



DWMS Annual Report 2018

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DWMS Annual Report 2018

Viridis Consultants Pty Ltd
PO Box 131
Bulimba Qld 4171
Australia
www.viridis.net.au
ABN: 49 129 185 271

Telephone: 1300 799 310

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Contents

Executive Summary	1
1. Introduction	2
2. Supply Schemes	2
3. Scheme Changes	4
3.1. Batlow Scheme	4
3.2. Brungle Scheme.....	4
3.3. Khancoban Scheme.....	4
3.4. Talbingo Scheme.....	4
3.5. Tumbarumba Scheme.....	4
3.6. Tumut Scheme	4
4. Critical Control Points	5
4.1. Batlow.....	5
4.2. Brungle.....	7
4.3. Khancoban	8
4.4. Talbingo	9
4.5. Tumbarumba	11
4.6. Tumut	12
5. Reservoir Integrity	14
6. Incidents Reported to NSW Health	14
7. Verification Monitoring Performance	15
7.1. Reticulation Water Quality Monitoring.....	15
7.2. Water Quality Customer Complaints.....	15
8. Improvement Plan Implementation	16
8.1. Status.....	16
8.2. New Additions.....	16
9. DWMS Review Outcomes	17
10. DWMS Audit Outcomes	17
Glossary	18

Appendices

Reticulation Water Quality Monitoring	A
Improvement Plan Status.....	G

Tables

Table 1 Council's Drinking Water Supply Schemes.....	2
Table 2 Batlow Scheme CCPs.....	5
Table 3 Batlow CCP Data Analysis	5
Table 4 Brungle Scheme CCPs.....	7

DWMS Annual Report 2018

Table 5 Brungle CCP Data Analysis	7
Table 6 Khancoban Scheme CCPs	8
Table 7 Khancoban CCPs Data Analysis	9
Table 8 Talbingo Scheme CCPs	9
Table 9 Talbingo CCP Data Analysis	10
Table 10 Tumbarumba Scheme CCPs	11
Table 11 Tumbarumba CCPs Data Analysis	11
Table 12 Tumut Scheme CCPs	12
Table 13 Tumut CCPs Data Analysis	12
Table 14 Batlow Verification Monitoring	A
Table 15 Brungle Verification Monitoring	B
Table 16 Khancoban Verification Monitoring	C
Table 17 Talbingo Verification Monitoring	D
Table 18 Tumbarumba Verification Monitoring	E
Table 19 Tumut Verification Monitoring	F

Figures

Figure 1 Batlow CCP1: Turbidity	6
Figure 2 Batlow CCP2: pH	6
Figure 3 Batlow CCP2: Turbidity	6
Figure 4 Batlow CCP2: Free Chlorine	6
Figure 5 Batlow CCP3: Fluoride	6
Figure 6 Brungle CCP1: Filtered Water Turbidity	8
Figure 7 Brungle CCP2: pH	8
Figure 8 Brungle CCP2: Turbidity	8
Figure 9 Brungle CCP2: Free Chlorine	8
Figure 10 Talbingo CCP1: Post Filter Turbidity	10
Figure 11 Talbingo CCP2: Treated Water pH	10
Figure 12 Talbingo CCP2: Treated Water Turbidity	10
Figure 13 Talbingo CCP2: Treated Water Free Chlorine	10
Figure 14 Tumbarumba CCP2: Chlorine Residual	11
Figure 15 Tumbarumba CCP3: Fluoride	11
Figure 16 Tumut CCP2: Average Filter Turbidity	13
Figure 17 Tumut CCP3: Treated Water pH	13
Figure 18 Tumut CCP3: Filtered Water Turbidity	13
Figure 19 Tumut CCP3: Treated Water Free Chlorine	13
Figure 20 Tumut CCP4: Fluoride	13

DWMS Annual Report 2018

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Executive Summary

Water suppliers in New South Wales (NSW) are required to establish and adhere to a 'quality assurance program', referred to as a Drinking Water Management System (DWMS). An annual review of the DWMS is recommended to ensure that it is valid and being implemented effectively. Furthermore, an annual report is required to be prepared and submitted to the local Public Health Unit (PHU), NSW Health.

Viridis Consultants P/L (Viridis) was engaged by NSW Health on behalf of Snowy Valleys Council (SVC) to prepare the DWMS Annual Report for the 2018 reporting period.

SVC is responsible for treating and distributing water to:

- Batlow Township
- Brungle Township
- Khancoban Township
- Talbingo Township
- Tumbarumba Township
- Tumut Township
- Morgans Reserve- Cloverdale
- Adelong Township.

All schemes were 100% compliant with the Australian Drinking Water Guidelines (ADWG) health-based guidelines other than one *E. coli* detection in Tumut of the 12th of December.

The CCPs generally performed well in 2018 with limited critical limit breaches. SVC received 6 customer complaints in 2018.

1. Introduction

Water suppliers in New South Wales (NSW) are required to establish and adhere to a 'quality assurance program', referred to as a Drinking Water Management System (DWMS). The DWMS is a risk-based approach to managing drinking water quality.

An annual review of the DWMS is recommended to ensure that it is valid and is being implemented effectively. In addition, an Annual Report is required to be prepared and submitted to the local Public Health Unit (PHU), NSW Health.

NSW Health has engaged Viridis Consultants P/L (Viridis) on behalf of Snowy Valleys Council (SVC) to prepare the DWMS Annual Report for 2018 reporting period.

This report covers a 12-month reporting period from 1 January 2018 to 31 December 2018. It summarises SVC's drinking water quality performance for the reporting period, outcomes of the DWMS annual review undertaken and progress on the implementation of the improvement plan.

2. Supply Schemes

SVC operates and manages the following drinking water supply schemes, as outlined in Table 1 below.

Table 1 Council's Drinking Water Supply Schemes

Scheme Name	Primary Source	Treatment Processes	Serviced Areas
Batlow	Kunama Dam (via Little Gilmore Creek)	<ul style="list-style-type: none"> Flocculation Ultrafiltration Disinfection (chlorine gas) Fluoridation (sodium fluoride) Storage (Batlow Reservoir) 	Batlow Township
Brungle	Nimbo Creek	<ul style="list-style-type: none"> Limestone Contact Tank (optional) Microfiltration Disinfection (sodium hypochlorite) Storage (Brungle Reservoir) 	Brungle Township
Khancoban	Khancoban Creek	<ul style="list-style-type: none"> Course filtration (offline) Disinfection (chlorine gas) Storage 	Khancoban Township
Talbingo	Jounama Creek	<ul style="list-style-type: none"> Flocculation Sand Filtration Disinfection (chlorine gas) Storage (high level and low level reservoir) 	Talbingo Township
Tumbarumba	<ul style="list-style-type: none"> Tumbarumba Creek Burra Creek McKeenin Street and Common Bore 	<ul style="list-style-type: none"> Flocculation Sand Filtration Fluoridation (sodium fluoride) Disinfection (chlorine gas) 	Tumbarumba Township
Tumut	Tumut River	<ul style="list-style-type: none"> Powdered activated carbon (optional) Flocculation Fluoridation (sodium fluoride) Sand Filtration 	<ul style="list-style-type: none"> Tumut Township Morgans Reserve- Cloverdale Adelong Township

DWMS Annual Report 2018

Scheme Name	Primary Source	Treatment Processes	Serviced Areas
		<ul style="list-style-type: none">• Disinfection (chlorine gas)• Adelong Rechlorination (chlorine gas)	

3. Scheme Changes

The scheme changes are discussed in this section.

3.1. Batlow Scheme

There were no significant process changes to the scheme, including for catchment characteristics, treatment processes, chemicals used and the distribution network.

3.2. Brungle Scheme

There were no significant process changes to the scheme, including for catchment characteristics, treatment processes, chemicals used and the distribution network.

3.3. Khancoban Scheme

There were no significant process changes to the scheme, including for catchment characteristics, treatment processes, chemicals used and the distribution network.

3.4. Talbingo Scheme

There were no significant process changes to the scheme, including for catchment characteristics, treatment processes, chemicals used and the distribution network.

3.5. Tumbarumba Scheme

There were no significant process changes to the scheme, including for catchment characteristics, treatment processes, chemicals used and the distribution network.

3.6. Tumut Scheme

There were no significant process changes to the scheme, including for catchment characteristics, treatment processes, chemicals used and the distribution network.

4. Critical Control Points

CCP implementation is discussed in this section.

4.1. Batlow

The current CCPs for the Batlow scheme are presented in Table 2.

Table 2 Batlow Scheme CCPs

Critical Control Point	Parameter	Operational Target	Adjustment Limit	Critical Limit
Batlow CCP 1: Filtration	Turbidity	<0.2 NTU	>0.2 NTU	>0.5 NTU
	TMP	TMP -60 to -30 kPa	-30 ≤ TMP < -25 kPa	TMP ≥ -25 kPa
Batlow CCP 2: Primary Disinfection	pH	pH 7.5 - 7.8	pH <7.5 or >7.8 for >24 hours	pH >8.2 (instantaneous)
	Turbidity	Turbidity <0.3 NTU	Turbidity >0.5 NTU (instantaneous)	Turbidity >1.0 NTU (instantaneous)
	Chlorine residual	Free Chlorine 0.7 - 1.0 mg/L	Free chlorine <0.7 mg/L or >1 mg/L (instantaneous)	Free chlorine <0.3 mg/L or >1.5 mg/L (instantaneous)
Batlow CCP 3: Fluoridation	Fluoride	0.9 - 1.1 mg/L	<0.9 mg/L or >1.1 mg/L (instantaneous)	<0.9 mg/L for greater than 72 hours or >1.5 mg/L (instantaneous)*
Batlow CCP 4: Distribution Reservoirs	Reservoir integrity	Vermin proof	Evidence of integrity breach	Integrity breach not rectified
		Secure and leak proof	Evidence of security breach	Security breach not rectified

Table 3 Batlow CCP Data Analysis

	Min	5th %ile	Mean	95th %ile	Max	Count
Filtered Turbidity (NTU)	0.05	0.06	0.075020747	0.1	0.14	241
Turbidity (NTU)	0.06	0.07	0.107147	0.18	0.58	361
Fluoride Reading (mg/l)	0.36	0.76	0.959392	1.07	1.15	362
pH To Town	5.9	7.2	7.682369	8.1	8.7	363
Free Residual Chlorine (mg/l)	0.24	0.58	0.792238	1.01	1.21	362

There were no alert limit breaches for filter turbidity indicating filters are performing well. There was one critical limit breach for free chlorine with control of chlorine otherwise maintained. There were numerous breaches of the low fluoride limit, particularly in May, with performance improving later in the year.

DWMS Annual Report 2018

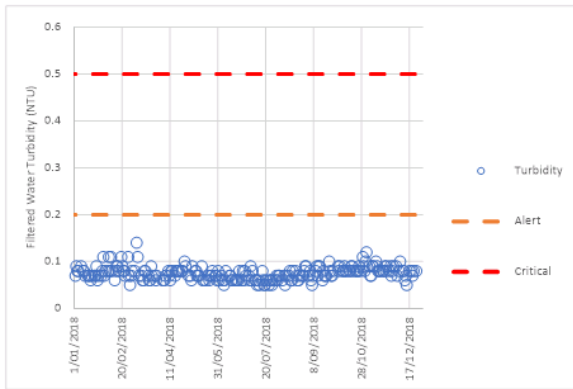


Figure 1 Batlow CCP1: Turbidity

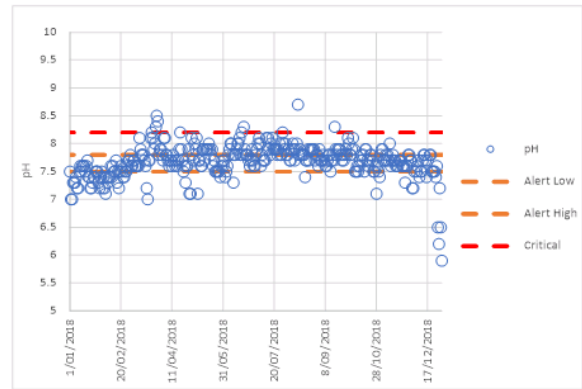


Figure 2 Batlow CCP2: pH

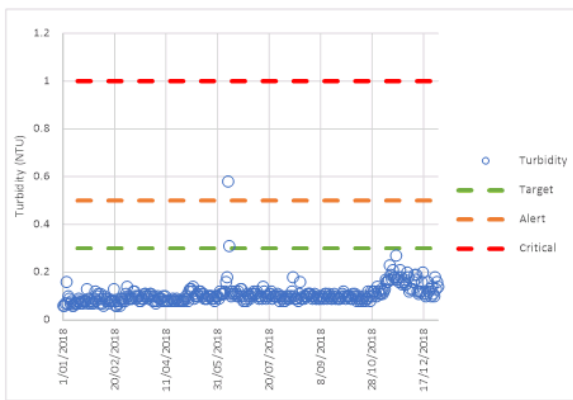


Figure 3 Batlow CCP2: Turbidity

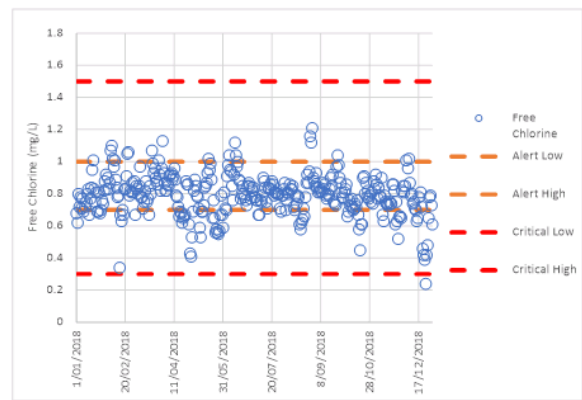


Figure 4 Batlow CCP2: Free Chlorine

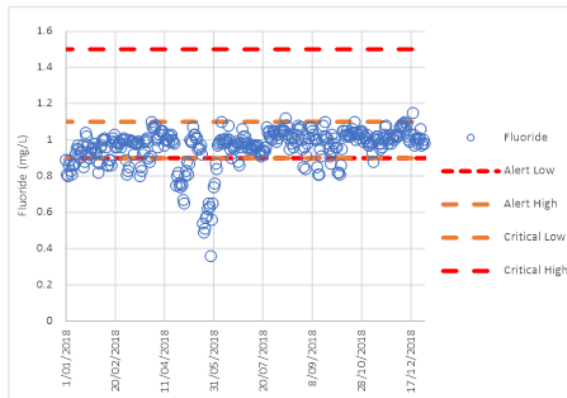


Figure 5 Batlow CCP3: Fluoride

4.2. Brungle

Table 4 Brungle Scheme CCPs

Critical Control Point	Parameter	Operational Target	Adjustment Limit	Critical Limit
Brungle CCP 1: Filtration	Turbidity	<0.4 NTU	>0.4 NTU (instantaneous)	>0.4 NTU after 24 hours
	TMP	50 kPa	70 kPa	>150 kPa
Brungle CCP 2: Primary Disinfection	pH	pH 7.5 - 7.8	pH <7.5 or >7.8 for >24 hours	pH >8.2 (instantaneous)
	Turbidity	Turbidity <0.3 NTU	Turbidity >0.5 NTU (instantaneous)	Turbidity >1.0 NTU (instantaneous)
	Chlorine residual	Free Chlorine 0.7 - 1.0 mg/L	Free chlorine <0.7 mg/L or > 1 mg/L (instantaneous)	Free chlorine <0.3 mg/L or >1.5 mg/L (instantaneous)
Brungle CCP 3: Distribution Reservoirs	Reservoir integrity	Vermis proof	Evidence of integrity breach	Integrity breach not rectified
		Secure and leak proof	Evidence of security breach	Security breach not rectified

Table 5 Brungle CCP Data Analysis

	Min	5th %ile	Mean	95th %ile	Max	Count
CCP 1: Turbidity (NTU)	0.05	0.06	0.145976	0.29	0.37	85
CCP 2: pH	7.22	7.3	7.644045	7.958	8.15	89
CCP 2: Turbidity (NTU)	0.06	0.07	0.160112	0.276	1.2	89
CCP 2: Chlorine Residual (mg/L)	0.16	0.608	1.165393	1.592	2.3	89

Filtered water turbidity has not exceeded the alert limit. Disinfection turbidity and pH have predominantly remained within limits, with one turbidity critical limit exceedance. Chlorine residual is typically greater than the alert limit indicating investigation into the suitability of limits and corrective actions should be undertaken.

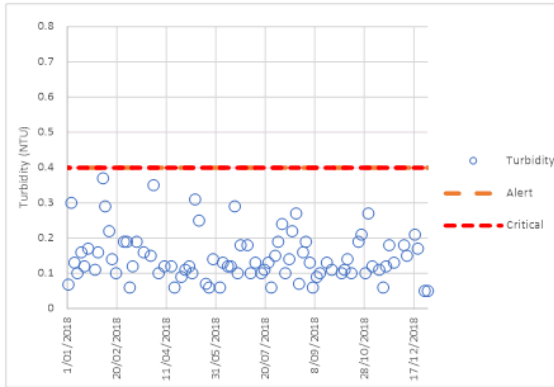


Figure 6 Brungle CCP1: Filtered Water Turbidity

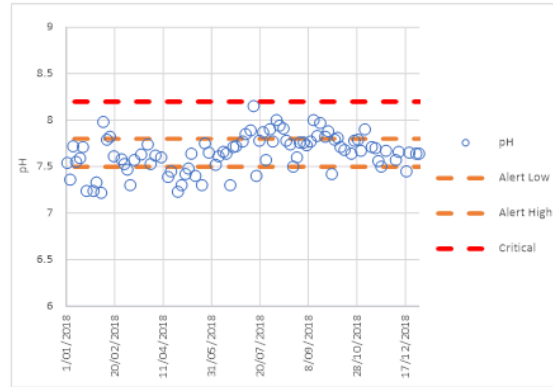


Figure 7 Brungle CCP2: pH

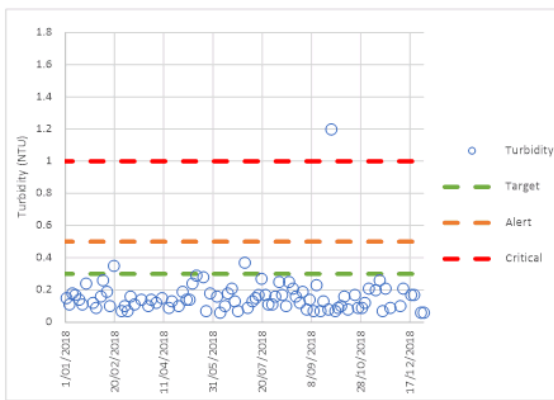


Figure 8 Brungle CCP2: Turbidity

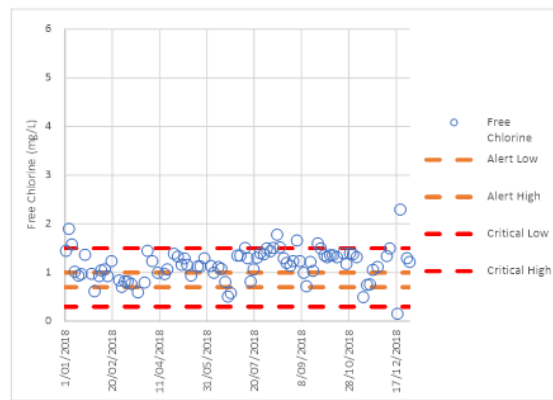


Figure 9 Brungle CCP2: Free Chlorine

4.3. Khancoban

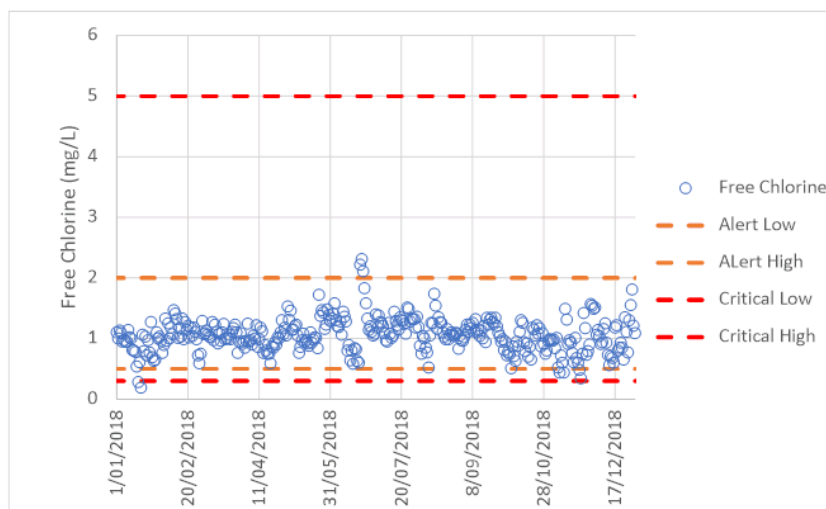
Table 6 Khancoban Scheme CCPs

Critical Control Point	Parameter	Operational Target	Adjustment Limit	Critical Limit
Khancoban CCP 1: Primary Disinfection	Chlorine residual	0.6 mg/L – 1 mg/L	< 0.5 mg/L or > 2 mg/L	< 0.3 mg/L > 24 hr or 5 mg/L
Khancoban CCP 2: Distribution Reservoirs	Reservoir integrity	Vermis proof	Evidence of integrity breach	Integrity breach not rectified
		Secure and leak proof	Evidence of security breach	Security breach not rectified

Table 7 Khancoban CCPs Data Analysis

	Min	5th %ile	Mean	95th %ile	Max	Count
Chlorine Residual Balance Tank	0.19	0.61	1.056129	1.488	2.31	365

Chlorine residual has typically remained within limits, with one critical low limit breach.



4.4. Talbingo

Table 8 Talbingo Scheme CCPs

Critical Control Point	Parameter	Operational Target	Adjustment Limit	Critical Limit
Talbingo CCP 1: Filtration	Turbidity	<0.1 NTU	>0.2 NTU (instantaneous)	>0.8 NTU for 15 minutes
Talbingo CCP 2: Primary Disinfection	pH	pH 7.5 - 7.8	pH <7.5 or >7.8 for >24 hours	pH >8.2 (instantaneous)
	Turbidity	Turbidity <0.3 NTU	Turbidity >0.5 NTU (instantaneous)	Turbidity >1.0 NTU (instantaneous)
	Chlorine residual	Free Chlorine 0.7 - 1.0 mg/L	Free chlorine <0.7 mg/L or >1 mg/L (instantaneous)	Free chlorine <0.3 mg/L or >1.5 mg/L (instantaneous)
Talbingo CCP 3: Distribution Reservoirs	Reservoir integrity	Vermin proof	Evidence of integrity breach	Integrity breach not rectified
		Secure and leak proof	Evidence of security breach	Security breach not rectified

Table 9 Talbingo CCP Data Analysis

	Min	5th %ile	Mean	95th %ile	Max	Count
CCP1: Turbidity	0.0114	0.045	0.125358	0.249	1.19	113
CCP 2: pH	7.08	7.48	7.742904	8.07	8.26	365
CCP 2: Turbidity (NTU)	0.054	0.062	0.080867	0.1089	0.134	362
CCP 2: Chlorine Residual	0.31	0.55	0.753123	0.97	1.24	365

There was one critical limit breach for post filter turbidity. Treated water turbidity was consistently low and treated water pH exceeded its critical limit twice. Free chlorine remained within critical limits.

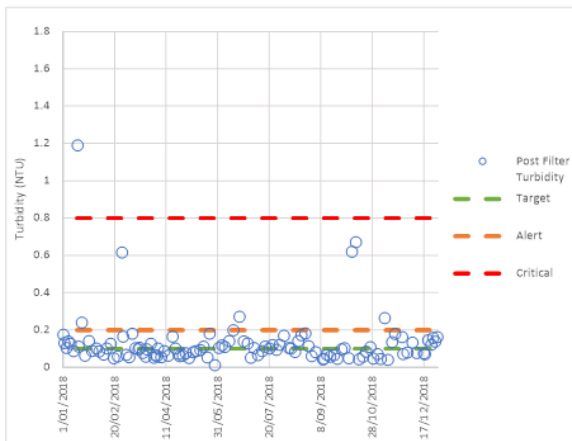


Figure 10 Talbingo CCP1: Post Filter Turbidity

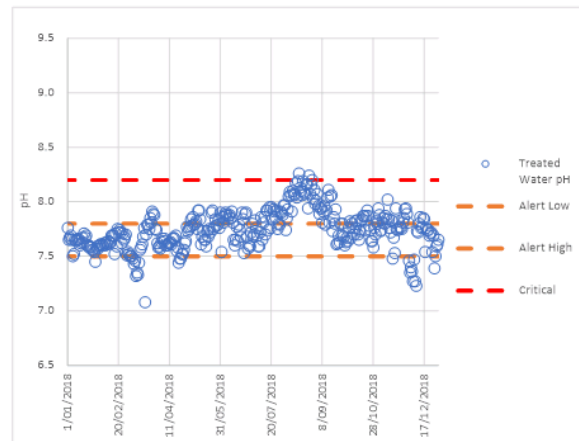


Figure 11 Talbingo CCP2: Treated Water pH

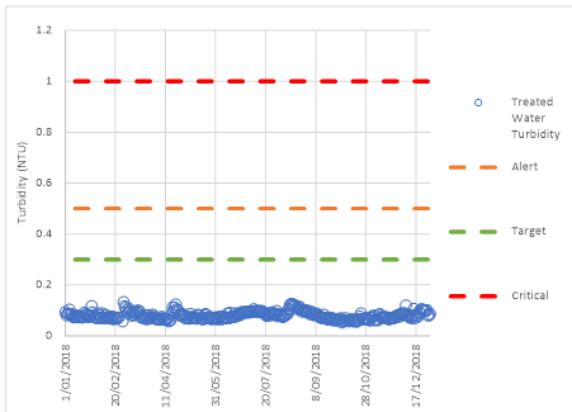


Figure 12 Talbingo CCP2: Treated Water Turbidity

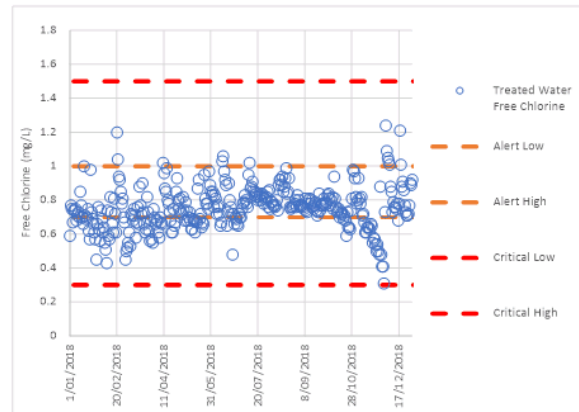


Figure 13 Talbingo CCP2: Treated Water Free Chlorine

4.5. Tumbarumba

Table 10 Tumbarumba Scheme CCPs

Critical Control Point	Parameter	Operational Target	Adjustment Limit	Critical Limit
Tumbarumba CCP 1: Filtration	Turbidity	<0.2 NTU	0.4 NTU	>0.5 NTU
Tumbarumba CCP 2: Primary Disinfection	Chlorine residual	Free Chlorine 0.6 mg/L	Free chlorine <0.45 mg/L or >1.2 mg/L (instantaneous)	Free chlorine <0.3 mg/L or >1.5 mg/L (instantaneous)
Tumbarumba CCP 3: Fluoridation	Fluoride	0.9 - 1.1 mg/L	<0.9 mg/L or >1.1 mg/L (instantaneous)	<0.9 mg/L for greater than 72 hours or >1.5 mg/L (instantaneous)*
Tumbarumba CCP 4: Distribution Reservoirs	Reservoir integrity	Vermin proof	Evidence of integrity breach	Integrity breach not rectified
		Secure and leak proof	Evidence of security breach	Security breach not rectified

Table 11 Tumbarumba CCPs Data Analysis

	Min	5th %ile	Mean	95th %ile	Max	Count
CCP2: Chlorine Residual	0.061	0.502	0.731663	1.058	1.54	365
CCP3: Fluoride	0.095	0.9012	1.00722	1.0996	1.217	365

Monitoring of filter turbidity has commenced in 2019, as such this information is not available for 2018. Chlorine residual had one critical low limit exceedance. Fluoride fell below its critical limit for several days in May, likely indicating a critical limit breach.



Figure 14 Tumbarumba CCP2: Chlorine Residual

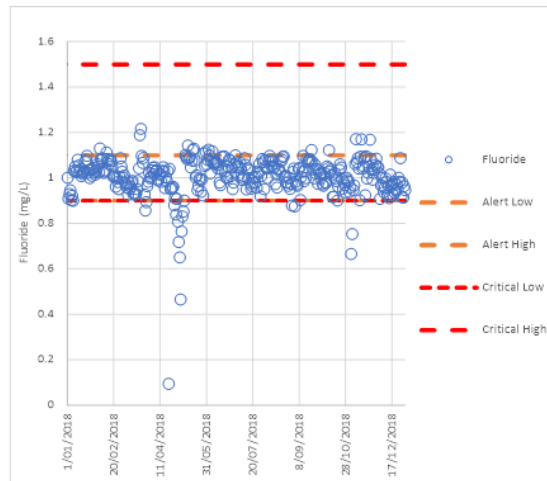


Figure 15 Tumbarumba CCP3: Fluoride

4.6. Tumut

Table 12 Tumut Scheme CCPs

Critical Control Point	Parameter	Operational Target	Adjustment Limit	Critical Limit
Tumut OCP 1: Raw Water Extraction	Turbidity, rainfall	<1 NTU	-	Operator adjustable
		No rain event	Rain event or forecast of rain event	
Tumut CCP 2: Filtration	Turbidity, rainfall	<0.2 NTU	>0.5 NTU	>1 NTU
Tumut CCP 3: Primary Disinfection	pH	pH 7.5 - 7.8	pH <7.5 or >7.8 for >24 hours	pH >8.2 (instantaneous)
	Turbidity	Turbidity <0.3 NTU	Turbidity >0.5 NTU (instantaneous)	Turbidity >1.0 NTU (instantaneous)
	Chlorine residual	Free Chlorine 0.7 - 1.0 mg/L	Free chlorine <0.7 mg/L or >1.2 mg/L (instantaneous)	Free chlorine <0.3 mg/L or >1.5 mg/L (instantaneous)
Tumut CCP 4: Fluoridation	Fluoride	0.9 - 1.1 mg/L	<0.9 mg/L or >1.1 mg/L (instantaneous)	<0.9 mg/L for greater than 72 hours or > 1.5 mg/L (instantaneous)
Tumut CCP 5: Distribution Reservoirs	Reservoir integrity	Vermin proof	Evidence of integrity breach	Integrity breach not rectified
		Secure and leak proof	Evidence of security breach	Security breach not rectified

Table 13 Tumut CCPs Data Analysis

	Min	5th %ile	Mean	95th %ile	Max	Count
OCP1: Raw Water Turbidity	0.78	0.92255	2.298827	4.426	130	358
CCP2: Average Filter Turbidity	0.054333	0.062667	0.153741	0.328	1.6	319
CCP3: Filtered Water Turbidity	0.061	0.0748	0.171868	0.38	1.51	357
CCP3: Treated Water pH	7.02	7.1775	7.457837	7.9625	8.88	356
CCP3: Treated Water Residual Chlorine	0.31	0.704	0.995534	1.316	3.7	365
CCP4: Treated Water Fluoride	0.6	0.9	0.988956	1.1	1.21	365

There was a filter breakthrough in December with three turbidity critical limit exceedances. pH for disinfection has had 7 critical limits breaches and free chlorine has breached its high critical limit 3 times. There were 8 low fluoride limits.

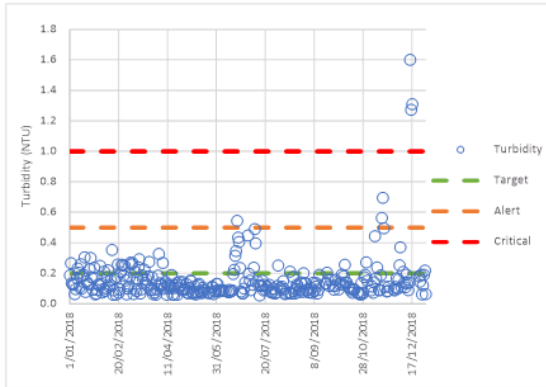


Figure 16 Tumut CCP2: Average Filter Turbidity

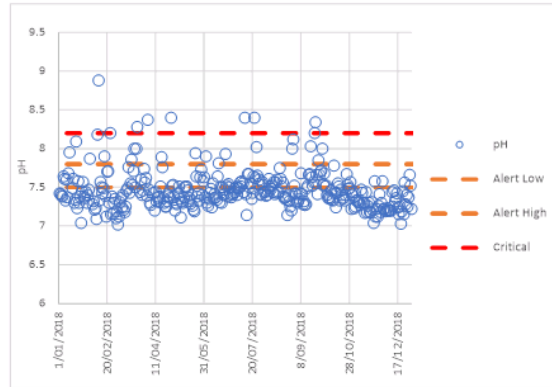


Figure 17 Tumut CCP3: Treated Water pH

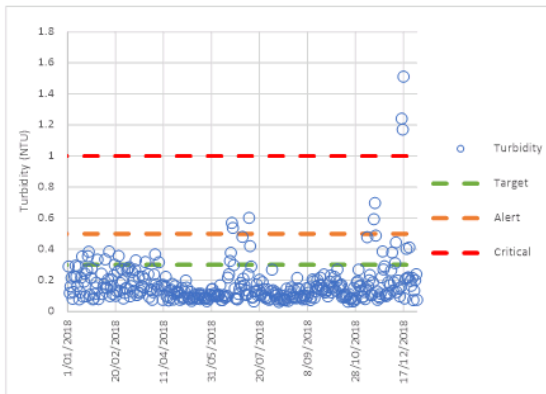


Figure 18 Tumut CCP3: Filtered Water Turbidity

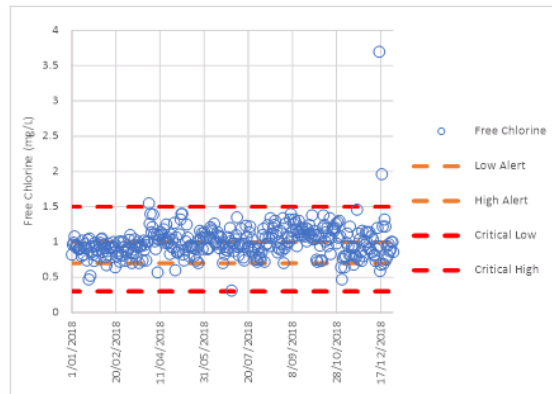


Figure 19 Tumut CCP3: Treated Water Free Chlorine

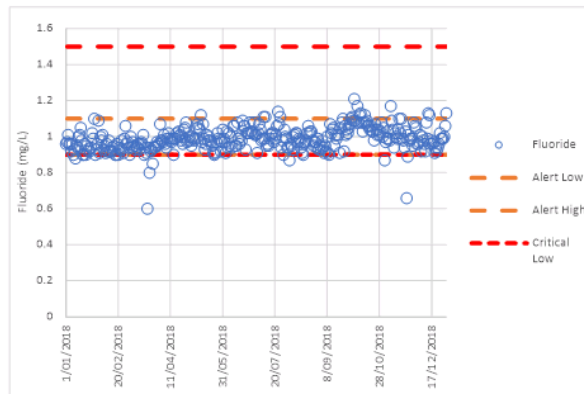


Figure 20 Tumut CCP4: Fluoride

5. Reservoir Integrity

Maintaining the integrity of the distribution system is an important barrier in keeping the supply safe from potential recontamination. This includes ensuring that the service reservoirs are not vulnerable to contamination, for example, by vermin, birds or rainwater runoff ingress.

SVC has a CCP for reservoir integrity.

6. Incidents Reported to NSW Health

There was one *E. coli* detections on 12/12/2018 at an undefined sample point for the Tumut Scheme. A boil water notice was issued in December 2018 for Cloverdale.

A Boil Water was issued in Coverdale in early December 2018 due to low chlorine level in the retic System. That sample was taken as a part of sampling program of the boil water notice for Cloverdale. It was taken from a fire Hydrant which was in a paddock with cattle. The investigation noted that the farmer had just put his cows out to feed on the grass before the sample was collected and it was highly likely that the sample was contaminated during sample collection. As a result, a new sample tap was installed to prevent cross contamination in the future.

Section 7 includes more details on verification monitoring.

7. Verification Monitoring Performance

Verification of drinking water quality provides an assessment of the overall performance of the system and the ultimate quality of drinking water being supplied to consumers. This incorporates monitoring drinking water quality as well as assessment of consumer satisfaction.

7.1. Reticulation Water Quality Monitoring

Drinking water quality monitoring is a wide-ranging assessment of the quality of water in the reticulation or distribution system and importantly, as supplied to the consumer. It includes regular sampling and testing to assess whether water quality is complying with ADWG guideline values. Monitoring of drinking water is regarded as the final check that, overall, the barriers and preventive measures implemented to protect public health are working effectively.

All schemes were 100% compliant with health guidelines other than Tumut which had an *E. coli* and Total Coliforms detection on the 12th December.

- In Batlow low fluoride and free chlorine were ongoing issues in the reticulation.
- Tumbarumba had 1 instance of high aluminium, however, this is an aesthetic limit and does not present a health risk.

7.2. Water Quality Customer Complaints

Monitoring of consumer complaints can provide valuable information on potential problems that may not have been identified by performance monitoring of the water supply system. Consumer satisfaction with drinking water quality is largely based on a judgment that the aesthetic quality of tap water is 'good', which usually means that it is colourless, free from suspended solids and has no unpleasant taste or odour.

There were six complaints largely due to dirty water, SVC attended the sites and undertook flushing.

8. Improvement Plan Implementation

An Improvement Plan is part of a management system and demonstrates the continual improvement process in place for an organisation. SVC has an Improvement Plan, which is part of their DWMS.

8.1. Status

The Improvement Plan was reviewed and updated during the preparation of this Annual Report. Refer to Appendix B for detailed progress of the Improvement Plan, including commentary.

8.2. New Additions

The Improvement Plan was fully reviewed in 2020 as part of the risk assessment review.

9. DWMS Review Outcomes

The NSW Guidelines for DWMS require that all water suppliers review their DWMS and major components on an annual basis. This is to ensure that the DWMS is managed as a quality system and to demonstrate continuous review and improvement of the system.

In June 2020, the SVC risk assessment was fully reviewed for all water supply systems, in consultation with NSW Health and DPIE Water. The risk assessment process included a comprehensive water quality data analysis, review of process flow diagrams, CCPs and catchment characteristics. Some key outcomes included:

- revising critical limits for filtered water turbidity
- development of procedures for operational correction.

The improvement plan was fully updated with new recommendations added as a result of the risk assessment review.

10. DWMS Audit Outcomes

There was no formal audit undertaken for DWMS implementation over the reporting period. The external audit frequency will be implemented as guided by NSW Health.

Glossary

Word	Description
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DWMS	Drinking Water Management System
NSW	New South Wales
NTU	Nephelometric Turbidity Units
pH	An expression of the intensity of the basic or acid condition of a liquid. Natural waters usually have a pH between 6.5 and 8.5
PHU	Public Health Unit
WTP	Water Treatment Plant

Appendix A

Reticulation Water Quality Monitoring

Table 14 Batlow Verification Monitoring

Parameter	Mean	Q1	Q3	Min	Max	Number	Guideline Value	Exceedances
Aluminium	0.01	0.01	0.01	0.01	0.01	3	0.2	0
Antimony	0	0	0	0	0	3	0.003	0
Arsenic	0	0	0	0	0	3	0.01	0
Barium	0.01	0.01	0.01	0.01	0.01	3	2	0
Boron	0.05	0.05	0.05	0.05	0.05	3	4	0
Cadmium	0	0	0	0	0	3	0.002	0
Calcium	3.766667	3.3	4.5	3.3	4.5	3	10000	0
Chloride	4	4	4	4	4	3	250	0
Chromium	0	0	0	0	0	3	0.05	0
Copper	0.05	0	0.1	0	0.1	3	2	0
<i>E. coli</i>						50	0	0
Fluoride	0.942308	0.9	0.99	0.8	1.06	13	1.5	0
Fluoride (daily WU)	0.959504	0.94	1.02	0.36	1.15	363	0.9 - 1.5	70
Fluoride (weekly WU)	0.947143	0.92	0.98	0.7	1.09	84	0.9 - 1.5	14
Fluoride (WU result)						0	1.5	0
Fluoride Ratio						0	0.8 - 1.2	0
Free Chlorine	0.3242	0.1375	0.4975	0.03	0.84	50	0.2 - 5	18
Iodine	0.01	0.01	0.01	0.01	0.01	3	0.5	0
Iron	0.01	0.01	0.01	0.01	0.01	3	0.3	0
Lead	0	0	0	0	0	3	0.01	0
Magnesium	0.783333	0.73	0.81	0.73	0.81	3	10000	0
Manganese	0.006667	0	0.01	0	0.01	3	0.5	0
Mercury	0	0	0	0	0	3	0.001	0
Molybdenum	0	0	0	0	0	3	0.05	0
Nickel	0.01	0.01	0.01	0.01	0.01	3	0.02	0
Nitrate	0.666667	0.5	1	0.5	1	3	50	0
Nitrite	0.05	0.05	0.05	0.05	0.05	3	3	0
pH	7.366667	7.3	7.4	7.3	7.4	3	6.5 - 8.5	0
Selenium	0	0	0	0	0	3	0.01	0
Silver	0	0	0	0	0	3	0.1	0
Sodium	4	4	4	4	4	3	180	0
Sulfate	0.5	0.5	0.5	0.5	0.5	3	500	0
Total Chlorine						0	5	0
Total Coliforms						50	0	0
Total Dissolved Solids (TDS)	21.33333	18	25	18	25	3	600	0
Total Hardness as CaCO ₃	12.63333	11.6	14.6	11.6	14.6	3	200	0
True Colour	1.5	0.5	3	0.5	3	3	15	0
Turbidity	0.216667	0.05	0.3	0.05	0.3	3	5	0
Uranium	0	0	0	0	0	3	0.017	0
Zinc	0.01	0.01	0.01	0.01	0.01	3	3	0

A



19NS16.1-REC-20-005-1.0
December 2020

DWMS Annual Report 2018

Table 15 Brungle Verification Monitoring

Parameter	Mean	Q1	Q3	Min	Max	Number	Guideline Value	Exceedances
Aluminium	0.01			0.01	0.01	1	0.2	0
Antimony	0			0	0	1	0.003	0
Arsenic	0			0	0	1	0.01	0
Barium	0.01			0.01	0.01	1	2	0
Boron	0.05			0.05	0.05	1	4	0
Cadmium	0			0	0	1	0.002	0
Calcium	3.9			3.9	3.9	1	10000	0
Chloride	5			5	5	1	250	0
Chromium	0			0	0	1	0.05	0
Copper	0.04			0.04	0.04	1	2	0
<i>E. coli</i>						32	0	0
Fluoride	0.05			0.05	0.05	1	1.5	0
Free Chlorine	0.569063	0.345	0.765	0.13	1.14	32	0.2 - 5	2
Iodine	0.01			0.01	0.01	1	0.5	0
Iron	0.01			0.01	0.01	1	0.3	0
Lead	0			0	0	1	0.01	0
Magnesium	0.97			0.97	0.97	1	10000	0
Manganese	0			0	0	1	0.5	0
Mercury	0			0	0	1	0.001	0
Molybdenum	0			0	0	1	0.05	0
Nickel	0.01			0.01	0.01	1	0.02	0
Nitrate	0.5			0.5	0.5	1	50	0
Nitrite	0.05			0.05	0.05	1	3	0
pH	7.4			7.4	7.4	1	6.5 - 8.5	0
Selenium	0			0	0	1	0.01	0
Silver	0			0	0	1	0.1	0
Sodium	5			5	5	1	180	0
Sulfate	1			1	1	1	500	0
Total Chlorine						0	5	0
Total Coliforms						32	0	0
Total Dissolved Solids (TDS)	25			25	25	1	600	0
Total Hardness as CaCO ₃	13.7			13.7	13.7	1	200	0
True Colour	3			3	3	1	15	0
Turbidity	0.1			0.1	0.1	1	5	0
Uranium	0			0	0	1	0.017	0
Zinc	0.01			0.01	0.01	1	3	0

B

19NS16.1-REC-20-005-1.0
December 2020

DWMS Annual Report 2018

Table 16 Khancoban Verification Monitoring

Parameter	Mean	Q1	Q3	Min	Max	Number	Guideline Value	Exceedances
Aluminium	0.01			0.01	0.01	1	0.2	0
Antimony	0			0	0	1	0.003	0
Arsenic	0			0	0	1	0.01	0
Barium	0.01			0.01	0.01	1	2	0
Boron	0.05			0.05	0.05	1	4	0
Cadmium	0			0	0	1	0.002	0
Calcium	5.8			5.8	5.8	1	10000	0
Chloride	3			3	3	1	250	0
Chromium	0			0	0	1	0.05	0
Copper	0.12			0.12	0.12	1	2	0
<i>E. coli</i>						24	0	0
Fluoride	0.05			0.05	0.05	1	1.5	0
Free Chlorine	0.837917	0.56	1.0225	0.14	1.75	24	0.2 - 5	1
Iodine	0.01			0.01	0.01	1	0.5	0
Iron	0.04			0.04	0.04	1	0.3	0
Lead	0			0	0	1	0.01	0
Magnesium	1.51			1.51	1.51	1	10000	0
Manganese	0			0	0	1	0.5	0
Mercury	0			0	0	1	0.001	0
Molybdenum	0			0	0	1	0.05	0
Nickel	0.01			0.01	0.01	1	0.02	0
Nitrate	0.5			0.5	0.5	1	50	0
Nitrite	0.05			0.05	0.05	1	3	0
pH	6.8696	6.785	6.93	6.68	7.2	25	6.5 - 8.5	0
Selenium	0			0	0	1	0.01	0
Silver	0			0	0	1	0.1	0
Sodium	4			4	4	1	180	0
Sulfate	1			1	1	1	500	0
Total Chlorine	0.920417	0.67	1.0825	0.31	1.85	24	5	0
Total Coliforms						24	0	0
Total Dissolved Solids (TDS)	27			27	27	1	600	0
Total Hardness as CaCO ₃	20.7			20.7	20.7	1	200	0
True Colour	3			3	3	1	15	0
Turbidity	0.05			0.05	0.05	1	5	0
Uranium	0			0	0	1	0.017	0
Zinc	0.01			0.01	0.01	1	3	0

C



19NS16.1-REC-20-005-1.0
December 2020

DWMS Annual Report 2018

Table 17 Talbingo Verification Monitoring

Parameter	Mean	Q1	Q3	Min	Max	Number	Guideline Value	Exceedances
Aluminium	0.045			0.03	0.06	2	0.2	0
Antimony	0			0	0	2	0.003	0
Arsenic	0			0	0	2	0.01	0
Barium	0.01			0.01	0.01	2	2	0
Boron	0.05			0.05	0.05	2	4	0
Cadmium	0			0	0	2	0.002	0
Calcium	7.95			4.8	11.1	2	10000	0
Chloride	2.5			2	3	2	250	0
Chromium	0			0	0	2	0.05	0
Copper	0			0	0	2	2	0
<i>E. coli</i>						24	0	0
Fluoride	0.05			0.05	0.05	2	1.5	0
Free Chlorine	0.485833	0.23	0.7275	0.13	0.91	24	0.2 - 5	5
Iodine	0.01			0.01	0.01	2	0.5	0
Iron	0.04			0.01	0.07	2	0.3	0
Lead	0			0	0	2	0.01	0
Magnesium	0.775			0.75	0.8	2	10000	0
Manganese	0			0	0	2	0.5	0
Mercury	0			0	0	1	0.001	0
Molybdenum	0			0	0	2	0.05	0
Nickel	0.01			0.01	0.01	2	0.02	0
Nitrate	0.5			0.5	0.5	2	50	0
Nitrite	0.05			0.05	0.05	2	3	0
pH	7.8			7.8	7.8	2	6.5 - 8.5	0
Selenium	0			0	0	2	0.01	0
Silver	0			0	0	2	0.1	0
Sodium	10.5			10	11	2	180	0
Sulfate	9			7	11	2	500	0
Total Coliforms						24	0	0
Total Dissolved Solids (TDS)	42			32	52	2	600	0
Total Hardness as CaCO ₃	23.05			15.1	31	2	200	0
True Colour	0.5			0.5	0.5	2	15	0
Turbidity	0.4			0.2	0.6	2	5	0
Uranium	0			0	0	2	0.017	0
Zinc	0.01			0.01	0.01	2	3	0

D



19NS16.1-REC-20-005-1.0
December 2020

DWMS Annual Report 2018

Table 18 Tumbarumba Verification Monitoring

Parameter	Mean	Q1	Q3	Min	Max	Number	Guideline Value	Exceedances
Aluminium	0.125			0.02	0.23	2	0.2	1
Antimony	0			0	0	2	0.003	0
Arsenic	0			0	0	2	0.01	0
Barium	0.01			0.01	0.01	2	2	0
Boron	0.05			0.05	0.05	2	4	0
Cadmium	0			0	0	2	0.002	0
Calcium	1.8			1.7	1.9	2	10000	0
Chloride	3			3	3	2	250	0
Chromium	0			0	0	2	0.05	0
Copper	0.02			0.01	0.03	2	2	0
<i>E. coli</i>						43	0	0
Fluoride	0.812222	0.595	0.97	0.4	1.09	9	1.5	0
Fluoride (daily WU)	1.006978	0.97	1.06	0.1	1.22	364	0.9 - 1.5	16
Fluoride (weekly WU)	1.011345	0.97	1.05	0.78	1.23	119	0.9 - 1.5	1
Fluoride (WU result)	0.8	0.725	0.905	0.47	0.95	8	1.5	0
Fluoride Ratio	0.95	0.8725	1	0.8	1.18	8	0.8 - 1.2	0
Free Chlorine	0.637619	0.4625	0.7725	0.05	1.4	42	0.2 - 5	2
Iodine	0.01			0.01	0.01	2	0.5	0
Iron	0.01			0.01	0.01	2	0.3	0
Lead	0.005			0	0.01	2	0.01	0
Magnesium	0.665			0.66	0.67	2	10000	0
Manganese	0			0	0	2	0.5	0
Mercury	0			0	0	2	0.001	0
Molybdenum	0			0	0	2	0.05	0
Nickel	0.01			0.01	0.01	2	0.02	0
Nitrate	0.5			0.5	0.5	2	50	0
Nitrite	0.05			0.05	0.05	2	3	0
pH	7.267273	7.15	7.45	6.75	7.65	44	6.5 - 8.5	0
Selenium	0			0	0	2	0.01	0
Silver	0			0	0	2	0.1	0
Sodium	20.5			20	21	2	180	0
Sulfate	19			18	20	2	500	0
Total Chlorine	0.702381	0.57	0.8625	0.2	1.3	42	5	0
Total Coliforms						43	0	0
Total Dissolved Solids (TDS)	52			47	57	2	600	0
Total Hardness as CaCO ₃	7.25			7	7.5	2	200	0
True Colour	1.5			1	2	2	15	0
Turbidity	0.125			0.05	0.2	2	5	0
Uranium	0			0	0	2	0.017	0
Zinc	0.03			0.01	0.05	2	3	0

E



19NS16.1-REC-20-005-1.0
December 2020

DWMS Annual Report 2018

Table 19 Tumut Verification Monitoring

Parameter	Mean	Q1	Q3	Min	Max	Number	Guideline Value	Exceedances
Aluminium	0.039167	0.0125	0.0475	0.01	0.13	12	0.2	0
Antimony	0	0	0	0	0	12	0.003	0
Arsenic	0	0	0	0	0	12	0.01	0
Barium	0.01	0.01	0.01	0.01	0.01	12	2	0
Boron	0.05	0.05	0.05	0.05	0.05	12	4	0
Cadmium	0	0	0	0	0	12	0.002	0
Calcium	3.75	3.25	4.075	3	4.6	12	10000	0
Chloride	3	3	3	3	3	12	250	0
Chromium	0	0	0	0	0	12	0.05	0
Copper	0.014167	0	0.01	0	0.09	12	2	0
<i>E. coli</i>					2	76	0	1
Fluoride	0.885833	0.8525	0.9275	0.81	0.95	12	1.5	0
Fluoride (daily WU)	0.983324	0.94	1.02	0.6	1.21	364	0.9 - 1.5	8
Fluoride (weekly WU)	0.966146	0.9125	1.01	0.79	1.13	96	0.9 - 1.5	5
Free Chlorine	0.544605	0.43	0.7075	0.1	0.98	76	0.2 - 5	4
Iodine	0.01	0.01	0.01	0.01	0.01	12	0.5	0
Iron	0.010833	0.01	0.01	0.01	0.02	12	0.3	0
Lead	0	0	0	0	0	12	0.01	0
Magnesium	0.981667	0.8825	1.0725	0.76	1.32	12	10000	0
Manganese	0.0025	0	0.0075	0	0.01	12	0.5	0
Mercury	0			0	0	1	0.001	0
Molybdenum	0	0	0	0	0	12	0.05	0
Nickel	0.01	0.01	0.01	0.01	0.01	12	0.02	0
Nitrate	0.5	0.5	0.5	0.5	0.5	12	50	0
Nitrite	0.05	0.05	0.05	0.05	0.05	12	3	0
pH	7.533333	7.4	7.6	7.3	7.8	12	6.5 - 8.5	0
Selenium	0	0	0	0	0	12	0.01	0
Silver	0	0	0	0	0	12	0.1	0
Sodium	5.166667	5	5.75	4	6	12	180	0
Sulfate	0.583333	0.5	0.5	0.5	1	12	500	0
Total Chlorine	0.406667	0.4	0.42	0.4	0.42	3	5	0
Total Coliforms					201	76	0	1
Total Dissolved Solids (TDS)	22.83333	20.5	24.75	16	27	12	600	0
Total Hardness as CaCO ₃	13.40833	12.4	14.05	11.5	15.9	12	200	0
True Colour	0.708333	0.5	0.875	0.5	2	12	15	0
Turbidity	0.166667	0.05	0.325	0.05	0.5	12	5	0
Uranium	0	0	0	0	0	12	0.017	0
Zinc	0.01	0.01	0.01	0.01	0.01	12	3	0

F



19NS16.1-REC-20-005-1.0
December 2020

Appendix B

Improvement Plan Status

G

19NS16.1-REC-20-005-1.0
December 2020





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