	High Pressure	Tank damage	Tank is filled faster than air can escape		Confirm the final tank spec has sufficient venting				Confirmed	Design	19-Mar-25								
	Low Temperature	Not considered a risk in this location																	
	High temperature	Not considered a risk in this location																	
	Composition or changing concentration	Algae develops	UV exposure of nutrient rich water.	Roof on tank to avoid UV exposure. The only incoming stream comes from within the plant which can't be more contaminated than plant feed.															
	Cleaning	Tank requires cleaning	Build up of material over time	Water in tank has already been screened and treated. Unlikely to contain foreign materials. Biological growth can be treated with chlorine.	Confirm access hatches available to enter tank if required.				Confirmed	Design	19-Mar-25								
	Testing				Is there a reason we may need to test water quality in this tank?	Aquacell Design Team			Sample point to be added.	Design	19-Mar-25								
	Maintenance	Maintaining probes	Difficult to access installed in the top of the tank	Level transducer and switches rarely require service. Tank unlikely to need servicing during service life.	Confirm final mechanical design allows for access for probe replacement	Aquacell Design Team			Access ladder to be provided. Level instruments to be positioned close to ladder	Design	19-Mar-25								
	Installation	Tank is large mechanical construction	Not installed correctly	Engage tank manufacturer to install as they have the correct equipment and competencies								Confirm sufficient access around all tank locations for installation							
	Isolation	Isolatoin to enable confined space entry.	Breakdown or cleaning	Tank feed can be isolated on both treatment trains post CCT piping. No equipment in tank that would require entry for routine servicing.															
Section 5 - Waste (Inclusive of Sludge Dewatering, Overflow and Drains)																			
5a - Sludge Dewatering	No or Low Flow	No or low flow from polymer dosing system. No or low flow from spray water. Poor dewatering from ineffective mixing of polymer.	Faulty Dosing pump. Issue with potable feed	run/alarm signals present in polymer dosing system. Flow switch present on potable make up to polymer dosing system.								Add flow switch to dewatering unit flush line.	AQ Design team	14-Jul-25	Closed				
	High Flow	Flow too high for polymer to dose properly Exceed capacity of dewatering system	Operator error Faulty VFD	VFD to control flow Flowmeter on WAS pump skid															
	Reverse Flow	Reverse flow through process water		NRVs present on all process water lines.															
	Low Level	Low level in polymer dosing	level instrument failure	Flow switch on make up water Level switch on dosing tank.															
	High Level	Skip overflows	Inadequate warning system																
	Low Pressure	Low pressure from compressed air system	Fault with compressed air system									Add camera into sludge handling room Pressure switch is provided within pneumatic panel by Hydroflux. Show on P&ID	AQ design team AQ design team	14-Jul-25 15-Jul-25	Closed Closed				
	High Pressure	High pressure from mono pump	Valve closed	Pressure relief valve on each mono pump															
	Low Temperature	N/A																	
	High temperature	N/A																	
	Composition or changing concentration	Incorrect sludge concentration may impact dewatering Polymer concentration not appropriate.	Wasting frequency not optimal.	Fully automated process. Flowmeter on dewatering line allows us to run for a set period of time to deliver a set SRT. Until process is optimised, periodic pump out of mixed liquir may be required to ensure that MLSS concentration is maintained.															
	Cleaning	Build up of sludge in sludge recirc line	Infrequent operation of process	Potable line to WAS pump skid to flush line after running sludge rescreening. Spray bar included on dewatering unit Doors included on screen to allow for additional manual cleaning if required.															
	Testing	Samples required	Monitor	Sample point included within sludge dewatering unit								Add additional sample point to sample sludge prior to polymer make up. Check whether there is an additional sample line on the dewatering unit subnatant.	AQ design team	14-Jul-25	Closed				
	Maintenance	Maintaining screw prew press.	Unable to maintain due to access	Sufficient access to maintain screw press in situ. Also sufficient space to lift complete unit outside if required.															
	Installation	Installation of screw press	Unable to install due to limited access	see above															
	Isolation	Unable to isolate any piece of the dewatering process	Inadequate valving	sufficient valves on all equipment to isolate if required. Duty/stand by pump arrangement															
5b - Plumbing Collecting Overflows and Drains	No or low Flow	Odour. Debris build up in screenings pipe	P-traps dry out	Service team discharge periodically to recharge traps	Ensure suitable fall on screenings overflow and other overflows to ensure debris has best chance of being flushed to wet well.	Aquacell Design Team			Ensure sufficient periodic flushing through overflow to avoid drying of debris is incorporated into the program.	Design	19-Mar-25								
	High flow	Fills up wet well which is then transferred into plant	Ingress from rainwater or other upstream source	All floor wastes are internal so no rainwater ingress. Monintoring or logs during rain events to identify possible Ingress of storm Water.	Ensure all below ground tanks are correctly sealed and installed in a manner that prevents rain or groundwater access. Similarly, ensure customer is aware the sewerage system should not allow storm water ingressm	Aquacell installation Team. Aquacell Service Team			Emergency overflow tank to be incorporated into the design	Design	19-Mar-25								

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Equipment, tank, process unit	Condition such as no flow, high flow, pH change	What happens	Why does it happen	Valves, alarms, instrument, design	To be done to mitigate	By	Date												
	Composition or changing concentration	Humidity/Moisture. Oil or other contaminant in air which causes equipment damage	Inherent in compressed air systems	Each compressor has an air dryer and air goes through a dual filter system prior to distribution. Compressors and receivers have automatic condensate drains.															
	Cleaning	Water on floor from autodrains	Autodrain discharges condensate	Condensate directed to floor drains															
	Testing	Pressure vessel inspection/test	Statutory requirement		If Aquacell service plant, allow for service of compressor and inspection of pressure vessels.	Aquacell Service Team Aquacell Design Team			Adequate service time to be allowed for compressors. Annual inspection to be organised for pressure vessels.	Aquacell Service Team	19/03/2025								
	Maintenance	Breakdown.	Inadequate servicing.	Compressors and dryers to be maintained as per manufacturers recommendation	If Aquacell service plant, allow for service of compressor and inspectino of pressure vessels. Confirm packaged compressor unit has autodrain to drain reciever	Aquacell Service Team Aquacell Design Team			Confirmed packaged compressor unit will have autodrain to drain reciever	Design	19/03/2025								
	Installation	Vibration damage Noise	Improper isolation.		Confirm packaged compressor unit has acoustic hood. Confirm if compressor mounted on vibration mounts. Ensure flexible connection from compressor to fixed pipework. Consider adding flexible hose between compressor and rigid piping	Aquacell Design Team			Compressor selection ongoing. Consider rotary screw compressor.	Design	19/03/2025	Rotary screw compressor has been selected. Flexible hose has been added between compressor and rigid piping	Design	14/07/2025	Closed				
	Isolation	Requirement to isolate and discharge stored energy	Service requirement	Isolation points and drain points	Confirm packaged compressor unit has a drain valve to drain receiver	Aquacell Design Team			Confirmed packaged compressor unit will have autodrain to drain reciever	Design	19/03/2025								
Section 8 - Odour																			
8a. Odour Scrubber	No or Low Flow	Air doesn't move through scrubber. Air not ejected into atmosphere to disipate. Odour complaints.	Carbon compacted or fouled. Blower on scrubber has failed. Upstream valves are closed.	Odour scrubber blower and upstream aerators all have monitored O/L's. Pre-screens are the only vent lines with dampers that can be closed.	Add valve to allow balancing of flow between tanks	Aquacell Design Team						Magnehelic pressure gauge is allowed for with skid mounted odour control unit. Service item to regularly monitor this locally on site.	AQ service team	14/07/2025					
	High Flow	Insufficient contact time with carbon. Odour complaints.	Low level or no carbon	Routine maintenance. Carbon sampling points	Add valve to allow balancing of flow between tanks.	Aquacell Design Team						Valves have been added to allow balancing between tanks.	Aquacell design team	14/07/2025					
	Reverse Flow	Odours escape	Incorrectly commissioned	Commissioning checks to ensure odour control system is installed correctly.															
	Low Level	Insufficient carbon to scrub odours	System not correctly filled	Carbon sampling points. O&M manual to teach operators correct fill level. Routine Maintenance															
	High Level	Carbon exhausts to atmosphere	System not correctly filled	Form of carbon used unlikely to be picked up by fan. Carbon sampling points. O&M manual to teach operators correct fill level. Routine Maintenance															
	Low Pressure	Odour scrubber collapses	Upstream valve closed causing blower to suck in scrubber housing.	Fan cannot generate sufficient pressure to collapse housing															
	High Pressure	High pressure is not possible as system is on suction side of blower and system is open to atmosphere. High differential pressure is possible, causing inefficiencies and odours.	Blocked carbon bed or inlet filters	Differential pressure indicator installed. Routine maintenance. Operator training.															
	Low Temperature	Not considered a risk in this location																	
	High temperature	Not considered a risk in this location																	
	Composition or changing concentration	Condensation can develop in vent lines. H2S concentrations exceeds design limits	Atmospheric conditions. Influent characteristics outside of range. Holding times exceeded. Ineffective mixing.	Sample points located on skid for monitoring H2S levels	Ensure all vent lines move uphill from a tank, or drainpoint where condensate can collect and be drained.	Aaquacell Design Team. Aquacell installation team			Confirmed	Design	19/03/2025								
	Cleaning	No specific cleaning requirements																	
	Testing	Test air or carbon quality	Maintor or check performance of unit	Carbon sampling points. Air sampling point.															
	Maintenance	Carbon exhausted and needs to be replaced. Breakdown or service on scrubber's blower.	Carbon is consumable.	Filter is accessible for cleaning.	Can entire system still run if the blower fails?							System will run passively in event of blower failure	AQ design team	14/07/2025	closed				
	Installation	System is difficult to install	Poor design	Skid mounted system located outside of main treatment plant.															
	Isolation	Can't isolate unit	No upstream or down stream valves	Mechanical and electrical isolation provided Minimum maintainable components means thie requirement will be rare.								Consider if bypass to stack is required during maintenance of carbon beds	AQ design team	14/07/2025	Closed (not required)				
9a - Climate change - Physical and Environmental Risks	Increased Rainfall and Flooding	Overflow of sewers Process inefficiencies Risk recycled water ingress into the stormwater network	Climate impacts not considered in tank sizing Climate impacts not considered in process design Climate impacts not considered in irrigation design/sizing	Sewer collection network is significantly smaller and so relatively contained, compared with a typical municipal wastewater network. Buffer tank (1ML), Off spec holding tank (1ML), Emergency overflow tank (300kL). The combined plant storage capacity will minimise the risk of sewer overflow during periods of increased rainfall. Any change in sewer composition will be monitored and equalised with the buffer tank to minimise the risk of process inefficiency. The plant's peak flow is 3x higher than average flow, in line with Sydney Water's "Wastewater Treatment Planning Guidelines". There is sufficient holding time within the treated water tank to store in extreme rainfall events when the the irrigation area is saturated. A comprehensive wet weather management strategy will be implemented. Further information can be found in the Land Capability Assessment and Irrigation Management Plan.															
	Drought and Reduced Water Availability	Insufficient water available for irrigation during drought and reduced water availability	Increased irrigation requirement	Influent generated from within the industrial developmont rather than relying on rainfall. Treated water storage system is sufficiently sized.															
	Rising Temperatures	Activated sludge process inefficiencies	High aerobic and anoxic temperature reduces the microbial activities	Tank is a large volume, constructed underground from concrete. Influent temperature will remain unaffected. Temperature is monitored at various stages throughout the process, from influent to effluent.															
	Sea Level Rise and Saltwater Intrusion	N/A - plant is approximately 106m above the sea level and so considered not to be an issue when compared with estimated seawater level rises																	
	Extreme Weather Events (Cyclones, Storms, Bushfires)	Damage to OSSM facility	Inadequate design with regard to extreme weather events.	The development is more than 100 m from forest hazards and more than 50 m from grassland hazards. Safe access and egress between the development and the public road system has been allowed for fire-fighters. A defendable space between structures and the bushfire hazard/boundaries has been provided to allow fire-fighters to gain access to all sides of the structures and the bushfire hazard at the boundary. Access to a reticulated water supply (e.g. hydrants) has been incorporated into the design. The building has been designed by structural engineers with consideration of wind loadings as per accepted Australian standards.															
9b - Climate change - Operational and Process Risks	Process Upsets	Uncompliant treated water.	Plant design has not considered variation in influent as a result of climate change.	Sewer collection network is significantly smaller and so relatively contained, compared with a typical municipal wastewater network. The plant has remote monitoring and control capability to ensure that any deviations in influent can be appropriately managed. Any change in sewer composition will be maintored and equalised with the buffer tank to minimise the risk of process inefficiency. The plant's peak flow is 3x higher than average flow, in line with Sydney Water's "Wastewater Treatment Planning Guidelines".															
	Increased Energy Demand	Greenhouse effect Higher operational cost	Higher energy consumption from pumps to deal with high flow during rainfall.	Sewer collection network is significantly smaller and so relatively contained, compared with a typical municipal wastewater network. Large buffer capacity will allow the process to operate at normal flow even during periods of wet weather. Recycling water at the source mitigates the need for pumping water large distances to the building from the public water supply, and mitigates the need to pump or transfer wastewater large distances for treatment.															
	Biosolids Management Challenges	Odour Higher waste sludge transportation and treatment cost	Open sludge area resulting in rainwater ingress leading to higher sludge volume	Sludge handling is located inside the shed. Advanced sludge dewatering unit to minimise sludge volumes															
9c - Climate change - Financial and Economic Risks	Higher O&M Costs	Financial viability of scheme becomes questionable.	Increased operating costs due to climate change	Robust financial planning assessment has been completed to ensure that maintenance costs remain viable. 10 year cashflow forecast has been provided allowing for CPI increases. Specific fees and usage rates can be adjusted if required.															
	Capital Investment Needs	Upgrades required to treatment plant	Insufficient redundancy in design to accommodate changes	Sufficient storage and process capacity has been considered within the treatment plant. Both CAPEX and OPEX costs have been considered															
9d - Climate change - Social and Reputational Risks	Public Health Risks	Disease Transmission via Pathogens	Inadequate controls of recycled water quality	A comprehensive RWQMP has been developed to implement critical and quality control points to ensure adequate pathogen reduction. Any uncompliant water will be diverted to off spec tank for furter treatment.															

[illegible]

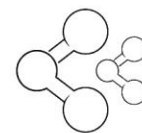


Appendix 5 – WICA Scheme Approval to Install - pending



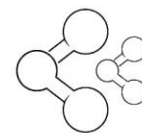
Appendix 6 – Aquacell Sampling Procedure

Sampling Work Instructions

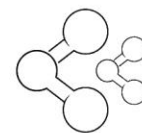


Revision	Date	Author	Amendments
2	11/05/21	Tass Meli	Full update to include new sample preparation requirements and better specify sample point disinfection process

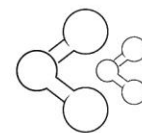
MR160-2
Revision 2, 11 May 2021
Sampling Work Instructions



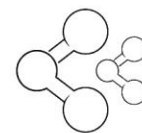
Process Step	Onsite Sampling
Objectives	The following procedure will be followed when sampling process or recycled waters from Aquacell wastewater treatment facilities that will undergo analytical quality testing including microbiological tests (typically E.coli or Faecal Coliforms). • To collect samples for physical, chemical or microbiological analysis by an external laboratory • Ensure proper sampling techniques are followed
Management Strategy	Aquacell greywater/blackwater treatment and water recycling plants are verified for effective performance on commissioning as required by the local regulator (eg: NSW Health) and/or to validate design performance. Ongoing monitoring via regular sampling is generally required in order to comply with regulations and ensure no health risks are present in recycled water reuse applications The ongoing operational performance of the system is monitored to ensure efficient operation and to protect human health and the environment. When out of specification results occur, they are addressed via the corrective action specified under the appropriate site management plan.
Health and Safety requirements	Biological hazards may be present in process waters. Use gloves safety glasses and protective clothing when sampling. Safely store the alcohol & lighter used for sample point disinfection. Make sure that you have conducted the site hazard assessment before commencing.



Process Step	Onsite Sampling
Actions – off-site preparation	Prior to the commencement of sampling; 1. Obtain sufficient sealed and unused sample bottles as provided by the testing laboratory (eg; Envirolab, ALS). Note: Microbiological sampling bottles are usually 250mL. They are supplied prestерilised and will contain a tiny amount of Sodium Thiosulphate solution as a preservative so it is normal for moisture to be present in the sample bottle and it must be unopened until sampling. Other sample bottles vary in size (up to 1000mL) and material according to the requirements of the analysis but will be plastic in almost all applications. Larger 15L or 20L carboys may be required for Cryptosporidium or Giardia testing in infrequent test 2. Place the sample bottles in a suitable clean cool storage or esky. Carry additional sample bottles in case resampling or extra samples become necessary. 3. Place frozen freezer blocks in the esky or obtain ice or other cooling medium for the esky once samples are taken - in order to keep samples cool during transport to the laboratory. Larger or carboy sample containers are to be kept out of the sun 4. Prepare a standard chain of custody (COC) form for each sampling site. These are printed from files stored on the Aquacell server at <i>S:\Aquacell Service\01 Admin\Sampling results - consolidated (use S folder for ongoing monitoring)\COC</i> 5. Ensure you have alcohol (spray or disinfectant wipes) for cleaning the sample point 6. Ensure you have gloves, safety glasses and any other required site PPE



Actions – On-site sampling	Sampling should be done at the end of site service visits to minimise the holding time prior to sample delivery. 7. Locate the correct sampling point(s). Greywater/blackwater influent sample will be collected from the appropriate sample points. For treated water, the sample point will be a dedicated valve and open line on the recirculation loop. (Note: If no sampling point is available, treated water may be sampled directly from the filtrate discharge to the filtrate pit (eg: Kurrajong) If no direct sampling point is available and a secondary sample container is to be used to dip in tanks or other sampling method, ensure it is clean and disinfected prior to use. If applicable sample collection devices will be rinsed with ethanol then water then dried (sample container for effluent and sample bailer or peristaltic pump for influent). 8. Check that the sample point is visually clean. If not, dismantle and clean the sample point and reassemble before sampling. 9. Complete the sample bottle label including the date and time. The sample description should state the site name. 10. Wear disposable gloves and safety glasses when sampling. 11. If any micro samples are to be taken, these should be taken first. Sample via the installed sample point after disinfecting as follows; - Fully open the sample tap and allow water to flow for 10-20 seconds. This purges the sample line with fresh sample - Close the sample tap - Spray or soak the sample pipe with alcohol. Ensure the open pipe tip is well covered with alcohol. If the sample pipe is metal flame off the alcohol by quickly striking a lighter near the alcohol-soaked sample pipe. Otherwise allow alcohol to evaporate. 12. Open the sample tap and set to flow at a flowrate suitable for sample collection. Flow should be fast enough to ensure quick sample bottle filling in 3-5 seconds but not too fast such that sample splashes out of the sample bottle. 13. Hold the unopened sample bottle close to the sample flow and carefully and quickly open the lid. Keep hold of the lid without touching the inside surface. Keep the lid face down while sampling. 14. Quickly place the sample bottle under the sample stream and fill to approximately 10-20mm from the top rim. Do not rinse out or overfill the sample bottle as this will reduce or remove the preservative in the bottle. 15. Quickly place the lid back on the bottle and tighten securely ensuring the lid is not cross-threaded. 16. If you suspect sampling has not been carried out correctly, discard the sample and retake the sample in a new unused sample bottle.
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Process Step	Onsite Sampling
	17. If other sample bottles are required to be filled for non-microbiological testing (such as BOD, TSS, TN, TP) these should now be taken. Micro samples should be taken first. 18. Place all sample bottles into the esky with ice bricks or ice as planned to keep samples cool. 19. Promptly deliver samples to the laboratory on the day of sampling. The chain of custody form(s) will be kept with the sample esky and final notes completed when samples are delivered to laboratory receipt point staff.
Corrective action	Depending on the analysis, test results will be available in 2-8 days following sampling. BOD or micro tests such as E.coli and Coliforms will generally require 5 – 8 days before sample results are available. If treated water test results do not comply with site critical specifications once received, immediately divert the treated water supply and take other response actions and notifications as required in the site management plan. Arrange for resampling and analysis as soon as possible. Investigate the cause of out of specification samples and implement remedial action as required.
Equipment	PPE; gloves, safety glasses, alcohol solution, lighter Sample bottles as specified by the laboratory. (Note that laboratories will generally accept each other's micro sample bottles if necessary.)
Reporting	Laboratories will provide sample results by email. Details of results of analytical testing must be maintained. Save sample certificates of analysis (COA) in the site service "Monitoring" folder when received. Record routine site service results in the results file stored on the Aquacell server at <i>S:\Aquacell Service\01 Admin\Sampling results - consolidated (use S folder for ongoing monitoring)</i> .



Appendix 7 – WICA Retailer Licence

Water Industry Competition Act 2006
Schedule 4, clause 10
Notice of decision – Grant of retailer licence
Licence No. 25_009R

The Independent Pricing and Regulatory Tribunal (**IPART**) grants Aquacell Pty Ltd (ACN 072 487 015) a retailer licence under Schedule 4, clause 10(1) of the *Water Industry Competition Act 2006* (**Act**).

The retailer licence takes effect on 1 March 2025.

In considering whether to grant the retailer licence and what conditions to impose on the licence, IPART had regard to the objects in sections 2A and 5A of the Act.

The retailer licence is attached.

23/01/2025

X



Signed by: carmel.donnelly@ipart.nsw.gov.au

Carmel Donnelly PSM
Chair

On behalf of the Independent Pricing and Regulatory Tribunal



New South Wales Government

Water Industry Competition Act 2006 (NSW)

Retailer Licence no. 25_009R

Aquacell Pty Ltd

(ACN 072 487 015)

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RETAILER LICENCE

Water Industry Competition Act 2006



Licence Authorisation Table

Licensee	Aquacell Pty Ltd
	ACN 072 487 015
Licence number	25_009R
Version history	Current licence in force since: 1 March 2025. Details about grant, variation, replacement, cancellation or surrender of this licence are set out in Schedule A.
Authorised activities (the Act, s 8F(a))	Sale of water and/or sewerage services.
Authorised maximum scale (the Act, s 8F(b))	249 customer premises per scheme (Category R1)

LICENCE TERMS

1. Grant and authorisation

- 1.1 The Independent Pricing and Regulatory Tribunal grants this licence under the Act, Schedule 4, clause 10(1).

Note: This licence is deemed to be a licence granted under section 8C of the Act.

- 1.2 The licensee is authorised to carry out the authorised activities in connection with the schemes for which the licensee is the registered retailer that do not exceed the authorised maximum scale.

Note: This clause authorises the licensee to carry out certain activities that would otherwise be prohibited under section 6B of the Act. This authorisation does not exempt the licensee from obligations under other laws unless expressly provided by those laws.

2. Licence conditions

The licensee must comply with the standard licence conditions specified in Schedule B, Item B2 and the special licence conditions specified in Schedule B, Item B3.

Note: The licensee must also comply with conditions specified in the Act and Regulations.

3. Interpretation

- 3.1 Expressions used in this licence that are defined in the Act or Regulations have the meanings set out in the Act or the Regulations unless the context otherwise requires.

- 3.2 In this licence, unless the context otherwise requires:

- a. the singular includes the plural and vice versa,
- b. a reference to this licence includes any schedule to this licence,
- c. a reference to a schedule is to a schedule to this licence, and
- d. explanatory notes and headings do not form part of this licence, but in the case of uncertainty may be relied on for interpretation purposes.

- 3.3 In this licence:

Act means the *Water Industry Competition Act 2006*.

authorised activities mean the activities specified in the licence authorisation table.

authorised maximum scale means the maximum scale of schemes specified in the licence authorisation table.

licensee means the person specified in the licence authorisation table.

Regulations means any regulations made under the Act.

Schedule A Version History

Current licence in force since	1 March 2025
Original grant date	2 February 2010
Transition date	Transitioned licence granted under the Act, Schedule 4, cl. 10(1) on: 1 March 2025
Variation history	Varied under the Act, s. 10 or s. 15 (now repealed) on: • 21 July 2014, • 26 July 2015, • 31 January 2018, • 1 November 2020. Varied under the Act, s. 8M on: Not applicable
Replacement history	Not applicable
Cancellation or surrender	Not applicable

Schedule B Licence Conditions

Item B1 Interpretation

1.1.1 In this schedule:

reporting manual means a document published on IPART's website from time to time setting out notification, information, consultation and reporting requirements for licensed retailers.

1.1.2 If any condition, or part of any condition, is unlawful, that condition, or part of the condition, is severable and does not affect the validity of the licence or the balance of the conditions or condition.

Item B2 Standard licence conditions

B2.1 Maintaining appropriate insurance

2.1.1 The licensee must hold insurance of an appropriate type, scope and limit for the activities it carries out under this licence.

2.1.2 The licensee must provide a copy of each certificate of currency of the insurance held by the licensee to IPART in accordance with the reporting manual.

2.1.3 The licensee must notify IPART in accordance with the reporting manual of a change to:

- (a) the insurer or underwriters for an insurance policy held by the licensee; or
- (b) the type, scope or limit of insurance held by the licensee.

2.1.4 The licensee must provide a report to IPART in accordance with the reporting manual from an insurance expert certifying that in the insurance expert's opinion the type, scope and limit of the insurance held by the licensee is appropriate for the activities the licensee carries out under this licence:

- (a) before commencing to supply water or sewerage services to a scheme; or
- (b) when requested by IPART.

2.1.5 In this condition B2.1, **insurance expert** means an insurance broker that holds an Australian financial services licence under Part 7.6 of the *Corporations Act 2001* (Cth) that authorises the broker to provide financial product advice for, and deal in, contracts of insurance within the meaning of Chapter 7 of that Act.

Note: The circumstances in which IPART may request the licensee provide a report under condition 2.1.4 include (but are not limited to) the following:

- where IPART considers that there may have been or may be a change in the type, scope or limit of the insurance held by the licensee; or
- where IPART considers that there may have been or may be a change in the activities the licensee carries out under this licence; or
- where IPART or an approved auditor considers that the type, scope or limit of the insurance held by the licensee may not be appropriate for the activities the licensee carries out under this licence.

B2.2 Complying with audit guidelines

2.2.1 The licensee must undertake audits of its authorised activities in accordance with any audit guidelines issued by IPART and published on IPART's website.

B2.3 Reporting in accordance with the reporting manual

2.3.1 The licensee must prepare and submit the following reports in accordance with the reporting manual:

(a) an annual compliance report, including:

- (i) the extent to which the licensee has or has not complied with the Act, the Regulations, this licence and approvals;
- (ii) for each failure to comply with the Act, Regulations, this licence or an approval:
 - a. the particulars of the non-compliance;
 - b. the reasons for the non-compliance;
 - c. the actions taken, or to be taken, to mitigate the effects of the non-compliance or to prevent a recurrence of the non-compliance;

(b) reports on performance indicators and other data specified in the reporting manual; and

(c) any other report required by the Act, the Regulations, this licence or an approval.

2.3.2 The licensee must give notices and provide information required by the Act, the Regulations, this licence or an approval in accordance with the reporting manual.

B2.4 Infrastructure to be used

2.4.1 The licensee must only source and supply water by means of water industry infrastructure if that water industry infrastructure is maintained and operated by a licensed operator under the authority of its operator licence or a public water utility.

2.4.2 The licensee must only provide sewerage services by means of water industry infrastructure if that water industry infrastructure is maintained and operated by a licensed operator under the authority of its operator licence or a public water utility.

B2.5 Delineating responsibilities under a code of conduct

2.5.1 The licensee must establish, and provide to IPART, a code of conduct for each scheme for which it is the registered retailer:

- (a) before commencing to supply water or sewerage services to a scheme; or
- (b) by another date nominated by the licensee and approved by IPART.

2.5.2 Subject to condition 2.5.3, the licensee must obtain agreement to the code of conduct from:

- (a) the registered operator for the scheme; and
- (b) each licensed operator, licensed retailer and public water utility that:

RETAILER LICENCE

Water Industry Competition Act 2006



- (i) supplies water or provides sewerage services in the same area of operations as the scheme (unless advised otherwise by IPART in writing); or
- (ii) constructs, maintains or operates any water industry infrastructure that is connected to the licensee's water industry infrastructure.

2.5.3 The code of conduct must set out the roles and responsibilities of the entities specified in condition 2.5.2, including by specifying as relevant:

- (a) who is responsible for repairing, replacing or maintaining the water industry infrastructure;
- (b) who is liable in the event of the unavailability of water;
- (c) who is liable in the event of failure of the water industry infrastructure;
- (d) who is responsible for sharing information and data and in what circumstances;
- (e) who is responsible for communicating with customers or dealing with customer complaints and how complaints will be handled;
- (f) who is responsible for managing incidents and how incidents will be managed;
- (g) who is responsible for managing water quality and preventing cross-connections; and
- (h) who is liable for the fees and charges payable in respect of the use of the water industry infrastructure.

2.5.4 The licensee must comply with its obligations and responsibilities under the code of conduct.

2.5.5 Where the licensee has established a code of conduct in accordance with clause 7 of Schedule B to Licence No. 09_004R granted under section 10 of the Act (now repealed), that code of conduct is deemed to:

- (a) have been established in accordance with condition 2.5.1; and
- (b) comply with conditions 2.5.2 and 2.5.3, until it is first amended or replaced following the grant of this licence.

2.5.6 In this condition B2.5, code of conduct means a utility service agreement or other agreement or document, however described, that includes a protocol for dealing with the matters set out in condition 2.5.3, as relevant.

Note: The objective of a code of conduct is to minimise risks to public health, safety and customers through the establishment of a protocol of efficient and effective day-to-day working arrangements between the licensee and a public water utility, licensed operator or licensed retailer in relation to the matters covered by the code, which include information sharing and handling customers, incidents or other events.

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B2.6 Notification of supply of water or provision of sewerage services

- 2.6.1 Within 10 days after commencing to supply water to a scheme under this licence, the licensee must notify IPART in accordance with the reporting manual that it has commenced supplying water to customers of the scheme.
- 2.6.2 Within 10 days after commencing to provide sewerage services to a scheme under this licence, the licensee must notify IPART in accordance with the reporting manual that it has commenced supplying sewerage services to customers of the scheme.

Item B3 Special licence conditions

B3.1 [Not applicable]



Appendix 8 – WICA Operator Licence



New South Wales Government

Water Industry Competition Act 2006 (NSW)

Operator Licence no. 25_008

Aquacell Pty Ltd

(ACN 072 487 015)

Contents

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OPERATOR LICENCE

Water Industry Competition Act 2006



Licence Authorisation Table

Licensee	Aquacell Pty Ltd ACN 072 487 015
Licence number	25_008
Version history	Current licence in force since: 17 July 2025 Details about grant, variation, replacement, cancellation or surrender of this licence are set out in Schedule A.
Authorised activities (the Act, s 8E(a))	Construction and operation of water industry infrastructure.
Authorised classes (the Act, s 8E(b))	The classes specified in Schedule B.
Authorised maximum schemes (the Act, s 8E(c))	10 schemes.
Authorised maximum scale (the Act, s 8E(d))	The scale specified for each class in Schedule B.

LICENCE TERMS

1. Grant and authorisation

- 1.1 The Independent Pricing and Regulatory Tribunal granted this licence under the Act, Schedule 4, clause 10(1).

Note: This licence is deemed to be a licence granted under section 8C of the Act.

- 1.2 The licensee is authorised to carry out the authorised activities in connection with water industry infrastructure for which the licensee is the registered operator that:

- a. is of an authorised class,
- b. has a design capacity that does not exceed the authorised maximum scale, and
- c. does not exceed the authorised maximum schemes.

Note: This clause authorises the licensee to carry out certain activities that would otherwise be prohibited under sections 6 and 6A of the Act. This authorisation does not exempt the licensee from obligations under other laws unless expressly provided by those laws.

2. Licence conditions

- 2.1 The licensee must comply with the standard licence conditions specified in Schedule C, Item C2 and the special licence conditions specified in Schedule C, Item C3.

Note: The licensee must also comply with conditions specified in the Act and Regulations.

3. Interpretation

- 3.1 Expressions used in this licence that are defined in the Act or Regulations have the meanings set out in the Act or the Regulations unless the context otherwise requires.

- 3.2 In this licence, unless the context otherwise requires:

- a. the singular includes the plural and vice versa,
- b. a reference to this licence includes any schedule to this licence,
- c. a reference to a schedule is to a schedule to this licence, and
- d. explanatory notes and headings do not form part of this licence, but in the case of uncertainty may be relied on for interpretation purposes.

- 3.3 In this licence:

Act means the *Water Industry Competition Act 2006*.

authorised activities mean the activities specified in the licence authorisation table.

authorised class means the class specified in the licence authorisation table.

authorised maximum scale means the maximum scale of schemes specified in the licence authorisation table.

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authorised maximum schemes means the maximum number of schemes specified in the licence authorisation table.

design capacity means the capacity of the class of infrastructure as determined in accordance with the document as in force from time to time entitled *Design Capacity Guidelines*, issued by IPART and published in the Gazette and on IPART's website.

licensee means the person specified in the licence authorisation table.

Regulations means any regulations made under the Act.

Schedule A Version History

Current licence in force since	17 July 2025
Original grant date	26 July 2015
Transition date	Transitioned licence granted under the Act, Schedule 4, cl.10(1) on: 1 March 2025
Variation history	Varied under the Act, s. 10 or s. 15 (now repealed) on: • 1 November 2020 • 26 July 2021 Varied under the Act, s. 8M on: • 17 July 2025
Replacement history	Not applicable
Cancellation or surrender	Not applicable

Schedule B Authorised Classes and Authorised Maximum Scales

Authorised classes of water industry infrastructure	Scale category	Parameter	Maximum Scale
Infrastructure for the purpose of the collection and treatment of sewage for disposal and the disposal of the treated sewage.	H3	Sewage processing capacity (kL/day)	900
Infrastructure for the purpose of the collection and treatment of sewage for the production, supply and use of recycled water.	D3	Sewage processing capacity (kL/day)	900

Schedule C Licence Conditions

Item C1 Interpretation

1.1.1 In this schedule:

NSW Health means the Department of the Public Service responsible to the Minister administering the *Public Health Act 2010*.

reporting manual means a document published on IPART's website from time to time setting out notification, information, consultation and reporting requirements for licensed operators.

1.1.2 If any condition, or part of any condition, is unlawful, that condition, or part of the condition, is severable and does not affect the validity of the licence or the balance of the conditions or condition.

Item C2 Standard licence conditions

C2.1 Maintaining appropriate insurance

2.1.1 The licensee must hold insurance of an appropriate type, scope and limit for the activities it carries out under this licence.

2.1.2 The licensee must provide a copy of each certificate of currency of the insurance held by the licensee to IPART in accordance with the reporting manual.

2.1.3 The licensee must notify IPART in accordance with the reporting manual of a change to:

- (a) the insurer or underwriters for an insurance policy held by the licensee; or
- (b) the type, scope or limit of insurance held by the licensee.

2.1.4 The licensee must provide a report to IPART in accordance with the reporting manual from an insurance expert certifying that in the insurance expert's opinion the type, scope and limit of the insurance held by the licensee is appropriate for the activities the licensee carries out under this licence:

- (a) before commencing to operate water industry infrastructure for a scheme under an operational approval; or
- (b) when requested by IPART.

2.1.5 In this condition C2.1, **insurance expert** means an insurance broker that holds an Australian financial services licence under Part 7.6 of the *Corporations Act 2001* (Cth) that authorises the broker to provide financial product advice for, and deal in, contracts of insurance within the meaning of Chapter 7 of that Act.

Note: The circumstances in which IPART may request the licensee provide a report under condition 2.1.4 include (but are not limited to) the following:

- where IPART considers that there may have been or may be a change in the type, scope or limit of the insurance held by the licensee; or
- where IPART considers that there may have been or may be a change in the activities the licensee carries out under this licence; or
- where IPART or an approved auditor considers that the type, scope or limit of the insurance held by the licensee may not be appropriate for the activities the licensee carries out under this licence.

C2.2 NSW Health requirements

- 2.2.1 The licensee must consult with NSW Health each time it develops or proposes to make a material change to any of the following:
- (a) a water quality management system for water industry infrastructure constructed or operated by the licensee for drinking water or recycled water, including:
 - (i) a detailed risk assessment; or
 - (ii) a technology assessment;
 - (b) a sewage management plan or system for water industry infrastructure constructed or operated by the licensee for the disposal of treated effluent, including a detailed risk assessment;
 - (c) a protocol to notify NSW Health of health-related incidents or complaints relating to drinking water, recycled water, non-potable water or treated effluent, as applicable.
- 2.2.2 The licensee must provide NSW Health with a copy of any report on an operational approval application audit under section 7E(2) of the Act at the same time it provides the report to IPART.
- 2.2.3 The licensee must provide documents to and consult with NSW Health in accordance with the reporting manual.

Note: Condition C2.7 requires the licensee to notify NSW Health when it commences operating water industry infrastructure.

C2.3 Complying with audit guidelines

- 2.3.1 The licensee must undertake audits of its authorised activities in accordance with any audit guidelines issued by IPART and published on IPART's website.

C2.4 Reporting in accordance with the reporting manual

- 2.4.1 The licensee must prepare and submit the following reports in accordance with the reporting manual:
- (a) an annual compliance report, including:
 - (i) the extent to which the licensee has or has not complied with the Act, the Regulations, this licence and approvals;
 - (ii) for each failure to comply with the Act, Regulations, this licence or an approval:
 - a. the particulars of the non-compliance;
 - b. the reasons for the non-compliance;
 - c. the actions taken, or to be taken, to mitigate the effects of the non-compliance or to prevent a recurrence of the non-compliance;
 - (b) reports on performance indicators and other data specified in the reporting manual; and
 - (c) any other report required by the Act, the Regulations, this licence or an approval.
- 2.4.2 The licensee must give notices, undertake consultation, and provide information required by the Act, the Regulations, this licence or an approval in accordance with the reporting manual.

C2.5 Monitoring

- 2.5.1 The licensee must undertake any monitoring that is required for the purposes of any of the following plans or systems, as applicable to the licensee's schemes, in accordance with this condition C2.5:
- (a) water quality management system;
 - (b) sewage management plan or system.
- 2.5.2 The licensee must keep the following records of any samples taken for monitoring purposes:
- (a) the date on which the sample was taken;
 - (b) the time at which the sample was collected;
 - (c) the point or location at which the sample was taken; and
 - (d) the chain of custody of the sample (if applicable under the relevant plan or system).
- 2.5.3 The licensee must ensure that analyses of all samples taken for the purposes of verification monitoring are carried out by a laboratory accredited for the specified tests by the National Association of Testing Authorities or an equivalent body that is acceptable to NSW Health.
- 2.5.4 In this condition C2.5, **verification monitoring** means verification monitoring as described in the national safety guidelines, as applicable.

C2.6 Delineating responsibilities under a code of conduct

- 2.6.1 The licensee must establish, and provide to IPART, a code of conduct for each scheme for which it is the registered operator:
- (a) before commencing to operate the scheme's water industry infrastructure under an operational approval; or
 - (b) by another date nominated by the licensee and approved by IPART.
- 2.6.2 Subject to condition 2.6.3, the licensee must obtain agreement to the code of conduct from:
- (a) the registered retailer for the scheme; and
 - (b) each licensed operator, licensed retailer and public water utility that:
 - (i) supplies water or provides sewerage services in the same area of operations as the scheme (unless advised otherwise by IPART in writing); or
 - (ii) constructs, maintains or operates any water industry infrastructure that is connected to the licensee's water industry infrastructure.
- 2.6.3 The code of conduct must set out the roles and responsibilities of the entities specified in condition 2.6.2, including by specifying as relevant:
- (a) who is responsible for repairing, replacing or maintaining the water industry infrastructure;
 - (b) who is liable in the event of the unavailability of water;
 - (c) who is liable in the event of failure of the water industry infrastructure;
 - (d) who is responsible for sharing information and data and in what circumstances;

- (e) who is responsible for communicating with customers or dealing with customer complaints and how complaints will be handled;
- (f) who is responsible for managing incidents and how incidents will be managed;
- (g) who is responsible for managing water quality and preventing cross-connections; and
- (h) who is liable for the fees and charges payable in respect of the use of the water industry infrastructure.

2.6.4 The licensee must comply with its obligations and responsibilities under the code of conduct.

2.6.5 Where the licensee has established a code of conduct in accordance with condition 8 of Schedule B to Licence No. 15_032 granted under section 10 of the Act (now repealed), that code of conduct is deemed to:

- (a) have been established in accordance with condition 2.6.1; and
- (b) comply with conditions 2.6.2 and 2.6.3, until it is first amended or replaced following the grant of this licence.

2.6.6 In this condition C2.6, **code of conduct** means a utility service agreement or other agreement or document, however described, that includes a protocol for dealing with the matters set out in condition 2.6.3, as relevant.

Note: The objective of a code of conduct is to minimise risks to public health, safety and customers through the establishment of a protocol of efficient and effective day-to-day working arrangements between the licensee and a public water utility, licensed operator or licensed retailer in relation to the matters covered by the code, which include information sharing and handling customers, incidents or other events.

C2.7 Notification of commencing operation of water industry infrastructure

2.7.1 Within 10 days after commencing to operate water industry infrastructure for a scheme under an operational approval or variation to an operational approval, the licensee must notify the following entities that it has commenced operating the infrastructure in accordance with the reporting manual:

- (a) IPART;
- (b) NSW Health;
- (c) any public water utility operating in the area of operations of the scheme; and
- (d) the local council in which the scheme is located.

C2.8 Notification of material change to plans or systems

2.8.1 If a material change is made to the licensee's asset management plan or system, water quality management system, or sewage management plan or system, the licensee must notify IPART within 10 days in accordance with the reporting manual.

C2.9 Notification of non-compliant plumbing

2.9.1 If the licensee becomes aware that a customer's plumbing is not code compliant, the licensee must within 10 days:

- (a) notify the customer of that fact; and

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- (b) where the plumbing that is not code compliant threatens, or could threaten, water quality, public health or safety, also notify the plumbing regulator of that fact.

2.9.2 In this condition C2.9:

- (a) **code compliant** has the meaning given to that term under the *Plumbing and Drainage Act 2011*;
- (b) **plumbing** means any pipe, fitting or apparatus that is located:
 - (i) downstream of a customer's connection point to a water main that is part of the licensee's water infrastructure;
 - (ii) upstream of a customer's connection point to a sewer main that is part of the licensee's sewerage infrastructure; or
 - (iii) upstream of a customer's connection point to a stormwater drain that is part of the licensee's water infrastructure; and
- (c) **plumbing regulator** has the meaning given to that term under the *Plumbing and Drainage Act 2011*.

Note: Without limiting condition 2.9.1(b), an example of plumbing that is not code compliant which must be notified to the plumbing regulator, is plumbing through which non-potable water can come into contact with drinking water.

Item C3 Special licence conditions

C3.1 [Not applicable]

C3.2 [Not applicable]



Appendix 9 – Plumbing Audit (Cross Connection Audit) - pending



Appendix 10 – Verification Report - pending



Appendix 11 – Operation and Maintenance Manual - pending