

Gladstone Area Water Board

Drinking Water Quality Management Plan Annual Report 2019/2020

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Gladstone Area Water Board

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DOCUMENT STATUS

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GLOSSARY OF TERMS

Term	Description
ADWG 2011	Australian Drinking Water Guidelines (2011). Published by the National Health and Medical Research Council of Australia
<i>E. coli</i>	<i>Escherichia coli</i> , a bacterium which may indicate the presence of faecal contamination and therefore potential health risk
HACCP	Hazard Analysis and Critical Control Points assessment for protecting drinking water quality
mg/L	Milligrams per litre
NTU	Nephelometric Turbidity Units
MPN/100mL	Most probable number per 100 millilitres
CFU/100mL	Colony forming units per 100 millilitres
<	Less than
>	Greater than

1.0 INTRODUCTION

Gladstone Area Water Board's (GAWB's) amended Drinking Water Quality Management Plan (DWQMP), approved on 21 September 2020, addresses the requirements of section 95(3) of the *Water Supply (Safety & Reliability) Act 2008* (WSSRA) to ensure safe drinking water for its customers. The Plan was first reviewed in 2014 and amendments approved on 28th May 2014. The Plan was reviewed again in early 2016, without the need for an amendment. The most recent amendment of GAWB's DWQMP was received by the Department of Natural Resources, Mines and Energy on 17 September 2020. The resulting approval notice was issued on 21 September 2020.

Gladstone Area Water Board (GAWB) is the bulk water provider for the Gladstone region, supplying drinking water services to the Gladstone Regional Council (GRC) (for reticulation to the city of Gladstone, the towns of Calliope, Tannum Sands, Benaraby and Mt Larcom) and to major industrial facilities located around Gladstone. GAWB also supplies a small number of domestic connections directly off the GAWB trunk mains.

Safe drinking water is essential to sustaining a healthy community. GAWB provides safe drinking water at a cost reasonable to the consumer. GAWB employs a multiple barrier system to ensure safe drinking water for its customers, using risk management methods consistent with the National Health and Medical Research Council's (NHMRC) Australian Drinking Water Guidelines 2011 (ADWG).

1.1 Registered Service Details

GAWB is a registered Water Service Provider (WSP) under the WSSRA, and is regulated by the Department of Natural Resources, Mines and Energy (DNRME). Powers under WSSRA have been delegated to the officers of the relevant section of the department; DNRME is the primary contact for communications regarding the DWQMP, including reporting requirements under the approval terms and conditions.

In addition, pursuant to section 1084 of the *Water Act 2000* (Water Act), GAWB is taken to be a Category 1 Water Authority from 1 July 2000 and is responsible to the Minister for Natural Resources, Mines and Energy. GAWB operates as a commercialised statutory authority with the function of carrying out water activities and has a key objective to ensure its operations are as efficient as possible, with its prices being cost reflective. GAWB's WSP details are provided in Table 1.1 below.

Table 1.1:
Water Service Provider information for Gladstone Area Water Board

Information Required	Details
SPID	200
Service Provider Name	Gladstone Area Water Board
Contact Details	PO Box 466 Gladstone QLD 4680 136 Goonoon St (p) 07 4976 3000 (fax) 07 4972 5632 www.gawb.qld.gov.au
Name of Schemes	Gladstone Water Treatment Plant Scheme Yarwun Water Treatment Plant Scheme

1.2 Purpose of this Report

The purpose of this report is to summarise the performance of GAWB against criteria detailed in its DWQMP. As per the Regulator's reporting guidelines, this Report:

- Documents the actions undertaken by GAWB to implement the DWQMP;
- Summarises any non-compliances and incidents under section 102 and 102A of the WSSRA;
- Summarises the results of the verification water quality monitoring program undertaken by GAWB;
- Summarises customer satisfaction and GAWB's response to any complaints regarding drinking water quality; and
- Summarises any reviews of the DWQMP.

2.0 OVERVIEW OF OPERATIONS 2019/2020

GAWB operates two drinking water schemes, from which it provides bulk drinking water to the Gladstone Regional Council (GRC) for reticulation to domestic users and to various industrial customers.

The table below details GAWB's potable water customer connections of its two schemes as of 2019/2020.

GAWB's current drinking water connection details

Customer	Number of Metered Connections
Gladstone WTP Scheme	
Boyne Smelters Limited	2
Gladstone Regional Council	9
Queensland Alumina Limited	2
APLNG	1
GLNG	1
QCLNG	1
Non-commercial connections	34
Yarwun WTP Scheme	
Cement Australia	2
Gladstone Regional Council	6
Jemena	1
Orica	3
Aurizon	2
WICET	2
Rio Tinto Aluminium Yarwun	3
TOTAL	69

2.1 Gladstone WTP Scheme

Drinking water supplied from the Gladstone scheme is treated at the Gladstone WTP and then distributed to GAWB's customers either directly off the mains or from the outlet of seven service reservoirs. Gladstone WTP services the requirements of the Gladstone Regional Council drinking water reticulation system for the City of Gladstone and surrounding townships (a population of about 63,400 – Source Gladstone Regional Council Annual report 2019/2020) a number of industrial customers and 34 residential customers.

Treatment Process and Delivery Network

Gladstone WTP conventional water treatment process has a nominal capacity of 55ML per day at 20 hours availability, and consists of parallel up-flow clarification and Dissolved Air Flotation (DAF) processes which can be operated together or independently of one another.

The plant has six operating modes, allowing either or both plants to be run and the filters can be configured in such a way as to keep the process streams separate or run water from either or both plants over all filters. Direct filtration modes on the plant are disabled and can only be operated manually with direct management approval.

Once filtered, water is corrected for pH and disinfected with sodium hypochlorite in two clear water wells, after which the process streams rejoin, and the fully treated water enters the 2.25ML clear water contact tank.

During 2019/2020, GWTP produced approximately 10.4 gigalitres of drinking water, as can be seen in the table below. Average production was approximately half of the capacity of the plant, with maximum day approximately 80% of plant capacity. Water is delivered either directly to a number of GRC reservoirs, or into GAWBs distribution system, which includes a number of reservoirs and rechlorination facilities.

Water quality

GAWB undertakes comprehensive operational and verification monitoring of water quality. The operational monitoring is concentrated around the quality of source water and the treatment process, and includes daily measurements throughout the plant as well as online monitoring through the process and of re-chlorination facilities. There have been only minor changes to the operational monitoring program since development of the DWQMP.

Filter operation is a Critical Control Point (CCP) in the treatment process and the turbidity of each filter is monitored continuously using online turbidity meters. The target filtrate turbidity is less than 0.1 nephelometric turbidity units (NTU) during normal operation (not including backwash or filter ripening). During the course of 2019/20, the GWTP consistently produced filtered waters of 0.05 NTU (Average - based on measurements taken with SCADA.)

Verification monitoring focuses on the finished product as it leaves the plant and is delivered to customer supply points. This includes weekly monitoring of parameters to verify effective disinfection and less-frequent monitoring of parameters which have been identified as having a lower risk in the drinking water. In terms of water quality, water delivered from the GWTP and transmission network achieved 100% compliance against ADWG health criteria. A full list of parameters and summary results can be found in Appendix A.

GWTP 2019/20 Performance		
Water production per annum	10,413 ML	
Average daily production	28.5 ML	
Maximum daily production	44.1ML	20 Dec 2019
Minimum daily production	10.7 ML	5 Nov 2019
Filtered water turbidity (NTU)	0.05 NTU	Average
Water Quality Compliance ADWG	100% compliance	

*Fluoridation has since ceased on 28th August 2016 as per Gladstone Regional Council directive.

2.2 Yarwun WTP Scheme

Drinking water supplied from the Yarwun scheme is treated at the Yarwun WTP which can be partially or fully supplemented with drinking water from the Gladstone scheme via an interconnection between the two systems, commissioned in early 2017. Drinking water is distributed to GAWB's customers either directly off the mains or from the outlet of two service reservoirs. GRC reticulates the water to domestic users after the points of supply.

Treatment Process and Delivery Network

The Yarwun WTP, located on Reid Road in the Yarwun Industrial Estate, has a total current design capacity of 5 megalitres per day based on 20hrs availability.

Yarwun WTP conventional treatment is a single stream process with one clarifier and 3 mono-media filters, pH correction, and chlorine disinfection. The plant is unattended and operates automatically, with daily operator visits to conduct general duties, monitoring and maintenance. The plant PLC and SCADA control system supervises all necessary functions and will shut the plant down automatically in the event of equipment failure or power loss. Online monitors are used throughout the system to facilitate control of the process.

Yarwun WTP services the requirements of the GRC and a number of industrial customers. Water is pumped from Yarwun WTP to the Mt Miller reservoir and then gravitates to the Boat Creek PS, supplying several industrial customers with process and drinking water. Water is then pumped to East End Reservoir, where it is re-chlorinated and supplied to the GRC for reticulation.

Since early 2017 the Gladstone and Yarwun systems have been interconnected to provide greater resilience to both YWTP and the network. There are several modes of interconnection operation, which GAWB can use to suit the needs of operation.

To ensure a disinfectant residual is maintained through to customer supply points GAWB practices supplementary disinfection at the East End Reservoir, where sodium hypochlorite is dosed to a set point in a recirculation stream from the reservoir. The chlorine residual is continuously monitored, with alarms for low and high dose relayed back to the treatment plant.

During 2019/20 YWTP produced approximately 1.04 gigalitres of drinking water, as can be seen in the table below. The average daily production was 2.8 ML/day with maximum day production 5.4ML.

Water quality

GAWB undertakes comprehensive operational and verification monitoring of water quality. The operational monitoring is concentrated around the quality of source water and the treatment process, and includes daily measurements throughout the plant as well as online monitoring through the process and delivery network. There have been only minor changes to the operational monitoring program since development of the DWQMP.

Filter operation is a Critical Control Point (CCP) in the treatment process at YWTP and the combined turbidity of the three filters is monitored continuously using an online turbidity meter. The target filtrate turbidity is less than 0.1 nephelometric turbidity units (NTU) during normal operation (that is, not including backwash or filter ripening). During the course of 2019/20 and under normal operation, the YWTP consistently produced filtered waters of 0.04 NTU (Average - based on measurements taken with SCADA).

Verification monitoring focuses on the finished product as it leaves the plant and is delivered to customer supply points. This includes weekly monitoring of parameters to verify effective disinfection and less-frequent monitoring of parameters which have been identified as having a lower risk in the drinking water. In terms of water quality, the YWTP and distribution network achieved 100% compliance against ADWG criteria. A full list of parameters and summary results can be found in Appendix A.

Measure	YWTP 2019/20 Performance	
Water production per annum	1.038ML	
Average daily production	2.84 ML	
Maximum daily production	5.4 ML	11 Sep 2019
Minimum daily production	0.35 ML	5 Oct 2019
Filtered water turbidity (NTU)	0.04	Average
Water Quality Compliance ADWG	100% compliance	

3.0 ACTIONS TAKEN TO IMPLEMENT THE DWQMP

During the development of its Drinking Water Quality Management Plan, GAWB identified a number of improvement actions in management of source water, in the treatment process at both of its plants and in the operations of its network, to improve the risks to drinking water quality.

The table below lists the outstanding improvement actions identified during the review of the DWQMP, target dates for completion and current status.

Item No.	Scheme Component / Sub-component	Action(s)	Target date	Status	Comments
	All of scheme	Critical Control Point Control Upgrades	Feb 20	Complete	Upgrades to SCADA system to include Critical Control Points information and limits into an easily accessible area within the system.
G6.9	Gladstone Transmission	South Gladstone Pipeline replacement Stage 3		Complete	Infrastructure replacement due to corrosion and deterioration
Y3.1	YWTP	Raw and clearwater turbidity meter upgrades	June 2021	Complete	End of life replacement of existing turbidity sensors
	Cybersecurity	Improvements to GAWB's Information Security Management System (GAWB IT Department)		Complete	<ul style="list-style-type: none"> ▪ GAWB has implemented 24x7x365 Security Operations Centre (SOC) and Security Incident and Event Management (SIEM) service through a managed service provider ▪ GAWB has established a Information Security Management System (ISMS) which acts as a framework across all GAWB systems GAWB has deployed a managed end point security solution on corporate GAWB assets; It is in process of developing a suitable end point security solution for the OT assets (due by 30.06.2021) ▪ Regular vulnerability assessments are completed

Item No.	Scheme Component / Sub-component	Action(s)	Target date	Status	Comments
					and identified issues are rectified <ul style="list-style-type: none"> ▪ GAWB has refreshed its all staff cybersecurity awareness training and its targeted to be completed by the staff members by 31.01.2021; and ▪ GAWB is planning to conduct its annual penetration testing, this is scheduled for completion by 31.06.2021

4.0 COMPLIANCE WITH WQ CRITERIA FOR DRINKING WATER

The results from the verification monitoring program have been compared against the levels of the water quality criteria specified by the Regulator in the *Water Quality and Reporting Guideline for a Drinking Water Service* and are summarised in Appendix A, Table A1. As can be seen, GAWB drinking water is compliant with the ADWG 2011 and meets the water quality criteria specified by the Queensland Water Supply Regulator

The reported statistics do not include results derived from quality control, blank or repeat samples, or from emergency or investigative samples undertaken in response to an elevated result.

Consistency of monitoring results over the 2019/20 period with previous years demonstrates a level of surveillance consistent and appropriate with the risks to drinking water quality. GAWB far exceeds the number of *E. coli* samples required to be taken under the Public Health Act 2015 according to population by almost threefold. The below table provides a summary of verification monitoring conducted for the 2019/2020 year. The figures in the below table take into account the full distribution (Gladstone and Yarwun), including water treatment plant inlets and outlets as well as both distribution networks including booster stations. The actual number of samples taken versus the sampling program reflects shutdowns and access issues, whereby sampling was not appropriate during various plant and network shutdowns or because safe access to sites was not available during sampling runs.

Scheme name	Parameter	No of samples required to be collected (as per the approved DWQMP)	No of samples actually collected	Water quality criteria		No of non-compliant samples	Comments
Gladstone	Free Chlorine	624	528	Health guideline limit	<5mg/l	0	
Gladstone	Dissolved Oxygen	674	571	Aesthetic guideline limit - treated water only	>85%	3	Only 3 treated water samples were below 85% saturation.
Gladstone	pH	674	576	Aesthetic guideline limit	6.5 - 8.5 pH Unit	0	
Gladstone	Turbidity	674	581	Aesthetic guideline limit	<5NTU	0	
Gladstone	Colour (number reduced in amended DWQMP)	236	101	Aesthetic guideline limit	<15HU	0	Colour and UVT were only sampled for 6 months of the year as part of a research program for possible UV treatment introduction.
Gladstone	Hardness	8	8	Recommended limit	<200mg/l	0	

Scheme name	Parameter	No of samples required to be collected (as per the approved DWQMP)	No of samples actually collected	Water quality criteria		No of non-compliant samples	Comments
Gladstone	Total dissolved solids	8	8	Recommended limit	<600mg/l	0	
Gladstone	Aluminium	144	136	Aesthetic guideline limit	<0.2mg/l	0	
Gladstone	Arsenic (Total)	52	51	Health guideline limit	0.01mg/l	0	
Gladstone	Ba,Cd,Cr,Cu,Pb,Hg,Ni,Se,Zn (total)	52	51	Health and Aesthetic guideline limit	Various depending on metal	0	
Gladstone	OC & OP Pesticides	4	4	Health guideline limit	Various depending on pesticide	0	
Gladstone	PAH's	4	4	Health guideline limit	10ng/l	0	
Gladstone	Cryptosporidium/Giardia	4	4	No guideline limit		0	
Gladstone	Cyanide (number reduced in amended DWQMP)	52	4	Health guideline limit	<0.08mg/l	0	
Gladstone	Iron	236	224	Aesthetic guideline limit	<0.3mg/l	0	
Gladstone	Manganese	236	224	Aesthetic guideline limit	<0.1mg/l	0	
Gladstone	THM's	144	143	Health guideline limit	<0.25mg/l	0	
Gladstone	Cyanobacteria	104	100	No guideline limit		0	
Gladstone	<i>E. coli</i>	674	580	Health guideline limit	0mg/l in any 100ml sample	0	

Scheme name	Parameter	No of samples required to be collected (as per the approved DWQMP)	No of samples actually collected	Water quality criteria		No of non-compliant samples	Comments
Yarwun	Free Chlorine	416	374	Health guideline limit	<5mg/l	0	
Yarwun	Dissolved Oxygen	468	422	Aesthetic guideline limit	>85%	1	

Scheme name	Parameter	No of samples required to be collected (as per the approved DWQMP)	No of samples actually collected	Water quality criteria		No of non-compliant samples	Comments
Yarwun	pH	468	420	Aesthetic guideline limit	6.5 - 8.5 pH Unit	0	.
Yarwun	Turbidity	468	418	Aesthetic guideline limit	<5NTU	0	
Yarwun	Colour (number reduced in amended DWQMP)	188	55	Aesthetic guideline limit	<15HU	0	Colour and UVT were only sampled for 6 months of the year as part of a research program for possible UV treatment introduction.
Yarwun	Hardness	4	4	Recommended limit	<200mg/l	0	
Yarwun	Total dissolved solids	4	4	Recommended limit	<600mg/l	0	
Yarwun	Aluminium	96	81	Aesthetic guideline limit	<0.2mg/l	0	
Yarwun	Arsenic (Total)	36	36	Health guideline limit	0.01mg/l	0	
Yarwun	Ba,Cd,Cr,Cu,Pb,Hg,Ni,Se,Zn (total)	36	36	Health and Aesthetic guideline limit	Various depending on metal	0	
Yarwun	Cyanide (number reduced in amended DWQMP)	32	8	Health guideline limit	<0.08mg/l	0	
Yarwun	Iron	188	168	Aesthetic guideline limit	<0.3mg/l	0	
Yarwun	Manganese	188	175	Aesthetic guideline limit	<0.1mg/l	0	
Yarwun	THM's	96	81	Health guideline limit	<0.25mg/l	0	
Yarwun	Cyanobacteria	104	99	No guideline limit		0	
Yarwun	<i>E. coli</i>	468	427	Health guideline limit	0mg/l in any 100ml sample	0	

5.0 NOTIFICATIONS TO THE REGULATOR

During the 2019/2020 year there were no notifications to the Regulator.

6.0 CUSTOMER SATISFACTION

GAWB monitors customer satisfaction of water quality by maintaining a register of complaints. Complaints are reported to the Minister in the 'Key Performance Measures' section of GAWB's Quarterly Reports on its Performance Plan for the financial year. During 2019/20 year, GAWB did not record any complaints about water quality from its customers, including GRC, industrial customers or the small number of reticulation customers on GAWB's network.

The Gladstone Regional Council (GRC) reticulates bulk drinking water produced by GAWB to domestic users. Consumer feedback on quality or supply of drinking water from domestic users is generally managed by the GRC, who maintain a database of customer feedback. In practice, GAWB will assist the regional council with enquiries on water quality where applicable, and escalate issues internally if there is cause. In response to previous concerns from GRC regarding Bromate in the treated water system, GAWB now monitors Bromates on a quarterly basis as part of the verification monitoring program. During 2019/20, there were no detections of Bromate within the system.

Additionally, GAWB has worked in conjunction with GRC to investigate chlorates in the distribution, and possible ways to decrease the levels of chlorate in parts of GRC's system.

In general, industrial customers use the bulk of their treated water reservation for process water (e.g. in boilers) and to provide drinking water to their sites. GAWB maintains an open and responsive relationship with its customers. GAWB receives several enquiries each year from current or potential customers for information on the quality of water, to inform the design of processing plant. During 2019/20, GAWB's industrial drinking water customers did not report any water quality complaints to GAWB.

7.0 FINDINGS AND RECOMMENDATIONS OF THE DWQMP AUDITOR

GAWB arranged for Viridis Consultants to conduct a regular audit of the DWQMP on the 2^{1st} and 2^{2nd} January 2020. The purpose of the audit was to verify the accuracy of the monitoring and performance data provided to the Regulator and assess compliance with the DWQMP. It also aims to assess the relevance of the DWQMP in relation to the service provided. A summary of outcomes of the audit are provided below. Minor non-conformances are highlighted in yellow, while the remainder of the recommendations are opportunities for improvement.

Improvement Recommendation	Recommendation or OFI	Status
Migrate jar test template into Tech One (AMS) system to ensure all jar testing records are maintained	OFI	In progress
Develop a procedure for compiling, sorting and analysing the verification monitoring data for the DWQMP Annual report, including sites to include or exclude as per the DWQMP	Recommendation	In progress
Develop a process to undertake periodic checks of SCADA alarms including shutdowns	Recommendation	In progress
Secure the Sth Gladstone entry hatch area to eliminate potential for roof runoff to enter the reservoir. Ensure the same for all other reservoirs as applicable	Recommendation	Complete
Investigate the background CT calculation in SCADA and ensure that it is set up correctly	Recommendation	Complete
Investigate and ensure that the flow rate of return stream to the head of the Yarwun plant is maintained at <10% of inflow	Recommendation	Complete
Ensure that the schematics and supply description details in the DWQMP reflect the current circumstances	Recommendation	Complete
Document the review process key steps including: triggers for a review, nature (comprehensive or minor), and essential inputs	Recommendation	In progress
Align the filtration CCP critical limit with the ADWG (ie 0.5NTU)	Recommendation	Complete
Develop a framework to guide the decision on the selection of intake level	OFI	In progress
Consider reworking the verification monitoring section of the DWQMP (Raw water testing is technically not verification data and may benefit from having a separate subsection)	OFI	Complete
Ensure that all relevant procedure are easily accessible through the document management system	OFI	In progress
Review the inhouse reservoir visit program/checklist to include water quality aspects in periodic inspections (eg vermin proof checking)	OFI	In progress
Review the DWQ Emergency management plan to include cybersecurity	OFI	In progress
Include tracking of improvements identified in the DWQMP as part of the DWQ Weekly meetings spreadsheet	OFI	In progress

Improvement Recommendation	Recommendation or OFI	Status
Consider additional hazards for completeness of risk register: PFAS Opportunistic pathogens Cybersecurity Staff and contractor skills and qualifications Yarwun WTP – pre chlorination step	OFI	In progress
Include a document history in the risk assessment register which captures a brief summary of changes	OFI	Complete
Include a justification on the selection of the CCP critical limit values in the DWQMP	OFI	In progress

8.0 OUTCOME OF THE REVIEW OF THE DWQMP

A review of the DWQMP was undertaken in 2020. All references to secondary or supporting documentation were checked and updated as necessary. All schematics of GAWB's network were updated to the most current available. A full review of GAWB's risk assessment has been completed, incorporating new process configurations, such as the GWTP interconnection to YWTP.

APPENDIX A – SUMMARY OF COMPLIANCE WITH WATER QUALITY CRITERIA

The results from the verification monitoring program have been compared against the levels of the water quality criteria specified by the Regulator in the *Water Quality and Reporting Guideline for a Drinking Water Service* and are summarised in Table A1. As can be seen, GAWB drinking water is compliant with the ADWG 2011 and meets the water quality criteria specified by the Office of the Water Supply Regulator

The reported statistics do not include results derived from quality control, blank or repeat samples, or from emergency or investigative samples undertaken in response to an elevated result. Nor does it include results from booster stations not considered to be direct customer offtakes as per recommendation by the DWQMP auditors. All 'less than' results have been analysed as having a value of zero (0), consistent with the quarterly reporting requirements of the QWSR.

Consistency of monitoring results over the 2018-19 period with previous years demonstrates a level of surveillance consistent and appropriate with the risks to drinking water quality.

Table A1: Verification monitoring results

Scheme name	Scheme component	Parameter	Units	Frequency of sampling	Total No. samples collected	No. of samples in which parameter was detected	No. of samples exceeding water quality criteria	Min	Max	Average (Mean)	95th %tile	Limit of reporting	Laboratory name
Lake Awoonga	Source Water	4.4'-DDD	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	4.4'-DDE	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	4.4'-DDT	µg/L	Q	4	0	0	0	0	0	0	2	ALS
Lake Awoonga	Source Water	Aldrin	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	alpha-BHC	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	alpha-Endosulfan	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	beta-BHC	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	beta-Endosulfan	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	cis-Chlordane	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	delta-BHC	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Dieldrin	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Endosulfan sulfate	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Endrin	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS

Scheme name	Scheme component	Parameter	Units	Frequency of sampling	Total No. samples collected	No. of samples in which parameter was detected	No. of samples exceeding water quality criteria	Min	Max	Average (Mean)	95th %tile	Limit of reporting	Laboratory name
Lake Awoonga	Source Water	Endrin aldehyde	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Endrin ketone	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	gamma-BHC	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Heptachlor	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Heptachlor epoxide	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Hexachlorobenzene (HCB)	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Methoxychlor	µg/L	Q	4	0	0	0	0	0	0	2	ALS
Lake Awoonga	Source Water	Sum of Aldrin + Dieldrin	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Sum of DDD + DDE + DDT	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Total Chlordane (sum)	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	trans-Chlordane	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Azinphos Methyl	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Bromophos-ethyl	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Carbophenothion	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Chlorfenvinphos	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Chlorpyrifos	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Chlorpyrifos-methyl	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Demeton-S-methyl	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Diazinon	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Dichlorvos	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Dimethoate	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Ethion	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Fenamiphos	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS

Scheme name	Scheme component	Parameter	Units	Frequency of sampling	Total No. samples collected	No. of samples in which parameter was detected	No. of samples exceeding water quality criteria	Min	Max	Average (Mean)	95th %tile	Limit of reporting	Laboratory name
Lake Awoonga	Source Water	Fenthion	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Malathion	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Monocrotophos	µg/L	Q	4	0	0	0	0	0	0	2	ALS
Lake Awoonga	Source Water	Parathion	µg/L	Q	4	0	0	0	0	0	0	2	ALS
Lake Awoonga	Source Water	Parathion-methyl	µg/L	Q	4	0	0	0	0	0	0	2	ALS
Lake Awoonga	Source Water	Pirimphos-ethyl	µg/L	Q	4	0	0	0	0	0	0	2	ALS
Lake Awoonga	Source Water	Prothiofos	µg/L	Q	4	0	0	0.0	0.0	0.0	0.0	0.5	ALS
Lake Awoonga	Source Water	Dissolved Oxygen	%	W	95	95	0	35.4	90.2	64.3	88.7	0.1	Internal
Lake Awoonga	Source Water	pH	pH Unit	W	95	95	0	7.1	8.1	7.6	8.0	0.1	Internal
Lake Awoonga	Source Water	Turbidity	NTU	W	95	95	0	0.71	4.51	1.60	3.34	0.1	Internal
Lake Awoonga	Source Water	Hardness	mg/L	Q	8	8	0	64	84	75	82.6	1	Internal
Lake Awoonga	Source Water	Total Dissolved Solids	mg/L	Q	8	8	0	117	184	144	175	10	ALS
Lake Awoonga	Source Water	Arsenic	mg/L	Q	4	4	0	0.0009	0.0015	0.0011	0.0014	0.0002	ALS
Lake Awoonga	Source Water	Barium	mg/L	Q	4	4	0	0.0096	0.0120	0.0112	0.0119	0.0005	ALS
Lake Awoonga	Source Water	Cadmium	mg/L	Q	8	0	0	0.0000	0.0000	0.0000	0.0000	0.00005	ALS
Lake Awoonga	Source Water	Chromium	mg/L	Q	4	0	0	0.000	0.0000	0.0000	0.0000	0.0002	ALS
Lake Awoonga	Source Water	Copper	mg/L	Q	4	4	0	0.0006	0.0009	0.0008	0.0009	0.0005	ALS
Lake Awoonga	Source Water	Lead	mg/L	Q	4	0	0	0.0000	0.0000	0.0000	0.0000	0.0001	ALS
Lake Awoonga	Source Water	Mercury	mg/L	Q	4	0	0	0.0000	0.0000	0.0000	0.0000	0.0001	ALS
Lake Awoonga	Source Water	Nickel	mg/L	Q	4	1	0	0.0000	0.0005	0.0001	0.0004	0.0005	ALS
Lake Awoonga	Source Water	Selenium	mg/L	Q	4	0	0	0.0000	0.0000	0.0000	0.0000	0.0002	ALS
Lake Awoonga	Source Water	Zinc	mg/L	Q	4	0	0	0.000	0.000	0.000	0.000	0.001	ALS
Lake Awoonga	Source Water	Cyanide	mg/L	Q	8	0	0	0.000	0.000	0.000	0.000	0.004	ALS
Lake Awoonga	Source Water	Manganese	mg/L	W	100	96	0	0.0000	0.0537	0.018	0.038	0.0005	ALS
Lake Awoonga	Source Water	Cyanobacteria	cells/mL	W	100	100	0	30	42840	7652	27382	1	Ecoscope

Scheme name	Scheme component	Parameter	Units	Frequency of sampling	Total No. samples collected	No. of samples in which parameter was detected	No. of samples exceeding water quality criteria	Min	Max	Average (Mean)	95th %tile	Limit of reporting	Laboratory name
Lake Awoonga	Source Water	Escherichia coli	MPN/10 0mL	W	100	20	0	0	44	1.8	12	1	Ecoscope
Lake Awoonga	Source Water	Cryptosporidium	oocysts/L	Q	4	0	0	0	0	0	0	1	ALS
Lake Awoonga	Source Water	Giardia	cysts/L	Q	4	0	0	0	0	0	0	1	ALS
Lake Awoonga	Source Water	Total PAHs	µg/L	Q	4	0	0	0	0	0	0	0.5	ALS
GWTP	Treatment Plant	Free Chlorine	mg/L	W	50	50	0	1.7	2.7	2.2	2.5	0.1	Internal
GWTP	Treatment Plant	Dissolved Oxygen	%	W	50	50	0	80.6	100.4	88.7	96.3	0.1	Internal
GWTP	Treatment Plant	pH	pH Unit	W	50	50	0	7.0	7.4	7.2	7.3	0.1	Internal
GWTP	Treatment Plant	Turbidity	NTU	W	50	50	0	0.07	0.13	0.09	0.11	0.1	Internal
GWTP	Treatment Plant	Colour	PCU	M	12	12	0	1	4	2	3	1	ALS
GWTP	Treatment Plant	Hardness	mg/L	Q	4	4	0	69	80	75	80	1	ALS
GWTP	Treatment Plant	Total Dissolved Solids	mg/L	Q	4	4	0	149	197	168	192	10	ALS
GWTP	Treatment Plant	Aluminium	mg/L	M	12	12	0	0.022	0.067	0.048	0.066	0.005	ALS
GWTP	Treatment Plant	Arsenic	mg/L	Q	4	4	0	0.0003	0.0004	0.0004	0.0004	0.0002	ALS
GWTP	Treatment Plant	Barium	mg/L	Q	4	4	0	0.0089	0.0114	0.0100	0.0114	0.0002	ALS
GWTP	Treatment Plant	Cadmium	mg/L	Q	4	0	0	0.00000	0.00000	0.00000	0.00000	0.00005	ALS
GWTP	Treatment Plant	Chromium	mg/L	Q	4	0	0	0.0000	0.0004	0.0001	0.0002	0.0002	ALS
GWTP	Treatment Plant	Copper	mg/L	Q	4	4	0	0.0008	0.0014	0.0010	0.0014	0.0005	ALS
GWTP	Treatment Plant	Lead	mg/L	Q	4	0	0	0.0000	0.0000	0.0000	0.0000	0.0001	ALS
GWTP	Treatment Plant	Mercury	mg/L	Q	4	0	0	0.0000	0.0000	0.0000	0.0000	0.0001	ALS
GWTP	Treatment Plant	Nickel	mg/L	Q	4	0	0	0.0000	0.0000	0.0000	0.0000	0.0005	ALS
GWTP	Treatment Plant	Selenium	mg/L	Q	4	0	0	0.0000	0.0000	0.0000	0.0000	0.0002	ALS
GWTP	Treatment Plant	Zinc	mg/L	Q	4	0	0	0.000	0.000	0.000	0.000	0.001	ALS
GWTP	Treatment Plant	Cyanide	mg/L	Q	4	0	0	0.000	0.000	0.000	0.000	0.004	ALS
GWTP	Treatment Plant	Iron	mg/L	M	50	20	0	0.000	0.006	0.001	0.005	0.002	ALS

Scheme name	Scheme component	Parameter	Units	Frequency of sampling	Total No. samples collected	No. of samples in which parameter was detected	No. of samples exceeding water quality criteria	Min	Max	Average (Mean)	95th %tile	Limit of reporting	Laboratory name
GWTP	Treatment Plant	Manganese	mg/L	W	50	11	0	0.0000	0.0042	0.0002	0.0010	0.0005	ALS
GWTP	Treatment Plant	Trihalomethanes	µg/L	M	12	10	0	0	22	11	21	5	ALS
GWTP	Treatment Plant	Cyanobacteria	cells/mL	W	50	6	0	0	30	2	20	1	Ecoscope
GWTP	Treatment Plant	Escherichia coli	MPN/100mL	W	50	0	0	0	0	0	0	1	Ecoscope
GWTP Distribution	Transmission	Free Chlorine	mg/L	W	479	479	0	0.1	2.8	1.3	2.0	0.1	Internal
GWTP Distribution	Transmission	Dissolved Oxygen	%	W	475	475	0	84.1	104.6	91.1	100.0	0.1	Internal
GWTP Distribution	Transmission	pH	pH Unit	W	478	478	0	7.0	8.3	7.4	7.7	0.1	Internal
GWTP Distribution	Transmission	Turbidity	NTU	W	483	483	0	0.06	0.56	0.12	0.21	0.1	Internal
GWTP Distribution	Transmission	Colour	PCU	M	58	83	0	1	2	1.9	2	1.0	ALS
GWTP Distribution	Transmission	Aluminium	mg/L	M	124	124	0	0.019	0.137	0.052	0.075	0.005	ALS
GWTP Distribution	Transmission	Arsenic	mg/L	Q	43	43	0	0.0003	0.0006	0.0004	0.0005	0.0002	ALS
GWTP Distribution	Transmission	Barium	mg/L	Q	43	43	0	0.0086	0.0124	0.0105	0.0121	0.0005	ALS
GWTP Distribution	Transmission	Cadmium	mg/L	Q	43	0	0	0.0000	0.0000	0.0000	0.0000	0.0002	ALS
GWTP Distribution	Transmission	Chromium	mg/L	Q	43	13	0	0.0000	0.0013	0.0001	0.0004	0.0002	ALS
GWTP Distribution	Transmission	Copper	mg/L	Q	43	1	0	0.0000	0.008	0.0023	0.0048	0.0005	ALS
GWTP Distribution	Transmission	Lead	mg/L	Q	43	30	0	0.0000	0.0005	0.0002	0.0004	0.0001	ALS
GWTP Distribution	Transmission	Mercury	mg/L	Q	43	0	0	0.0000	0.0000	0.0000	0.0000	0.0001	ALS
GWTP Distribution	Transmission	Nickel	mg/L	Q	43	3	0	0.0000	0.0057	0.0002	0.0009	0.0005	ALS
GWTP Distribution	Transmission	Selenium	mg/L	Q	43	1	0	0.0000	0.0000	0.0000	0.0000	0.0002	ALS
GWTP Distribution	Transmission	Zinc	mg/L	Q	43	43	0	0.001	0.021	0.004	0.007	0.001	ALS
GWTP Distribution	Transmission	Iron	mg/L	M	124	97	0	0.000	0.12	0.008	0.022	0.002	ALS

Scheme name	Scheme component	Parameter	Units	Frequency of sampling	Total No. samples collected	No. of samples in which parameter was detected	No. of samples exceeding water quality criteria	Min	Max	Average (Mean)	95th %tile	Limit of reporting	Laboratory name
GWTP Distribution	Transmission	Manganese	mg/L	M	124	49	0	0.000	0.0019	0.000	0.001	0.001	ALS
GWTP Distribution	Transmission	Trihalomethanes	µg/L	M	131	131	0	26	164	89	150	5	ALS
GWTP Distribution	Transmission	Escherichia coli	MPN/100mL	W	480	0	0	0	0	0	0	1	Ecoscope
YWTP	Water Treatment	Free Chlorine	mg/L	W	48	48	0	1.6	3.3	2.3	2.8	0.1	Internal
YWTP	Water Treatment	Dissolved Oxygen	%	W	48	48	0	76.6	98.2	88.4	96.0	0.1	Internal
YWTP	Water Treatment	pH	pH Unit	W	49	49	0	6.9	7.4	7.2	7.3	0.1	Internal
YWTP	Water Treatment	Turbidity	NTU	W	47	47	0	0.06	0.17	0.09	0.12	0.1	Internal
YWTP	Water Treatment	Colour	PCU	M	12	12	0	1	2	2	2	1	ALS
YWTP	Water Treatment	Hardness	mg/L	Q	4	4	0	66	80	74	80	1	ALS
YWTP	Water Treatment	Total Dissolved Solids	mg/L	Q	4	4	0	138	174	159	173	10	ALS
YWTP	Water Treatment	Aluminium	mg/L	M	12	12	0	0.027	0.107	0.050	0.088	0.005	ALS
YWTP	Water Treatment	Arsenic	mg/L	Q	4	4	0	0.0003	0.0005	0.0004	0.0005	0.0002	ALS
YWTP	Water Treatment	Barium	mg/L	Q	4	4	0	0.009	0.0114	0.010	0.0113	0.0005	ALS
YWTP	Water Treatment	Cadmium	mg/L	Q	4	0	0	0.00000	0.00000	0.00000	0.00000	0.00005	ALS
YWTP	Water Treatment	Chromium	mg/L	Q	4	1	0	0.0000	0.0026	0.0007	0.0022	0.0002	ALS
YWTP	Water Treatment	Copper	mg/L	Q	4	3	0	0.0000	0.0013	0.0009	0.0013	0.0005	ALS
YWTP	Water Treatment	Lead	mg/L	Q	4	0	0	0.0000	0.0000	0.000	0.0000	0.0001	ALS
YWTP	Water Treatment	Mercury	mg/L	Q	4	0	0	0.0000	0.0000	0.0000	0.0000	0.0001	ALS
YWTP	Water Treatment	Nickel	mg/L	Q	4	1	0	0.0000	0.011	0.0027	0.0094	0.0005	ALS
YWTP	Water Treatment	Selenium	mg/L	Q	4	0	0	0.0000	0.0000	0.0000	0.0000	0.0002	ALS
YWTP	Water Treatment	Zinc	mg/L	Q	4	3	0	0.000	0.004	0.001	0.002	0.004	ALS
YWTP	Water Treatment	Cyanide	mg/L	Q	4	0	0	0.000	0.000	0.000	0.000	0.004	ALS
YWTP	Water Treatment	Iron	mg/L	M	49	20	0	0.000	0.015	0.002	0.011	0.002	ALS
YWTP	Water Treatment	Manganese	mg/L	M	49	27	0	0.0000	0.0157	0.0011	0.0017	0.0005	ALS

Scheme name	Scheme component	Parameter	Units	Frequency of sampling	Total No. samples collected	No. of samples in which parameter was detected	No. of samples exceeding water quality criteria	Min	Max	Average (Mean)	95th %tile	Limit of reporting	Laboratory name
YWTP	Water Treatment	Trihalomethanes	µg/L	M	12	11	0	0	33	20	31	5	ALS
YWTP	Water Treatment	Cyanobacteria	cells/mL	W	49	1	0	0	10	0.2	700	1	Ecoscope
YWTP	Water Treatment	Escherichia coli	MPN/100mL	W	50	0	0	0	0	0	0	1	Ecoscope
YWTP Distribution	Transmission	Free Chlorine	mg/L	W	326	326	0	0.25	2.4	1.3	2.0	0.1	Internal
YWTP Distribution	Transmission	Dissolved Oxygen	%	W	326	326	0	85.1	106.4	91.2	100	0.1	Internal
YWTP Distribution	Transmission	pH	pH Unit	W	324	324	0	7.0	8.3	7.6	8.1	0.1	Internal
YWTP Distribution	Transmission	Turbidity	NTU	W	325	325	0	0.05	0.9	0.11	0.16	0.1	Internal
YWTP Distribution	Transmission	Colour	PCU	M	12	12	0	1	2	2	2	1	ALS
YWTP Distribution	Transmission	Aluminium	mg/L	M	69	69	0	0.026	0.106	0.051	0.076	0.005	ALS
YWTP Distribution	Transmission	Arsenic	mg/L	Q	23	23	0	0.0003	0.0005	0.0004	0.0005	0.0002	ALS
YWTP Distribution	Transmission	Barium	mg/L	Q	23	23	0	0.0092	0.0122	0.0107	0.0136	0.0005	ALS
YWTP Distribution	Transmission	Cadmium	mg/L	Q	23	0	0	0.00000	0.00000	0.00000	0.00000	0.00005	ALS
YWTP Distribution	Transmission	Chromium	mg/L	Q	23	5	0	0.0000	0.0032	0.0004	0.0024	0.0002	ALS
YWTP Distribution	Transmission	Copper	mg/L	Q	23	19	0	0.0000	0.0049	0.0019	0.0042	0.0005	ALS
YWTP Distribution	Transmission	Lead	mg/L	Q	23	15	0	0.0000	0.0004	0.0001	0.0003	0.0001	ALS
YWTP Distribution	Transmission	Mercury	mg/L	Q	23	0	0	0.0000	0.0000	0.0000	0.0000	0.0001	ALS
YWTP Distribution	Transmission	Nickel	mg/L	Q	23	1	0	0.0000	0.0014	0.0000	0.0000	0.0005	ALS
YWTP Distribution	Transmission	Selenium	mg/L	Q	23	0	0	0.0000	0.0000	0.0000	0.0000	0.0002	ALS
YWTP Distribution	Transmission	Zinc	mg/L	Q	23	19	0	0.000	0.008	0.002	0.005	0.001	ALS
YWTP Distribution	Transmission	Iron	mg/L	M	69	31	0	0.00	0.019	0.003	0.009	0.002	ALS
YWTP Distribution	Transmission	Manganese	mg/L	M	69	19	0	0.0000	0.0019	0.0003	0.0013	0.0005	ALS

Scheme name	Scheme component	Parameter	Units	Frequency of sampling	Total No. samples collected	No. of samples in which parameter was detected	No. of samples exceeding water quality criteria	Min	Max	Average (Mean)	95th %tile	Limit of reporting	Laboratory name
YWTP Distribution	Transmission	Trihalomethanes	µg/L	M	69	69	0	24	98	53	91	5	ALS
YWTP Distribution	Transmission	Escherichia coli	MPN/100mL	W	327	0	0	0	0	0	0	1	Ecoscope

Tables A2 and A3 summarise the monthly results for all *E. coli* verification monitoring undertaken in the Gladstone and Yarwun systems.

Table A2 - Reticulation *E. coli* verification monitoring in Gladstone WTP Distribution

Gladstone WTP Distribution 2019/20												
Month	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20
No. Samples collected	48	52	46	56	46	41	49	35	41	44	33	41
No samples collected in which <i>E. coli</i> was detected	0	0	0	0	0	0	0	0	0	0	0	0
No samples collected in previous 12 month period	59	55	39	40	40	28	54	39	45	48	36	45
No samples in which <i>E.coli</i> detected for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% samples that comply	100	100	100	100	100	100	100	100	100	100	100	100
Compliance with 98% annual value	100	100	100	100	100	100	100	100	100	100	100	100

Table A3 - Reticulation E. coli verification monitoring in Yarwun WTP Distribution

Yarwun WTP Distribution 2019/20												
Month	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20
No. Samples collected	37	32	30	38	28	28	37	27	16	40	24	40
No samples collected in which E. coli was detected	0	0	0	0	0	0	0	0	0	0	0	0
No samples collected in previous 12 month period	26	20	24	27	25	28	37	27	16	40	24	40
No samples in which E.coli detected for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% samples that comply	100	100	100	100	100	100	100	100	100	100	100	100
Compliance with 98% annual value	100	100	100	100	100	100	100	100	100	100	100	100

