ANNUAL DRINKING WATER QUALITY REPORT 2017-18

South Gippsland Region Water Corporation

South Gippsland Water

Front page image of Korumburra's Coalition Creek Reservoir courtesy of David Barton.
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Message from the Managing Director

2017/18 Water Quality Report

I am pleased to present South Gippsland Water's drinking water quality report for the year ending 30th June 2018. This report is produced annually to provide the community with information relating to the quality of drinking water supplied across the South Gippsland Water service area.

South Gippsland Water operates ten individual water supply systems with open catchment areas totalling over 1,200 square kilometres. Water is constantly tested for quality and safety through our monitoring programs, with results being assessed against guidelines and legislated drinking water quality standards.

South Gippsland Water has again performed extremely well in complying with drinking water quality standards of the Safe Drinking Water Regulations 2015. We have also met all other obligations in supplying water to the public under the *Safe Drinking Water Act* 2003, as evidenced by a recent audit of our drinking water risk management plan.

The dry summer and autumn conditions contributed to some challenges for Korumburra, Poowong, Loch and Nyora in terms of managing aesthetic water quality in 2017/18. The adverse conditions highlighted the dedication and professionalism of our staff in navigating complex challenges, and attending to customers. I thank our customers for their patience over this time.

The construction of the State Government backed Lance Creek Water Connection has been a substantial achievement for the 2017-18 year. The project utilises an existing connection to the Melbourne supply system, including Cardinia Reservoir at Emerald and the Victorian Desalination Plant at Wonthaggi. This important project has progressed significantly during 2017/18 and will be completed in late 2018, within budget and ahead of schedule. The connection will not only secure the long-term water supply for Korumburra, Poowong, Loch and Nyora, it will also allow the Corporation an opportunity to better mitigate aesthetic water quality issues.

Philippe du Plessis
Managing Director

Photos: Under construction - Lance Creek water connection

1. Introduction

Welcome to South Gippsland Water's annual drinking water quality report for the period 1st July 2017 to 30th June 2018. In accordance with requirements of the Safe Drinking Water Act 2003 ("the Act"), this report summarises our performance against water quality standards, provides an overview of our management practices, and describes how we respond to water quality challenges as they arise.

"Committed to the management of our water supply systems for the provision of safe, high-quality drinking water for all customers"

As part of South Gippsland Water's commitment to quality, we maintain a drinking water management system based on Hazard Analysis and Critical Control Point (HACCP) principles and the Australian Drinking Water Guidelines[1]. The system incorporates a catchment-to-tap monitoring program to ensure drinking water consistently meets legislative requirements of the Act and associated Safe Drinking Water Regulations 2015 ("the Regulations"). More information on water treatment, quality management systems and operational improvements for 2017-18 can be found in part 2.

For the 2017-18 financial year, we are pleased to report that drinking water supplied in all South Gippsland Water localities complied with the prescribed standards of the Regulations for *Escherichia coli* (*E. coli*), turbidity and trihalomethanes. Part 4 of this report provides a summary of results from our comprehensive monitoring program, while part 3 outlines corrective actions taken to resolve water quality issues. Also worth noting here is a successful audit of our drinking water risk management plan conducted in April 2018. As further testament to our commitment to providing high quality drinking water, South Gippsland Water was found to be compliant in all auditable elements. Details with respect to the audit are provided in part 6.

Customer satisfaction is very important to us at South Gippsland Water and we strive to meet expectations in supplying water that is not only safe to drink but also aesthetically-pleasing. Another important aim is to provide prompt and helpful service in response to water quality concerns. For details on the number of customer calls received in relation to water quality in 2017-18, as well as general information on how complaints are addressed, please refer to part 5.

Of significance in terms of continual improvement for the 2017-18 year is the Lance Creek Water Connection project. Once commissioned, the newly constructed pipeline will connect the towns of Korumburra, Poowong, Loch and Nyora to the Lance Creek system. The Lance Creek system is also now connected to the Melbourne water grid. This will provide greater water surety for these growing towns as well as reducing the number of customer complaints in relation to discoloured water.

We hope that you find this report informative. For additional information on anything presented within, we invite you to contact us by phoning 1300 851 636 or emailing sgwater@sgwater.com.au

[1] National Health and Medical Research Council *Australian Drinking Water Guidelines* 2011

Characterisation of the System

Source water system

As part of the catchment-to-tap approach to providing safe drinking water, South Gippsland Water monitors for hazards in all water supply catchments. This approach is underpinned by the preventative and multiple barrier principles described in the *Australian Drinking Water Guidelines* 2011 (ADWG). The ADWG states that "prevention of contamination provides greater surety than removal of contaminants by treatments, so the most effective barrier is protection of source waters to the maximum degree practicable."

South Gippsland Water is reliant on "open" catchments for all source water. An open catchment is one in which part or all of the catchment area is in private ownership and access and usage is largely unrestricted, as opposed to a "closed" catchment where the whole of the catchment area is publicly owned and controlled. While this means that complete protection of source waters is not achievable, improving the resilience of water supply catchments to minimise water quality deterioration is a crucial part of our role in providing safe drinking water.

Where hazards cannot be prevented, they are managed with robust and reliable barriers. Examples of these measures are documented in our Water Supply Catchment Monitoring Assessment and Improvement Program which is integrated into the Water Safety Plan and the Drinking Water Quality Management System. The program involves coordination of activities, including catchment surveillance, river health monitoring, land use planning assessment, and Source Water and Health-Based Target reporting. The Corporation also undertakes various catchment improvement works, including tree plantings and weed control, as well as promoting the importance of source water protection to the community via stakeholder engagement programs.

South Gippsland Water system

The service area of South Gippsland Water (SGW) covers approximately 4,000 square kilometres of the South Gippsland region, from Wonthaggi in the west to Yarram in the east. Drinking water is supplied to 22 rural centres via ten separate supply systems; refer to Figure 1 (map).

The total water supply operation for 2017-18 comprised:

- 1,234 square kilometres of total catchment area
- 13 reservoirs and 4 raw water storage basins or tanks
- 18 service storages
- 10 water treatment plants
- 25 treated water distribution storages
- 15 water pump stations
- 703 kilometres of water mains
- 4,604 megalitres (million litres) of metered water supplied to customers

Information on localities and water supply systems is provided in Table 1. There have been no major changes in arrangements with respect to water supply since the previous reporting period.

Table 1: South Gippsland Water water sampling localities and supply sources

Localities supplied	Population serviced[2]	Principal raw water supply sources	Supplementary raw water supply sources	Raw water storage	Water treatment plant
Alberton Yarram	550 2,480	Tarra River	Gippsland Basin groundwater aquifer (via bore, Devon North)	Devon North Raw Water Basin	Devon North
Dumbalk	410	Tarwin River (east branch)		Dumbalk Raw Water Tank	Dumbalk
Fish Creek	830	Battery Creek		Battery Creek Reservoir	Fish Creek
Foster	1,840	Deep Creek		Deep Creek Reservoir; Foster Dam; Foster Raw Water Basin	Foster
Korumburra	4,470	Coalition Creek; Bellview Creek; Ness Creek.	Tarwin River (West Branch)	Coalition Creek Reservoir; Bellview Reservoir; Ness Gully Reservoir	Korumburra
Cape Paterson Inverloch Lance Creek Wonthaggi	890 5,390 100 8,680	Lance Creek		Lance Creek Reservoir	Lance Creek
Koonwarra Leongatha	400 5,650	Ruby Creek		No. 1 Reservoir; No. 2 Reservoir; No. 3 Reservoir (Hyland); No. 4 Reservoir (Western)	Leongatha
Meeniyan	770	Tarwin River		Meeniyan Raw Water Basin	Meeniyan
Loch Nyora Poowong	640 1,530 640	Little Bass River		Little Bass Reservoir	Poowong
Port Franklin Welshpool Toora	130 540 780	Agnes River		Cooks Dam	Toora

[2] Population Served based on ABS 2017 Census data. The ABS method of calculation of population is based on State Suburbs (SSC) and may not always reflect the exact sewer/water district.

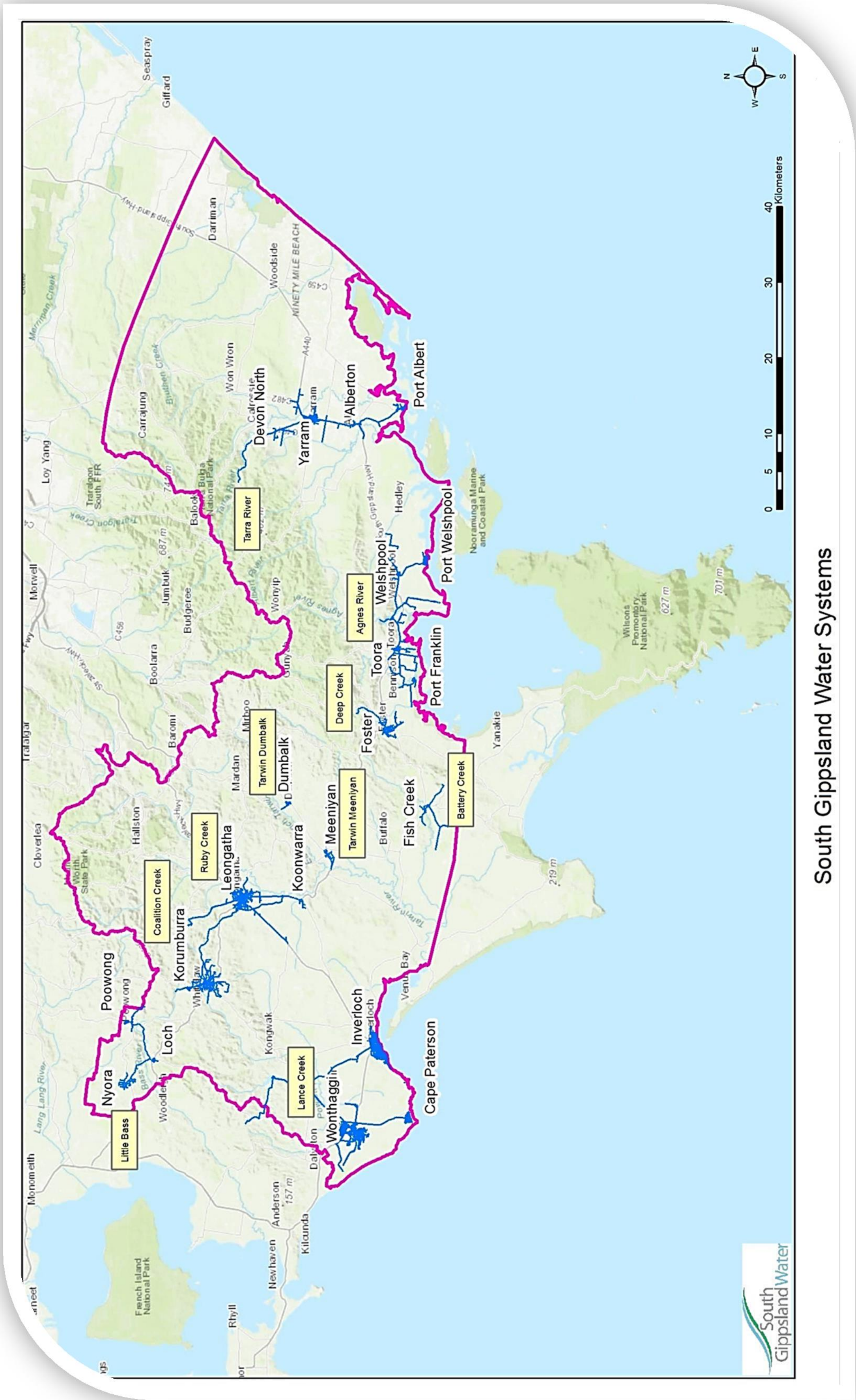

Figure 1: South Gippsland Water water supply area and systems

2. Water Treatment and Quality Management Systems

Water treatment overview

Conventional water treatment is a process whereby water is purified to a level suitable for human consumption. It generally begins with raw source water being allowed to settle in a reservoir so that natural sedimentation of large particulate matter can occur. The next step involves oxidation and precipitation of dissolved substances using aeration devices. Chemical agents are added as water flows through pipes from reservoir to treatment plant. These cause small particles to clump together into large insoluble masses known as floc in the processes of coagulation and flocculation. The floc formed is separated from water via gravitational settling or flotation. Filtration of the clarified water further reduces the load of small particles, microorganisms and other contaminants. The final step in the process is disinfection. This commonly involves the addition of chlorine-based disinfectants but other chemical agents or ultra-violet light may also be used to ensure water supplied to customers is free of harmful microorganisms.

A summary of the processes by which the drinking water supplied by South Gippsland Water (SGW) is treated and disinfected is provided in Table 2.

Changes in water treatment since previous reporting period

A change to the disinfection process was commenced for the Lance Creek system in April 2017. This involved the installation of a secondary chloramine dosing unit at the Lance Creek clear water storage. Previously, chlorine and ammonia were dosed in close succession via injection points as treated water flowed from the treatment plant into the clear water storage. The new design sees only chlorine being injected into the water flow at the inlet to the clear water storage while ammonia and a secondary dose of chlorine are applied at the outlet. The advantage of altering the process in this way is that primary disinfection is more rapid due to the greater potency of chlorine over chloramine. This is important for ensuring water is adequately disinfected prior to reaching the first customers in the supply system, particularly during times of high water demand and flow rates. The secondary chloramine dosing ensures a protective disinfection residual persists to the ends of the system. Refer to part 4 for further information on disinfection.

Photos: Imagery of Lance Creek reservoir, water treatment plant and clear water storage.

Table 2: List of processes and chemicals used to treat and disinfect water supplied by SGW[3]

Water Treatment Plant	Localities supplied	Treatment process	Treatment frequency	Added substances
Devon North	Alberton Yarram	Pre-treatment pH correction Manganese oxidation Coagulation and flocculation Dissolved air flotation clarification Filtration by granular medium Chloramine disinfection Dewatering of waste water	As required As required Regular Regular Regular Regular Regular	Sodium carbonate Potassium permanganate Aluminium sulphate / aluminium chlorohydrate - - Sodium hypochlorite and ammonia -
Dumbalk	Dumbalk	Pre-treatment pH correction Manganese oxidation Coagulation and flocculation Sedimentation clarification Filtration by granular medium Ultraviolet (UV) disinfection Primary chlorination disinfection Secondary chlorination disinfection Removal of volatile organics by aeration Dewatering of waste water	Regular As required As required Regular Regular Regular Regular Regular Regular Regular	Sodium carbonate Potassium permanganate Aluminium chlorohydrate - - - Sodium hypochlorite Sodium hypochlorite - Anionic polyacrylamide
Fish Creek	Fish Creek	Pre-treatment pH correction Manganese oxidation Coagulation and flocculation Sedimentation clarification Filtration by granular medium Post-treatment pH correction Primary chlorination disinfection Removal of volatile organics by aeration Secondary chlorination disinfection Dewatering of waste water	Regular As required Regular Regular Regular Regular Regular Regular Regular Regular	Sodium carbonate Potassium permanganate Aluminium sulphate - Anionic polyacrylamide Sodium carbonate Sodium hypochlorite - Sodium hypochlorite -
Foster	Foster	Taste and odour control Pre-treatment pH correction Manganese oxidation Coagulation and flocculation Sedimentation clarification Filtration by granular medium Post-treatment pH correction Primary chlorination disinfection Secondary chlorination disinfection Dewatering of waste water	As required Regular As required Regular Regular Regular Regular Regular Regular Regular	Powdered activated carbon Sodium carbonate Potassium permanganate Aluminium sulphate / aluminium chlorohydrate - - Sodium carbonate Chlorine (gas) Sodium hypochlorite -
Korumburra	Korumburra	Taste and odour control Pre-treatment pH correction Manganese oxidation Coagulation and flocculation Sedimentation clarification Filtration by granular medium Manganese sequestration Primary chlorination disinfection Secondary chlorination disinfection Dewatering of waste water	As required Regular As required Regular Regular Regular As required Regular Regular Regular	Powdered activated carbon Sodium carbonate Potassium permanganate Aluminium chlorohydrate Cationic polyacrylamide - Sodium hexametaphosphate Chlorine (gas) Chlorine (gas) -

Table 2 continues over page

[3] Refer to Glossary at end of report for further information

Table 2 (continued): List of processes and chemicals used to treat and disinfect water supplied by SGW

Water Treatment Plant	Localities supplied	Treatment process	Treatment frequency	Added substances
Lance Creek	**Cape Paterson** **Inverloch** **Lance Creek** **Wonthaggi**	**Taste and odour control** **Pre-treatment pH correction** **Manganese oxidation** **Coagulation and flocculation** **Dissolved air flotation clarification** **Filtration by granular medium** **Post-treatment pH correction** **Fluoridation** **Primary chlorination disinfection*** **Secondary chloramination disinfection** **Dewatering of waste water**	As required As required As required Regular Regular Regular Regular Regular Regular Regular Regular	**Powdered activated carbon** **Sodium hydroxide / hydrochloric acid** **Potassium permanganate** **Aluminium sulphate / aluminium chlorohydrate** **-** **-** **Sodium hydroxide** **Hexafluorosilicic acid** **Chlorine (gas)** **Chlorine (gas) and ammonia** **Anionic polyacrylamide**
Leongatha	**Koonwarra** **Leongatha**	**Taste and odour control** **Pre-treatment pH correction** **Manganese oxidation** **Coagulation and flocculation** **Sedimentation clarification** **Filtration by granular medium** **Post-treatment pH correction** **Primary chlorination disinfection** **Secondary chlorination disinfection** **Dewatering of waste water**	As required Regular As required Regular Regular Regular Regular Regular Regular Regular	**Powdered activated carbon** **Sodium hydroxide** **Potassium permanganate** **Aluminium sulphate** **-** **-** **Sodium hydroxide** **Chlorine (gas)** **Chlorine (gas)** **-**
Meeniyan	**Meeniyan**	**Manganese oxidation** **Coagulation and flocculation** **Sedimentation clarification** **Filtration by granular medium** **Chlorination disinfection** **Ultraviolet (UV) disinfection** **Removal of volatile organics by aeration** **Dewatering of waste water**	As required Regular Regular Regular Regular Regular Regular Regular	**Sodium hypochlorite** **Aluminium chlorohydrate** **Anionic polyacrylamide** **-** **Sodium hypochlorite** **-** **-** **Anionic polyacrylamide**
Poowong	**Loch** **Nyora** **Poowong**	**Taste and odour control** **Pre-treatment pH correction** **Manganese oxidation** **Coagulation and flocculation** **Sedimentation clarification** **Filtration by granular medium** **Post treatment pH correction** **Chloramination disinfection** **Dewatering of waste water**	As required As required As required Regular Regular Regular Regular Regular Regular	**Powdered activated carbon** **Sodium carbonate** **Potassium permanganate** **Aluminium sulphate** **Anionic polyacrylamide** **-** **Sodium hypochlorite** **Sodium hypochlorite and ammonia** **-**
Toora	**Port Franklin** **Port Welshpool** **Toora**	**Taste and odour control** **Pre-treatment pH correction** **Manganese oxidation** **Coagulation and flocculation** **Sedimentation clarification** **Filtration by granular medium** **Post treatment pH correction** **Chlorination disinfection** **Dewatering of waste water**	As required As required As required Regular Regular Regular Regular Regular Regular	**Powdered activated carbon** **Sodium carbonate** **Potassium permanganate** **Aluminium sulphate** **-** **-** **Sodium hypochlorite** **Chlorine (gas)** **-**

***** A change to process for Lance Creek system disinfection was implemented in 2017-18. Refer to previous page for details.

Water Treatment Issues

Continual process monitoring and jar tests are used in water treatment plant laboratories to simulate plant conditions and ensure correct dosage of treatment chemicals. This enables optimisation of treatment processes in response to changes in raw water quality and other factors. Occasionally issues arise out of the application of water treatment processes and corrective actions must be taken.

There were issues with manganese treatability at the Korumburra and Poowong water treatment plants in 2017-18. There were also some issues with treatment of taste and odour producing algal compounds for the Lance Creek system. Refer to Part 3 for further details.

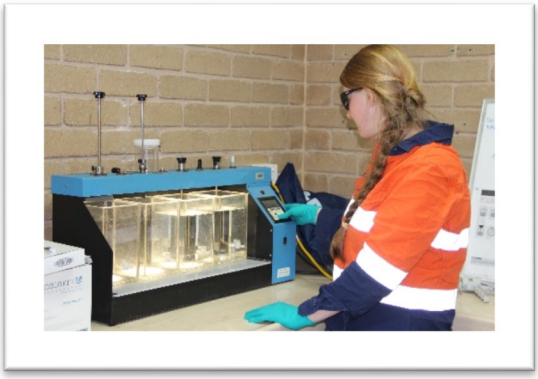

Photo: Trainee Water Treatment Plant Operator carries out a jar test

Quality Management Systems and Continual Improvement

The risk management approach adopted by South Gippsland Water is based on the twelve elements of the Framework for Management of Drinking Water Quality as described in the *Australian Drinking Water Guidelines.* A number of on-going programs and practices form part of the risk management system. These are designed to ensure treatment plants and water supply distribution systems are operating optimally at all times; examples are as follows:

- Filter management program
- Backflow prevention program
- Regular site security checks of all water treatment facilities and distribution system water storages
- Procedures in relation to hygienic mains break repair and replacement
- Proactive mains flushing and air-scouring programs
- Hydrant replacement program

The risk management system also includes a commitment to continual improvement, with the aim of achieving best practice in the delivery of drinking water to customers. Training, attendance at seminars, and membership of peak industry bodies (including the Australian Water Association, the Water Industry Operators Association, and the Water Services Association of Australia) ensure all employees involved in water treatment and quality assurance are well-informed about drinking water related research, and advances in technologies and practices.

3. Emergency, Incident and Event Management

Incidents reported under the Safe Drinking Water Act

Section 22 of the *Safe Drinking Water Act* 2003 (the Act) requires water suppliers to immediately notify the Department of Health and Human Services (the Department) of any circumstances where it is believed that drinking water supplied to the public may be the cause of an illness, pose a risk to human health or cause widespread public complaint. Based on this requirement, the incidents described in this section have been reported to the Department in the 2017-18 reporting period. Table 3 provides a summary of the events reported under section 22 of the Act.

Table 3: Summary of events reported to the Department of Health and Human Services under section 22 of the Safe Drinking Water Act 2003

Water sampling locality affected	Date of incident	Location of Incident	Nature of incident	Nature of known or suspected contamination / cause of incident
Korumburra	10/11/2017 to 23/2/2018	Distribution system	Widespread customer complaint due to dirty/discoloured water	Manganese oxides
Little Bass System (Poowong, Loch Nyora)	24/1/2018 to 1/2/2018	Distribution system	Potential for widespread customer complaint due to dirty/discoloured water	Manganese oxides
Lance Creek System (Lance Creek, Wonthaggi, Inverloch, Cape Paterson)	26/1/2018 to 14/3/2018	Distribution system	Earthy/musty taste and odour	MIB and Geosmin (algal metabolites)

Widespread customer complaint – Korumburra

The Department of Health and Human Services was advised in accordance with section 22 of the Safe Drinking Water Act of widespread customer complaint for Korumburra. In the period 10th November 2017 to 23rd February 2018, there were approximately 70 complaints related to "dirty" and discoloured water. The colour and dirty appearance were due to the presence of manganese oxides. The issue may be attributed to a combination of factors, including seasonal increases in dissolved manganese entering the treatment plant and unintentional scouring of the distribution system following mains breaks. In response to the issue, the following actions were carried out:

- Specific mains flushing in response to individual complaints
- Full system flushing in the period 9th to 12th January 2018
- Review of treatment options for removing dissolved manganese from source water
- Preparation of media releases and information sheets for affected customers
- The holding of a public drop-in information day at the water treatment plant

- Air-scour cleaning of the entire reticulation system, carried out over eight weeks from the 12th February 2018.

A decline in dirty/discoloured water issues of this nature is expected once connection of the Korumburra reticulation to the Lance Creek system in late 2018 is commissioned.

Potential for widespread complaint – Little Bass System

A section 22 report of potential widespread customer complaint was submitted to the Department in January 2018 for the localities of Poowong, Loch and Nyora. This was in response to high levels of soluble manganese in the raw water supply to the Poowong water treatment plant from the Little Bass Reservoir. Summer conditions, low rainfall, and a malfunctioning aeration unit in the reservoir are likely to have contributed the issue. Treatment plant operation was adjusted for the changed raw water quality in response but optimisation proved challenging. Water mains flushing was carried out in Nyora to mitigate the effects and prevent customer dissatisfaction. In all there were only actually four complaints received in relation to colour for Nyora and Loch, and none for Poowong in the period 24th January to the 1st of February 2018

Widespread customer complaint due to taste and odour – Lance Creek system

The Department was informed of widespread public complaint due to unpleasant taste and odour for the Lance Creek system in January 2018. Growth of cyanobacteria (blue-green algae) during the warm summer conditions was the cause of the taste and odour. The cyanobacteria produce the compounds geosmin and 2-methyliosborneol (MIB). While non-toxic, these compounds confer earthy and musty flavours on water, even at extremely low concentrations in the order of nanograms per litre ("parts-per-trillion"). In response to the issue, powdered activated carbon dose at the treatment plant was increased and frequent monitoring of taste and odour compounds was carried out. There were 18 complaints received from the localities of Wonthaggi, Inverloch and Cape Paterson in the period 26th January to the 14th March 2018 in relation to the taste and odour.

With the connection of the Lance Creek system to the Melbourne water grid (which commenced operating in July 2018) a reduction in taste and odour complaints is expected. Dilution of algal-affected water from the treatment plant with water from the Melbourne supply will help minimise taste and odour issues. A more robust and reliable carbon dosing system will also be installed to further mitigate effects of cyanobacterial blooms in the Lance Creek reservoir.

4. Drinking Water Quality Standards

During the 2017-18 reporting period, South Gippsland Water implemented water quality monitoring programs consistent with requirements of the *Safe Drinking Water Act 2003* (the Act) and associated Safe Drinking Water Regulations 2015 (the Regulations).

Schedule 2 of the Regulations lists three water quality parameters—*Escherichia coli*, trihalomethanes (total), and turbidity—and stipulates both the sampling frequency required for each parameter and the acceptable standard with which collected and tested samples must comply. As specified in the Regulations, mandatory samples must be collected from the drinking water supply at relevant frequencies and analysed for performance against water quality standards as shown in Table 4 below.

Table 4: Drinking water quality standards and required sampling frequencies as defined in Schedule 2 of the Safe Drinking Water Regulations 2015

Parameter	Relevant sampling frequency for each water sampling locality	Quality standard for each water sampling locality
Escherichia coli	One sample per week	All samples of drinking water collected are found to contain no Escherichia coli per 100 millilitres of drinking water, with the exception of any false positive sample. For the purposes of this quality standard, ***a false positive sample*** means a sample that is found, after an analysis conducted in accordance with regulation 14, to contain *Escherichia coli* per 100 millilitres of drinking water, if--- **a)** following the analysis, the water supplier has conducted an investigation, which has been conducted in accordance with any guidelines issued by the Secretary in relation to such investigations, including any timeframes for commencement and completion of the investigations, to ascertain whether the results for the analysis are representative of water in the relevant sampling locality; and **b)** the water supplier has reported the results of the investigation to the Secretary in relation to such reports, including any timeframes for provision of the report; and **c)** the investigation has concluded that the results of the analysis conducted in accordance with regulation 14 were not representative of the water in the relevant water sampling locality because the investigation established that— (i) all other factors that would indicate the presence of *Escherichia coli* are not present in that water in the water sampling locality at the time of the investigation; and (ii) the drinking water treatment process applied, or other specified actions taken by the water supplier, are such as would be reasonably expected to have eliminated the presence of Escherichia coli in the water sampling locality at the relevant time; and (iii) all plant and infrastructure associated with the water treatment process were operating to specification at all relevant times; and (iv) there were no issues arising from degradation of plant or infrastructure in or around the relevant water sampling locality that could reasonably be suspected to have contributed to the presence of *Escherichia coli* in the drinking water in that water sampling locality. A sample analysed in accordance with regulation 14 that is found, on that analysis, to contain *Escherichia coli* per 100 millilitres of drinking water is not a false positive sample unless all of the circumstances in paragraphs (a), (b) and (c) apply.
Trihalomethanes (total)	One sample per month	Less than or equal to 0.25 milligrams per litre of drinking water
Turbidity	One sample per week	The 95 percentile of results for samples in any 12-month period must be less than or equal to 5.0 Nephelometric Turbidity Units

Analysis Results – Schedule 2 parameters

Results of analysis for 2017-18 are summarised in Tables 5 to 24 on subsequent pages in this report.

Section 23 of the Act requires that a water supplier make available for inspection by the public the results of any water quality monitoring program that is conducted on any drinking water it supplies. Customers and members of the public may access drinking water quality data by telephoning South Gippsland Water Customer Service on 1300 851 636, or by emailing **sgwater@sgwater.com.au**

Escherichia coli

Escherichia coli (E. coli) is used as a specific indicator of faecal contamination to determine the safety of water for drinking.

For the quality standard for each water sampling locality to be met with respect to *E. coli*, then all samples of drinking water collected must have been found to contain no *E. coli* per 100 millilitres of drinking water, with the exception of any false positive sample (refer to Table 4 above for definition of "*false positive sample*").

Results: *Escherichia coli*

Monitoring for *E. coli* for the 2017-18 reporting period was conducted in accordance with requirements of the Regulations and South Gippsland Water's risk-based monitoring program. The program specifies which sites are to be sampled and at what frequencies. Samples for *E. coli* analysis are collected weekly from a range of different sampling sites and locations including dedicated customer tap sites, clear water storages (CWS), and process water from water treatment plants. Other sites in distribution systems, such as upstream and downstream of secondary disinfection dosing units, and at the inlets and outlets of CWS tanks and basins are also sampled on a weekly or less-frequent basis.

Compliance with the water quality standard for *E. coli* is based on monitoring of drinking water as it is supplied to customers. For some localities, this includes the results of distribution clear water storage sample analysis (where there is not a more representative site downstream of the storage) in addition to those from customer tap sample analysis. All samples of drinking water collected were found to contain no *Escherichia coli* per 100 millilitres of drinking water. Results of *E. coli* compliance monitoring are presented in Table 5.

Table 5: Escherichia coli results for 2017-18

Water Sampling Locality	Customer tap sampling frequency (samples per time period)	Clear water storage outlet sampling frequency (samples per time period)	Total number of samples collected in compliance period	Average result (Orgs/100mL)	Maximum result (Orgs/100mL)	Number of samples where standard was not met
Alberton	one/week	-	52	0	0	0
Cape Paterson	one/week	one/week	104	0	0	0
Dumbalk	one/week	one/week	104	0	0	0
Fish Creek	one/week	one/week	104	0	0	0
Foster	one/week	one/week	104	0	0	0
Inverloch	two/week	one/week	156	0	0	0
Koonwarra	one/week	-	52	0	0	0
Korumburra	one/week	two/week	153	0	0	0
Lance Creek	one/week	one/week	104	0	0	0
Leongatha	two/week	one/week	156	0	0	0
Loch	one/week	one/week	104	0	0	0
Meeniyan	one/week	one/week	104	0	0	0
Nyora	one/week	-	52	0	0	0
Poowong	one/week	two/week	153	0	0	0
Port Franklin	one/week	-	52	0	0	0
Port Welshpool	one/week	-	52	0	0	0
Toora	one/week	two/week	153	0	0	0
Wonthaggi	two/week	one/week	153	0	0	0
Yarram	one/week	one/week	102	0	0	0

Photos: Water Quality Officers carry out routine weekly water supply monitoring in Loch

Trihalomethanes

Trihalomethanes (THMs) are organic chemical compounds in which three of the four hydrogen atoms of methane (CH_4) are replaced by halogen atoms. The compounds may be present in drinking water principally as a result of chlorination or, to a much lesser extent, chloramination. Chlorine, which produces hypochlorous acid when added to water, can react with naturally-occurring organic material to produce the trihalomethane species trichloromethane (chloroform), bromodichloromethane, dibromochloromethane, and tribromomethane (bromoform)

The ADWG states that, "Based on health considerations, the concentration of trihalomethanes, either individually or in total, in drinking water should not exceed 0.25 mg/L. Trihalomethane concentrations fluctuating occasionally (for a day or two annually) up to 1 mg/L are unlikely to pose a significant health risk. Action to reduce trihalomethanes is encouraged, but must not compromise disinfection, as non-disinfected water poses significantly greater risk than Trihalomethanes."

Total trihalomethanes results for 2017-18

For the year ending 30th June 2018, testing for trihalomethanes was conducted in accordance with South Gippsland Water's risk-based monitoring program. Monitoring frequency for trihalomethanes was undertaken monthly for the ten chlorinated localities and quarterly for the remaining nine chloraminated localities (refer to following section on Chlorine disinfection residual for further information). There were no exceedances of the regulatory limit of 0.25 mg/L; results are presented in Table 6.

Drinking water quality standard not met and actions undertaken

For the 2017-18 period, the chloraminated water sampling localities of Alberton, Cape Paterson, Inverloch, Lance Creek, Loch, Nyora, Poowong, Wonthaggi, and Yarram were not compliant with minimum sampling requirements of the drinking water quality standard for trihalomethanes. These localities were sampled at a frequency of one sample per each quarter (three-month period), rather than one sample per month as required under the Safe Drinking Water Regulations 2015. The non-compliance was due to an administrative oversight; it occurred following the expiry of a Variation of Water Sampling Frequency notice (published in Victoria Government Gazette S260, dated 1 August 2014), which permitted South Gippsland Water to sample according to this frequency in the period 1 August 2014 to 31 July 2017.

There was no risk to public health in relation to the non-compliance with the sampling regulation. Consistent with long-term historical data, all samples taken in the aforementioned water sampling localities recorded trihalomethanes results within the regulatory limit of 0.25 mg/L. The monitoring program has since been updated so that all localities are again being sampled monthly. Should South Gippsland Water apply for and be granted a Variation of Water Sampling Frequency in the future, the Corporation works management system will be utilised to ensure expiry date is observed.

Table 6: Trihalomethanes (total) results for 2017-18

Water Sampling Locality	Customer tap sampling frequency (samples per time period)	Number of Clear water storage Outlet samples taken	Total number of samples collected in compliance period	Average result (mg/L)	Maximum result (mg/L)	Number of samples where standard was not met
Alberton	one/quarter	0	4	0.006	0.013	0
Cape Paterson	one/quarter	1	4	0.070	0.160	0
Dumbalk	one/month	0	12	0.099	0.170	0
Fish Creek	one/month	18	30	0.137	0.190	0
Foster	one/month	0	12	0.102	0.140	0
Inverloch	one/quarter	0	4	0.049	0.140	0
Koonwarra	one/month	0	12	0.124	0.160	0
Korumburra	one/month	0	12	0.092	0.120	0
Lance Creek	one/quarter	0	4	0.048	0.130	0
Leongatha	one/month	0	12	0.110	0.170	0
Loch	one/quarter	0	4	0.012	0.018	0
Meeniyan	one/month	0	12	0.122	0.220	0
Nyora	one/quarter	0	4	0.018	0.027	0
Poowong	one/quarter	0	4	0.016	0.029	0
Port Franklin	one/month	0	12	0.093	0.130	0
Port Welshpool	one/month	0	12	0.070	0.095	0
Toora	one/month	0	12	0.067	0.097	0
Wonthaggi	one/quarter	0	4	0.051	0.150	0
Yarram	one/quarter	0	4	0.006	0.013	0

Turbidity

Turbidity is the measurement of the light-scattering property of water which is dependent on the amount, size and composition of fine suspended matter. The Safe Drinking Water Regulations 2015 specify that the 95th percentile of results for samples in any 12-month period must be less than or equal to 5.0 Nephelometric Turbidity Units (NTU).

Results: Turbidity

Monitoring for compliance with the water quality standard for turbidity was conducted in accordance with the Regulations and South Gippsland Water's risk-based monitoring program. Turbidity results are presented in Table 7.

Table 7: Turbidity Results 2017-18

Water Sampling Locality	Customer tap sampling frequency (samples per time period)	Total number of samples collected in compliance period	Maximum turbidity in a sample (NTU)	Maximum 95th percentile of turbidity results in any 12 months	Number of 95th percentile of results in any 12 months above standard
Alberton	one/week	52	0.6	0.2	0
Cape Paterson	one/week	52	0.2	0.1	0
Dumbalk	one/week	52	0.2	0.2	0
Fish Creek	one/week	52	0.4	0.2	0
Foster	one/week	52	0.8	0.3	0
Inverloch	two/week	104	1.0	0.2	0
Koonwarra	one/week	52	0.2	0.2	0
Korumburra	one/week	52	1.2	0.2	0
Lance Creek	one/week	52	0.4	0.2	0
Leongatha	two/week	104	0.4	0.2	0
Loch	one/week	52	0.6	0.2	0
Meeniyan	one/week	52	0.5	0.2	0
Nyora	one/week	52	0.8	0.2	0
Poowong	one/week	52	1.0	0.2	0
Port Franklin	one/week	52	1.6	0.3	0
Pt Welshpool	one/week	52	0.7	0.2	0
Toora	one/week	52	1.4	0.3	0
Wonthaggi	two/week	104	0.2	0.2	0
Yarram	one/week	52	0.2	0.2	0

Analysis Results - Other water quality standards (algal toxin, pathogen, chemical or substance that may pose a risk to human health)

As part of South Gippsland Water's drinking water quality management system, specific water quality parameters that have the potential to affect human health are monitored. These parameters are measured against standard values defined in the *Australian Drinking Water Guidelines 2011* (ADWG).

As many of these parameters do not change significantly over time or through water supply systems, frequent monitoring is not required.

Aluminium (acid-soluble)

Aluminium may be present in drinking water where aluminium salts are used as coagulants in water treatment processes to destabilise particles in water. Water quality performance with respect to aluminium was measured against the ADWG aesthetic guideline value of 0.2 mg/L. As stated in the ADWG, "no health-based guideline is set for aluminium at this time this issue will be kept under review." A summary of aluminium results is presented in Table 8.

Table 8: Aluminium (acid-soluble) results for 2017-18

Water Sampling Locality	Frequency of sampling (samples per time period)	Customer Tap samples collected	Aesthetic drinking water quality guideline (mg/L)	Maximum result (mg/L)	Average result (mg/L)	Number of samples where guideline was not met
Alberton	one/month	12	0.2	0.05	0.02	0
Cape Paterson	one/month	12	0.2	0.05	0.03	0
Dumbalk	one/month	12	0.2	<0.01	<0.01	0
Fish Creek	one/month	12	0.2	0.02	0.02	0
Foster	one/month	12	0.2	<0.01	<0.01	0
Inverloch	one/month	12	0.2	0.06	0.03	0
Koonwarra	one/month	12	0.2	0.04	0.02	0
Korumburra	one/month	12	0.2	<0.01	<0.01	0
Lance Creek	one/month	12	0.2	0.09	0.03	0
Leongatha	one/month	12	0.2	0.03	0.01	0
Loch	one/month	12	0.2	0.05	0.02	0
Meeniyan	two/month	24	0.2	0.19	0.07	0
Nyora	one/month	12	0.2	0.05	0.02	0
Poowong	one/month	12	0.2	0.04	0.02	0
Port Franklin	one/month	12	0.2	0.09	0.02	0
Port Welshpool	one/month	12	0.2	0.03	0.01	0
Toora	one/month	12	0.2	0.07	0.02	0
Wonthaggi	one/month	12	0.2	0.05	0.03	0
Yarram	one/month	12	0.2	0.10	0.02	0

Arsenic

Arsenic is a naturally-occurring element which can be introduced to water through dissolution of minerals and ores, or from industrial effluent, atmospheric deposition, drainage from old gold mines or the use of some types of sheep dip. The ADWG specify that, from a health perspective, the concentration of arsenic should not exceed 0.01 mg/L. Water supplied by South Gippsland water complied with the ADWG guideline value for arsenic, with all results indicating levels were below detection limits; refer to Table 9.

Table 9 Arsenic results for 2017-18

Water treatment plant / system	Locality supplied	Sampling frequency (samples per time period)	Total number of samples	Drinking water quality guideline (mg/L)	Result (mg/L)	Number of samples where guideline was not met
Devon North	Alberton Yarram	one/year	1	0.01	<0.001	0
Dumbalk	Dumbalk	one/year	1	0.01	<0.001	0
Fish Creek	Fish Creek	one/year	1	0.01	<0.001	0
Foster	Foster	one/year	1	0.01	<0.001	0
Korumburra	Korumburra	one/year	1	0.01	<0.001	0
Lance Creek	Cape Paterson Inverloch Lance Creek Wonthaggi	one/year	1	0.01	<0.001	0
Leongatha	Leongatha Koonwarra	one/year	1	0.01	<0.001	0
Meeniyan	Meeniyan	one/year	1	0.01	<0.001	0
Poowong	Loch Nyora Poowong	one/year	1	0.01	<0.001	0
Toora	Port Franklin Port Welshpool Toora	one/year	1	0.01	<0.001	0

Copper

Copper is naturally distributed in rocks and soils. It may also be present in drinking water where aggressive waters of low pH and hardness induce corrosion of copper pipes. The ADWG specify that the concentration of copper should not exceed 1 mg/L based on aesthetic considerations, and 2 mg/L based on health considerations. Water supplied by South Gippsland Water complied with both aesthetic-based and health-based guideline values for copper; refer to Table 10.

Table 10 Copper results for 2017-18

Water Sampling Locality	Frequency of sampling (samples per time period)	Customer Tap samples collected	Drinking water quality health guideline (mg/L)	Average result (mg/L)	Maximum result (mg/L)	Number of samples where guideline was not met
Alberton	one/quarter	4	2	0.002	0.002	0
Cape Paterson	one/quarter	4	2	0.013	0.025	0
Dumbalk	one/quarter	4	2	0.009	0.012	0
Fish Creek	one/quarter	4	2	0.006	0.013	0
Foster	one/quarter	4	2	0.007	0.009	0
Inverloch	one/quarter	4	2	0.009	0.012	0
Koonwarra	one/quarter	4	2	0.009	0.011	0
Korumburra	one/quarter	4	2	0.014	0.015	0
Lance Creek	one/quarter	4	2	0.023	0.047	0
Leongatha	one/quarter	4	2	0.009	0.014	0
Loch	one/quarter	4	2	0.010	0.017	0
Meeniyan	one/quarter	4	2	0.005	0.006	0
Nyora	one/quarter	4	2	0.011	0.019	0
Poowong	one/quarter	4	2	0.010	0.012	0
Port Franklin	one/quarter	4	2	0.004	0.004	0
Port Welshpool	one/quarter	4	2	0.005	0.007	0
Toora	one/quarter	4	2	0.007	0.013	0
Wonthaggi	one/quarter	4	2	0.012	0.015	0
Yarram	one/quarter	4	2	0.002	0.003	0

Note: Samples are taken for analysis from the reticulation system. Copper levels may be higher at the customers' internal taps if copper plumbing is used in the domestic system. Customers experiencing blue copper staining of fixtures or discolouration of water are advised to call South Gippsland Water Customer Service on 1300 851 636.

Cyanogen chloride

Cyanogen chloride is a byproduct of chloramination that can be formed through the reaction between organic precursors with hypochlorous acid in the presence of the ammonium ion. Based on health considerations, the ADWG specify that the concentration of total cyanogenic compounds in drinking water should not exceed 0.08 mg/L.

Monitoring of chloraminated water systems confirmed that water supplied by South Gippsland Water complied with the guideline value for cyanogen chloride, with all results indicating levels were below the detection limit; refer to Table 11.

Table 11: Cyanogen chloride for 2017-18: chloraminated systems only

Water Treatment plant / system	Locality supplied	Frequency of sampling (samples per time period)	Number of samples collected	Drinking water quality guideline (mg/L)	Result (mg/L)	Number of samples where guideline was not met
Devon North	Alberton Yarram	one/year	1	0.01	<0.05	0
Lance Creek	Cape Paterson Inverloch Lance Creek Wonthaggi	one/year	1	0.01	<0.05	0
Poowong	Loch Nyora Poowong	one/year	1	0.01	<0.05	0

Chlorine disinfection residual (Free or Total Chlorine)

Disinfection is a critical part of water treatment. Not all microorganisms can be removed during clarification and filtration processes so an additional "kill-step" is required to ensure drinking water safety. Chlorine and chloramine (compounds formed from chlorine and ammonia) are the most commonly used agents. These are applied in carefully controlled dosages at treatment plants in the process known as primary disinfection.

The actual amount of disinfection agent dosed is very small (to visualise, think of about a cup's worth in a swimming pool). It is just adequate to both inactivate microorganisms that have made it through the purification process, and to confer a disinfection residual on the water. The residual helps to protect water as it passes through the pipes and storages of the distribution system. Chlorine and, to a lesser extent, chloramine tend to dissipate with time and distance through a water supply network so secondary dosing units may be used to ensure water remains protected to the ends of the system.

Disinfection agent dosing is automatically controlled by on-line monitoring systems which shut-down treatment plant operation in the event of levels being either too low or too high. This prevents out-of-specification water from being produced while the problem is addressed. With these controls in place, water supplied to customers is unlikely to ever exceed the ADWG guideline. The main purpose of disinfection residual monitoring is to ensure that it remains at an adequate level throughout the distribution system. There is no guideline for minimum disinfection residual and what is considered acceptable is particular to an individual water supply system based on its size and components, as well as the results of microbiological monitoring results.

South Gippsland Water uses both chlorine and chloramine disinfection. Chlorine dissociates in water to form free chlorine, which consists of aqueous molecular chlorine, hypochlorous acid and hypochlorite ion. Free chlorine is monitored in the reticulation systems of chlorinated supplies on a (minimum) weekly basis during routine sampling. For the chloraminated supplies, total chlorine is monitored. Total chlorine is the sum of chlorine in combined form (with ammonia and other nitrogenous or organic compounds) and free chlorine.

Based on health considerations, the ADWG guideline value for total chlorine in drinking water is 5 mg/L. There is no specific guideline for free chlorine; however, in chlorinated systems free chlorine generally approximates total chlorine. As both total and free chlorine levels are well below 5 mg/L, all localities can be assumed to be compliant with the water quality guideline for total chlorine; refer to tables 12 and 13.

Table 12: Free Residual Chlorine for 2017-18 (chlorinated localities)

Water sampling locality	Minimum sampling frequency (samples per time period)	Total number of samples	Minimum result (mg/L)	Average result (mg/L)	Maximum result (mg/L)	Number of samples where guideline was not met
Dumbalk	one/week	52	0.02	0.34	0.78	0
Fish Creek	one/week	52	0.02	0.40	0.99	0
Foster	one/week	52	0.00	0.25	1.06	0
Koonwarra	one/week	52	0.00	0.02	0.15	0
Korumburra	one/week	52	0.11	1.15	1.72	0
Leongatha	two/week	104	0.03	0.56	1.17	0
Meeniyan	one/week	53	0.02	0.37	0.94	0
Port Franklin	one/week	52	0.01	0.49	0.85	0
Port Welshpool	one/week	98	0.00	0.81	1.71	0
Toora	one/week	52	0.36	0.90	1.30	0

Table 13: Total Chlorine for 2017-18 (chloraminated localities)

Water sampling locality	Minimum sampling frequency (samples per time period)	Total number of samples	Minimum result (mg/L)	Average result (mg/L)	Maximum result (mg/L)	Number of samples where standard was not met
Alberton	one/week	68	0.30	2.34	3.9	0
Cape Paterson	one/week	52	0.02	0.78	2.8	0
Inverloch	two/week	123	0.38	2.11	3.7	0
Lance Creek	one/week	52	1.17	3.33	4.6	0
Loch	one/week	68	1.20	2.63	3.8	0
Nyora	one/week	70	1.30	2.90	4.1	0
Poowong	one/week	52	1.08	2.86	4.7	0
Wonthaggi	two/week	104	0.06	1.85	3.9	0
Yarram	one/week	67	0.14	2.44	3.9	0

Fluoride

Naturally-occurring fluoride concentrations in drinking water are largely dependent on the type soil and rock through which source water drains. Fluoride may also be added to drinking water supplies as a public health measure for the prevention of dental decay. The Australian Drinking Water Guidelines 2011 (ADWG) specify that the maximum concentration of fluoride in drinking water should not exceed 1.5 mg/L. The Code of practice for fluoridation of drinking water supplies (2018) made under the *Health (Fluoridation) Act 1973* states that a water agency must not add fluoride to an extent that results in an average optimum concentration in excess of one part fluoride per million parts of water (1.0 mg/L) over any 12-month period in any water sampling locality.

Under the *Health (fluoridation) Act*, an obligation is imposed on suppliers of fluoridated water to achieve a dose rate that confers a dental health benefit on consumers. Based on annual average maximum daily air temperature (which has been show to correlate closely with water consumption), and as specified in the Code of practice for fluoridation of drinking water supplies, the optimal fluoride concentration for drinking water supplied in the South Gippsland region is 0.9 mg/L. While fluoridated water suppliers must aim for the specified optimal concentration, an annual average fluoride concentration of greater than or equal to 0.6 mg/L (which is the minimum concentration that confers a dental health benefit) is deemed as meeting the obligation.

Results: Fluoride in non-fluoridated supplies

Monitoring of non-fluoridated drinking water is conducted annually to verify continued low levels of naturally-occurring fluoride, as have been recorded historically. Results of fluoride monitoring for non-fluoridated supplies are provided in Table 14.

Table 14: Fluoride results for non-fluoridated supplies for 2017-18

Water treatment plant / system	Locality supplied	Sampling frequency (samples per time period)	Total number of samples	Drinking water quality guideline (mg/L)	Result (mg/L)	Number of samples where guideline was not met
Devon North	Alberton Yarram	one/year	1	1.5	0.06	0
Dumbalk	Dumbalk	one/year	1	1.5	0.12	0
Fish Creek	Fish Creek	one/year	1	1.5	<0.05	0
Foster	Foster	one/year	1	1.5	<0.05	0
Korumburra	Korumburra	one/year	1	1.5	<0.05	0
Leongatha	Leongatha Koonwarra	one/year	1	1.5	0.06	0
Meeniyan	Meeniyan	one/year	1	1.5	0.08	0
Poowong	Loch Nyora Poowong	one/year	1	1.5	0.08	0
Toora	Port Franklin Port Welshpool Toora	one/year	1	1.5	<0.05	0

Results: Fluoride in fluoridated supplies

For the fluoridated supply system of Lance Creek, monitoring is conducted in accordance with the Code of practice for fluoridation of drinking water supplies (2018) under the *Health (fluoridation) Act 1973*. Drinking water in all fluoridated localities complied with the *Health (Fluoridation) Act* for allowable fluoride concentration. Based on the requirement that the annual average fluoride concentration be greater than or equal to 0.6 mg/L, the obligation imposed by the *Health (Fluoridation) Act* with regard to conferring a dental health benefit was also fulfilled. Refer to Table 15 for results.

Table 15: Results: Fluoride in fluoridated supply for 2017-18

Water sampling locality	Frequency of sampling (samples per time period)	Total Number of samples	Operating target range mg/L	Min. result mg/L	Max. result mg/L	Average result mg/L	Complying with regulation (yes/no)	Meeting obligation (yes/no)
Cape Paterson	one/week	52	0.9±0.1	0.19	0.94	0.75	yes	yes
Inverloch	one/week	52	0.9±0.1	0.14	0.94	0.76	yes	yes
Lance Creek	one/week	52	0.9±0.1	0.08	1.00	0.75	yes	yes
Wonthaggi	one/week	52	0.9±0.1	0.14	0.92	0.76	yes	yes

Lead

Lead may be detected in drinking water as a result of dissolution from natural sources or from household plumbing systems containing lead. The ADWG specify that, from a health perspective, the concentration of lead should not exceed 0.01 mg/L. Water supplied by South Gippsland Water complied with the ADWG guideline value; refer to Table 16.

Table 16: Lead results for 2017-18

Water sampling locality	Frequency of sampling (samples per time period)	Total number of samples	Drinking water quality guideline (mg/L)	Minimum result (mg/L	Maximum result (mg/L)	Number of samples where standard was not met
Alberton	one/quarter	4	0.01	<0.001	<0.001	0
Cape Paterson	one/quarter	4	0.01	<0.001	<0.001	0
Dumbalk	one/quarter	4	0.01	<0.001	<0.001	0
Fish Creek	one/quarter	4	0.01	<0.001	<0.001	0
Foster	one/quarter	4	0.01	<0.001	<0.001	0
Inverloch	one/quarter	4	0.01	<0.001	<0.001	0
Koonwarra	one/quarter	4	0.01	<0.001	<0.001	0
Korumburra	one/quarter	4	0.01	<0.001	<0.001	0
Lance Creek	one/quarter	4	0.01	<0.001	<0.001	0
Leongatha	one/quarter	4	0.01	<0.001	<0.001	0
Loch	one/quarter	4	0.01	<0.001	<0.001	0
Meeniyan	one/quarter	4	0.01	<0.001	<0.001	0
Nyora	one/quarter	4	0.01	<0.001	<0.001	0
Poowong	one/quarter	4	0.01	<0.001	<0.001	0
Port Franklin	one/quarter	4	0.01	<0.001	<0.001	0
Port Welshpool	one/quarter	4	0.01	<0.001	0.002	0
Toora	one/quarter	4	0.01	<0.001	<0.001	0
Wonthaggi	one/quarter	4	0.01	<0.001	<0.001	0
Yarram	one/quarter	4	0.01	<0.001	<0.001	0

Manganese

Manganese may be present in source waters as a result of dissolution form natural sources. Concentrations may be reduced in drinking water by converting soluble forms of the element to insoluble precipitates followed by physical removal using filtration. The ADWG specify that the concentration of manganese should not exceed 0.1 mg/L based on aesthetic considerations, and 0.5 mg/L based on health considerations. Drinking water supplied by South Gippsland Water complied with the health-based guideline values for manganese; refer to Table 17. Single incidences of sample results exceeding the aesthetic guideline for Port Franklin and Toora were addressed with mains flushing. Corrective actions additional to mains flushing were taken to address manganese levels above the aesthetic guideline for Korumburra, Loch, Poowong and Nyora. Further details are provided in Part 3 - Emergency, incident and event management.

Table 17: Manganese for 2017-18

Water sampling locality	Minimum Frequency of sampling (samples per time period)	Total number of samples collected*	Drinking water quality health guideline (mg/L)	Minimum result (mg/L)	Average result (mg/L)	Maximum result (mg/L)	Number of samples where guideline was not met
Alberton	one/month	12	0.5	<0.001	0.001	0.002	0
Cape Paterson	one/month	12	0.5	0.002	0.009	0.022	0
Dumbalk	one/month	12	0.5	<0.001	0.001	0.004	0
Fish Creek	one/month	12	0.5	0.002	0.002	0.014	0
Foster	one/month	12	0.5	<0.001	0.001	0.051	0
Inverloch	one/month	12	0.5	0.002	0.002	0.046	0
Koonwarra	one/month	12	0.5	0.001	0.001	0.011	0
Korumburra	one/month	18	0.5	0.005	0.042	0.500	0
Lance Creek	one/month	12	0.5	0.002	0.010	0.029	0
Leongatha	one/month	12	0.5	0.002	0.006	0.015	0
Loch	one/month	18	0.5	0.004	0.018	0.062	0
Meeniyan	one/month	12	0.5	<0.001	0.002	0.003	0
Nyora	one/month	15	0.5	0.004	0.027	0.100	0
Poowong	one/month	16	0.5	0.005	0.038	0.120	0
Port Franklin	one/month	12	0.5	0.002	0.023	0.180	0
Port Welshpool	one/month	12	0.5	<0.001	0.003	0.010	0
Toora	one/month	12	0.5	0.004	0.022	0.130	0
Yarram	one/month	12	0.5	<0.001	0.001	0.003	0

* Includes additional samples taken in relation to discoloured water issues for Korumburra, Loch, Nyora and Poowong. Refer to Part 3 for further details.

Nitrate and Nitrite

Nitrates and nitrites are naturally-occurring oxides of nitrogen. Nitrite is rapidly oxidised to nitrate and is seldom present in well-oxygenated or chlorinated supplies. Chloramination disinfection can lead to nitrate and nitrite formation in the distribution system due to the action of nitrifying bacteria. The ADWG specify that, from a health perspective, the concentrations of nitrate and nitrite should not exceed 50 mg/L and 3 mg/L respectively. Monitoring for oxidised nitrogen (nitrate plus nitrite) was conducted in all South Gippsland Water systems in 2017-18. Specific analysis for both nitrate and nitrite was also conducted in the chloraminated localities. All localities complied with the guideline values for nitrate and nitrite; refer to Tables 18, 19, and 20.

Table 18: Oxidised nitrogen (nitrate + nitrite) for 2017-18

Water treatment plant / system	Localities supplied	Sampling frequency	Total number of samples	Minimum Result (mg/L)	Maximum Result mg/L	Number of samples where standard was not met
Devon North	Alberton Yarram	one/quarter	4	0.10	0.84	0
Dumbalk	Dumbalk	one/quarter	4	0.18	1.20	0
Fish Creek	Fish Creek	one/quarter	4	0.35	0.48	0
Foster	Foster	one/quarter	4	0.09	0.25	0
Korumburra	Korumburra	one/quarter	4	0.08	0.21	0
Lance Creek	Cape Paterson Inverloch Lance Creek Wonthaggi	one/quarter	4	0.17	0.31	0
Leongatha	Leongatha Koonwarra	one/quarter	4	0.10	1.1	0
Meeniyan	Meeniyan	one/quarter	4	0.15	1.2	0
Poowong	Loch Nyora Poowong	one/quarter	4	0.24	1.0	0
Toora	Port Franklin Post Welshpool Toora	one/quarter	4	0.05	1.8	0

Table 19: Nitrate for 2017-18 (chloraminated localities only)

Water sampling locality	Frequency of sampling Winter and Spring	Frequency of sampling Summer & Autumn	Total number of samples	Minimum result (mg/L)	Maximum result (mg/L)	Number of samples where guideline was not met
Alberton	one per month	two per month	18	0.07	0.88	0
Cape Paterson	one per month	two per month	18	0.13	0.63	0
Inverloch	one per month	two per month	18	0.09	0.62	0
Lance Creek	one per month	two per month	19	0.07	0.45	0
Loch	one per month	two per month	18	0.84	0.94	0
Nyora	one per month	two per month	18	0.07	0.89	0
Poowong	one per month	two per month	18	0.05	1.00	0
Wonthaggi	one per month	two per month	19	0.22	0.54	0
Yarram	one per month	two per month	18	0.07	0.84	0

Table 20: Nitrite for 2017-18 (Chloraminated localities only)

Water sampling locality	Frequency of sampling Winter and Spring	Frequency of sampling Summer & Autumn	Total number of samples	Minimum result (mg/L)	Maximum result (mg/L)	Number of samples where guideline was not met
Alberton	one per month	two per month	18	0.005	0.120	0
Cape Paterson	one per month	two per month	18	0.009	0.160	0
Inverloch	one per month	two per month	18	0.005	0.021	0
Lance Creek	one per month	two per month	19	0.002	0.014	0
Loch	one per month	two per month	18	0.009	0.022	0
Nyora	one per month	two per month	18	0.008	0.022	0
Poowong	one per month	two per month	18	0.002	0.017	0
Wonthaggi	one per month	two per month	18	0.004	0.019	0
Yarram	one per month	two per month	18	0.002	0.021	0

Nitrosodimethylamine (NDMA)

N-Nitrosodimethylamine (NDMA) is produced as a byproduct of chloramination of drinking water due to the oxidation of natural organic matter by chlorine in the presence of ammonia. The ADWG specify that, based on health considerations, the concentration of NDMA in drinking water should not exceed 0.0001 mg/L (100 ng/L).

Monitoring of chloraminated systems for NDMA was conducted quarterly, with results indicating water supplied by South Gippsland Water complied with the guideline value for NDMA; refer to Table 21.

Table 21: NDMA in chloraminated supplies for 2017-18

Water treatment plant /system	Localities supplied	Sampling frequency (samples per time period)	Total number of samples	Result (mg/L)	Number of samples where standard was not met
Devon North	Alberton Yarram	one/year	1	0.000027	0
Lance Creek	Cape Paterson Inverloch Lance Creek Wonthaggi	one/year	1	0.000038	0
Poowong	Loch Nyora Poowong	one/year	1	0.000017	0

Other inorganic chemicals

Inorganic chemicals may be present in water as a result of the natural dissolution of rocks, soils and some plants, or through contamination from industrial and agricultural sources. Materials used to coat pipes and plumbing fittings may also be sources of inorganic chemicals in drinking water. Monitoring of all water supply systems was conducted to verify compliance with ADWG health-related guidelines for chemical concentrations as specified in Table 22.

Table 22: Other inorganic chemicals for 2017-18

Parameter	Sampling frequency	Number of samples per water supply/locality*	Total Number of samples taken in 2017-18	ADWG guideline value (mg/L)	Maximum results (mg/L)	Number of samples where standard was not met
Antimony	Annually	one per locality	19	0.003	<0.001	0
Barium	Annually	one per system	10	2	0.028	0
Beryllium	Annually	one per system	10	0.06	<0.001	0
Boron	Annually	one per system	10	4	0.03	0
Cadmium	Annually	one per locality	19	0.002	<0.0002	0
Chromium	Annually	one per locality	19	0.05	<0.001	0
Cyanide	Annually	one per system	10	0.08	<0.005	0
Mercury	Annually	one per system	10	0.001	<0.001	0
Molybdenum	Annually	one per system	10	0.05	<0.001	0
Nickel	Annually	one per locality	19	0.02	<0.001	0
Selenium	Annually	one per system	10	0.01	<0.001	0
Silver	Annually	one per system	10	0.1	<0.001	0
Sulphate	Quarterly	one per locality	40	500	72	0
Zinc	Annually	one per locality	19	3	0.005	0

*Monitoring is conducted at the entry point to distribution systems or at customer tap sites in each locality dependent on likelihood of change in level of chemical as it passes through the water supply system.

Other organic chemicals

Potential sources of contamination of the drinking water supply with organic chemicals are industrial effluent, run-off from agricultural land, and the use of pesticides and herbicides. Organic disinfection byproducts, such as the chloroacetic acids, can also form as result of disinfection processes. Consistent with historical data, monitoring of raw water intakes, distribution entry point water or customer tap sites found that levels of organic chemicals were compliant with the ADWG health-related guidelines for the 2017-18 period; refer to Table 23.

Table 23: Organic chemical monitoring results for 2017-18

Parameter	Sampling frequency	Number of samples per water supply system/locality*	Total Number of samples taken in 2017-18	Maximum results mg/L	ADWG Guideline value mg/L	Number of samples where guideline was not met
1,1-dichloroethane	Annually	One per system	10	<0.001	a	-
1,2-dichloroethane	Annually	One per system	10	<0.001	0.003	0
2,4,5-T	Biannually	Two per system	20	<0.00001	0.1	0
2,4,5-TP	Biannually	Two per system	20	<0.00001	b	-
2,4,6-T	Biannually	Two per system	20	<0.0001	b	-
2,4,6-trichlorphenol	Annually	One per system	10	<0.001	0.02	0
2,4-D	Biannually	Two per system	20	0.00006	0.03	0
2,4-DB	Biannually	Two per system	20	<0.00001	b	-
2,4-DP	Biannually	Two per system	20	<0.00001	b	-
2,6-D	Biannually	Two per system	20	<0.0001	b	-
4-Chlorophenoxyacetic Acid	Biannually	Two per system	20	<0.00001	b	-
Atrazine	Biannually	Two per system	20	<0.002	0.02	0
Benzene	Annually	One per system	10	<0.001	0.001	0
Benzo(a)pyrene	Annually	One per system**	4	<0.000002	0.00001	0
Carbon tetrachloride	Annually	One per system	10	<0.001	0.003	0
Chloroacetic acid	Annually	One per locality	19	<0.005	0.15	0
Clopyralid	Biannually	Two per system	20	<0.00005	2	0
Dicamba	Biannually	Two per system	20	<0.00001	0.1	0
Dichloroacetic acid	Annually	One per locality	19	0.028	0.1	0
Fluoroxypyr	Biannually	Two per system	20	<0.00005	b	-
Glyphosate	Biannually	Two per system	20	<0.03	1	0
MCPA	Biannually	Two per system	20	0.00001	0.04	0
MCPB	Biannually	Two per system	20	<0.00001	b	-
Mecoprop	Biannually	Two per system	20	<0.00001	b	-
Metsulfuron methyl	Annually	One per system	10	<0.0001	0.04	0
Pentachlorphenol	Annually	One per system	10	<0.001	0.01	0
Picloram	Biannually	Two per system	20	0.00007	0.3	0
Prometryn	Biannually	Two per system	20	<0.002	b	-
Simazine	Biannually	Two per system	20	<0.002	0.02	0
Tetrachloroethene	Annually	One per system	10	<0.001	0.05	0
Trichloroacetic acid	Annually	One per locality	19	0.017	0.1	0
Trichloroethylene	Annually	One per system	10	<0.001	a	-
Triclopyr	Biannually	Two per system	20	0.00084	0.02	0

Table notes:

a Insufficient data to set an ADWG guideline value based on health considerations

b No ADWG information available

***** Monitoring is conducted at raw water inlets to treatment plants or at clear water storage outlets to distribution systems

****** Monitoring conducted at Devon North, Korumburra, Lance Creek and Leongatha water treatment plants only

Raw water monitoring

For the purposes of risk management, the parameters listed in Table 24 were monitored in raw water at the specified (minimum) frequencies by external laboratory analysis in raw water at all South Gippsland Water treatment plants for the 2017-18 reporting period.

Table 24: Raw water monitoring frequencies

Parameter	Sampling frequency
Escherichia coli	Weekly
Total Coliforms	Weekly
Cryptosporidium	Event-based
Giardia	Event-based
Cyanobacteria (Blue-green algae)	Weekly (external/internal)
Algae byproducts (MIB/Geosmin/Saxitoxin)	Event-based
Alkalinity	Monthly
Aluminium	Quarterly
Calcium	Quarterly
Copper	Quarterly
Dissolved Organic Carbon	Quarterly
Manganese	Quarterly
Nitrogen	Quarterly
Orthophosphorous	Quarterly
Total Organic Carbon	Quarterly
Turbidity	Weekly
Pesticides	Annually/Biannually/Event-based
Radionuclides	Every 7 years: Sampling conducted in 2016

Data obtained from all water quality monitoring programs conducted by South Gippsland Water is available on request by telephoning Customer Service on 1300 5682 0444 or emailing sgwater@sgwater.com.au

Aesthetics

South Gippsland Water strives to provide drinking water that is consistently clear and pleasant to drink for all customers. Actions taken to manage aesthetic characteristics include:

- Optimisation of treatment processes to minimise levels of iron, manganese and organic compounds in supplied water
- pH adjustment of treated water
- Regular flushing and air-scouring to remove sediment accumulation in mains
- Frequent sampling and analysis for aesthetic parameters
- Monitoring and management of algal blooms in raw water reservoirs
- Monitoring when required for compounds that may impart unpleasant tastes and odours to drinking water

Results of monitoring for aesthetic characteristics are provided in Tables 25 to 30 on the following pages.

Photos: Senior Operator inspects water for clarity and flavour during air-scour cleaning of the Korumburra system

Colour

Water may appear coloured due to the presence of natural organic substances including humic and fulvic acids, and dissolved inorganics, such as iron and manganese. Based on aesthetic considerations, the ADWG specifies that colour should not exceed 15 Hazen Units (HU). In terms of average results; water supplied by South Gippsland Water complied with the guideline value for colour; refer to Table 25. Two separate instances of 16 HU results being recorded—one for the Korumburra system in September 2017 and the other for the Poowong system in February 2018—may be attributed to seasonal increases in manganese and related water treatment challenges. Refer to part 3—Emergency, incident and event management—for further information.

Table 25: Colour Results for 2017-18

Water treatment plant / system	Localities supplied	Sampling frequency (samples per time period)	Total number of samples	Average result (HU)	Maximum result (HU)	Number of samples where guideline was not met
Devon North	Alberton Yarram	one/month	12	2	4	0
Dumbalk	Dumbalk	one/month	12	2	2	0
Fish Creek	Fish Creek	one/month	12	3	6	0
Foster	Foster	one/month	12	2	4	0
Korumburra	Korumburra	one/month	12	4	16	1
Lance Creek	Cape Paterson Inverloch Lance Creek Wonthaggi	one/month	12	4	6	0
Leongatha	Leongatha Koonwarra	one/month	12	2	4	0
Meeniyan	Meeniyan	one/month	12	2	2	0
Poowong	Loch Nyora Poowong	one/month	12	7	16	1
Toora	Port Franklin Port Welshpool Toora	one/month	12	2	4	0

Iron

Iron is present in source waters due to dissolution of soil and rock. High iron concentrations in drinking water can occur through rusting of iron pipes and fittings. Based on aesthetic considerations, the ADWG specify that the concentration of iron should not exceed 0.3 mg/L. Water supplied by South Gippsland Water complied with the guideline value for iron; refer to Table 26.

Table 26: Iron results for 2017-18

Water sampling locality	Frequency of sampling (samples per time period)	Total number of samples	Minimum result mg/L	Maximum result mg/L	Number of samples where guideline was not met
Alberton	one/quarter	4	0.01	0.05	0
Cape Paterson	one/quarter	4	<0.01	0.02	0
Dumbalk	one/quarter	4	<0.01	0.01	0
Fish Creek	one/quarter	4	0.01	0.03	0
Foster	one/quarter	4	<0.01	0.04	0
Inverloch	one/quarter	4	<0.01	<0.01	0
Koonwarra	one/quarter	4	<0.01	0.02	0
Korumburra	one/quarter	4	<0.01	0.04	0
Lance Creek	one/quarter	4	<0.01	<0.01	0
Leongatha	one/quarter	4	<0.01	<0.01	0
Loch	one/quarter	4	<0.01	<0.01	0
Meeniyan	one/quarter	4	<0.01	<0.01	0
Nyora	one/quarter	4	<0.01	<0.01	0
Poowong	one/quarter	4	<0.01	0.03	0
Port Franklin	one/quarter	4	<0.01	0.02	0
Port Welshpool	one/quarter	4	<0.01	<0.01	0
Toora	one/quarter	4	<0.01	<0.01	0
Wonthaggi	one/quarter	4	<0.01	0.02	0
Yarram	one/quarter	4	<0.01	0.03	0

Alkalinity

Alkalinity is defined as the quantitative capacity of an aqueous solution to neutralise an acid. In simpler terms, it is a measure of how easily the pH of water can be changed. Alkalinity is mainly determined by the levels of carbonate, bicarbonate and hydroxyl anions (negatively-charged ions) present, and it has a strong influence on water stability. The term water stability refers to the tendency of water to be either corrosive, stable, or scale-forming with regard to the surfaces it comes in to contact with.

Water stability is complex and influenced by a number of factors, but soft water of low pH and low alkalinity will generally tend to corrode surfaces. Highly corrosive (aggressive) water is not desirable in that it can lead to the leaching of copper and other metals from pipes and plumbing fittings.

In contrast, hard water of high pH and high alkalinity will generally tend to deposit calcium carbonate (form scale) on pipes, plumbing fittings and hot water systems. While encrustation of pipes and fittings is not desirable, a thin layer of calcium carbonate on surfaces can be beneficial in that it provides protection against corrosion.

There are no specific standards for alkalinity in drinking water but as this property provides resistance against changes in pH that can lead to either corrosion or excessive encrustation, a reasonable level should be maintained in drinking water supplies. What is reasonable for a particular type of water will depend mainly upon its other characteristics of pH and hardness, but a value in the range of 50 to 200 mg/L $CaCO_3$ is generally considered to be optimal.

Results of alkalinity monitoring are provided in Table 27.

**Explanatory note on units used to express both alkalinity and hardness properties*

Calcium carbonate equivalent (mg/L $CaCO_3$) is the value obtained when taking into account the different characteristics in relation to reactivity (ability to combine) of various salts, such that the overall effect is the same as that produced by the expressed concentration of calcium carbonate. This allows for a convenient method of comparison in chemistry. As both alkalinity and hardness are aggregate properties created by the combined effects of different salts, the calcium carbonate equivalent unit is used in each case. This does not mean, however, that alkalinity and hardness are the same property. Alkalinity is chemically defined as the sum of all titratable bases in a solution, whereas hardness is the sum of all polyvalent cation (ions having more than one positive charge) concentrations in a solution. With respect to a solution made purely from the compound calcium carbonate, therefore, the property of alkalinity is due to the component carbonate anion (a base), while the property of hardness is due to the component calcium cation

Table 27: Alkalinity Results for 2017-18

Water treatment plant / system	Localities supplied	Sampling frequency (samples per time period)	Total number of samples	Minimum result (mg/L as $CaCO_3$)*	Maximum result (mg/L as CaCO3)*	Number of samples where guideline was not met
Devon North	Alberton Yarram	one/quarter	4	30	39	0
Dumbalk	Dumbalk	one/quarter	4	50	120	0
Fish Creek	Fish Creek	one/quarter	4	36	45	0
Foster	Foster	one/quarter	4	40	48	0
Korumburra	Korumburra	one/quarter	4	54	76	0
Lance Creek	Cape Paterson Inverloch Lance Creek Wonthaggi	one/quarter	4	66	84	0
Leongatha	Leongatha Koonwarra	one/quarter	4	41	51	0
Meeniyan	Meeniyan	one/quarter	4	37	75	0
Poowong	Loch Nyora Poowong	one/quarter	4	71	130	0
Toora	Port Franklin Post Welshpool Toora	one/quarter	4	41	62	0

**refer to explanatory note in text above*

Hardness

Hardness is a measure of the concentration of calcium and magnesium ions in water. To minimise undesirable build-up of scale in hot water systems, the ADWG specifies that total hardness (as calcium carbonate) in drinking water should not exceed 200 mg/L. Water supplied by South Gippsland Water complied with the guideline value for hardness; refer to Table 28.

Table 28: Total Hardness in calcium carbonate ($CaCO_3$) equivalents* for 2017-18

Water treatment plant / system	Localities supplied	Sampling frequency (samples per time period)	Total number of samples	Average result (mg/L as $CaCO_3$)*	Maximum result (mg/L as $CaCO_3$)*	Number of samples where guideline was not met
Devon North	Alberton Yarram	one/quarter	4	28	31	0
Dumbalk	Dumbalk	one/quarter	4	112	150	0
Fish Creek	Fish Creek	one/quarter	4	40	45	0
Foster	Foster	one/quarter	4	32	35	0
Korumburra	Korumburra	one/quarter	4	51	60	0
Lance Creek	Cape Paterson Inverloch Lance Creek Wonthaggi	one/quarter	4	84	90	0
Leongatha	Leongatha Koonwarra	one/quarter	4	73	87	0
Meeniyan	Meeniyan	one/quarter	4	84	98	0
Poowong	Loch Nyora Poowong	one/quarter	4	65	68	0
Toora	Port Franklin Port Welshpool Toora	one/quarter	4	38	44	0

**refer to explanatory note on units in alkalinity section on previous pages.*

pH

The property of pH relates to the hydrogen ion concentration of water. pH is measured on a logarithmic scale from 0 to 14. A pH of 7 is neutral, a pH greater than 7 is alkaline, and a pH less than 7 is acidic.

To reduce corrosion and encrustation in pipes and fittings, the ADWG specifies that the pH of drinking water should be between 6.5 and 8.5. The ADWG also states that new concrete tanks and cement-mortar lined pipes can significantly increase pH and a value up to 9.2 may be tolerated, provided monitoring indicates no deterioration in microbiological quality.

The reference to microbiological quality is made in the ADWG since the disinfecting power of chlorine in chlorinated systems is greatest at lower pH and gradually declines as pH increases. Significant impairment of chlorine disinfection occurs above pH 8.0. The results for pH in chlorinated systems are provided in Table 29. Based on mean pH values, all localities complied with the aesthetic guideline.

The chemistry of disinfection (and the effects of pH) where chloramine is used instead of chlorine is different. A higher pH is actually beneficial in chloraminated systems as this slows the natural decay of monochloramine and prevents the formation of dichloramine and trichloramine, which can cause unpleasant tastes and odours. A consequence of maintaining a higher pH is that occasional exceedance of the ADWG guideline can occur. As shown in Table 30 there were five results which did not meet the aesthetic guideline for Alberton in 2017-18. Such instances are addressed with water main flushing to remove aged water from the system. Based on mean pH results as provided in Table 30, all chloraminated localities complied with the aesthetic guideline of 6.5 to 9.2.

Table 29: pH results for chlorinated system in 2017-18

Water sampling locality	Minimum frequency of sampling (samples per time period)	Total number of samples	Minimum result pH	Mean result pH	Maximum result pH	Number of samples not compliant with aesthetic guideline
Dumbalk	one/week	52	8.0	8.2	8.4	0
Fish Creek	one/week	52	7.8	8.1	8.7	0
Foster	one/week	52	7.4	7.7	8.1	0
Koonwarra	one/week	52	7.6	7.8	8.0	0
Korumburra	one/week	52	7.2	7.6	8.1	0
Leongatha	two/week	104	7.4	7.6	8.0	0
Meeniyan	one/week	52	7.4	7.6	8.0	0
Port Franklin	one/week	52	7.5	8.0	8.5	0
Port Welshpool	one/week	52	7.1	7.5	7.9	0
Toora	one/week	52	7.1	7.5	7.9	0

Table 30: pH results for chloraminated localities in 2017-18

Water sampling locality	Minimum frequency of sampling (samples per time period)*	Total number of samples	Minimum result pH	Mean result pH	Maximum result pH	Number of samples not compliant with aesthetic guideline
Alberton	one to two per week	68	8.1	8.8	9.5	5
Cape Paterson	two per week	104	7.5	8.2	8.8	0
Inverloch	two to three per week	121	7.9	8.3	8.9	0
Lance Creek	one per week	52	6.6	8.3	9.0	0
Loch	one to two per week	68	8.0	8.3	8.6	0
Nyora	one to two per week	69	7.3	8.2	8.6	0
Poowong	one per week	52	7.3	8.2	8.8	0
Wonthaggi	two per week	104	7.5	8.3	8.9	0
Yarram	one to two per week	67	7.7	8.3	9.2	0

*Monitoring frequency changes seasonally for some localities

Analysis of results

Comparison of results for Schedule 2 parameters over three years

A comparison of compliance with water quality standards specified in Schedule 2 of the Safe Drinking Water Regulations 2015 in the 2017-18 period with that of the previous two financial years is presented in Figure 2. Consistent compliance is illustrated and in measure with the water quality standards listed in Schedule 2 of the Safe Drinking Water Regulations 2015; these being *Escherichia coli*, Trihalomethanes and Turbidity.

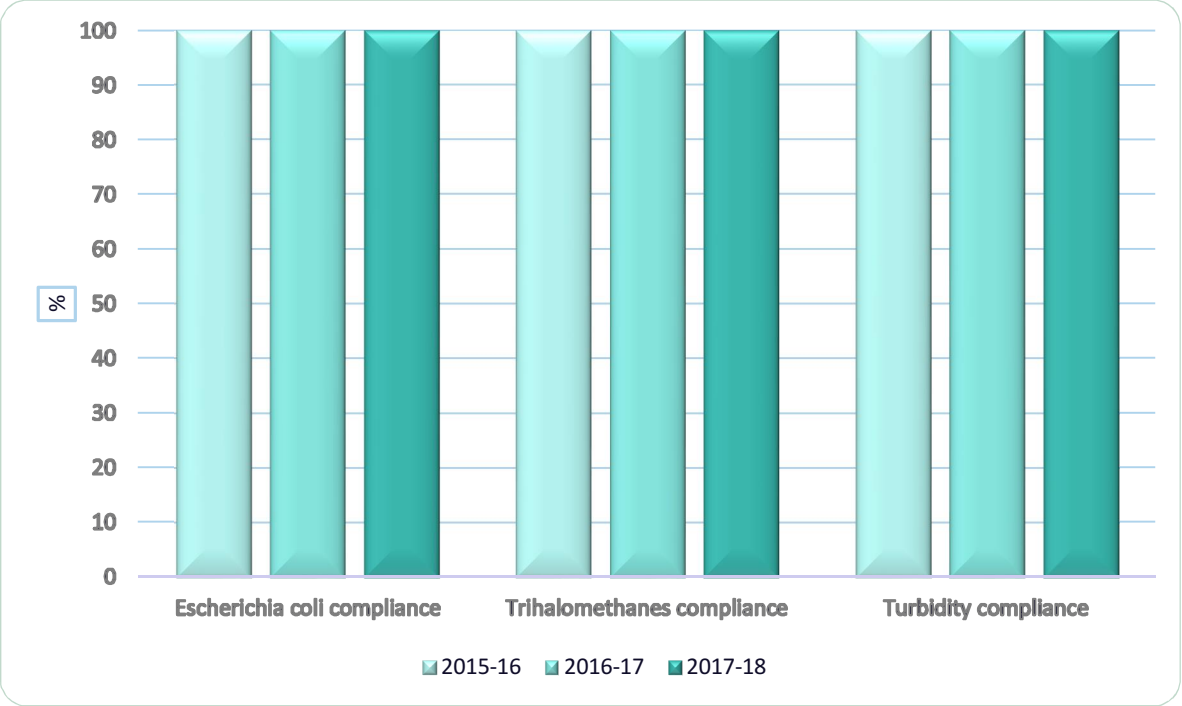

Figure 2: Percentage of localities where the drinking water complied with the water quality standards for Escherichia coli, trihalomethanes and turbidity

Comparison of results of other water quality parameters over three years

A comparison of results for the 2017-18 reporting period and the previous two financial years for water quality parameters other than those listed in Schedule 2 of the Safe Drinking Water Regulations 2015 is presented in Table 31. The comparison is based on percentage compliance with the guideline values of the *Australian Drinking Water Guidelines 2011.*

Table 31: Percentage of samples compliant with health-related guidelines from the ADWG

Water Quality Parameter	Percentage of samples compliant with health-related guidelines from the *Australian Drinking Water Guidelines 2011*		
	2015-16	2016-17	2017-18
Arsenic	100 %	100 %	100 %
Aluminum	100 %	100 %	100 %
Chlorine	100 %	100 %	100 %
Copper	100 %	100 %	100 %
Cyanogen chloride	100 %	100 %	100 %
Iron	100 %	100 %	100 %
Lead	100 %	100 %	100 %
Manganese	100 %	100 %	100 %
Nitrate	100 %	100 %	100 %
Nitrite	100 %	100 %	100 %
NDMA	100 %	100 %	100 %
Antimony	100 %	100 %	100 %
Barium	100 %	100 %	100 %
Beryllium	100 %	100 %	100 %
Boron	100 %	100 %	100 %
Cadmium	100 %	100 %	100 %
Chloroacetic acid	100 %	100 %	100 %
Chromium	100 %	100 %	100 %
Cyanide	100 %	100 %	100 %
Dichloroacetic acid	100 %	100 %	100 %
Mercury	100 %	100 %	100 %
Molybdenum	100 %	100 %	100 %
Nickel	100 %	100 %	100 %
Selenium	100 %	100 %	100 %
Silver	100 %	100 %	100 %
Sulphate	100 %	100 %	100 %
Trichloroacetic acid	100 %	100 %	100 %
Zinc	100 %	100 %	100 %
1,2-dichloroethane	100 %	100 %	100 %
2,4,5-T	100 %	100 %	100 %
2,4,6-trichlorphenol	100 %	100 %	100 %
2,4-D	100 %	100 %	100 %
Atrazine	100 %	100 %	100 %
Benzene	100 %	100 %	100 %
Benzo(a)pyrene	100 %	100 %	100 %
Carbon tetrachloride	100 %	100 %	100 %
Clopyralid	100 %	100 %	100 %
Dicamba	100 %	100 %	100 %
Glyphosate	100 %	100 %	100 %
MCPA	100 %	100 %	100 %
Metsulfuron methyl	100 %	100 %	100 %
Pentachlorphenol	100 %	100 %	100 %
Picloram	100 %	100 %	100 %
Simazine	100 %	100 %	100 %
Tetrachloroethene	100 %	100 %	100 %
Triclopyr	100 %	100 %	100 %
Gross Alpha *	100 %	Not monitored	Not monitored
Gross Beta *	100 %	Not monitored	Not monitored

*Radiological parameters monitored once every seven years as per risk-based monitoring program. No monitoring occurred in the 2017-18 reporting period.

5. Complaints relating to water quality for 2017-18

South Gippsland Water records and attends to all complaints relating to drinking water quality to ensure the highest level of customer satisfaction. Table 32 below illustrates the four complaint types and the number of complaints received for each type over the 2017-18 year. Determination of the number of complaints per 100 customers supplied is based on the number of complaints compared with the total number of connected properties. A comparison of the number complaints with that of the previous two reporting periods is provided in Table 33. Complaints for 2017-18 are broken down into complaint type per locality and supply system in Table 34.

Table 32: Customer complaints for 2017-18

Type of complaint	Number of complaints	Number of complaints per 100 customers (connected properties) supplied
Dirty/discoloured water	**142**	**0.67**
Taste and/or odour	**62**	**0.29**
Air in water	**13**	**0.06**
Alleged/suspected illness	**6**	**0.03**
Other	**4**	**0.02**
Total complaints	**227**	**1.07**

Table 33: Complaints comparison of 2017-18 with the previous two reporting periods

Type of complaint	Number of Complaints			Comparison with previous reporting periods	Comments
	2015-16 reporting period	2016-17 reporting period	**2017-18 reporting period**		
Dirty/discoloured Water	99	96	**142**	Moderately significant increase	Refer to Part 3 of this report for details
Taste or odour	22	28	**62**	Moderately significant increase	Refer to Part 3 of this report for details
Air in Water	5	5	**13**	Slight increase	Complaints due to air-scour water mains cleaning
Alleged illness	1	0	**6**	Slight increase	Includes general queries re water quality and health concerns. No evidence provided or found that supplied drinking water was cause
Other	0	7	**4**	Slight decrease	Complaints include corrosion of internal household plumbing

Table 34: Customer complaints according to complaint type for 2017-18

Water treatment plant / supply system	Water sampling locality	Complaint category					Total complaints per locality	Total complaints per supply system
		Dirty / discoloured water	Taste and/or odour	Air in water	Alleged illness	Other		
Devon North	Alberton	1	0	5	0	0	6	7
	Yarram	1	0	0	0	0	1	
Dumbalk	Dumbalk	0	0	0	0	0	0	0
Fish Creek	Fish Creek	0	0	2	0	0	2	2
Foster	Foster	20	1	0	1	2	24	24
Korumburra	Korumburra	81	6	0	0	0	87	87
Lance Creek	Cape Paterson	0	5	0	0	0	5	49
	Inverloch	2	19	0	2	0	23	
	Lance Creek	0	0	0	0	0	0	
	Wonthaggi	3	17	1	0	0	21	
Leongatha	Koonwarra	0	0	5	0	0	5	21
	Leongatha	8	6	0	0	2	16	
Meeniyan	Meeniyan	1	3	0	0	0	4	4
Poowong	Loch	2	0	0	0	0	2	9
	Nyora	2	2	0	3	0	7	
	Poowong	0	0	0	0	0	0	
Toora	Port Franklin	2	0	0	0	0	2	24
	Port Welshpool	13	0	0	0	0	13	
	Toora	6	3	0	0	0	9	
Total complaints per category		142	62	13	6	4	227	227

Management of complaints

Dirty/discoloured water

Dirty/discoloured water complaints relate to problems with the clarity of water. Tap water that contains sediments or particles and is coloured yellow, brown or blackish hues is often reported as "dirty water" by the customer. The particles and colour are produced by manganese and other mineral oxides rather than what might commonly be referred to as "dirt" (i.e. soil, mud, sewerage), but the overall effect is that water appears dirty and is unacceptable to the customer. Complaints in this category include reports of stained laundry items which may result from oxidation of minerals in contact with laundry detergents in a washing machine.

Dirty/discoloured water complaints primarily result from:

- High manganese levels in source waters. The soil in the South Gippsland region is naturally high in manganese, and run-off into reservoirs and rivers is unavoidable. Not all manganese can be removed during the water treatment process so accumulation in the distribution system can occur;
- Accumulation of sediment within water mains over time; and/or
- Unintended scouring of water mains following high flows or recharging of the system.

Corrective actions to address dirty/discoloured water include:

- Use of aeration and potassium permanganate dosing systems at water treatment plants to oxidise manganese and maximise physical removal through filtration;
- Implementation of scheduled air-scouring and flushing programs within all water sampling localities to remove manganese and other accumulated sediments;
- Additional flushing when required in response to individual complaints, and increased frequency of flushing regimes for 'problem-spot' areas.
- Provision of a commercial cleaning product which removes discolouration marks from laundry items in response to individual customer complaints.

There were 142 complaints received in relation to dirty/discoloured water in the 2017-18 financial year. Korumburra recorded the most significant increase in complaints; refer to Part 3—Emergency, Incident and Event Management—for further information.

Taste and odour

What is considered acceptable in terms of the flavour and smell of water has some level of individual subjectivity. For instance, some customers object to the taste and odour of chlorine in water, while others receiving water with the same chlorine concentration do not. This may be because the objecting customers sense the chlorine taste and odour more acutely than others, or because they perceive chlorine as something they don't want to drink. While tastes and odours in drinking water do not generally denote that the water is unsafe to drink, South Gippsland Water always endeavors to minimise unpleasant flavours. This is important not only for the customer's satisfaction and enjoyment but also so that the customer will choose supplied tap water over other potentially less-

safe options (e.g. from a poorly-managed tank water system) or options having adverse environmental impacts (i.e., bought bottled water).

Taste and odour complaints result primarily from:

- Algae-related compounds in the water;
- Manganese and/or iron sediment in the water;
- Changes in pH, dissolved oxygen and other factors in relation to ageing of water within a water main due to low flows.
- Chlorine in water.

Corrective actions to prevent or address taste and odour issues include:

- Routine monitoring of supplied water for taste and odour, manganese, iron, turbidity, pH and chlorine;
- Specific analysis for taste and odour related parameters (as above) when required in response to individual complaints;
- Use of powdered activated carbon (PAC) at treatment plants to remove algae-related and other taste and odour compounds from water;
- Use of aeration and potassium permanganate dosing systems at water treatment plants to oxidise manganese and maximise removal from source waters.
- Water main flushing and air-scouring programs

There were 62 complaints relating to taste and odour issues received from customers in 2017-18. The majority of these were for the Lance Creek water supply system; refer to Part 3 for more information.

Air in water

Air in water complaints are generally received following the implementation of air-scour cleaning programs. While notification is given to residents prior to air-scouring, customers may become concerned at the 'milky' appearance of water. Customers are advised that the white colour of the water is due to the presence of tiny air-bubbles and that flushing through a tap for a few minutes should correct the problem. If the problem cannot be resolved by the customer, mains flushing is carried out.

There were 13 complaints involving air in water from South Gippsland Water customers in the 2017-18 reporting period.

Alleged illness

Customers may make an alleged illness complaint if they suspect that supplied tap water is the cause of illness or other conditions, such as skin or eye irritation. Generally a customer will call to seek reassurance with regards to water quality rather than alleging that the water is the cause of their health problem. Customers with health concerns are encouraged to consult a medical professional for diagnosis and treatment. Depending on the nature of the complaint, additional monitoring to verify

quality of drinking water supplied to the customer's residence and through the domestic plumbing system may be carried out. Details of the complaint and results of both monitoring and diagnostic testing (if provided) are recorded via an Illness Complaint Record Form. In the unlikely event of supplied drinking water being found to be a causative factor of illness, the Department of Health and Human Services would be immediately notified. Further actions, which might include issuing of a boil water advisory, would be implemented as a matter of the highest priority.

There were six calls received in relation to health concerns for 2017-18. For all complaints or queries related to illness, investigation found no evidence that the drinking water supply was the cause of the issue.

Other complaints

Other complaints generally relate to concerns that are beyond the control and responsibility of South Gippsland Water, such as problems with aquarium fish or garden plants, and issues with domestic plumbing or appliances. In response to such complaints, results of monitoring programs that may be relevant are reviewed, and additional investigation and monitoring is carried out where appropriate. Customers are informed of the likelihood of supplied water being the cause of the problem and given advice on where to seek additional assistance if required.

There were a total of four calls in this category for 2017-18.

6. Findings of the most recent risk management plan audit

Under section 7 of the Safe Drinking Water Act 2003 (the Act), a water supplier is required to prepare, implement and review a risk management plan for the supply of drinking water to the public. The most recent risk management plan audit carried out by a Department of Health and Human Services approved auditor occurred in April 2018. South Gippsland Water was found to be compliant in all auditable elements for the period 8th June 2016 to 27th April 2018. The Risk Management Plan Audit Certificate is provided in Appendix 2 of this report.

While no non-compliances were recorded, the auditor made a number of observations and identified some opportunities for improvement as noted below. Specific findings, including opportunities for improvement, were also reported by the auditor; these can be found in Appendix 3. South Gippsland Water has considered and prioritised all opportunities for improvement for actioning or further review as deemed appropriate.

Items noted by auditor in audit report

1. Overall South Gippsland Water Corporation (SGWC) met its regulatory obligations over the audited period 08th June 2016 to 27th April 2018.

2. All risk management activity elements are present within the revised WSPs (March 2018) is in accordance with relevant sections of the *Safe Drinking Water Act 2003*.

3. Of the six auditable elements as described in Table 1 (*of audit report*), only two identified as compliant with opportunity for improvement against the requirements of the Water Safety Plan (WSP).

4. Even though SGWC met all the regulatory requirements, there appears to be an increasing trend of dissatisfaction in the aesthetic water quality supplied to customers in some townships. Proactive strategies, action plans, KPIs and investments are needed manage these issues to improve customer experience and built trust.

5. During the audits it was evident the critical asset management needs some focus to be able to maintain water safety moving forward given the budgetary limitations, e.g. chemical dosing pumps, damaged floating roof covers, backflow prevention inspections and rectification programs, etc.

6. Lance Creek water systems are modified to receive VDP desalinated water (forward flow), Melbourne Water's Cardinia storage water (reverse flow) and Lance Creek treated water mixed at varying quantities and times to supply Northern townships. The impacts of this change and risks associated with the supply needs to be understood and managed to minimize customer complaints.

7. The practice of validation and confirmation of operational field_data with independent test results of key water quality parameters have improved the way water safety is being managed.

8. SGWC have managed to retain experienced and qualified staff to maintain all water systems. Training could be improved and formalized to keep up with new knowledge and technology.

9. Major issues for SGWC is the changing source water quality from climate change, development activities impacts to their source water catchments. More work on source water characteristics are recommended to improve the water treatment processes and the feed water quality into the water distribution network.

10. Over the long-term, reduction in dissolved organic carbon by retrofitting existing water treatment processes to adequately address the water safety and aesthetic parameters needs to be considered as a long-term strategy. Lifecycle costs needs to be investigated to balance improvement costs against the customer value, organization's reputational standing in the community.

7. Regulated water

Regulation 16 of the Safe Drinking Water Regulations 2015 requires details of regulated water supplied be included in this annual report. Regulated water is defined as "water that is not intended for drinking but could reasonably be mistaken as drinking water". South Gippsland Water did not supply any regulated water in the 2017-18 period.

Appendices

Appendix 1: South Gippsland Water's Drinking Water Quality Policy

Drinking Water Quality Policy

South Gippsland Water

"Committed to high-quality drinking water"

South Gippsland Water is committed to the management of its water supply systems to ensure the provision of safe, high-quality drinking water that consistently meets customer expectations, the National Health and Medical Research Council's Australian Drinking Water Guidelines, and relevant legislation and regulatory requirements. In order to achieve this objective, in partnership with stakeholders and relevant agencies, the Corporation will:

- Implement and maintain a Drinking Water Quality Management System to identify and minimise risks to drinking water quality at all points from catchment to consumer.
- Develop and implement an appropriate drinking water quality monitoring program and reporting system to provide relevant and timely information, and ensure confidence in the water supply and its management.
- Implement appropriate contingency and incident response systems to effectively manage incidents that may adversely affect drinking water quality.
- Review and assess the performance of the Drinking Water Quality Management System with respect to this Policy to ensure continual improvement and best practice management.
- Integrate into the Corporation's planning, the needs and expectations of its consumers, stakeholders, regulators and employees to ensure both effective and economical solutions for managing drinking water supplies.
- Ensure compliance with all Acts, regulations, guidelines and standards relevant to drinking water quality.

This Policy requires all managers and employees at South Gippsland Water involved in the supply of drinking water to be responsible for understanding, implementing, maintaining and continually improving the Drinking Water Quality Management System.

This Drinking Water Quality Policy is proudly displayed at South Gippsland Water facilities and is communicated to all persons working for or on the Corporations behalf during induction or contract proceedings. The Policy is available to the public upon request or via the South Gippsland Water website. Contact details are:–

South Gippsland Water
14-18 Pioneer Street
PO Box 102
Foster, Victoria 3960
(03) 5682 0444

or: www.sgwater.com.au

Appendix 2: Drinking water risk management plan audit certificate

Schedule 1

Safe Drinking Water Regulations 2015 – Regulation 10

RISK MANAGEMENT PLAN AUDIT CERTIFICATE

Certificate Number: 156

Audit period: 08th June 2016 to 27th April 2018

To: Mr Philippe du Plessis
Managing Director
South Gippsland Water Corporation
PO Box 102
Foster, Vic 3960

Australian Business Number (ABN): 40 349 066 713

I, Dr.Pararajasegram (Dharma) Dharmabalan, after conducting a risk management plan audit of the water supplied by South Gippsland Water Corporation, am of the opinion that—

South Gippsland Water Corporation has complied with the obligations imposed by section 7(1) of the ***Safe Drinking Water Act* 2003** during the audit period.

Signature of approved auditor: _____

Dr.P. (Dharma) Dharmabalan

Date: 27th April 2018

Exemplar Global Certified Auditor
Drinking Water QMS Scheme
Certificate Number 14555

Appendix 3: Risk Management Plan Audit report – specific findings

Number	Australian Drinking Water Guidelines	Audit – Evidence	Compliance Grades & Actions
E1	Commitment to Drinking Water Quality management		
C1.1	Drinking Water Quality Policy		
A 1.1.1	Formulate a drinking water quality policy, endorsed by senior executives, to be implemented throughout the organization.	Policy endorsed by management and board sighted.	Compliant
A1.1.2	Ensure that the policy is visible and is communicated, understood and implemented by employees.	Staff spoken in the office and filed are aware of the policy.	Compliant
C1.2	Regulatory and formal requirements		
A1.2.1	Identify and document all relevant regulatory and formal requirements.	Water Safety Plan (WSP) IOW/WQ -001 March 2018 considered all formal requirements considering all 12 elements of ADWG	Compliant
A1.2.2	Ensure responsibilities are understood and communicated to employees.	Staff spoken in the office and filed are able to describe the relevant requirements for their jobs to meet the WSP	Compliant
A1.2.3	Review requirements periodically to reflect any changes.	Aware of new regulatory or scientific developments and engaged via collaboration.	Compliant
C1.2.3	Engaging stakeholders		
A1.3.1	Identify all stakeholders who could affect, or be affected by, decisions or activities of the drinking water supplier.	Updated and available for use. All staff has access through the intranet.	Compliant
A1.3.2	Develop appropriate mechanisms and documentation for stakeholder commitment and involvement.	Periodically community consultations are undertaken to plan needs.	Compliant
A1.3.3	Regularly update the list of relevant agencies.	List available but needs update	Compliant with OFI
E2	Assessment of the Drinking Water Supply System		
C 2.1	Water Supply System Analysis		
A2.1.1	Assemble a team with appropriate knowledge and expertise.	The WQ management structure and operational staff work collaboratively and knowledgeable.	Compliant
A2.1.2	Construct a flow diagram of the water supply system from catchment to consumer.	Process diagram with CCPs posted at each WTP facility.	Compliant
A2.1.3	Assemble pertinent information and document key characteristics of the water supply system to be considered.	No water quality compliance breaches are noticed for the audit period. However WQ complaints are in the increase due to discoloration and Taste & odour.	Compliant with OFI
A2.1.4	Periodically review the water supply system.	Consider event-based (system changes) sampling to understand the systems behavior.	Compliant with OFI
C2.2	Assessment of water quality data		
A2.2.1	Assemble historical data from sources of water, treatment plants and finished water supplied to consumers (over time and following specific events).	The use of WIMS has enhanced and used by filed staff.	Compliant
A2.2.2	List and examine exceedances.	ALS (testing Laboratory) staff communicates timely on any exceedances to the Water Quality Coordinator.	Compliant
A2.2.3	Assess data using tools such as control charts and trend analysis to identify trends and potential problems.	Improvements noticed in the field operational data (CCP), SCADA and laboratory data for matching and timely alerts and actions.	Compliant
C2.3	Hazard identification and risk assessment		
A2.3.1	Define the approach and methodology to be used for hazard identification and risk assessment.	Drinking Water Source assessments and treatment requirements for HBTs were updated in 2018.	Compliant
A 2.3.2	Identify and document hazards, sources and hazardous events for each component of the water supply system.	Risk assessments have been undertaken and major risks in each system identified.	Compliant
A2.3.3	Estimate the level of risk for each identified hazard or hazardous event.	Improvement plans has prioritized the risks and appears to be managed effectively	Compliant
A2.3.4	Evaluate the major sources of uncertainty associated with each hazard and hazardous event and consider actions to reduce uncertainty.	Northern Towns Supply connection works nearing completion. Focus on issues such as DOC & THMs reduction.	Compliant with OFI
A.2.3.5	Determine significant risk and document priorities for risk management.	Introduction of VDPs desalinated, Melbourne Cardinia Storage and LC waters blending with associated risks, controls need to be established	Compliant with OFI
A2.3.6	Periodically review and update the hazard identification and risk assessment to incorporate any changes.	There is evidence to suggest reviews have been undertaken and updated regularly.	Compliant
E3	Preventive Measures for Drinking Water Quality Management		
C3.1	Preventive measures and multiple barriers		
A3.1.1	Identify existing preventive measures from catchment to consumer for each significant hazard or hazardous event and estimate the residual risk.	Source water quality is significantly impacted after rain events. Long term strategies need to be mapped out to reduce DOC in finished waters. Current short-term actions such as Copper Sulphate, PAC dosing and use of Sodium Hexametaphosphate (CALGON) many not meet future "Good Water" customer expectations consistently.	Compliant with OFI
A3.1.2	Evaluate alternative or additional preventive measures where improvement is required.	Input water quality into water distribution network including Fe, Mn , DBPs & DOC reduction and network understanding and management is critical moving forward to meet future customer expectations	Compliant with OFI
A3.1.3	Document the preventive measures and strategies into a plan addressing each significant risk.	CCPs compliance and escalation procedures are well understood and used by the operational staff.	Compliant
C3.2	Critical Control Points		
A3.2.1	Assess preventive measures from catchment to consumer to identify critical control points.	Formalize the internal audits for compliance with established procedures and documentations.	Compliant with OFI
A3.2.2	Establish mechanisms for operational control.	Matured mechanisms exist for operational controls.	Compliant

Number	Australian Drinking Water Guidelines	Audit – Evidence	Compliance Grades & Actions
A3.2.3	Document the critical control points, critical limits and target criteria.	Well developed and implemented, being part of the culture of the organization now.	Compliant
E4	Operational Procedures and Process Control		
C4.1	Operational Procedures		
A4.1.1	Identify procedures required for processes and activities from catchment to consumer.	Good understanding among those interviewed with operating procedures	Compliant
A4.1.2	Document all procedures and compile into an operation manual.	System integrity checks and control measures are to be reviewed and updated regularly to reflect changes.	Compliant with OFI
C4.2	Operational Monitoring		
A4.2.1	Develop monitoring protocols for operational performance of the water supply system, including the selection of operational parameters and criteria and routine analysis of results.	Well-developed software's in use to collate vital operational data and analytics to take corrective timely actions.	Compliant
A4.2.2	Document monitoring protocols into an operational monitoring plan.	Satisfactory	Compliant
C4.3	Corrective action		
A4.3.1	Establish and document procedures for corrective action to control excursions in operational parameters.	Operational staff understand the requirements of the CCPs.	Compliant .
A4.3.2	Establish rapid communication systems to deal unexpected events.	Catchment risks are high for many of the water systems and impacted by Climate change. EPA, CMA, other information from identified stakeholders requires coordination.	Compliant with OFI
C4.4	Equipment capability and maintenance.		
A4.4.1	Ensure that equipment performs adequately and provides sufficient flexibility and process control.	Calibration frequencies inspected are adequate and processed via the HASEN asset management system. Maintenance of critical equipment could be improved. e.g Chemical dosing pumps, injection points, rectifying leaking floating cover roof materials etc.	Compliant with OFI
A4.4.2	Establish a program for regular inspection and maintenance of all equipment, including monitoring equipment.	Asset Management team are responsible for these tasks and have system in place with limited budget to undertake remedial tasks.	Compliant with OFI
C4.5	Materials and Chemicals		
A4.5.1	Ensure that only approved materials and chemicals are used.	Chemicals are purchased via an established supply provider MAPS Sighted delivery protocols for quality and safety.	Compliant
A4.5.2	Establish documented procedures for evaluating chemicals, materials and suppliers.	Chemical Composition checks to be undertaken to avoid substandard products being delivered to sites.	Compliant
E5	Verification of drinking water		
C5.1	Drinking water quality monitoring		
A5.1.1	Determine the characteristics to be monitored in the distribution system and in water as supplied to consumer.	A well-established DHHS approved monitoring program is in place for compliance sampling. However further studies are required to bring the water quality complaints to acceptable levels.	Compliant with OFI
A5.1.2	Establish and document a sampling plan for each characteristic, including the location and frequency of sampling.	External contracted laboratory undertakes the analysis of samples independent of South Gippsland Water.	Compliant
A5.1.3	Ensure monitoring data is representative and reliable.	Random sampling as per regulation are in place. Event sampling could enhance to identify issues and close the gaps.	Compliant
C5.2	Consumer Satisfaction		
A5.2.1	Establish a consumer complaint and response program, including appropriate training of employees.	Evidence suggests adequate program is in place to deal with consumer complaints. However SGW should consider moving from reactive to proactive space to minimize consumer outrage.	Compliant with OFI
C5.3	Short term evaluation of results		
A5.3.1	Establish procedures for the daily review of drinking water quality monitoring data and consumer satisfaction.	External Laboratory (ALS) Staff also notify Water Quality Coordinator by phone.	Compliant
A5.3.2	Develop reporting mechanisms internally, and externally, where required.	Systems in place and records inspected are satisfactory	Compliant
C5.4	Corrective action		
A5.4.1	Establish and document procedures for corrective action in response to non-conformance or consumer feedback.	Sufficient documented response procedures detailed in Safety Plans. Operational responses are more advanced than that detailed.	Compliant
A5.4.2	Establish rapid communication systems to deal with unexpected events.	Protocols are adequate to deal with unexpected events. Requires updates to keep it current.	Compliant with OFI
E6	Management of Incidents and Emergencies		
C6.1	Communication		
A6.1.1	Define communication protocols with the involvement of relevant agencies and prepare a contact list of key people, agencies and businesses.	WSPs refers to specific references to emergencies and responses. Contact list needs to be updated.	Compliant with OFI
A6.1.2	Develop a public and media communications strategy.	Good communication protocols are in place and sighted during the audit	Compliant
C6.2	Incident and emergency response protocols		
A6.2.1	Define potential incidents and emergencies and document procedures and response plans with the involvement of relevant agencies.	Incidences audited during the rainfall events are managed adequately to maintain water safety.	Compliant
A6.2.2	Train employees and regularly test emergency response plans.	Training matrix are in place but requires formalizing by inclusion into position descriptions and follow ups to keep up to date.	Compliant with OFI
A6.2.3	Investigate any incidents or emergencies and revise protocols as necessary.	Review of past incidents suggest adequate protocols exists	Compliant
E7	Employees awareness and training		
C7.1	Employees awareness and involvement	Employees interviewed are aware of their role to protect water safety.	Compliant
A7.1.1	Develop mechanisms and communication procedures to increase employee awareness of and participation in drinking water quality management.	Training programs are attended by staff with respect to drinking water quality management but could be formalized in a structured way.	Compliant
C7.2	Employee training		
A7.2.1	Ensure that employees, including contractors, maintain the appropriate experience and qualifications.	SGW has managed to retain qualified and experienced staff within the water quality management group.	Compliant
A7.2.2	Identify training needs and ensure resources are available to support training programs.	Documented evidence sighted during audit but could be structured.	Compliant
A7.2.3	Document training and maintain records of all employees training.	Documented evidence sighted during audit	Compliant
E8	Community Involvement and Awareness		No legislative

Number	Australian Drinking Water Guidelines	Audit – Evidence	Compliance Grades & Actions
			requirement
C8.1	Community consultation		
A8.1.1	Assess requirements for effective community involvement.	Consumer Consultative Committees work closely with WQ management team	
A8.2.1	Develop a comprehensive strategy for community consultation.	Evidence exist to support community involvement	
C8.2	Communication		
A8.2.1	Develop an active two-way communication program to inform consumers and promote awareness of drinking water quality issues.	Adequate protocols in place	
E9	Research and Development		
C9.1	Investigative studies and research monitoring	Change in coagulation and flocculation chemical trails are being undertaken to improve filter performance.	Compliant
A9.1.1	Establish programs to increase understanding of the water supply system.	Water network modeling could provide adequate information to manage and minimize WQ related issues within the distribution network.	Compliant with OFI
A9.1.2	Use information to improve management of the water supply system.	Improve systems understanding to minimize WQ issues. DOC content, Chlorine residual, Water Quality Complaints. More work is required in this area to reduce the WQ complaints.	Compliant with OFI
C9.2	Validation process		
A9.2.1	Validate processes and procedures to ensure that they are effective at controlling hazards.	External activities from farming have significant impact to the source water quality to many supply systems for SGW. Catchment Knowledge and information feedback is critical.	Compliant with OFI
C9.3	Design and equipment		
A 9.3.1	Validate the selection and design of new equipment and infrastructure to ensure continuing reliability.	Understand the review is currently underway to introduce Melbourne's water source into LC water supply system.	Compliant with OFI
E10	Documentation and record keeping		
C10.1	Management of documentation and records	Good system available	Compliant
A10.1.1	Document information pertinent to all aspects of drinking water quality management.	Water Safety Plan cover this part adequately	Compliant
A10.1.2	Develop a document control system to ensure current versions are in use.	Quality System adequately covers this part	Compliant
A10.1.3	Establish a records management system and ensure that employees are trained to fill out records.	Well established and used.	Compliant
A10.1.4	Periodically review documentation and revise as necessary.	WSPs developed in 2009 and last reviewed in March 2018.	Compliant
C10.2	Reporting		
A10.2.1	Establish procedures for effective internal and external reporting.	Limited evidence with monthly reports to the Board.	Compliant
A10.2.2	Produce an annual report to be made available to consumers, regulatory authorities and stakeholders.	Done satisfactorily	Compliant
E11	Evaluation and Audit		
C11.1	Long term evaluation of results		
A11.1.1	Collect and evaluate long term data to assess performance and identify problems.	WIMS will help to meet this requirement	Compliant
A11.1.2	Document and report results.	Complies with reporting requirements	Compliant
C11.2	Audit drinking water quality management	Some evidence exists.	Compliant
A11.2.1	Establish processes for internal and external audits.	Could be improved	Compliant with OFI
A11.2.2	Document and communicate audit results.	Could be improved	Compliant with OFI
E12	Review and continual improvement		No legislative requirement
C12.1	Review by senior executive		
A12.1.1	Senior executive review of the effectiveness of the management system.	Board reporting evident	
A12.1.2	Evaluate the need for change.	Not assessed	
C12.2	Drinking water quality improvement management plan	Evident within the current approved short Water Plan.	
A12.2.1	Develop a drinking water quality management improvement plan.	WSPs cover this adequately	
A12.2.2	Ensure that the plan is communicated and implemented and that improvements are monitored for effectiveness.	Operational staff spoken is aware of the WSP.	

Glossary of acronyms and terms used in report

ADWG	*Australian Drinking Water Guidelines* 2011; published by the National Health and Medical Research Council
Coliforms	A general term for certain types of rod-shaped bacteria that share identifying characteristics.
Cyanobacteria	Photosynthetic aquatic bacteria commonly referred to as 'blue-green algae' (though not actually algae).
DWMS	Drinking Water Management System
'the Department'	Department of Health and Human Services (State Government of Victoria)
E. coli	*Escherichia coli*: thermotolerant bacteria used as an indicator of faecal contamination
HACCP	Hazard Analysis and Critical Control Point
<	'Less than' (mathematical term)
>	'Greater than' (mathematical term)
L	Litre: a unit of volume (equal to 1000 cubic centimetres)
mg/L	Milligrams per litre: a unit of concentration (one milligram is equal to 0.001 grams)
ML	Megalitres: a unit of volume (one megalitre is equal to one million litres)
NATA	National Association of Testing Authorities
ng/L	Nanograms per Litre: a unit of concentration (one ng is equal to 0.000000001 grams)
NHMRC	National Health and Medical Research Council
Orgs/100 mL	Organisms/per 100 millilitre of water: a unit of measurement used in microbiology
Pathogen	Disease-causing microorganism
PAC	Powdered activated carbon
PLC	Programmable logic controller: a digital computer used for automation of electromechanical processes
Quarter	Time period referring to one quarter of a year, *i.e.* three months.
RMP	Risk Management Plan
'the Act'	*Safe Drinking Water Act 2003*
'the Regulations'	Safe Drinking Water Regulations 2015
SGW	South Gippsland Water (South Gippsland Region Water Corporation, 'the Corporation')

Glossary of water treatment agents and processes

Aluminium chlorohydrate	Aluminium salt used as a coagulant in water treatment
Aluminum sulphate	Aluminium salt used as a coagulant in water treatment
Chloramine	A compound of chlorine and ammonia used for disinfection
Chlorine	An element used as a disinfectant in water treatment. May be applied in gaseous, elemental form, or via aqueous solution of sodium hypochlorite.
Coagulation	A chemical water treatment process that involves neutralisation of charge on particles (impurities) in water. This destabilisation of charge allows for particles to clump together rather than repel each other electrostatically.
Dewatering of waste water	Method of post water treatment water conservation. Removes excess water from sludge so it can be returned to a reservoir and reused.
Disinfection	Use of chemical, other agent (e.g. ultraviolet light) or process to kill or inactivate microorganisms which may be harmful to human health.
Dissolved air floatation (DAF) clarification	Water treatment process involving use of pressurised air for clarification. Microscopic air bubbles attach to floc and cause floc to float and make a sludge layer. This allows for separation of impurities (as floc) from water.
Filtration	Final water treatment process prior to disinfection; clarified water passes through large filters where impurities are entrapped.
Flocculation	A physical water treatment process that causes clumps formed through coagulation processes to come together into larger masses known as floc. Formation of floc allows for purification of water via sedimentation and filtration processes.
Fluoridation	Addition of fluoride to water for public dental health purposes.
Granular medium	Layers of sand, gravel and crushed anthracite that make up a water treatment plant filter.
Hydrochloric acid	An acid used to lower the pH of water which enables optimisation of coagulation processes
Manganese oxidation	Water treatment process important for minimising dirty/discoloured water complaints. Oxidation of dissolved manganese in raw (source) water causes it to precipitate out of solution as a solid. This is in turn allows for the solid oxidised manganese particles to be removed via coagulation, flocculation and filtration processes.
Manganese sequestration	Process that may be used to mitigate post treatment manganese oxidation and resulting discolouration of water. Manganese that has not been removed in treatment may oxidise on contact with chlorine disinfectants or air. Sequestration (or chelation) causes manganese to form soluble complexes that do not cause discolouration of water.
pH correction (pre/post treatment)	Raw water pH can vary due to environmental factors. Pre pH correction is needed to optimise treatment processes. Post pH treatment may be required to ensure pH is suitable for disinfection, and for distribution to customers in terms of aesthetics and water stability.
Polyacrylamide	Chemical polymer which may be used to facilitate flocculation or dewatering processes. Acts by binding particles/floc together.
Potassium permanganate	Compound used to oxidise manganese
Powdered activated carbon (PAC)	Primarily used to adsorb taste and odour compounds produced by algae from raw water
Sedimentation clarification	A physical water treatment process using gravity to remove suspended solids from water
Sodium hydroxide	Base used to raise the pH of water and optimise coagulation pH levels.
Ultraviolet disinfection	Use of ultraviolet light to kill/inactivate water-borne microorganisms that may be harmful to human health.