WATER SERVICES

ATTACHMENT A

DRINKING WATER QUALITY MANAGEMENT SYSTEM ANNUAL REPORT SUMMARY 2016-2017

ORDINARY MEETING

22 NOVEMBER 2017

Drinking Water Quality Management System

Annual Report Summary 2016-2017

MidCoast Water
Document # A622539

EXECUTIVE SUMMARY

This report describes the progress of MidCoast Water's Drinking Water Quality Management System implementation during 2016 - 2017 financial year reporting period. It measures performance of water supply systems against targets set in Australian Drinking Water Guidelines (ADWG).

Following a decision from Office of Local Government, MidCoast Water has been dissolved effective 1st July 2017. Water and sewerage functions have been integrated into MidCoast Council. This will be the final annual report from MidCoast Water. The report for 2017 – 2018 will be prepared by MidCoast Water Services, a division of MidCoast Council.

MidCoast Water is responsible for the operation of five drinking water supply systems; Manning, Bulahdelah, Stroud, Tea Gardens and Gloucester. Bulk water is purchased from Hunter Water Corporation for distribution to North Karuah.

Significant upgrades to water supply systems during 2016 - 2017 were concentrated in Manning, Gloucester and Tea Gardens water supplies. Routine maintenance and asset renewals continued across all schemes.

Extensive water quality monitoring is undertaken following requirements of ADWG and regulators. Results for microbiological water quality testing across all water supply schemes met Australian Drinking Water Guidelines for 100% of samples collected and tested. Results of physical parameters within guidelines (ADWG) improved from the previous year and chemical results remained steady.

Monitoring of customer complaints can provide useful information of potential water quality issues. All complaints and notifications are registered and investigated.

There was one low level water quality incident relating to dirty water at Forster (Manning supply) during the 2016 - 2017 reporting period.

Internal reviews of the quality system were undertaken during 2016 - 2017. A new version of the quality system was adopted and implemented. Significant progress was made on the continuous improvement of the quality system with corrective actions and improvement plans progressing.

An improved reservoir integrity program has resulted in enhanced maintenance schedules focussed on protection of water quality. Significant rectification works were completed on reservoirs during the reporting period.

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1. REPORT PURPOSE

The purpose of this report is to present progress on the implementation of MidCoast Water's Drinking Water Quality Management System (DWQMS) during 2016 – 2017 reporting period. This report is a summary of the full report which fulfils MidCoast Water's responsibilities stated in; Memorandum of Understanding between NSW Health and MidCoast Water, and NSW Guidelines for Drinking Water Management Systems, produced by NSW Health and Crown Lands & Water (previously DPI Water).

Water supply performance is measured against Australian Drinking Water Guidelines (ADWG).

Following a decision from Office of Local Government, MidCoast Water has been dissolved effective 1st July 2017. Water and sewerage functions have been integrated into MidCoast Council. This will be the final annual report from MidCoast Water. The report for 2017 – 2018 will be prepared by MidCoast Council Water Services.

2. WATER SUPPLY SYSTEM DESCRIPTION

MidCoast Water supplies drinking water to residents in MidCoast Council local government area. This is achieved through the operation of five drinking water supply systems; Manning, Bulahdelah, Stroud, Tea Gardens and Gloucester.

The largest of these supplies is Manning Water Supply Scheme. It serves a population of approximately 70 000 across the Manning and Great Lakes districts, which accounts for 90% of MidCoast Water's customers. Water is extracted from Manning River, stored at Bootawa Dam and treated at Bootawa Membrane Filtration Water Treatment Plant (WTP), constructed in 2010.

Bulahdelah Water Supply Scheme serves a population of approximately 1 500 in the town of Bulahdelah. Source water comes from Crawford River and is treated at a small conventional water treatment plant located at Bulahdelah.

Stroud Water Supply Scheme draws source water from Karuah River. The water is treated at a small conventional water treatment plant, including an off river storage. The scheme serves a population of approximately 1 000 in the villages of Stroud and Stroud Road.

The residents of Tea Gardens and Hawks Nest, approximately 3 800, are supplied with drinking water from Tea Gardens Membrane Filtration Water Treatment Plant, constructed in 2013. Source water for this scheme is groundwater from Viney Creek Aquifer north-west of Tea Gardens.

Gloucester Water Supply Scheme serves a population of approximately 3 500 residents of Gloucester and Barrington. Source water comes from Barrington River and water is treated at a conventional water treatment plant at Gloucester.

MidCoast Water purchases bulk water from Hunter Water for distribution to residents of North Karuah. Monitoring of water quality in the reticulation system of North Karuah is included in

MidCoast Water's drinking water quality monitoring. Water treatment and monitoring through the treatment process is the responsibility of Hunter Water.

These water supply systems vary in size and complexity. A general description of each system is presented in the table below.

Table 1: Description of MidCoast Water supply systems

Water supply system	Source water	Treatment process	Towns supplied	Population served
Manning	Manning River	Selective pumping, retention and sedimentation in Bootawa Dam, screening, water stabilisation, coagulation, microfiltration, ozonation, BAC filtration, chlorination, fluoridation	Taree, Forster, Tuncurry, Hallidays Point, Wingham, Pacific Palms, Old Bar, Harrington, Coopernook, Crowdy Head, Cundletown, Krambach, Nabiac, Lansdowne, Manning Point, Tinonee and Green Point	**70,000**
Tea Gardens	Viney Creek Aquifer	Aeration, water stabilisation, coagulation, microfiltration, pH correction, chlorination, fluoridation	Tea Gardens and Hawks Nest	**3,800**
Gloucester	Barrington River	Coagulation, sedimentation, sand filtration, pH correction, chlorination, fluoridation	Gloucester and Barrington	**3,500**
Bulahdelah	Crawford River	Coagulation, sedimentation, sand filtration, pH correction, chlorination, fluoridation	Bulahdelah	**1,500**
Stroud	Karuah River	Coagulation, flocculation, sedimentation, sand filtration, pH correction, chlorination, fluoridation	Stroud and Stroud Road	**1,000**
North Karuah	Bulk water supplied by Hunter Water – Tomago bore fields	Aeration, coagulation, filtration, pH correction, fluoridation, chlorination. Treated by Hunter Water at Lemon Tree Passage WTP.	North Karuah	**100**

3. UPGRADE AND SYSTEM IMPROVEMENTS

During 2016 - 2017, significant upgrades to water supply systems were concentrated in Manning, Gloucester and Tea Gardens water supply systems. Details are provided below.

The upgrade of chemical dosing systems continued at all water treatment plants. Routine maintenance and asset renewals continued across all schemes.

3.1 MANNING WATER SUPPLY

Construction of Nabiac Inland Dune Aquifer Water Supply Scheme is underway which will improve water security for the Manning system. The full scope of this project includes development of the bore field, bore huts, water treatment plant, storage reservoirs and connections into the existing Manning reticulation system. The system is scheduled to be commissioned and operating by November 2018.

Bootawa ozone generator has been redesigned with new pipes and diffusers installed. The new system will be operational early in 2017 – 2018.

3.2 GLOUCESTER WATER SUPPLY

To improve the operational performance of Gloucester Water Treatment Plant (WTP) a three staged upgrade is underway. It is based upon serviceability, condition and process criticality. Key deliverables include: chemical dosing systems upgrade, online water analysis, river pump station upgrade, plant automation, electrical upgrade and control building improvements. Examples of completed actions relating to process include; replacement of sodium hypochlorite dosing system, upgrade of fluoride system, replacement and relocation of final water analysers, some improvements to programmable logic controller (PLC) and supervisory control and data acquisition (SCADA). This project is ongoing.

Gloucester water supply reticulation system project is in the early stages. It aims to improve reliability and operational performance of Gloucester water supply network.

3.3 TEA GARDENS WATER SUPPLY

Aeration is part of the pre-treatment process at Tea Gardens WTP. Both aeration towers required significant work during 2016 – 2017 due to collapse of media within the towers, which also resulted in structural damage of the towers. The aeration system was redesigned. The first aeration tower was repaired with new media installed and began operation in June 2017. The second aeration tower will be repaired and have new media installed in the first half of 2017 - 2018.

4. WATER QUALITY

The Australian Drinking Water Guidelines have been developed by the National Health and Medical Research Council (NHMRC) and Natural Resource Management Ministerial Council (NRMMC) of the Australian Government. These guidelines have been updated several times, with the most recent update released in 2011. The ADWG are intended to provide a framework for good management of drinking water supplies that, if implemented, will assure good quality water. Exceedance of a guideline value is a trigger for further investigation.

All MidCoast Water schemes achieved 100% of microbiological results over the 12 month reporting period within Australian Drinking Water Guidelines. This is consistent with results over the past three years. Combined results of physical parameters were 99.9% within ADWG (compared to 98.7% during 2015 – 2016). Combined results of chemical parameters were 99.8% within ADWG (compared to 99.6% during 2015 – 2016). A summary of water quality parameters is provided below.

MICROBIOLOGICAL PARAMETERS

- *E. coli*

PHYSICAL PARAMETERS

- pH
- turbidity
- true colour
- hardness

CHEMICAL PARAMETERS

- iron
- manganese
- aluminium
- arsenic
- fluoride
- other metals

Figure 1: Collecting water sample at reticulation site

Trends for water quality results over the past five years are shown in the figure below.

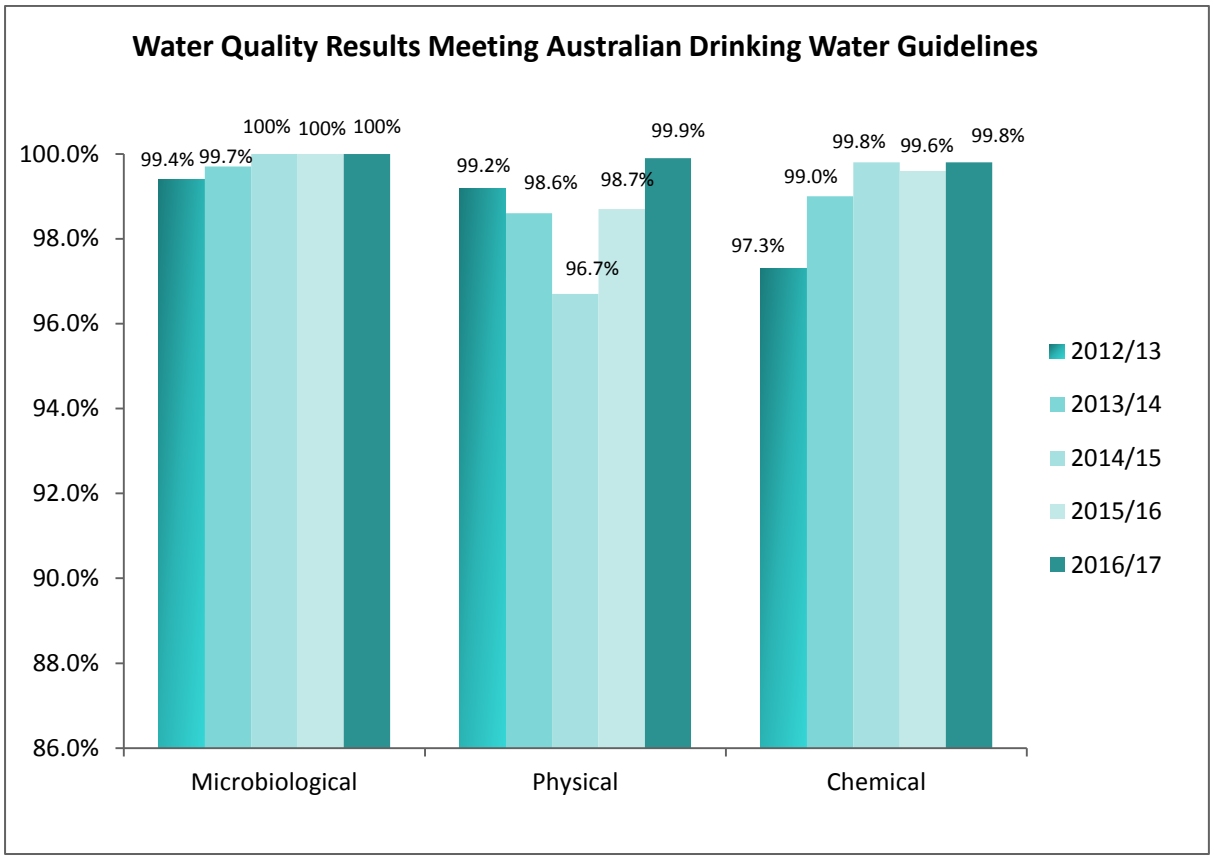

Figure 2: Water quality results meeting Australian Drinking Water Guidelines – all schemes

Detailed water quality data for each supply system is provided in *Appendix: Water quality data*.

4.1 DATA COLLECTION

The Australian Drinking Water Guidelines recognise that it is impossible to test every water supply for every parameter listed in the guidelines, therefore monitoring programs need to be structured effectively to capture, analyse and interpret water quality data. Selecting parameters and frequency of monitoring should be based on system analysis and risk assessment to ensure safety at point of use. It is recognised that the most likely and serious form of contamination risk comes from microbiological contamination. MidCoast Water's drinking water quality monitoring program has been designed based on these principles.

Operational monitoring is used to confirm that preventive measures to reduce hazards are in place and performing effectively. These preventive measures are applied throughout all stages of the water supply system, from catchment to tap and need to be checked regularly. Critical control points are included in operational monitoring.

Verification monitoring is the final check of water quality which confirms the effectiveness of preventive measures and barriers throughout the system. Samples are collected throughout the reticulation system at customers' taps or public reserves for water quality monitoring.

MidCoast Water's Drinking Water Quality Monitoring Plan underwent an annual review in June 2017. Minor changes were made to operational monitoring. Verification monitoring did not require any adjustment.

4.2 WATER QUALITY DISCUSSION

Manning water supply system achieved 99.9% of water quality results meeting ADWG for the 12 month reporting period, compared to 99.6% during 2015 - 2016. There were 2123 analytes tested for verification monitoring in the Manning system. One turbidity result was above ADWG in Tuncurry. Investigations and corrective actions included flushing and extra monitoring which revealed this was an isolated result that was rectified quickly. There was one occasion of copper above ADWG value in Wingham. The sampling site is located at a school and the sample was collected in January, towards the end of the school holidays. With little to no usage at the site for the previous six weeks, copper may have leached out of the pipe resulting in a higher level of copper than normally expected. There were no other elevated copper results detected across the system. After flushing and resampling, the copper result was back within ADWG. The school was notified and advised to flush the internal lines prior to students returning to school after the holidays. Following this, information will be provided to all schools within MidCoast Water supply systems before the end of the school year, advising flushing of internal lines after school holidays as a precaution.

Tea Gardens water supply system achieved 99.3% of results within ADWG compared to 98.3% during 2015 - 2016. A total of 306 analytes were tested for verification monitoring in Tea Gardens reticulation system. Total trihalomethanes (THMs) were above the guideline value on two occasions. Disinfection by-products are formed when organic matter reacts with chlorine. The long detention time in reservoirs and reticulation system, partly due to low water usage outside holiday periods has contributed to these elevated readings. In response to this, water levels have been reduced in reservoirs when appropriate, and monitoring frequency has been increased. While action to reduce disinfection by-products is encouraged, it is recognised in the Australian Drinking Water Guidelines

that disinfection must not be compromised, as non-disinfected water poses significantly more risk than disinfection by-products.

Bulahdelah water supply achieved 100% of results meeting ADWG, compared to 99.8% during 2015 - 2016. There were 310 analytes tested for verification monitoring within the Bulahdelah system.

Stroud water supply system achieved 100% of samples within ADWG, compared to 96.9% during 2015 - 2016. A total of 310 analytes were tested in Stroud reticulation system for verification monitoring in the reporting period.

Gloucester water supply system achieved 100% of samples within ADWG, compared with 99.1% during 2015 - 2016. There were 392 analytes tested for verification monitoring in Gloucester reticulation system.

North Karuah reticulation system achieved 100% of water quality results within ADWG during 2016 - 2017 which is consistent with the previous year. A total of 149 analytes were tested in this reticulation system during the reporting period.

5. WATER QUALITY COMPLAINTS

Recording and analysing the number and nature of customer notifications and complaints can provide useful information to inform of potential water quality issues, which can assist timely response and rectification. Any rapid or noticeable change in conditions including water quality, pressure etc. may be detected by customers. All notifications and complaints are registered and investigated. This monitoring forms part of verification of water supply performance.

Australian Standards define a complaint as an ‘expression of dissatisfaction made to an organisation, related to its products, or the complaints handling process itself, where a response or resolution is explicitly or inexplicitly expected’ (AS ISO 10002-2006).

Water quality complaints are reported in the following categories; taste, dirty, odour, chlorine and other. The category ‘other’ covers complaints such as scaling or illness. These categories and definitions are consistent with Crown Lands & Water requirements for NSW Water Utilities Performance Monitoring. Details of complaints are provided in the following table.

Table 2: Summary of water quality complaints 2016 - 2017

Water supply	Taste	Dirty	Odour	Chlorine	Other	TOTAL
Manning	6	13	0	4	0	23
Bulahdelah	0	0	0	0	0	0
Stroud	0	0	0	0	0	0
Tea Gardens	4	1	1	0	0	6
Gloucester	2	1	0	3	0	6
North Karuah	0	0	0	0	0	0
TOTAL	12	15	1	7	0	35

It is important to note that all water quality notifications and complaints from customers are treated seriously and investigated as appropriate.

6. WATER QUALITY INCIDENTS

There was one low level water quality incident during 2016 – 2017 affecting customers in Forster in the Manning water supply.

6.1 FORSTER WATER QUALITY INCIDENT

ISSUE

Maintenance activities were undertaken at Forster Reservoir site (Likely St, Forster) from 21/11/2016 to 23/11/2016. This work included valve actuation activities. During the process of opening valves, some dirty water entered the reticulation system. MidCoast Water Customer Service received multiple calls from customers advising of dirty water in the Forster area.

RESPONSE

The response from MidCoast Water included immediate flushing of the local area known to be experiencing dirty water, which was later extended to a wider area as a precaution. Chlorine levels were increased at Forster Reservoir. Water samples were collected at seven sites across Forster and one in Tuncurry to confirm water quality.

Information was provided on MidCoast Water website to notify customers in the affected area they may experience dirty water, and requesting they contact MidCoast Water if the problems persist.

IMPACT

All water quality results of samples collected were within Australian Drinking Water Guidelines. Turbidity results in some locations were higher than normal for the reticulation system.

MidCoast Water received nine phone calls from customers to advise they were experiencing dirty water.

FOLLOW UP ACTIONS

More flushing was undertaken the following day until water quality results were back within expected ranges for the area (turbidity). Key customers were contacted to ensure water had returned to acceptable quality.

NSW Health was notified and provided with a briefing paper including water quality results.

A debrief meeting was held with relevant staff to discuss the incident and identify opportunities for improvement relating to procedures and communication to prevent a reoccurrence.

7. REVIEW OF DRINKING WATER QUALITY MANAGEMENT SYSTEM IMPLEMENTATION AND CONTINUOUS IMPROVEMENT

MidCoast Water's Drinking Water Quality Management System underwent a thorough internal review during 2016 – 2017. Recommendations from previous reviews (internal and external) and improvements made to water supply systems were incorporated into the quality system. A new version of the DWQMS was endorsed by MidCoast Water executive team, provided to MidCoast Water board and submitted to NSW Health and Crown Lands & Water in March 2017.

A summary of the Drinking Water Quality Management System can be accessed at: www.midcoastwater.com.au/client_images/1905375.pdf and the full document is available upon request.

A review summary is provided in the following table.

Table 3: Summary of internal reviews

Date	Reviewer	Scope	Findings	Actions
Oct 2016	MidCoast Water, NSW Health, Atom, Bligh Tanner	Adoption and implementation of CCPs to achieve full compliance with ADWG	Implementation; changes to SCADA, formalising procedures and documentation, training and reporting procedures	Adopted Oct 2016. Fully implemented March 2017
March 2017	Strategic & Regulatory Compliance Catchment & Treatment	Full review of DWQMS	Improvements to systems, risk assessments, CCPs, emergency and incident management and documentation	New version of DWQMS adopted and submitted to regulators
June 2017	Strategic & Regulatory Compliance Catchment & Treatment	Annual review of all drinking water quality operational and verification monitoring	Operational monitoring schedule optimised	Changes to monitoring plan implemented

Significant progress has been made on the implementation and continuous improvement of MidCoast Water's drinking water quality management system during 2016 - 2017. With a focus on continuous improvement, the water quality team monitor and manage corrective actions recommended during review processes.

Significant actions during 2016 – 2017 include;

- Risk assessments reviewed for all water supply systems
- Critical control points reviewed, updated, adopted and implemented
- New version of DWQMS adopted
- Significant improvements to the operation of Gloucester WTP and water supply system
- Improvements to chemical dosing systems at WTPs
- Significant progression of backflow prevention program
- Continued development of standard operating procedures
- Development of organisation wide Incident and Emergency Management Framework
- Implementation of Strategic Asset Management Framework including failures and issues register and sustaining works program.

8. RESERVOIR CONDITION

MidCoast Water reservoir integrity program includes ten types of routine reservoir inspections carried out on all service reservoirs. Details of inspections are provided in the table below including frequency and type of inspection.

Table 4: Routine reservoir inspection program

Frequency	Type of inspection	Inspected by	Process of inspection/reporting
Monthly	External integrity check, vermin proofing, grounds, fencing, inspection hatches	MidCoast Water operator	Work order sent to relevant staff through maintenance schedule. Findings recorded in work order system; pass/fail. Issues rectified or sent to failures and issues register for further consideration including prioritisation and funding.
Monthly	Online chlorine analysers	MidCoast Water operator	Work order sent to relevant staff through maintenance schedule. Findings recorded in work order system; pass/fail. Issues rectified or sent to failures and issues register for further consideration including prioritisation and funding.
Monthly	Chlorine booster stations	MidCoast Water operator	Work order sent to relevant staff through maintenance schedule. Findings recorded in work order system; pass/fail. Issues rectified or sent to failures and issues register for further consideration including prioritisation and funding.
Annually	Electrical	MidCoast Water electrician	Work order sent to relevant staff through maintenance schedule. Findings recorded in work order system; pass/fail. Issues rectified or sent to failures and issues register for further consideration including prioritisation and funding.
Annually	Major site inspection: ensure roof is secure from birds, vermin, windborne contaminants, check rainwater cannot enter reservoir, drainage, signage, security of site	MidCoast Water operator	Work order sent to relevant staff through maintenance schedule. Findings recorded in work order system; pass/fail. Issues rectified or sent to failures and issues register for further consideration including prioritisation and funding. In accordance with Crown Lands & Water Circular LWU 18.
Annually	Roof structure	MidCoast Water engineer. External engineer if	Work order sent to relevant staff through maintenance schedule. Findings recorded in work order system; pass/fail. Issues rectified or sent to failures and issues register for further

Frequency	Type of inspection	Inspected by	Process of inspection/reporting
		required.	consideration including prioritisation and funding.
Every 2 years	Valve exercising	MidCoast Water mechanical technician	Work order sent to relevant staff through maintenance schedule. Findings recorded in work order system; pass/fail. Issues rectified or sent to failures and issues register for further consideration including prioritisation and funding.
Every 2 years	Major electrical	MidCoast Water electrician	Work order sent to relevant staff through maintenance schedule. Findings recorded in work order system; pass/fail. Issues rectified or sent to failures and issues register for further consideration including prioritisation and funding.
Every 2 years	Instrumentation checks and calibration (level indicators)	MidCoast Water electrician. External instrument technician where required.	Work order sent to relevant staff through maintenance schedule. Calibration certificates issued.
Every 2 years	Structural integrity and internal inspection by divers	External contractors	Detailed reports provided by contractor with recommendations for repairs where necessary. Issues rectified or sent to failures and issues register for further consideration including prioritisation and funding.

In addition to these inspections, operators monitor reservoir integrity and chlorine levels in accordance with critical control point requirements.

Repair works are undertaken according to priority. The initial focus is to rectify roof issues which may affect water quality, e.g. rusting screws and bird proofing. Roof replacements, and items requiring design review to ensure adequate roof structure are raised and included in the failures and issues register.

Figure 3: Bulahdelah Reservoirs

Figure 4: Tea Gardens Reservoirs

9. CONCLUSION

MidCoast Water understands the importance of a risk based, proactive quality system to effectively manage drinking water quality, and staff committed to ensuring the delivery of safe, clean drinking water to customers. This is a key focus and requires support and commitment from all areas of the organisation. This commitment is demonstrated through strategic planning, adherence to the Drinking Water Quality Management System including review and continuous improvement and relationships with regulators and other stakeholders. Significant progress has been made on implementation of the DWQMS throughout the 2016 - 2017 reporting period.

APPENDIX: WATER QUALITY DATA

WATER QUALITY DATA SUMMARY

Water quality data for each scheme is presented in the following tables. Raw water quality is measured before water enters the treatment plant. Final treated water quality is measured as water leaves the treatment plant and is sent to reticulation. Water quality in the reticulation system is measured at customers' taps or public sites throughout the distribution system. The water quality data summary includes samples tested at National Association of Testing Authorities (NATA) laboratories including MidCoast Water Laboratory and FASS (Forensic Analytical Science Services) Laboratory as part of NSW Health Drinking Water Quality Monitoring Program. This does not include samples collected and tested by operators at water treatment plant laboratories.

Water quality results supplied for North Karuah supply are from the reticulation system only. Hunter Water is responsible for treating and monitoring water before it is sent to the reticulation system.

MANNING WATER QUALITY

Raw water quality summary – Manning

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.4	7.78	8.1	26
Turbidity	NTU	0.6	1.5	3.6	26
True colour	Colour units	9	15.73	74	26
Alkalinity	mg/L	40	47.9	57.5	26
Calcium hardness	mg/L	22.5	28.9	53.5	14
E. coli	orgs/100ml	<1	14	190	26
Total coliforms	orgs/100ml	130	1152	>2400	26
Soluble aluminium	mg/L	<0.005	0.007	0.015	26
Total iron	mg/L	0.065	0.133	0.252	26
Total manganese	mg/L	0.009	0.019	0.042	26
Total cadmium	mg/L	<0.001	<0.001	<0.001	4
Total strontium	mg/L	0.0567	0.074	0.086	4
Total silver	mg/L	<0.0001	<0.0001	0.0001	4
Total cyanide	mg/L	<0.005	<0.005	0.005	4
Total chromium	mg/L	<0.002	<0.002	0.002	4
Total copper	mg/L	0.0068	0.009	0.0125	2
Fluoride	mg/L	<0.1	<0.1	0.2	4

Final treated water quality summary– Manning

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.1	7.32	7.6	52
Turbidity	NTU	0.1	0.12	0.2	52
True colour	Colour units	<2	<2	<2	13
Total dissolved solids	mg/L	80	102	120	18
Alkalinity	mg/L	49	56.8	120	18
Calcium hardness	mg/L	34	42.5	48.5	18
Free chlorine	mg/L	1.57	2.07	2.4	52
Total chlorine	mg/L	1.73	2.28	2.80	52
E. coli	orgs/100ml	<1	<1	<1	52
Total coliforms	orgs/100ml	<1	<1	<1	52
Soluble aluminium	mg/L	0.006	0.022	0.064	26
Total iron	mg/L	<0.005	0.004	0.007	13
Total manganese	mg/L	<0.0005	0.0009	0.0025	13
Total copper	mg/L	0.0029	0.0074	0.0138	20
Fluoride	mg/L	0.98	1.01	1.06	12

Reticulated water quality summary – Manning

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.2	7.68	8.8	464
Turbidity	NTU	<0.1	0.19	8.1	464
True colour	Colour units	<2	0.06	1	31
Free chlorine	mg/L	0.04	1.07	2.01	452
Total chlorine	mg/L	0.16	1.23	2.16	452
E. coli	orgs/100ml	<1	<1	<1	452
Total coliforms	orgs/100ml	<1	<1	<1	452
Soluble aluminium	mg/L	<0.01	0.012	0.02	31
Total iron	mg/L	<0.005	0.004	0.02	31
Total manganese	mg/L	<0.005	0.0003	0.002	31
Total antimony	mg/L	<0.0003	<0.0003	<0.0003	31
Total arsenic	mg/L	<0.001	0.0005	0.001	31
Total barium	mg/L	0.006	0.007	0.009	12
Total boron	mg/L	<0.1	0.028	0.05	31
Total cadmium	mg/L	<0.0005	<0.0005	<0.0005	12
Total calcium	mg/L	12.7	15.3	20.2	12
Total chloride	mg/L	14	16.08	19	12
Total chromium	mg/L	<0.0002	<0.0002	0.022	31
Total copper	mg/L	0.009	0.267	2.34	31
Total iodine	mg/L	<0.02	<0.02	<0.02	12
Total lead	mg/L	<0.002	0.0009	0.0047	31
Total magnesium	mg/L	<0.01	5.32	10.48	12
Total mercury	mg/L	<0.0001	0.00004	0.0003	12
Total molybdenum	mg/L	<0.005	<0.005	<0.005	12
Total nickel	mg/L	<0.0002	0.0002	0.0057	31
Nitrate	mg/L	0.02	0.22	0.5	31
Nitrite	mg/L	<0.001	<0.001	<0.001	31
Total selenium	mg/L	<0.0002	0.00006	0.002	31
Total silver	mg/L	<0.002	<0.002	<0.002	12
Total sodium	mg/L	8	14.6	62	12
Total sulphate	mg/L	2	3.58	5	12
Total zinc	mg/L	<0.005	0.016	0.12	31
Total hardness	mg/L	50.5	60.28	74.9	12
Total dissolved solids	mg/L	77	85.69	100	13
Chloroacetic acid	ug/L	<1	1.4	4	62
Dichloroacetic acid	ug/L	2	18.9	43	62
Trichloroacetic acid	ug/L	2	32.3	62	62
Total trihalomethanes	ug/L	30.5	63.73	119	62
Bromate	ug/L	<0.0005	0.0003	0.003	26
Fluoride	mg/L	0.85	0.97	1.08	12

BULAHDELAH WATER QUALITY

Raw water quality summary - Bulahdelah

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	6.3	6.9	7.4	26
Turbidity	NTU	1.1	6.5	27	26
True colour	Colour units	29	91.7	210	26
Total dissolved solids	mg/L	110	208	270	14
Alkalinity	mg/L	10	24.3	41	26
Calcium hardness	mg/L	11.5	20.5	29	13
E. coli	orgs/100ml	<2	56	350	26
Total coliforms	orgs/100ml	71	1951	20000	26
Soluble aluminium	mg/L	0.02	0.23	0.815	26
Total iron	mg/L	0.207	0.827	1.88	26
Total manganese	mg/L	0.0157	0.070	0.215	26

Final treated water quality summary - Bulahdelah

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.6	7.78	8.0	52
Turbidity	NTU	0.1	0.14	0.35	52
True colour	Colour units	<2	<2	2	13
Total dissolved solids	mg/L	140	231	300	13
Alkalinity	mg/L	42	54.8	69.5	13
Calcium hardness	mg/L	11	18.5	27.5	13
Free chlorine	mg/L	2.1	3.09	4.0	52
Total chlorine	mg/L	2.3	3.60	4.6	52
E. coli	orgs/100ml	<1	<1	<1	52
Total coliforms	orgs/100ml	<1	<1	<1	52
Soluble aluminium	mg/L	<0.01	0.013	0.03	26
Total iron	mg/L	<0.005	0.0046	0.005	13
Total manganese	mg/L	<0.0005	0.0008	0.0035	13
Fluoride	mg/L	0.93	0.98	1.04	12

Reticulated water quality summary – Bulahdelah

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.6	7.86	8.0	54
Turbidity	NTU	<0.1	0.24	0.65	54
True colour	Colour units	<2	<2	1	4
Free chlorine	mg/L	0.15	0.65	1.14	52
Total chlorine	mg/L	0.37	0.84	1.34	52
E. coli	orgs/100ml	<1	<1	<1	52
Total coliforms	orgs/100ml	<1	<1	1	52
Soluble aluminium	mg/L	0.024	0.069	0.11	4
Total iron	mg/L	0.02	0.026	0.04	4
Total manganese	mg/L	<0.005	0.0009	0.0029	4
Total antimony	mg/L	<0.001	<0.001	<0.001	4
Total arsenic	mg/L	<0.001	<0.001	<0.001	4
Total barium	mg/L	0.018	0.022	0.025	2
Total boron	mg/L	<0.1	<0.1	<0.1	4
Total cadmium	mg/L	0.0003	0.0003	0.0003	2
Total calcium	mg/L	6.5	7.2	7.9	2
Total chloride	mg/L	79	86	93	2
Total chromium	mg/L	<0.001	<0.001	<0.015	4
Total copper	mg/L	<0.005	0.009	0.015	4
Total iodine	mg/L	<0.02	<0.02	<0.02	2
Total lead	mg/L	<0.001	<0.001	<0.001	4
Total magnesium	mg/L	4.59	5.32	6.06	2
Total mercury	mg/L	0.0001	0.0001	0.0001	2
Total molybdenum	mg/L	<0.005	<0.005	<0.005	2
Total nickel	mg/L	<0.01	<0.01	<0.01	4
Nitrate	mg/L	<0.1	<0.1	<0.1	4
Nitrite	mg/L	<0.001	<0.1	<0.1	4
Total selenium	mg/L	<0.002	<0.002	<0.002	4
Total silver	mg/L	<0.002	<0.002	<0.002	2
Total sodium	mg/L	59	59	59	2
Total sulphate	mg/L	5	5.5	6	2
Total zinc	mg/L	<0.005	0.001	0.03	4
Total hardness	mg/L	35.1	39.9	44.7	2
Total dissolved solids	mg/L	184	195	206	2
Chloroacetic acid	ug/L	<1	1.08	2	13
Dichloroacetic acid	ug/L	<1	7.65	23	13
Trichloroacetic acid	ug/L	23	39.1	68	13
Total trihalomethanes	ug/L	113	191.2	250	13
Fluoride	mg/L	0.89	1.05	1.35	12

STROUD WATER QUALITY

Raw water quality summary - Stroud

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.1	7.56	7.9	26
Turbidity	NTU	1.3	8.06	33	26
True colour	Colour units	15	57.56	170	25
Total dissolved solids	mg/L	110	165	230	13
Alkalinity	mg/L	13.5	51.8	82.5	26
Calcium hardness	mg/L	16	35.2	63	13
E. coli	orgs/100ml	<1	151	720	26
Total coliforms	orgs/100ml	<1	4938	20000	26
Soluble aluminium	mg/L	0.007	0.147	0.707	26
Total iron	mg/L	0.222	0.716	2.07	26
Total manganese	mg/L	0.011	0.038	0.185	26
Soluble reactive phosphorus	mg/L	0.006	0.018	0.034	26
Dissolved organic carbon	mg/L	4.5	8.4	13.6	26
Total cadmium	mg/L	<0.001	<0.001	0.001	4
Total chromium	mg/L	<0.0002	0.0006	0.002	4
Total strontium	mg/L	0.0796	0.1194	0.16	4
Total silver	mg/L	<0.0001	<0.0001	0.0001	4
Total cyanide	mg/L	<0.005	<0.005	0.005	4

Final treated water quality summary - Stroud

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	8.0	8.46	9.2	52
Turbidity	NTU	0.25	0.38	0.7	52
True colour	Colour units	<2	<2	<2	13
Total dissolved solids	mg/L	120	166.2	210	13
Alkalinity	mg/L	37	53.5	68	13
Calcium hardness	mg/L	26	35.4	44.5	13
Free chlorine	mg/L	1.62	2.18	2.9	52
Total chlorine	mg/L	1.86	2.55	3.2	52
E. coli	orgs/100ml	<1	<1	<1	52
Total coliforms	orgs/100ml	<1	<1	<1	52
Soluble aluminium	mg/L	0.022	0.064	0.128	26
Total iron	mg/L	0.005	0.012	0.027	13
Total manganese	mg/L	<0.001	0.0012	0.016	13
Dissolved organic carbon	mg/L	2.3	3.7	5.5	26
Fluoride	mg/L	0.92	0.98	1.09	13

Reticulated water quality summary – Stroud

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.8	8.39	9.0	54
Turbidity	NTU	0.05	0.43	1.8	54
True colour	Colour units	<2	<2	<2	4
Free chlorine	mg/L	0.35	0.89	1.80	52
Total chlorine	mg/L	0.49	1.07	1.99	52
E. coli	orgs/100ml	<1	<1	<1	52
Total coliforms	orgs/100ml	<1	<1	<1	52
Soluble aluminium	mg/L	0.034	0.107	0.174	4
Total iron	mg/L	0.01	0.017	0.02	4
Total manganese	mg/L	<0.005	<0.005	<0.005	4
Total antimony	mg/L	<0.001	<0.001	<0.001	4
Total arsenic	mg/L	<0.001	<0.001	<0.001	4
Total barium	mg/L	0.0025	0.0038	0.005	2
Total boron	mg/L	<0.1	<0.1	<0.1	4
Total cadmium	mg/L	<0.0005	<0.0005	<0.0005	2
Total calcium	mg/L	10.8	14.2	17.6	2
Total chloride	mg/L	51	59.5	68	2
Total chromium	mg/L	<0.005	<0.005	<0.005	4
Total copper	mg/L	0.0019	0.0047	0.008	4
Total iodine	mg/L	<0.02	<0.02	<0.02	2
Total lead	mg/L	<0.002	<0.002	<0.002	4
Total magnesium	mg/L	4.55	6.33	8.12	2
Total mercury	mg/L	0.0001	0.0001	0.0001	2
Total molybdenum	mg/L	<0.005	<0.005	<0.005	2
Total nickel	mg/L	<0.001	<0.001	<0.001	4
Nitrate	mg/L	<0.01	<0.01	<0.01	4
Nitrite	mg/L	<0.001	0.0003	0.001	4
Total selenium	mg/L	<0.002	0.0005	0.002	4
Total silver	mg/L	<0.002	<0.002	<0.002	2
Total sodium	mg/L	27	32.5	38	2
Total sulphate	mg/L	4	4.5	5	2
Total zinc	mg/L	<0.005	0.008	0.02	4
Total hardness	mg/L	45.7	61.5	77.4	2
Total dissolved solids	mg/L	122	151.5	181	2
Chloroacetic acid	ug/L	<1	1.46	3	13
Dichloroacetic acid	ug/L	<1	12.2	32	13
Trichloroacetic acid	ug/L	7	14.8	22	13
Total trihalomethanes	ug/L	58.2	106.2	179	13
Fluoride	mg/L	0.83	0.99	1.07	13

TEA GARDENS WATER QUALITY

Raw water quality summary – Tea Gardens

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	5.4	5.65	6.0	28
Turbidity	NTU	0.1	0.46	5.5	28
True colour	Colour units	14	17	32	28
Total dissolved solids	mg/L	83	94.4	110	14
Alkalinity	mg/L	8.0	9.05	11.5	26
Calcium hardness	mg/L	3.5	4.57	5.5	14
E. coli	orgs/100ml	<1	<1	<1	28
Total coliforms	orgs/100ml	<1	<1	<1	28
Soluble aluminium	mg/L	0.239	0.288	0.364	27
Total iron	mg/L	0.869	0.957	1.10	27
Total manganese	mg/L	0.004	0.005	0.0054	27
Total chromium	mg/L	<0.001	0.00015	0.0002	4
Total arsenic	mg/L	<0.001	0.0015	0.002	4
Total sulphide	mg/L	<0.002	0.462	0.684	15
Dissolved organic carbon	mg/L	5	6.07	7.4	25

Final treated water quality summary – Tea Gardens

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.0	7.25	7.5	53
Turbidity	NTU	0.1	0.14	0.3	53
True colour	Colour units	<2	<2	3	15
Total dissolved solids	mg/L	120	145	160	15
Alkalinity	mg/L	33.5	39.9	44	14
Calcium hardness	mg/L	31	39.2	45	14
Free chlorine	mg/L	1.28	2.62	3.6	53
Total chlorine	mg/L	1.62	3.37	4.8	53
E. coli	orgs/100ml	<1	<1	<1	53
Total coliforms	orgs/100ml	<1	<1	<1	53
Soluble aluminium	mg/L	0.025	0.050	0.152	53
Total iron	mg/L	0.011	0.038	0.151	15
Total manganese	mg/L	0.0005	0.002	0.0047	15
Total sulphide	mg/L	<0.002	0.006	0.034	15
Dissolved organic carbon	mg/L	2.8	3.71	5.0	26
Fluoride	mg/L	<0.1	0.5	1.05	12

Reticulated water quality summary – Tea Gardens

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.3	7.5	8.4	55
Turbidity	NTU	<0.1	0.17	0.5	55
True colour	Colour units	<1	1.5	4	4
Free chlorine	mg/L	0.05	0.78	1.31	53
Total chlorine	mg/L	0.22	1.01	1.78	53
E. coli	orgs/100ml	<1	<1	<1	53
Total coliforms	orgs/100ml	<1	<1	<1	53
Soluble aluminium	mg/L	0.029	0.04	0.071	4
Total iron	mg/L	0.01	0.069	0.13	4
Total manganese	mg/L	<0.001	0.003	0.006	4
Total antimony	mg/L	<0.001	<0.001	<0.001	4
Total arsenic	mg/L	<0.001	<0.001	0.001	4
Total barium	mg/L	0.010	0.013	0.016	2
Total boron	mg/L	<0.1	0.009	0.018	4
Total cadmium	mg/L	<0.0005	<0.0005	<0.0005	2
Total calcium	mg/L	15.3	15.7	16.1	2
Total chloride	mg/L	41	44	47	2
Total chromium	mg/L	<0.001	0.007	0.026	4
Total copper	mg/L	0.010	0.070	0.151	4
Total iodine	mg/L	0.04	0.04	0.04	2
Total lead	mg/L	<0.001	0.001	0.004	4
Total magnesium	mg/L	3.03	3.15	3.28	2
Total mercury	mg/L	0.0001	0.0001	0.0001	2
Total molybdenum	mg/L	<0.005	<0.005	<0.005	2
Total nickel	mg/L	<0.001	<0.001	<0.001	4
Nitrate	mg/L	<0.10	0.025	0.09	4
Nitrite	mg/L	<0.001	<0.001	<0.001	4
Total selenium	mg/L	<0.002	<0.002	<0.002	4
Total silver	mg/L	<0.002	<0.002	<0.002	2
Total sodium	mg/L	24	26	28	2
Total sulphate	mg/L	8	9.5	11	2
Total zinc	mg/L	<0.005	0.026	0.080	4
Total hardness	mg/L	51.7	52.2	52.7	2
Total dissolved solids	mg/L	121	125	129	2
Chloroacetic acid	ug/L	2	5.5	9	13
Dichloroacetic acid	ug/L	9	30	59	13
Trichloroacetic acid	ug/L	15	31.9	46	13
Total trihalomethanes	ug/L	156	222.5	303	13
Fluoride	mg/L	0.83	0.96	1.06	5

GLOUCESTER WATER QUALITY

Raw water quality summary– Gloucester

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	6.9	7.4	7.8	26
Turbidity	NTU	0.75	2.3	13	26
True colour	Colour units	13	22.6	55	26
Total dissolved solids	mg/L	25	40.9	51	14
Alkalinity	mg/L	11	22.2	34	26
Calcium hardness	mg/L	10	15.8	23.5	13
E. coli	orgs/100ml	86	301	980	26
Total coliforms	orgs/100ml	920	3643	12000	26
Soluble aluminium	mg/L	<0.01	0.016	0.048	26
Total iron	mg/L	0.103	0.196	0.34	26
Total manganese	mg/L	0.037	0.051	0.989	26
Total cadmium	mg/L	<0.001	0.002	0.005	4
Total chromium	mg/L	<0.001	0.0003	0.0005	4
Total strontium	mg/L	0.031	0.048	0.065	4
Total silver	mg/L	<0.0001	0.0043	0.005	4
Total cyanide	mg/L	0.0025	0.0043	0.005	4

Final treated water quality summary – Gloucester

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.7	8.2	8.4	51
Turbidity	NTU	0.1	0.24	1.4	51
True colour	Colour units	<2	<2	<2	13
Total dissolved solids	mg/L	39	58.6	83	13
Alkalinity	mg/L	23	29.5	39.5	13
Calcium hardness	mg/L	9.5	14.1	20	13
Free chlorine	mg/L	1.18	2.03	3.1	51
Total chlorine	mg/L	1.29	2.27	3.2	51
E. coli	orgs/100ml	<1	<1	<1	51
Total coliforms	orgs/100ml	<1	<1	<1	51
Soluble aluminium	mg/L	0.008	0.032	0.102	26
Total iron	mg/L	<0.005	0.006	0.017	13
Total manganese	mg/L	0.0005	0.0011	0.0038	13
Fluoride	mg/L	<0.1	0.67	1.19	11

Reticulated water quality summary – Gloucester

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.8	8.07	8.8	80
Turbidity	NTU	<0.1	0.23	0.8	80
True colour	Colour units	<2	<2	<2	4
Free chlorine	mg/L	0.47	1.42	2.7	78
Total chlorine	mg/L	0.57	1.56	2.7	78
E. coli	orgs/100ml	<1	<1	<1	78
Total coliforms	orgs/100ml	<1	<1	<1	78
Soluble aluminium	mg/L	0.021	0.048	0.09	4
Total iron	mg/L	<0.01	<0.01	<0.01	4
Total manganese	mg/L	<0.005	<0.005	<0.005	4
Total antimony	mg/L	<0.001	<0.001	<0.001	4
Total arsenic	mg/L	<0.001	0.001	0.001	4
Total barium	mg/L	<0.005	<0.005	<0.005	2
Total boron	mg/L	<0.005	<0.005	0.008	4
Total cadmium	mg/L	<0.0005	<0.0005	<0.0005	2
Total calcium	mg/L	5.4	6.55	7.7	2
Total chloride	mg/L	13	14.5	16	2
Total chromium	mg/L	<0.001	<0.001	<0.001	4
Total copper	mg/L	<0.005	0.015	0.033	4
Total iodine	mg/L	<0.02	<0.02	0.02	2
Total lead	mg/L	<0.001	<0.001	<0.001	4
Total magnesium	mg/L	1.99	2.51	3.03	2
Total mercury	mg/L	0.0001	0.0001	0.0001	2
Total molybdenum	mg/L	<0.005	<0.005	<0.005	2
Total nickel	mg/L	<0.001	<0.001	<0.001	4
Nitrate	mg/L	<1	<1	<1	4
Nitrite	mg/L	<0.1	<0.1	<0.1	4
Total selenium	mg/L	<0.002	<0.002	<0.002	4
Total silver	mg/L	<0.002	<0.002	<0.002	2
Total sodium	mg/L	13	14.5	16	2
Total sulphate	mg/L	2.0	2.5	3.0	2
Total zinc	mg/L	<0.005	0.008	0.02	4
Total hardness	mg/L	21.7	26.7	31.7	2
Total dissolved solids	mg/L	57	63.5	70	2
Chloroacetic acid	ug/L	<1	0.46	2	13
Dichloroacetic acid	ug/L	1	9.38	24	13
Trichloroacetic acid	ug/L	4	14.23	30	13
Total trihalomethanes	ug/L	13.9	36.9	105	13
Fluoride	mg/L	0.79	0.92	1.09	6

NORTH KARUAH WATER QUALITY

Reticulated water quality summary – North Karuah

Parameter	Unit	Minimum	Average	Maximum	No. samples
pH	pH units	7.7	8.13	8.5	28
Turbidity	NTU	0.05	0.50	3.8	28
True colour	Colour units	1	1	1	2
Free chlorine	mg/L	0.03	0.50	1.13	26
Total chlorine	mg/L	0.08	0.65	1.22	26
E. coli	orgs/100ml	<1	<1	<1	26
Total coliforms	orgs/100ml	<1	<1	<1	26
Soluble aluminium	mg/L	0.02	0.03	0.04	2
Total iron	mg/L	0.01	0.05	0.09	2
Total manganese	mg/L	0.006	0.0043	0.006	2
Total antimony	mg/L	<0.001	<0.001	<0.001	2
Total arsenic	mg/L	<0.001	<0.001	<0.001	2
Total barium	mg/L	0.012	0.012	0.012	2
Total boron	mg/L	<0.1	<0.1	<0.1	2
Total cadmium	mg/L	<0.0005	<0.0005	<0.0005	2
Total calcium	mg/L	25.6	26	26.4	2
Total chloride	mg/L	26	26.5	27	2
Total chromium	mg/L	<0.005	0.0123	0.022	2
Total copper	mg/L	0.006	0.181	0.355	2
Total iodine	mg/L	<0.02	<0.02	<0.02	2
Total lead	mg/L	<0.002	0.004	0.007	2
Total magnesium	mg/L	1.45	1.475	1.50	2
Total mercury	mg/L	0.0002	0.00025	0.0003	2
Total molybdenum	mg/L	<0.005	<0.005	<0.005	2
Total nickel	mg/L	<0.01	<0.01	<0.01	2
Nitrate	mg/L	<1	<1	<1	2
Nitrite	mg/L	<0.1	<0.1	<0.1	2
Total selenium	mg/L	<0.002	<0.002	<0.002	2
Total silver	mg/L	<0.002	<0.002	<0.002	2
Total sodium	mg/L	12	12.5	13	2
Total sulphate	mg/L	3	3	3	2
Total zinc	mg/L	0.01	0.025	0.04	2
Fluoride	mg/L	0.9	0.91	0.92	2