Drinking Water Management System

Annual Report

August 2018 – July 2019

Warrumbungle Shire Council

Date: December 2019

Version: 2.1

Document control

Date	Version	Status	Person
22/08/2019	1.0	Internal draft	Lucy Parsons (Atom Consulting)
28/08/2019	1.1	Onsite review of data with Council	Natalie Crawford (Atom Consulting)
13/09/2019	2.0	For Council review	Natalie Crawford and Lucy Parsons (Atom Consulting)
2/12/2019	2.1	Council review	Cornelia Wiebels (Warrumbungle Water)

Executive Summary

This Annual Report documents Warrumbungle Shire Council's Drinking Water Management System (DWMS) implementation and drinking water performance from 1 August 2018 to 31 July 2019. Drinking water performance for the period is summarised below.

Critical Control Points

Critical control point exceedances are summarised in Table i-i.

Table i-i. Critical control point (CCP), critical operational point (COP) and operational critical point (OCP) exceedance summary

Number of CCP exceedances	CCP Filtration	CCP Disinfection	CCP Fluoridation	COP pH	CCP Reservoirs	CCP Distribution Free chlorine	OCP Distribution Turbidity
Coonabarabran	-	-	Not fluoridating		*	2	-
Baradine	1	-	Not fluoridating		*	-	-
Kenebri		2			*	1	-
Bugaldie		1			*	3	2
Mendooran	2	2	Not fluoridating	2	*	5	1
Coolah		1	Not fluoridating		Breach *	1	
Binnaway	-	-	Not fluoridating		*		
Dunedoo	-	-			*		

*CCP inspections were not undertaken in the reporting period

Water quality

NSW Health verification monitoring exceptions are summarised by system in Table i-ii. In January 2019 Coolah was on a boil water alert due to an E.coli read in the reticulation and the discovery of possums in the reservoir, the animals were removed and the reservoir secured; details in Section 8.6.

Table i-ii. NSW Health verification data summary

System	Characteristic	Date	Exception value	Units
Coonabarabran	**Total Coliforms**	1/05/2019	200	mpn/100 mL
		28/05/2019	1	mpn/100 mL
		26/06/2019	62	mpn/100 mL
Baradine	**Total Chlorine**	24/07/2018	7.91	mg/L
		18/09/2018	7.98	mg/L
	Total Coliforms	17/04/2019	5	mpn/100 mL
		1/05/2019	45	mpn/100 mL
Kenebri	**Free Chlorine**	22/01/2019	0.08	mg/L
	Total Coliforms	18/12/2018	8	mpn/100 mL
Bugaldie	**Iron**	27/03/2019	0.35	mg/L
	Total Coliforms	22/01/2019	38	mpn/100 mL
		28/05/2019	12	mpn/100 mL
	Turbidity	27/03/2019	5.54	NTU

System	Characteristic	Date	Exception value	Units
		23/04/2019	6.35	NTU
Mendooran	**Total Coliforms**	8/01/2019	2	mpn/100 mL
		30/04/2019	200	mpn/100 mL
	Total Dissolved Solids (TDS)	26/03/2019	637	mg/L
	Total Hardness as CaCO3	25/09/2018	204.3	mg/L
		26/03/2019	224.6	mg/L
	Turbidity	25/02/2019	8.36	NTU
Coolah	***E. coli***	15/01/2019	15	mpn/100 mL
	Free Chlorine	13/11/2018	0	mg/L
		10/04/2019	0.06	mg/L
	Total Chlorine	10/07/2018	5.07	mg/L
	Total Coliforms	5/12/2018	1	mpn/100 mL
		15/01/2019	200	mpn/100 mL
		30/04/2019	200	mpn/100 mL
	Total Hardness as CaCO3	25/09/2018	474.3	mg/L
		26/03/2019	395.2	mg/L
Binnaway	**pH**	10/04/2019	1.41	
	Sodium	26/03/2019	209	mg/L
	Total Coliforms	6/05/2019	3	mpn/100 mL
	Total Dissolved Solids (TDS)	26/03/2019	899	mg/L
	Total Hardness as CaCO3	2/10/2018	226.8	mg/L
		26/03/2019	219.7	mg/L
Dunedoo	**Total Coliforms**	23/01/2019	8	mpn/100 mL
		30/04/2019	12	mpn/100 mL
	Total Dissolved Solids (TDS)	26/03/2019	757	mg/L
	Total Hardness as CaCO3	25/09/2018	409.3	mg/L
		26/03/2019	352.6	mg/L

Continuous improvement plan

A summary of improvement plan progress summary is show in Table i-iii.

Table i-iii. Summary of water quality improvement plan progress

Row Labels	Closed	Complete / implemented	Complete, follow up required	In progress	Not started
Very high	6	15	2	13	
High	18	51		62	23
Medium	23	40		39	29
Low	4	2		7	7
Total	**51**	**108**	**2**	**121**	**59**

DWMS Reviews

A summary of DWMS reviews is shown in Table i-iv.

Table i-iv. Review of DWMS reviews

Date	Attendance	Scope	Findings	Actions
25/1/2019	Council, NSW Health, NSW DIPE	Water quality review meeting	Review of water quality data,	
1/03/2019	Council, NSW DIPE	Water quality review meeting	CCPs were reviewed and updated Review of water quality data	
28/6/2019	Atom Consulting,	Review of water quality	Progress of actions	Timelines and

Date	Attendance	Scope	Findings	Actions
	Council, NSW Health, NSW DIPE	improvement plan (very high- and high-level priority actions)	reviewed	responsibility assigned
30/07/2019	Atom Consulting, Council	Review of water quality improvement plan (high and medium priority actions)	Progress of actions reviewed	Timelines and responsibility assigned

Reservoir inspections

A summary of reservoir inspections is shown in Table i-v.

Table i-v. Summary of reservoir inspections

Date	Reservoirs inspected	Findings	Corrective actions
13-17/5/2019	Baradine WTP CWT	New access hatch installed and external wall sealing and vermin proof works undertaken.	-
13/02/2019	Baradine HL Reservoir	The entry hatch is unsealed against natural and deliberate contamination. The roof area is also unsealed.	The identified issues have been rectified. New access hatch installed.
3/02/209	Binnaway Reservoir	The entry hatch is unsealed around the edges and leaves and debris are entering via the unsealed ridge caps.	This tank still needs to be renovated. Project planning and budgeting is in progress.
7/02/2019	Bugaldie Reservoir	The roof area is unsealed in several areas – the internal areas of the reservoir could not be inspected as there is no entry hatch.	Project planning and budgeting is in progress.
20/02/2019	Coolah Martin St Reservoir	The inspection and cleaning of this reservoir was requested due to a poor sample being taken. Significant water quality risks were present around this reservoir.	The identified issues have been rectified. New access hatch installed.
05/02/2019	Coolah Wentworth Ave No. 1 Reservoir	No water quality issues noted. Entry hatch needs lock.	Entry hatch is now locked.
05/02/2019	Coolah Wentworth Ave No. 2 Reservoir	No water quality issues noted. Entry hatch needs lock.	Entry hatch is now locked.
06/02/2019	Coonabarabran Rifle Range No. 1 Reservoir	There is significant corroded items present in the reservoir.	Project planning and budgeting is in progress.
05/02/2019	Coonabarabran Rifle Range No. 2 Reservoir	The platform/hatch areas are unsealed against contamination.	Project planning and budgeting is in progress.
06/02/2019	Coonabarabran WTP CWT	The entry hatch is unsealed against natural or deliberate contamination.	New access hatch installed.
04/02/2019	Dunedoo – Rhodes No. 1 Reservoir	The roof is at risk of failure due to the corrosion on the rafters and design. There is a significant amount of bird faeces on the roof and platform areas which are unsealed	The entry hatch edges have been mastic sealed and the roof sheet edges have also been sealed off.
04/02/2019	Dunedoo – Rhodes No. 2 Reservoir	The roof is at risk of failure due to the corrosion on the rafters and design. There is a significant amount of bird faeces on the roof and platform areas which are unsealed.	The roof edges have been sealed.
02/02/2019	Dunedoo - Bullinda Reservoir	No water quality issues noted.	New access hatch installed.

Date	Reservoirs inspected	Findings	Corrective actions
2/03/2019	Mendooran Cobra St Reservoir	The entry hatch has no raised or sealed edge and bird faecal material is present on the platform area - the overhead rescue system is attractive to roosting birds, so this faecal issue will be an ongoing problem until the entry hatch is upgraded.	The entry hatch has been upgraded and the centre roof vent area has been sealed off.
24/06/2019	Mendooran WTP CWT	The CWT has been effectively sealed against contamination ingress.	-
29/4-3/5/19	Mendooran Reservoir Coolabah No. 1	Installed new access hatch to seal against contamination ingress.	-
29/4-3/5/19	Mendooran Reservoir Coolabah No. 2	Installed new access hatch to seal against contamination ingress.	-
29/4-3/5/19	Mendooran Reservoir Coolabah No. 2	Installed new access hatch and filling of gaps to seal against contamination ingress.	-

Contents

Tables

Figures

1 Report Purpose

This Annual Report documents Warrumbungle Shire Council's DWMS implementation for the period 1 August 2018 to 31 July 2019. It has been prepared to support the reporting (Element 10), evaluation (Element 11) and review and continual improvement (Element 12) requirements of the DWMS.

This report includes the following areas:

- Performance of critical control points
- Water quality review
- Consumer complaints
- Water quality incidents
- Staff development and training
- Improvement plan implementation

A review of system performance has been made against Australian Drinking Water Guidelines (2011), levels of service and other regulatory requirements (Element 1).

2 DWMS document control

Updates to the DWMS documentation have been summarised in Table 2-1.

Table 2-1. DWMS document control

Document	Version	Updates	Submitted to NSW Health and date submitted?
Warrumbungle Shire Council Drinking Water Management System	October 2014	None	
CCP reference guide	June 2019	Updates to limits and protocols	As part of March 2019 quarterly water quality meeting

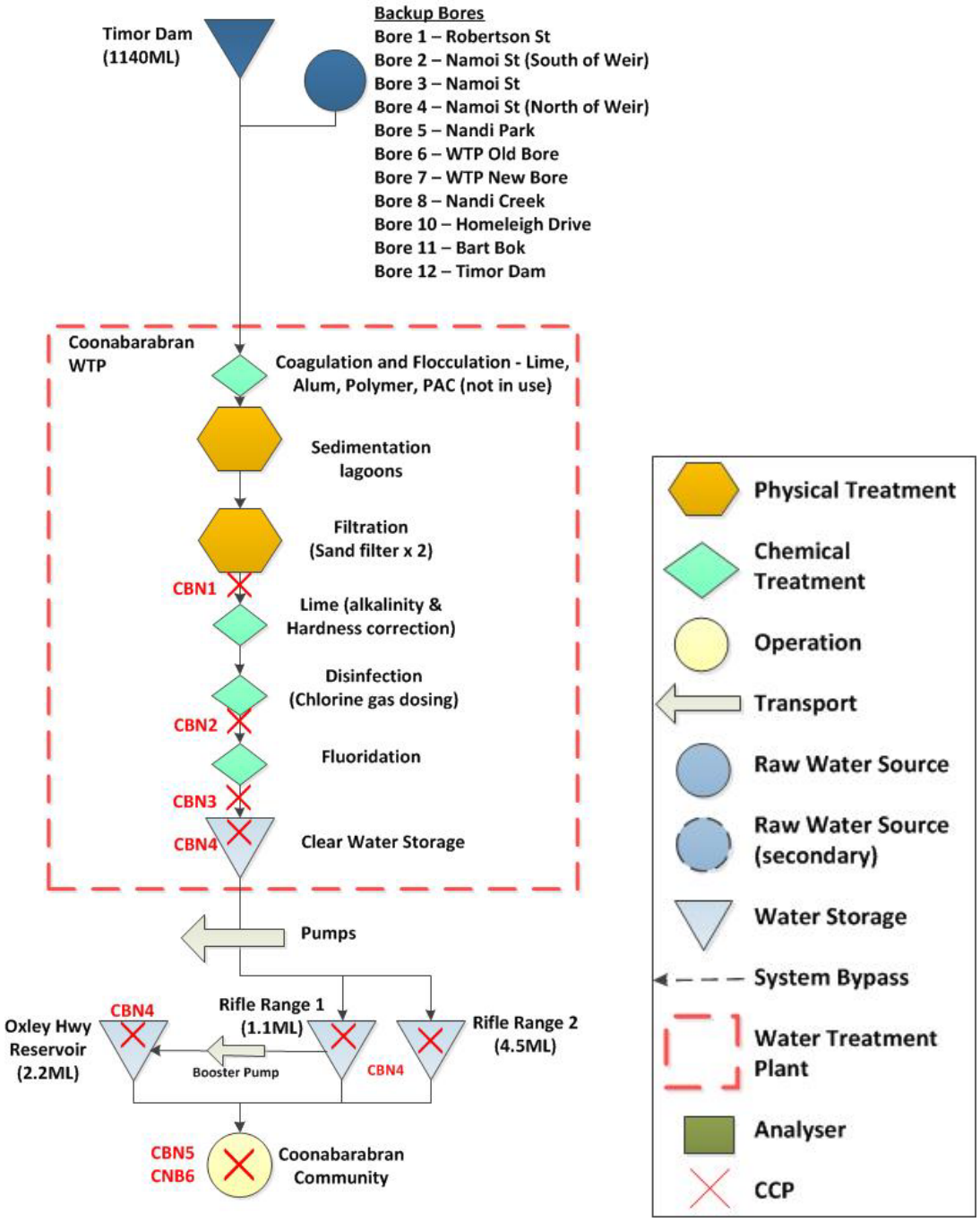
3 Coonabarabran

3.1 Scheme summary

The Coonabarabran water supply system comprises:

- Source water: Castlereagh River (Timor Dam, Poundyard Weir), supplementary bores
- Treatment: WTP with coagulation (alum, polymer), flocculation, sedimentation (x2 lagoons), sand bed filtration (x2 filters), pH correction (lime), chlorine gas disinfection and fluoridation (currently off-line).
- Number of residential connections: 1152
- Number of non-residential connections: 238

Figure 3-1: Water supply flow diagram – Coonabarabran



Improvement works undertaken from August 2018 to July 2019 for the Coonabarabran water supply include:

- Telemetry Upgrades
- Clear water tank & reservoir upgrades
- Upgrades to chlorine room
- WTP Renewals/improvements
- Cap old bore
- New bores (Table 3-1)

Table 3-1. Summary of new bore numbers, names/locations and depths - Coonabarabran

Bore No	Bore name/location	Bore depths, new bores (m)
1	Robertson Street	22
2	Namoi Street, South of river	24
3	Namoi Street, North of river, old (closest to White Street)	90
4	Namoi Street, North of river, new (closest to river)	26
5	Nandi Park	48
6	WTP*, old	39
7	WTP*, new	88
8	Nandi Creek	150
9	Morrissey's Corner – discontinued/not equipped due to insufficient yield	150
10	Home leigh Drive	150
11	Bart Bok	136
12	New bore at Timor Dam	150

* WTP – Water Treatment Plant Coonabarabran

3.2 Critical control points

The CCPs for Coonabarabran are shown in Table 3-2. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 3-3.

Table 3-2. Summary of critical control points and critical operational points – Coonabarabran

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
CBN1	Filtration	Turbidity	<0.3 NTU	>0.5 NTU	>0.7 NTU
CBN2	Disinfection (gas)	Chlorine	2.0 – 3.5 mg/L	<1.8 mg/L, >3.5 mg/L	<1.5 mg/L, >4.0 mg/L
CBN3	Fluoridation	Fluoride	1 mg/L (leaving WFP, leaving reservoir and throughout distribution system)	< 0.9 mg/L for >72hrs > 1.1 mg/L	<0.9 mg/L for >72hrs >1.5 mg/L 0.0 mg/L for >24hrs
CBN4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
CBN5	Distribution	Chlorine	0.6 - 3.0 mg/L	< 0.4 mg/L, >3.5 mg/L	< 0.2 mg/L, or >4 mg/L
CBN6	Distribution **(OCP)**	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

Table 3-3. Summary of critical control points changes – Coonabarabran

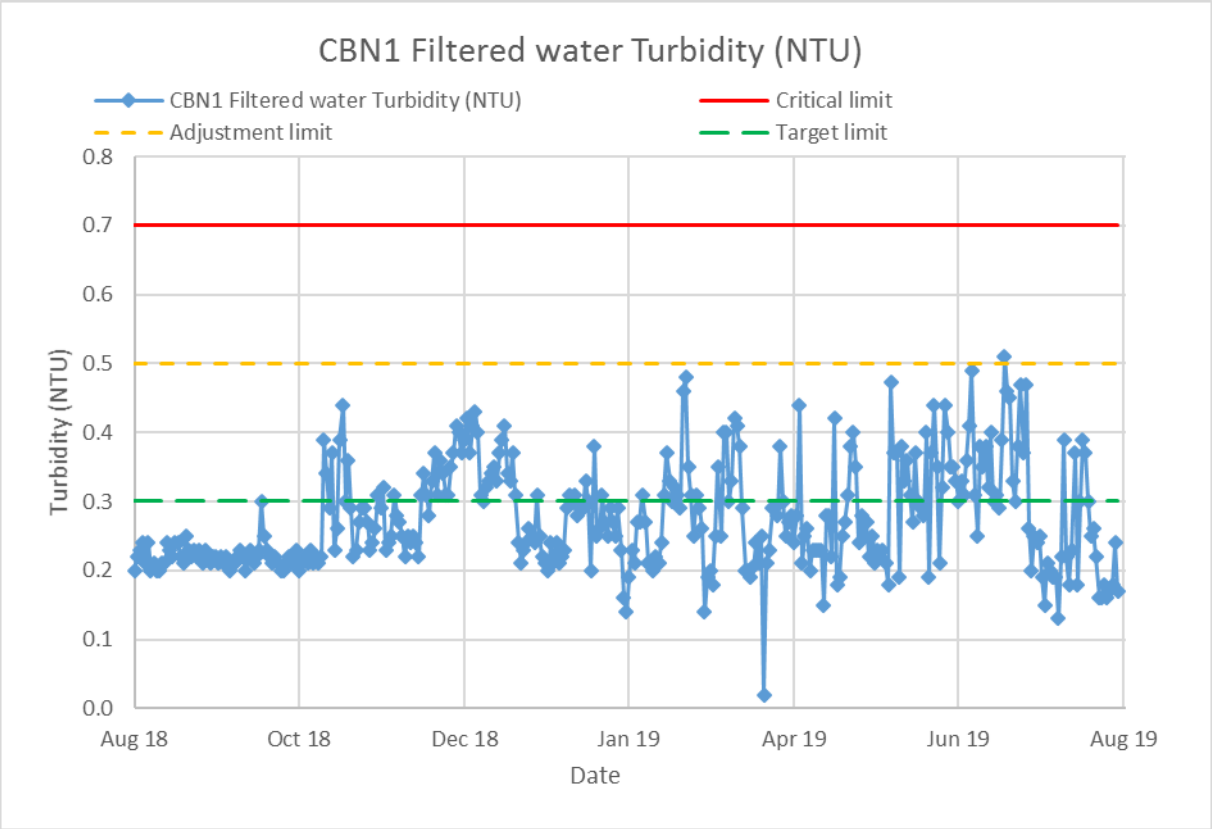
Date	CCP	Limit	Old	New	Reason for change
8 March 2019 Water Quality Meeting	CBN3 Fluoridation	Alert Level	<0.9 mg/L or >1.1 mg/L (calculated daily concentration) OR <0.9 mg/L or > 1.2 mg/L measured concentration	<0.9 mg/L for >72hrs	Recommendation/ action item from last meeting to be in line with the NSW Health Form 5 requirements
		Critical Limit	>1.5 mg/L (calculated daily concentration) OR >1.4 mg/L (concentration leaving reservoir)	>1.5 mg/L, 0.0 mg/L for >24hrs	
	CBN2 Disinfection	Target	2.0 – 3.5 mg/L	2.0 – 3.0 mg/L	Recommendation/acti on item from last meeting to prevent low chlorine residual in reticulation system
		Alert Level	<2.0 or >4.0 mg/L	<1.8 or >3.5 mg/L	
		Critical Limit	<1.8 or >4.5 mg/L	<1.5 or >4.0 mg/L	
	CBN5 Distribution	Target	0.6 - 3.5 mg/L	0.6 – 3.0 mg/L	
		Alert Level	< 0.4 mg/L, >4.0 mg/L	<0.4 mg/L, > 3.5mg/l	
		Critical Limit	< 0.2 mg/L, or >4.5 mg/L	< 0.2mg/L, or > 4.0 mg/L	

Critical control point performance for the reporting period is graphed in Figure 3-2, Figure 3-3 and Figure 3-4.

The fluoridation plant was offline during the reporting period.

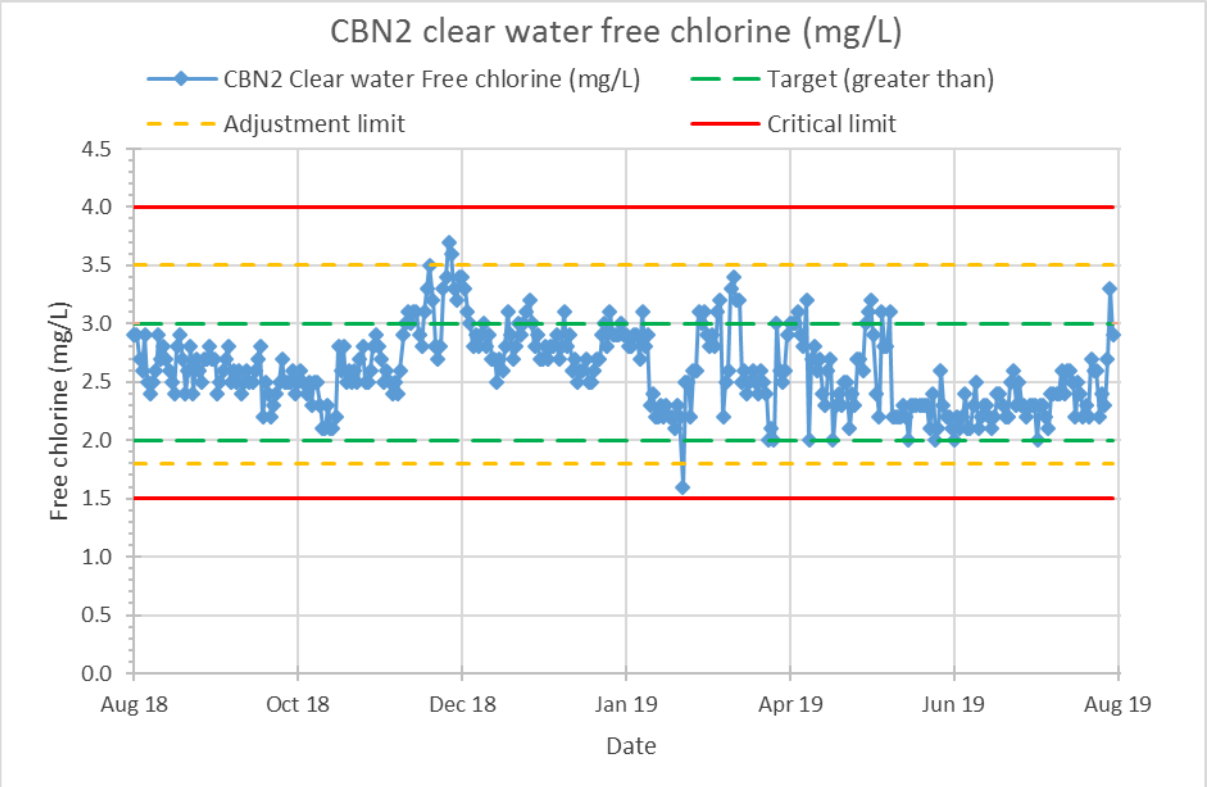
Inspections of the reservoir CCP are not currently being undertaken due to WHS issues. Development of a reservoir inspection SOP is included as an action item in the improvement plan and is currently in progress.

Figure 3-2: Coonabarabran - Filtered water turbidity CCP (CBN1)



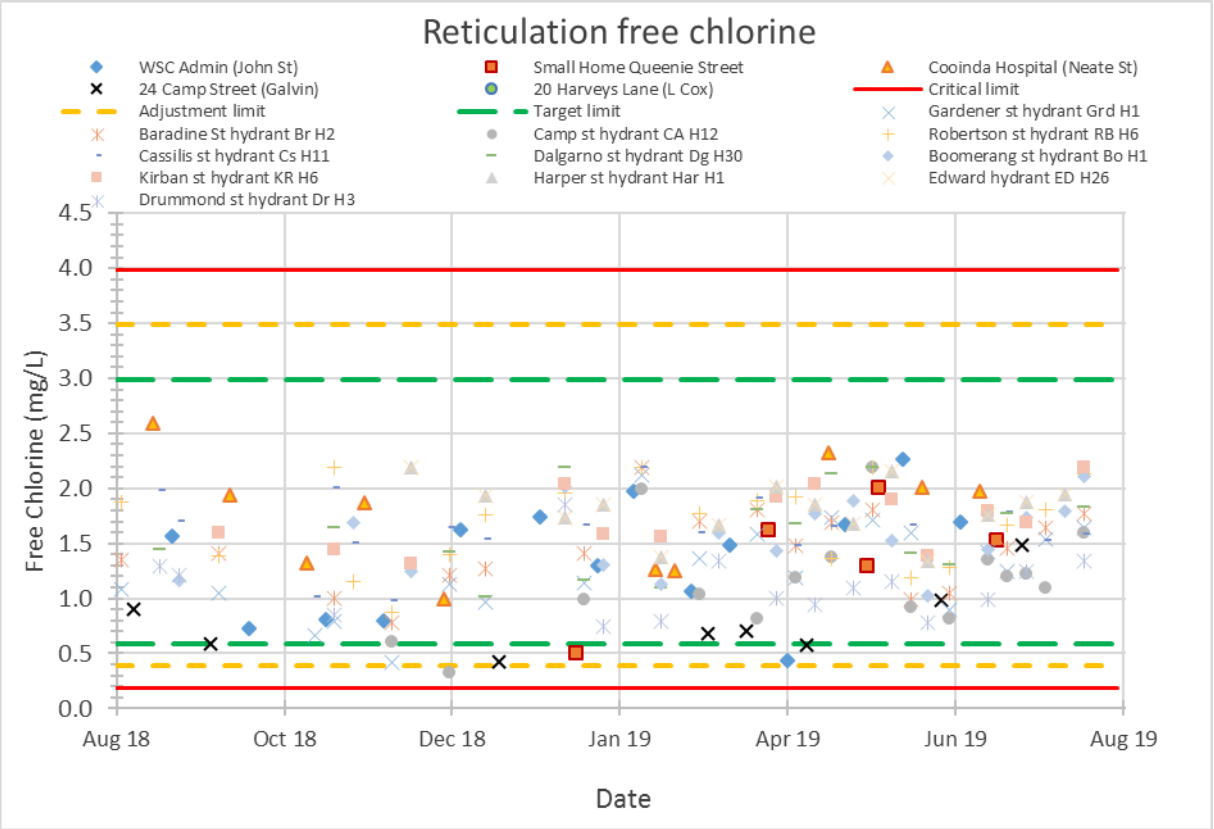
Source: *Coonabarabran operational monitoring spreadsheet*

Figure 3-3: Coonabarabran - Clear water free chlorine CCP



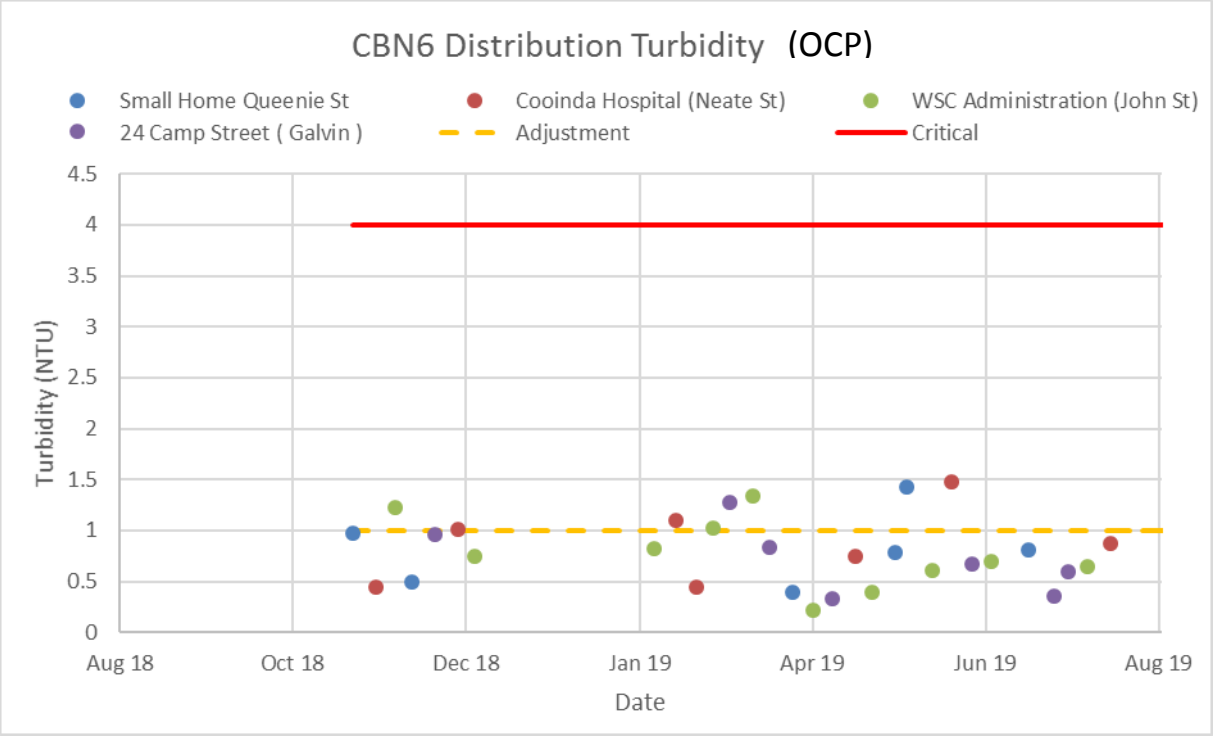
Source: *Coonabarabran operational monitoring spreadsheet*

Figure 3-4: Coonabarabran - Reticulation free chlorine CCP (CBN5)



Source: *Coonabarabran operational monitoring spreadsheet*

Figure 3-5: Coonabarabran - Reticulation turbidity OCP (CBN6)



Source: *2018 and 2019 Verification monitoring spreadsheets*

3.3 Critical limit exceedance

Critical limit exceedances in the reporting period are detailed in Table 3-4. CBN4 reservoir integrity was not inspected due to WHS concerns. The fluoridation plant was offline during the reporting period.

Table 3-4. Critical limit exceedances – Coonabarabran

Date	CBN1 Filtration	CBN2 Free chlorine	CBN3 Fluoridation	CBN4 Reservoirs	CBN5 Distribution Cl	CBN6 Distribution NTU (OCP)	Reason	Immediate correction	Preventive Action
2/11/18					0		Lack of water turn over due to restriction	Line flushed, which increased chlorine	Weekly flushing program; Mains replacement program (higher chlorine consumption in old cast iron pipes)
20/11/18					Low, Camp St				

3.4 Water quality

This section includes a review of water quality data for the Coonabarabran water supply system from the reporting period, 1 August 2018 to 31 July 2019, including data collected as part of the NSW Health drinking water monitoring system program.

3.4.1 Data collection

The Coonabarabran scheme operational water quality monitoring plan is shown in Table 3-5.

Table 3-5. Monitoring undertaken for Coonabarabran water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Timor line Raw water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
Poundyard Raw water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
Settled water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
Filtered water	CBN1	Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
Clear water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
	CBN2	Free chlorine	mg/L	Daily
	CBN3	Fluoride	mg/L	Daily (when operational)
Reticulation	CBN5	Free chlorine	mg/L	Weekly
		Total Chlorine	mg/L	Weekly
		pH		Weekly
	CBN6 (OCP)	Turbidity	mg/L	Weekly

3.4.2 Water quality issues

Monitoring of Coonabarabran water supply system detected no exceptions with ADWG health and aesthetic guidelines. There were three samples with detections of total coliforms.

3.5 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 3-6. There were 5 water quality complaints concerning dirty water in Coonabarabran (October 2018, March 2019 and May 2019.

Table 3-6. Summary of water quality customer complaints / enquiries – Coonabarabran

Complaints/Enquires	Type	Number
Water Quality	Complaints	5
Water Main (leaks /bursts)	Enquiry	13
	Complaints	1
Water (pressure / lack of water)	Enquiry	12
Water restrictions	Enquiry	3
Water Meter	Enquiry	35
	Complaints	4

3.6 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Coonabarabran water supply system in the reporting period.

3.7 Reservoir inspections

Details of reservoir inspections undertaken from August 2018 to July 2019 are shown in Table 3-7.

Informal visual inspections of the reservoirs by the WTP operators were also undertaken approximately on a weekly basis.

Table 3-7. Summary of reservoir inspections - Coonabarabran

Date	Reservoirs inspected	Findings	Corrective actions
06/02/2019	Coonabarabran Rifle Range No. 1 Reservoir	There is significant corroded items present in the reservoir.	Project planning and budgeting is in progress.
05/02/2019	Coonabarabran Rifle Range No. 2 Reservoir	The platform/hatch areas are unsealed against contamination.	Project planning and budgeting is in progress.
06/02/2019	Coonabarabran WTP CWT	The entry hatch is unsealed against natural or deliberate contamination.	New access hatch installed.

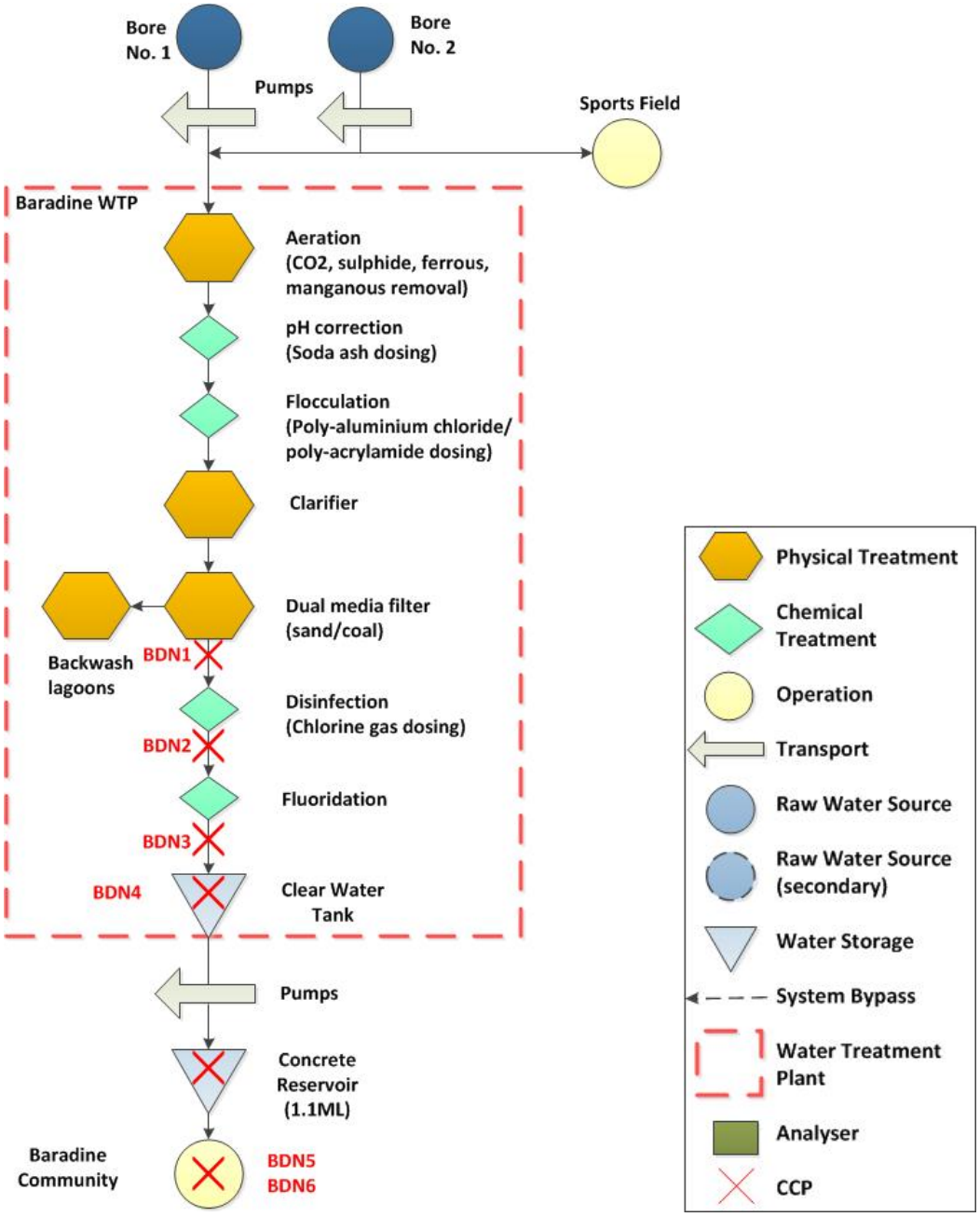
4 Baradine

4.1 Scheme summary

The Baradine water supply system comprises:

- Source water: Bore
- Treatment: WTP with aeration, pH correction (soda ash), flocculation (PACl, electrolyte), clarification, sand bed filtration (x1 filter), backwash/sludge lagoons, chlorine gas disinfection and fluoridation (currently off-line).
- Distribution note: rising main = distribution main, reservoir inlet = reservoir outlet
- Number of residential connections: 320
- Number of non-residential connections: 51

Figure 4-1: Water supply flow diagram – Baradine



Improvement works undertaken from August 2018 to July 2019 for the Baradine water supply include:

- Removal of Dead Ends
- Concrete cap old bore
- WTP Renewals & Improvements
- Telemetry Upgrades
- Clear water tank & reservoir upgrades
- Upgrades to chlorine room

4.2 Critical control points

The CCPs for Baradine are shown in Table 3-2. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 4-2.

Table 4-1. Summary of critical control points – Baradine

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
BDN1	Filtration	Turbidity	<0.3 NTU	>0.5 NTU	>0.8 NTU
BDN2	Disinfection (gas)	Chlorine	1.4 – 1.9 mg/L	<1.2 mg/L, >2.5 mg/L	<1.0 mg/L, >4.0 mg/L
BDN3	Fluoridation	Fluoride	1 mg/L (leaving WTP, leaving reservoir and throughout distribution system)	< 0.9 mg/L for >24hrs > 1.1 mg/L	<0.9 mg/L for >72hrs >1.5 mg/L 0.0 mg/L for >24hrs
BDN4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
BDN5	Distribution	Chlorine	>0.8 mg/L, <2.0 mg/L	<0.5 mg/L, >2.5 mg/L	<0.2 mg/L, >4.0 mg/L
BND6	Distribution (**OCP**)	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

Table 4-2. Summary of critical control points changes – Baradine

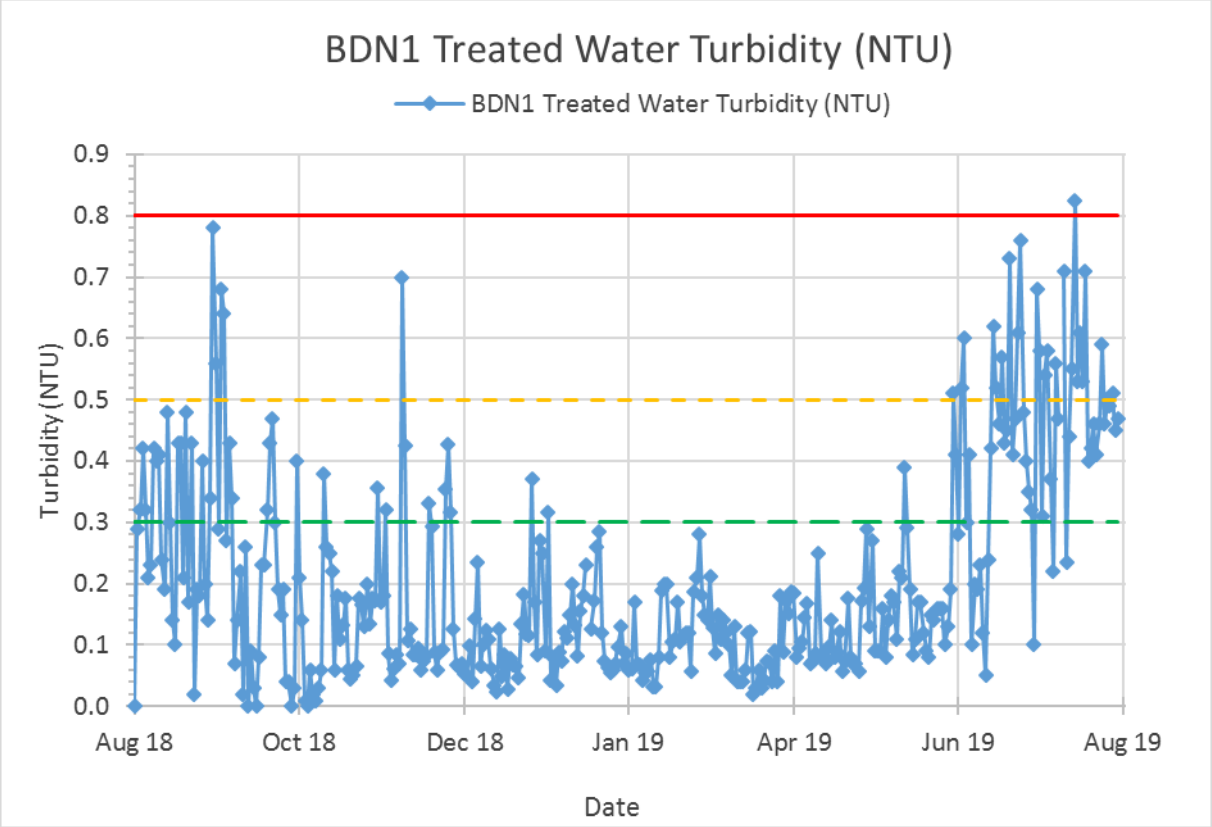
Date	CCP	Limit	Old	New	Reason for change
8 March 2019 Water Quality Meeting	BDN2 Disinfection	Target	1.4 – 1.5 mg/L	1.4 – 1.9 mg/L	Upper target level now in line with operational levels.
		Alert Level	<1.2 mg/L, >2.0 mg/L	<1.2 mg/L, >2.5 mg/L	
		Critical Limit	<0.8 mg/L, >4.0 mg/L	<1.0 mg/L, >4.0 mg/L	Increased to increase CT.

Critical control point performance for the reporting period is graphed in Figure 4-2, Figure 4-3, Figure 4-4 and Figure 4-5.

The fluoridation plant was offline during the reporting period.

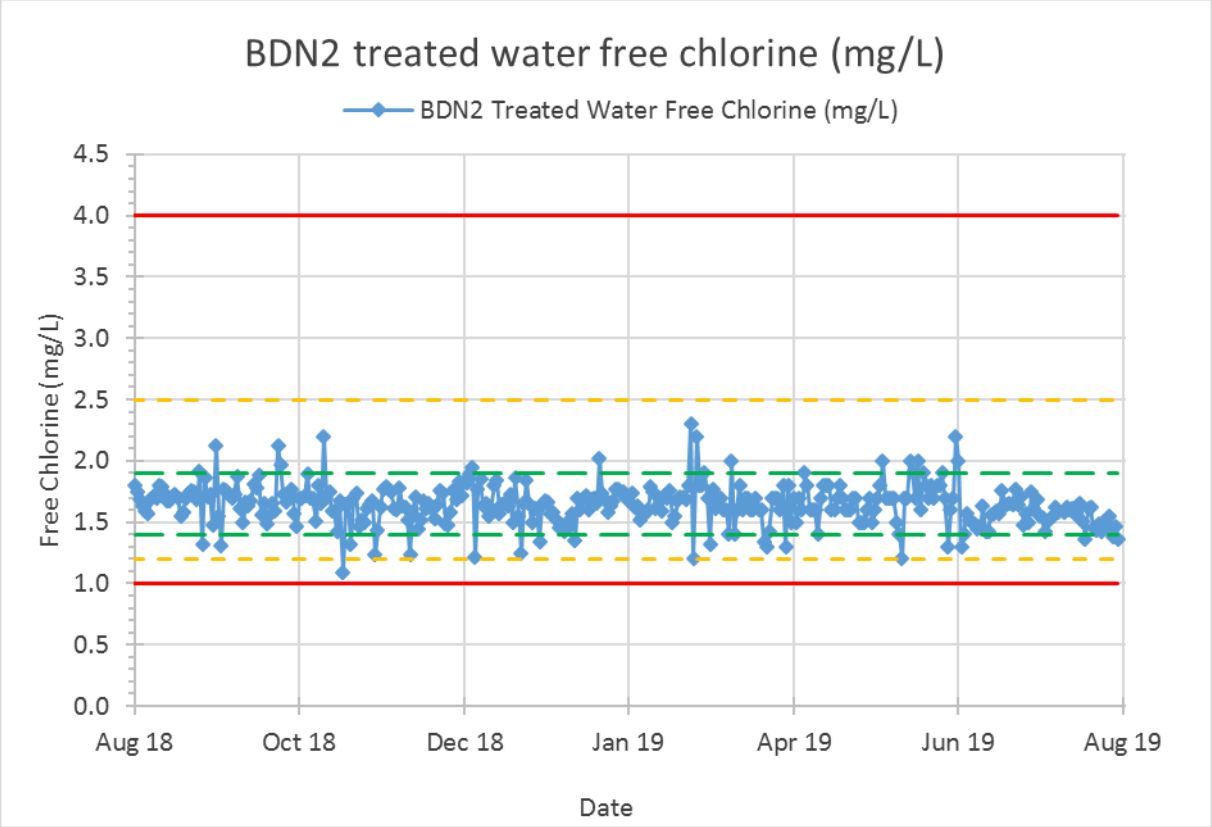
Inspections of the reservoir CCP are not currently being undertaken. Development of a reservoir inspection SOP is included as an action item in the improvement plan and is currently in progress.

Figure 4-2: Treated water turbidity (BDN1) – Baradine



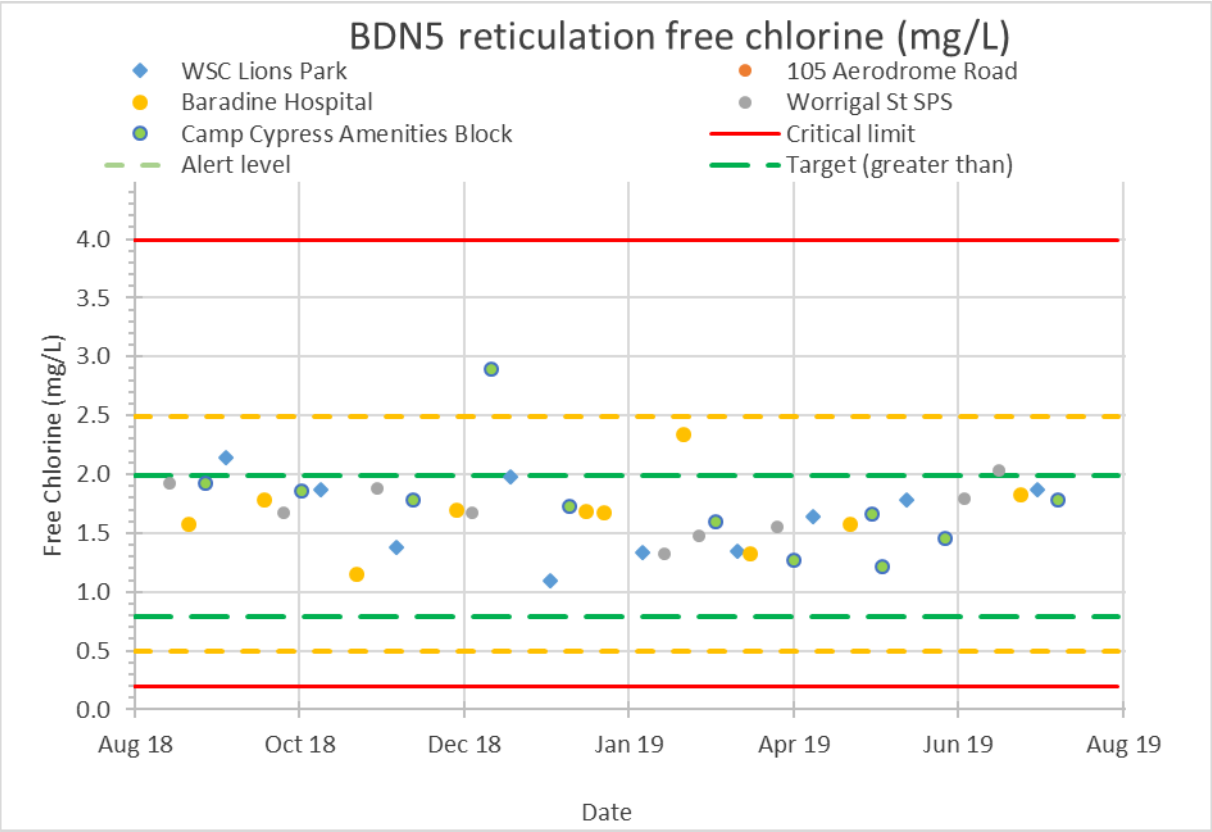
Source: *Baradine operational monitoring spreadsheet*

Figure 4-3: Treated water free chlorine (BDN2) – Baradine



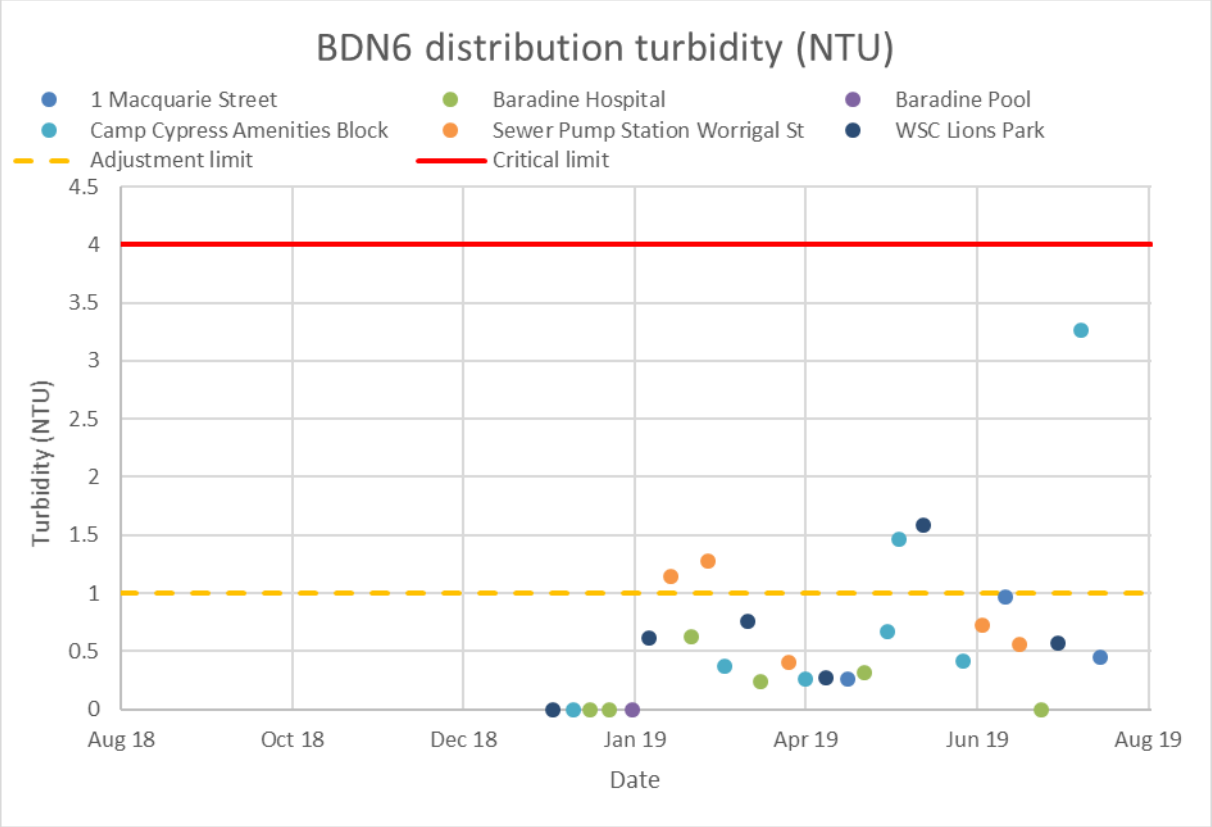
Source: *Baradine operational monitoring spreadsheet*

Figure 4-4: Reticulation free chlorine (BDN5) – Baradine



Source: *Baradine operational monitoring spreadsheet*

Figure 4-5: Distribution turbidity (BDN6) – Baradine



Source: *Baradine operational monitoring spreadsheet*

4.3 Critical limit exceedance

Critical limit exceedances in the reporting period are detailed in Table 4-2. BDN4 reservoir integrity was not inspected due to WHS concerns. The fluoridation plant was offline during the reporting period.

Table 4-3. Critical limit exceedances – Baradine

Date	BDN1 Filtration	BDN2 Disinfection	BDN3 Fluoridation	BDN4 Reservoirs	BDN5 Distribution Cl	BDN6 Distribution NTU (OCP)	Reason	Immediate correction	Preventive Action
15/7/19	0.85 NTU						Assumed iron and manganese issue		Chlorine dose pre filter was unsuccessful; clarifier cleaned – no improvement; sought proposal from consultant to troubleshoot + arranged for filter inspection through NSW Health

4.4 Water quality

This section includes a review of water quality data for the Baradine water supply system from the reporting period, 1 August 2018 to 31 July 2019, including data collected as part of the NSW Health drinking water monitoring system program.

4.4.1 Data collection

The Baradine scheme operational water quality monitoring plan is shown in Table 4-4.

Table 4-4. Monitoring undertaken for Baradine water supply system

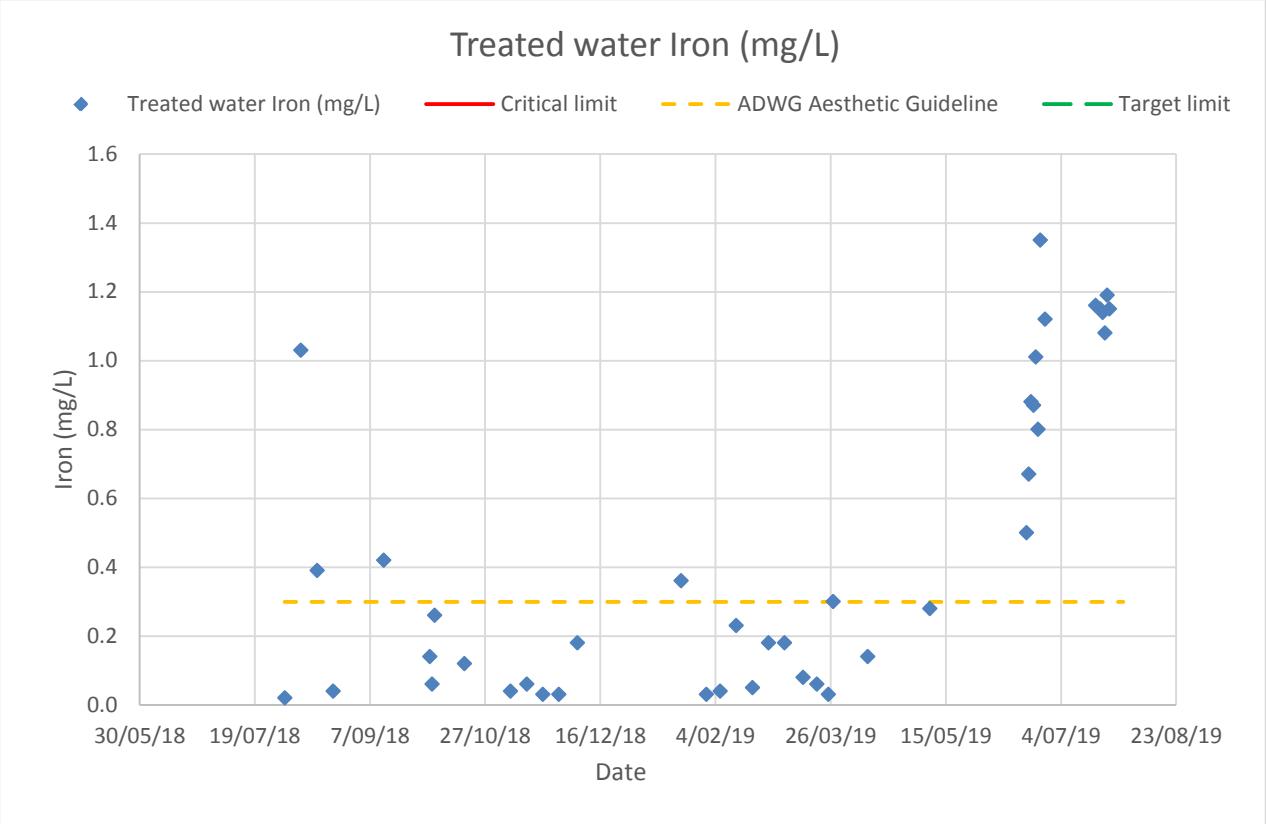
Process	CCP /OCP	Parameter	Unit	Frequency
Raw water		pH		Daily
Aerated Water		pH		Daily
Treated water		pH		Daily
	BDN2	Free Chlorine	mg/L	Daily
	BDN1	Turbidity	NTU	Daily
		Iron	mg/L	Weekly
		Manganese	mg/L	Weekly
	BDN5	Free Chlorine	mg/L	Weekly
Reticulation		Total Chlorine	mg/L	Weekly
		pH		Weekly
	BDN6	Turbidity	NTU	Weekly

4.4.2 Water quality issues

Monitoring of Baradine water supply detected two ADWG health exceptions for high chlorine (July and August 2018). Two total coliform detects occurred in April and May 2019.

An increase in treated water turbidity is seen from July 2019 due to issues with increased levels of iron (Figure 4-6) and manganese in the raw water.

Figure 4-6: Treated water iron – Baradine



4.5 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 4-5. There was one water quality complaint of dirty water in March 2019).

Table 4-5. Summary of water quality customer complaints / enquiries – Baradine

Complaints/Enquires	Type	Number
Water Quality	Complaints	1
Water (pressure / lack of water)	Enquiry	1
Water restrictions	Enquiry	1
Water Main (leaks /bursts)	Enquiry	3
Water Meter	Enquiry	6

4.6 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Baradine water supply system in the reporting period.

4.7 Reservoir inspections

Details of reservoir inspections undertaken from August 2018 to July 2019 are shown in Table 4-6. Informal visual inspections of the reservoirs by the WTP operators were also undertaken approximately on a weekly basis.

Table 4-6. Summary of reservoir inspections - Baradine

Date	Reservoirs inspected	Findings	Corrective actions
13-17/5/2019	Baradine WTP CWT	New access hatch installed and external wall sealing and vermin proof works undertaken.	-
13/02/2019	Baradine HL Reservoir	The entry hatch is unsealed against natural and deliberate contamination. The roof area is also unsealed.	The identified issues have been rectified. New access hatch installed.

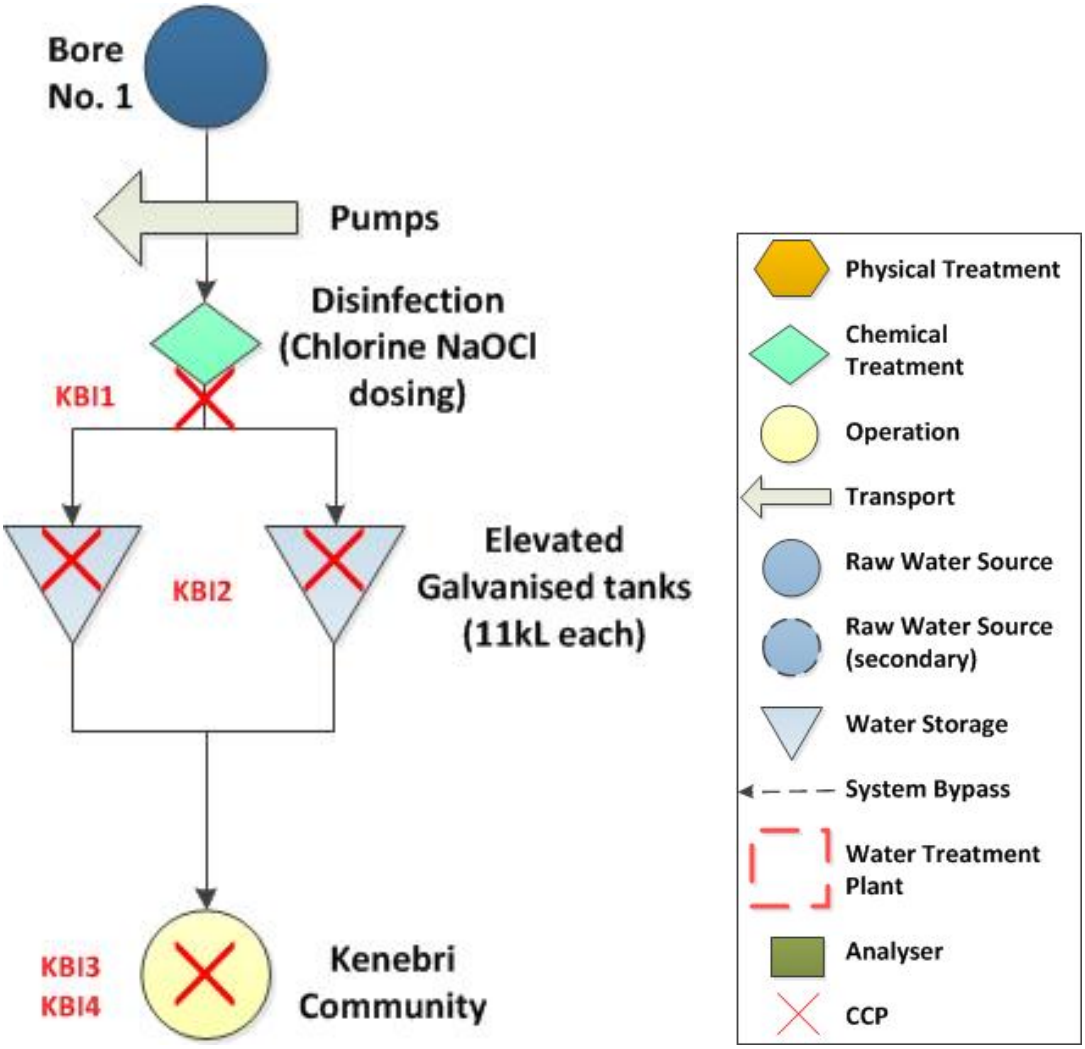
5 Kenebri

5.1 Scheme summary

The Kenebri water supply system comprises:

- Source water: Bore
- Chlorination disinfection only (NaOCl)
- Number of residential connections: 15
- Number of non-residential connections: none

Figure 5-1: Water supply flow diagram – Kenebri



Improvement works undertaken from August 2018 to July 2019 for the Kenebri water supply include:

- Telemetry Upgrades
- Reservoir Replacement
- Upgrades to chlorine room

5.2 Critical control points

The CCPs for Kenebri are shown in Table 5-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 5-2.

Table 5-1. Summary of critical control points – Kenebri

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
KBI1	Disinfection (hypo)	Chlorine	1.5 – 2.3 mg/L	<1.2 mg/L, >2.8 mg/L	<1.0 mg/L, >4.0 mg/L
KBI2	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
KBI3	Distribution	Chlorine	1.0- 2.0 mg/L	< 0.4 mg/L, >2.5 mg/L	< 0.2 mg/L, >4.0 mg/L
KBI4	Distribution **(OCP)**	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

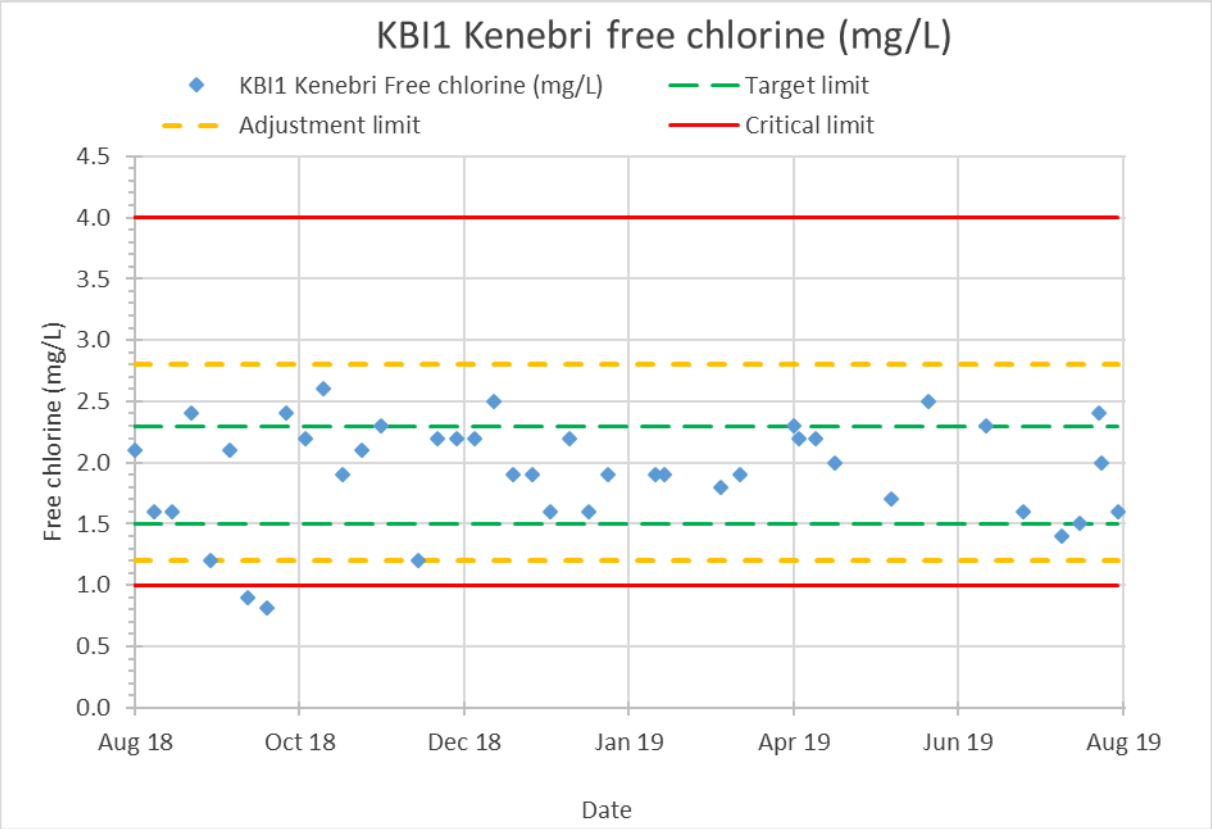
Table 5-2. Summary of critical control points changes – Kenebri

Date	CCP	Limit	Old	New	*Reason for change*
8 March 2019 Water Quality Meeting	KBI1 Disinfection	Target	1.8 mg/L - 2.0 mg/L	1.5 mg/L – 2.3 mg/L	Levels now in line with operational levels.

Critical control point performance for the reporting period is graphed in Figure 5-2, Figure 5-3 and Figure 5-4.

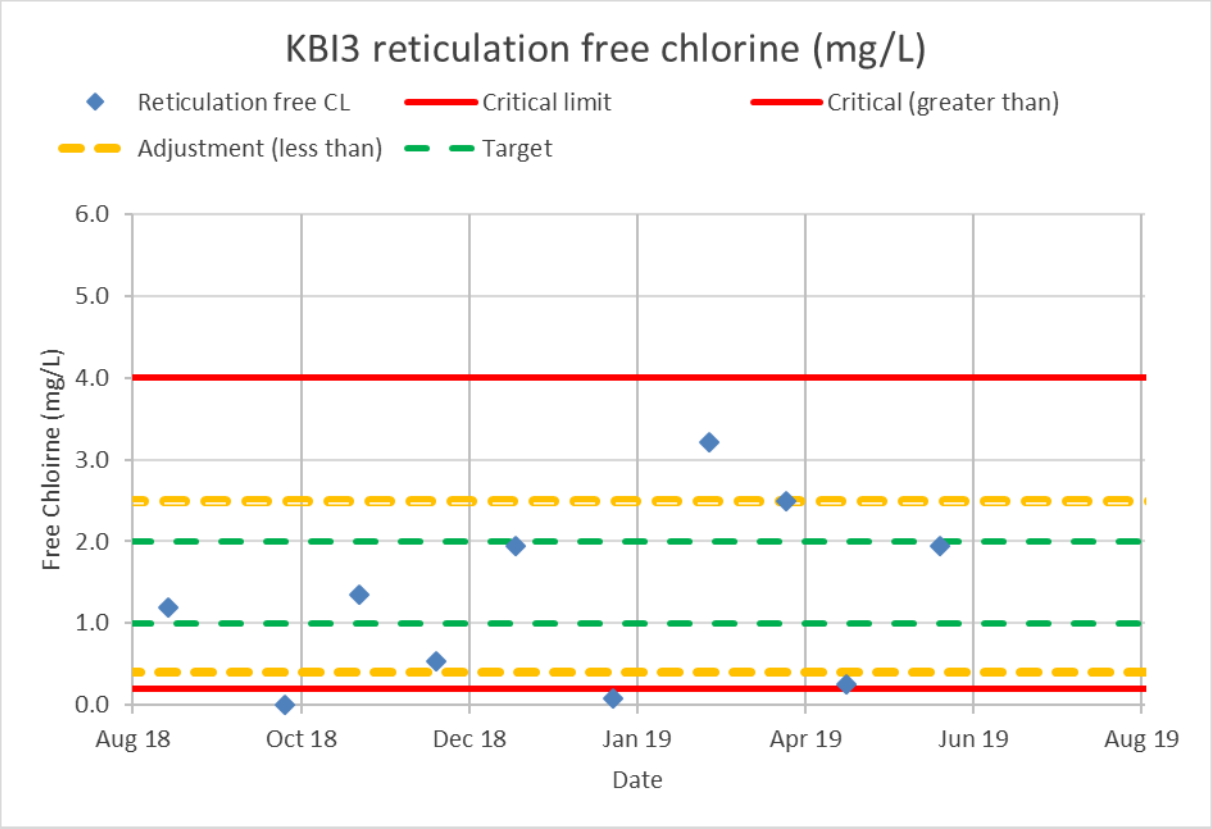
Inspections of the reservoir CCP are not currently being undertaken. Development of a reservoir inspection SOP is included as an action item in the improvement plan and is currently in progress.

Figure 5-2: Treated water free chlorine (KBI1) – Kenebri



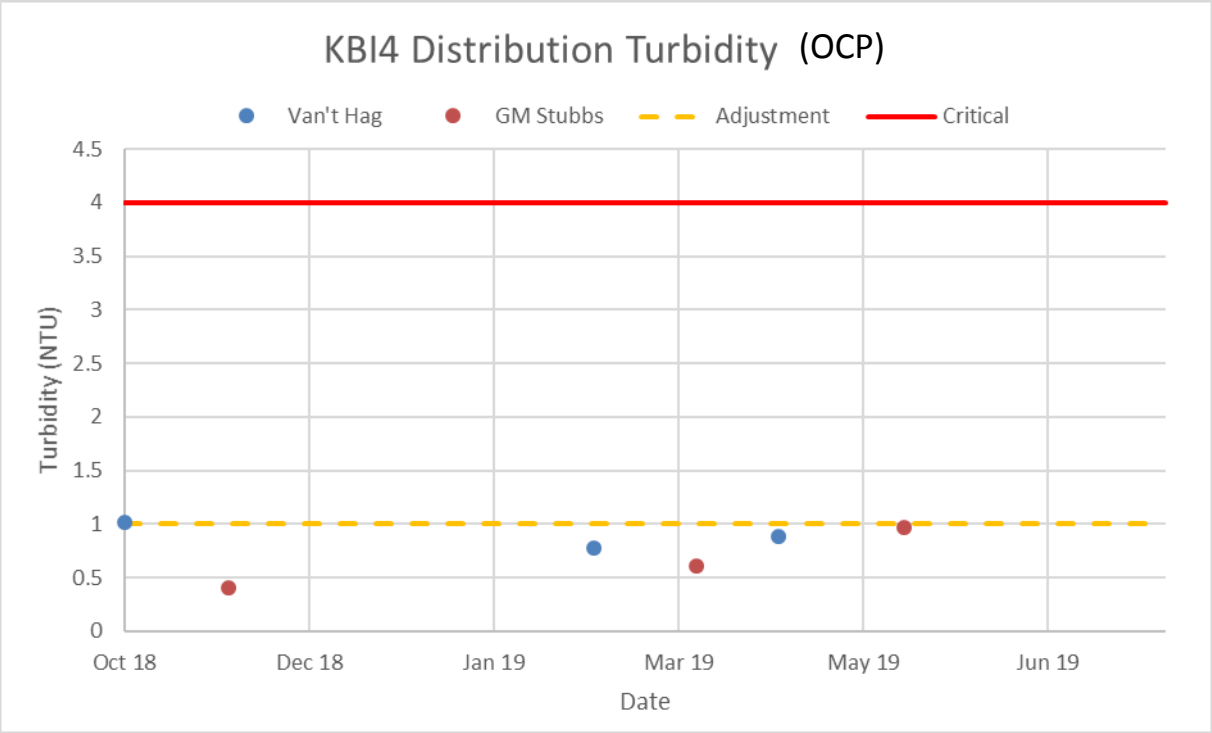
Source: *Kenebri operational monitoring spreadsheet*

Figure 5-3: Reticulation free chlorine (KBI3) – Kenebri



Source: *Kenebri operational monitoring spreadsheet*

Figure 5-4: Distribution turbidity (KBI4) – Kenebri



Source: *2018 and 2019 Verification monitoring spreadsheets*

5.3 Critical limit exceedance

A summary of critical limit exceedances is shown in Table 5-3. Inspections of the reservoir CCP were not undertaken.

Table 5-3. Critical limit exceedances – Kenebri

Date	KBI1 Disinfection	KBI2 Reservoirs	KBI3 Distribution Cl	KBI4 Distribution NTU (OCP)	Reason	Immediate correction	Preventive Action
12/9/18	0.9				Cracked dosing line	Dosing line was repaired	Inline chlorine analyser installed with feedback to bore pump
19/9/18	0.8				Broken injector	Injector was repaired	
25/9/18			0		Broken main	Repair main and refill chlorine tank	

5.4 Water quality

This section includes a review of water quality data for the Kenebri water supply system from the reporting period, 1 August 2018 to 31 July 2019, including data collected as part of the NSW Health drinking water monitoring system program.

5.4.1 Data collection

The Kenebri scheme operational water quality monitoring plan is shown in Table 5-4.

Table 5-4. Monitoring undertaken for Kenebri water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Treated water	KBI1	Free Chlorine	mg/L	Weekly

Process	CCP/OCP	Parameter	Unit	Frequency
Reticulation	KBI3	Free Chlorine	mg/L	Monthly
		Total Chlorine	mg/L	Monthly
		pH		Monthly
	KBI4 (OCP)	Turbidity	NTU	Monthly

5.4.2 Water quality issues

Monitoring of Kenebri water supply system detected no exceptions with ADWG health and aesthetic guidelines. There was one sample where total coliforms were detected.

Low free chlorine was detected on a number of occasions (9% of samples).

5.5 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 5-5. There were no water quality complaints in Kenebri.

Table 5-5. Summary of water quality customer complaints / enquiries – Kenebri

Complaints/Enquires	Type	Number
Water Meter	Enquiry	1

5.6 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Kenebri water supply system in the reporting period.

5.7 Reservoir inspections

No reservoir inspections were undertaken at Kenebri from August 2018 to July 2019 are shown in Table 3-7.

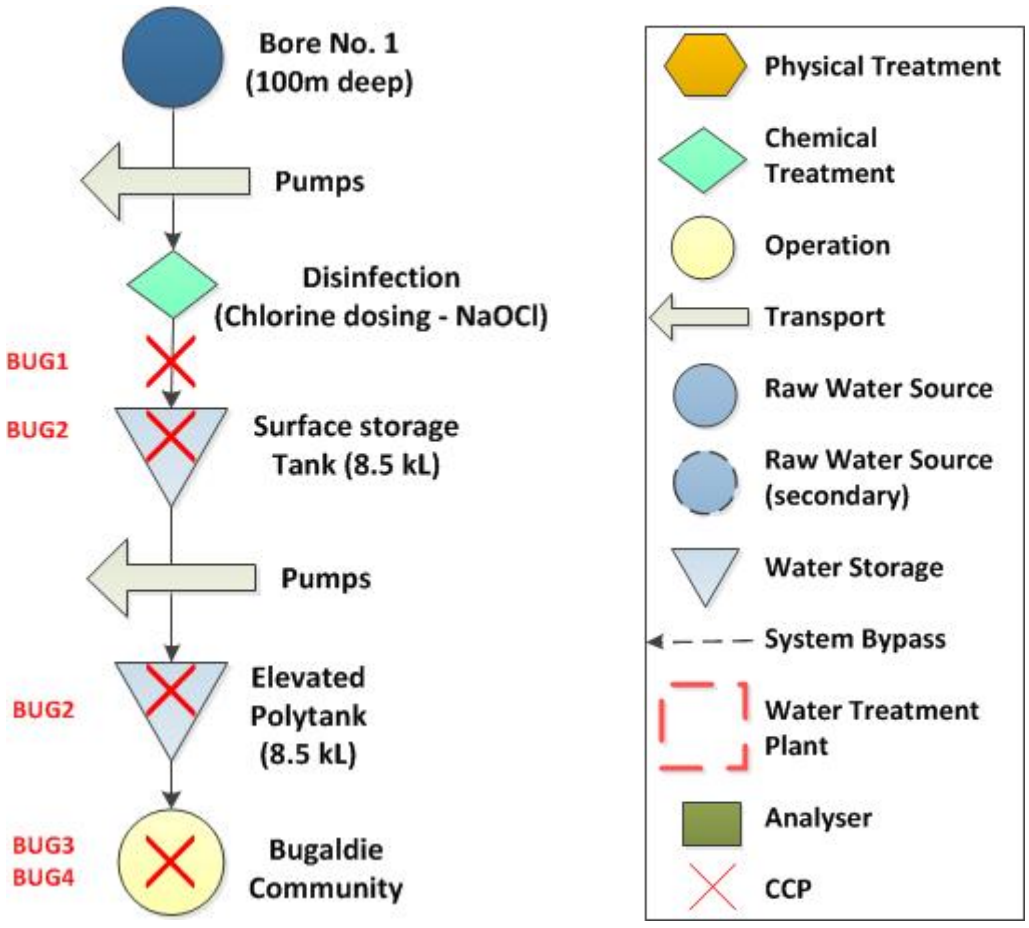
6 Bugaldie

6.1 Scheme summary

The Bugaldie water supply system comprises:

- Source water: Bore
- Chlorination disinfection only (NaOCl)
- Number of residential connections: 12
- Number of non-residential connections: none

Figure 6-1: Water supply flow diagram – Bugaldie



Improvement works undertaken from August 2018 to July 2019 for the Bugaldie water supply include:

- Telemetry Upgrades
- Reservoir upgrades
- Upgrades to chlorine room

6.2 Critical control points

The CCPs for Bugaldie are shown in Table 6-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 6-2.

Table 6-1. Summary of critical control points – Bugaldie

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
BUG1	Disinfection (Hypo)	Chlorine	1.5 – 2.3 mg/L	< 1.2 mg/L >2.8 mg/L	< 1.0 mg/L, >4.0 mg/L
BUG2	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
BUG3	Distribution	Chlorine		< 0.4 mg/L >2.5mg/L	< 0.2 mg/L, >4.0 mg/L
BUG4	Distribution (**OCP**)	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

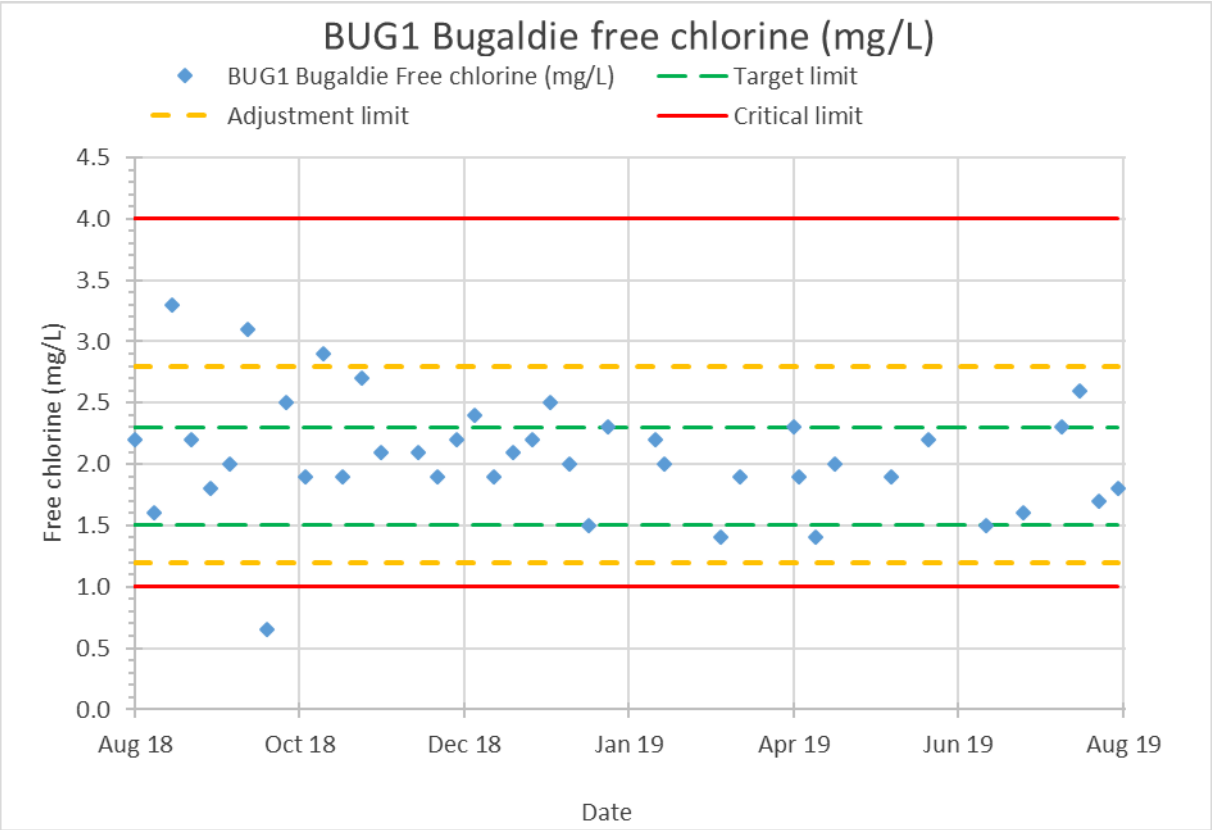
Table 6-2. Summary of critical control points changes – Bugaldie

Date	CCP	Limit	Old	New	Reason for change
8 March 2019 Water Quality Meeting	BUG 1 Disinfection	Target	2.5 – 3.5 mg/L	1.5 mg/L – 2.3 mg/L	New values are in line with Kenebri CCPs.
		Alert Level	<2.0, >4.0 mg/L	<1.2 mg/L, >2.8 mg/L	
		Critical Limit	<1.8, >4.5 mg/L	<1.0, >4.0 mg/L	

Critical control point performance for the reporting period is graphed in Figure 6-2, Figure 6-3 and Figure 6-4.

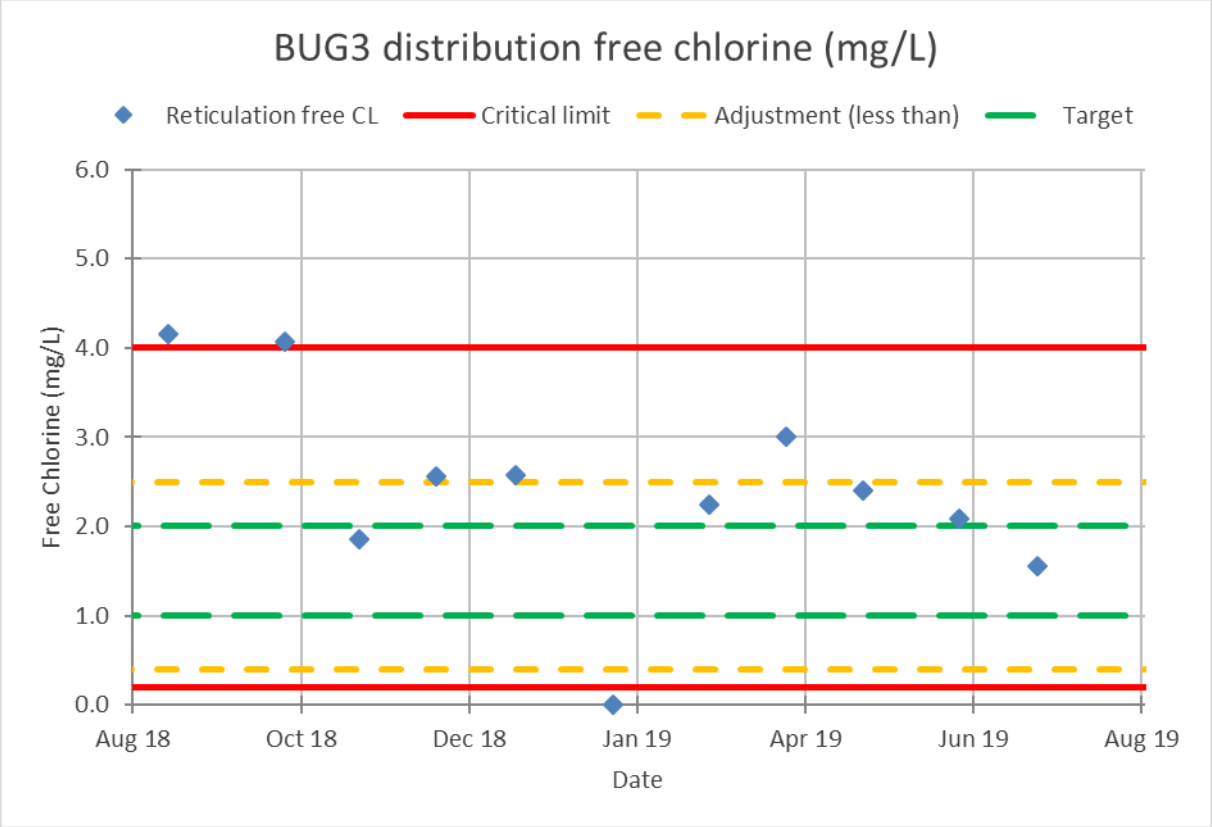
Inspections of the reservoir CCP are not currently being undertaken. Development of a reservoir inspection SOP is included as an action item in the improvement plan and is currently in progress.

Figure 6-2: Reservoir free chlorine (BUG1) – Bugaldie



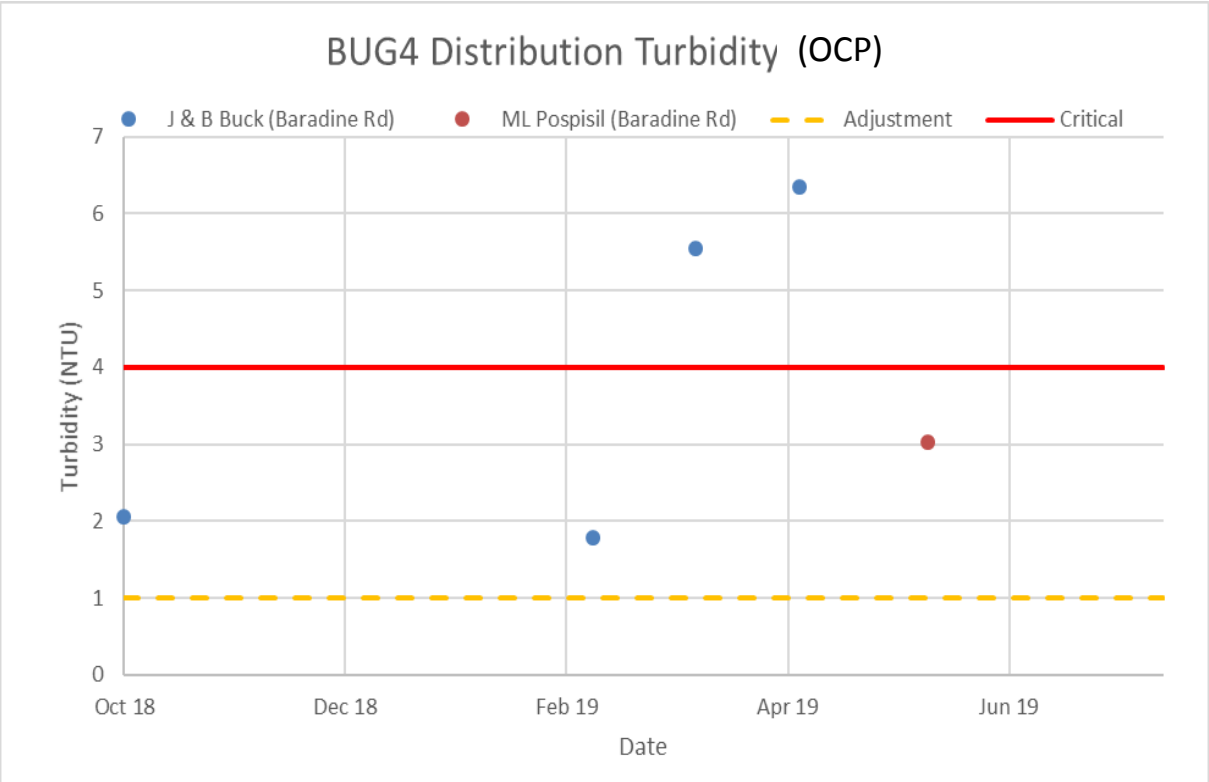
Source: *Bugaldie operational monitoring spreadsheet*

Figure 6-3: Reticulation free chlorine (BUG3) – Bugaldie



Source: *Bugaldie operational monitoring spreadsheet*

Figure 6-4: Distribution turbidity (BUG4) – Bugaldie



Source: *2018 and 2019 Verification monitoring spreadsheets*

6.3 Critical limit exceedance

Reservoir integrity was not routinely inspected during the reporting period due to WHS concerns. It is noted that the reservoir CCP was noted to have integrity issues throughout the monitoring period.

Table 6-3. Critical limit exceedances – Bugaldie

Date	BUG1 Disinfection	BUG2 Reservoirs	BUG3 Distribution Cl	BUG4 Distribution NTU (OCP)	Reason	Immediate correction	Preventive Action
14/8/18			4.15		Pump dose rate high	Turn down dose rate	Installed online chlorine analyser with feedback to bore pump
19/9/18	0.65				Pump failure	Replaced pump	
25/9/18			4.07		Pump dose rate high	Turn down dose rate	
22/1/19			0		Blackout caused dosing pump to stop	Dosing pump reset	
26/3/19				5.54	High levels of iron were also detected as part of NSW Health reticulation monitoring	Flushed	
23/4/19				6.35			

6.4 Water quality

This section includes a review of water quality data for the Bugaldie water supply system from the reporting period, 1 August 2018 to 31 July 2019, including data collected as part of the NSW Health drinking water monitoring system program.

6.4.1 Data collection

The Bugaldie scheme operational water quality monitoring plan is shown in Table 6-4.

Table 6-4. Monitoring undertaken for Bugaldie water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Treated water	BUG1	Free Chlorine	mg/L	Weekly
Reticulation	BUG 3	Free Chlorine	mg/L	Monthly
		Total Chlorine	mg/L	Monthly
		pH		Monthly
	BUG 4 (OCP)	Turbidity	NTU	Monthly

6.4.2 Water quality issues

Monitoring of Bugaldie water supply detected exception against the ADWG aesthetic guidelines for high levels of iron and turbidity. There were also two occasions where total coliforms were detected.

6.5 Consumer water quality complaints/enquires

There were no water quality complaints at Bugaldie.

6.6 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Bugaldie water supply system in the reporting period.

6.7 Reservoir inspections

Details of reservoir inspections undertaken from August 2018 to July 2019 are shown in Table 6-5.

Informal visual inspections of the reservoirs by the WTP operators were also undertaken approximately on a weekly basis.

Table 6-5. Summary of reservoir inspections - Bugaldie

Date	Reservoirs inspected	Findings	Corrective actions
7/02/2019	Bugaldie Reservoir	The roof area is unsealed in several areas – the internal areas of the reservoir could not be inspected as there is no entry hatch.	Project planning and budgeting is in progress.

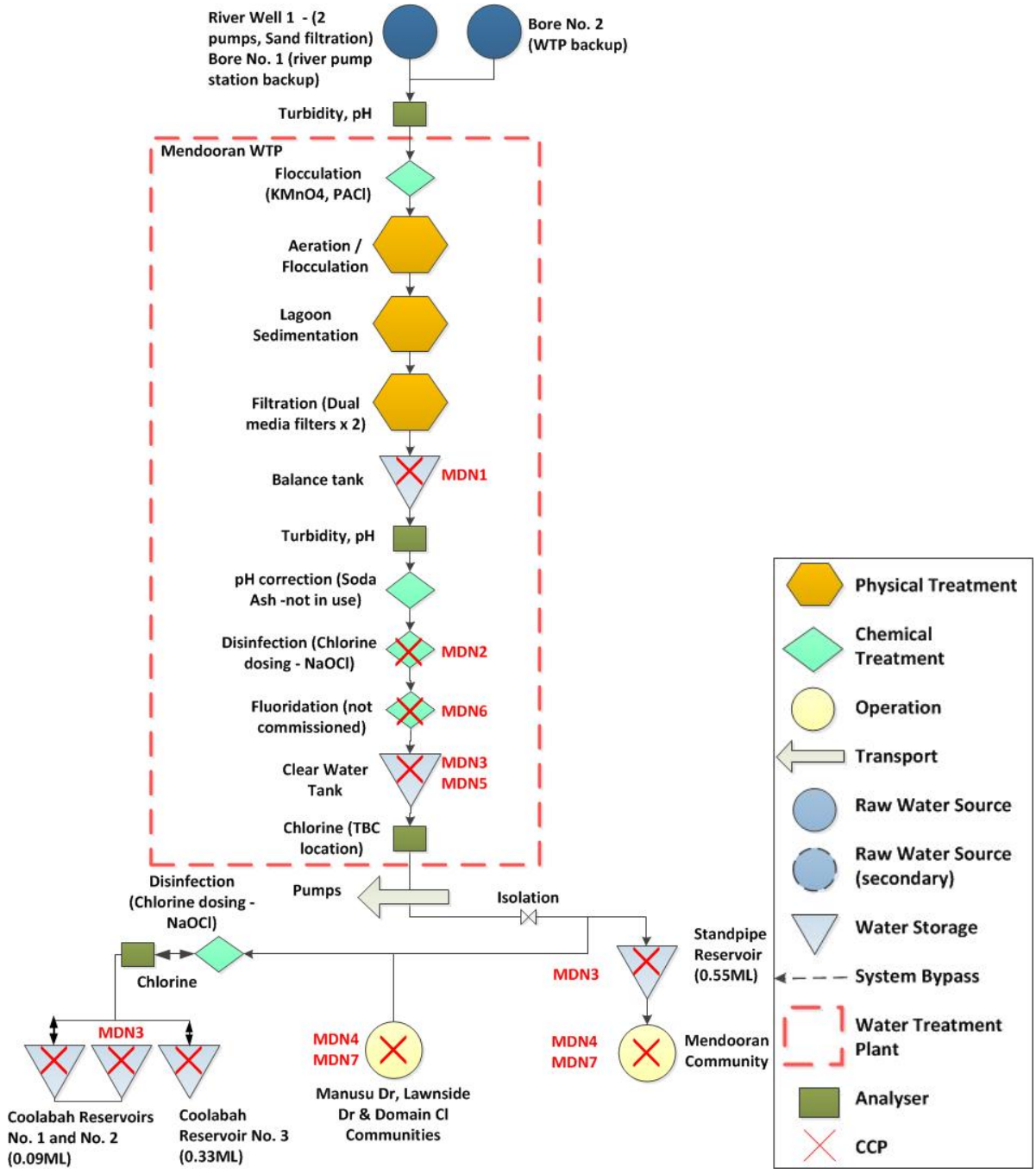
7 Mendooran

7.1 Scheme summary

The Mendooran water supply system comprises:

- Source water: Castlereagh River, back-up bore
- Treatment: WTP with oxidation (KMnO4), flocculation (PACl), Aeration (cascade), sedimentation (x2 lagoons), sand bed filtration (x2 filters), disinfection (NaOCl) and fluoridation (not yet commissioned).
- Number of residential connections:231
- Number of non-residential connections: none

Figure 7-1: Water supply flow diagram – Mendooran



Improvement works undertaken from August 2018 to July 2019 for the Mendooran water supply include:

- New bore
- Telemetry Upgrades
- Reservoir upgrades
- Upgrades to chlorine room

7.1 Critical control points

The CCPs for Mendooran are shown in Table 7-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 7-2.

Table 7-1. Summary of critical control points – Mendooran

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
MDN1	Filtration	Turbidity	<0.2 NTU	>0.3 NTU	>0.5 NTU
MDN2	Disinfection (hypo)	Chlorine	1.5- 3.0 mg/L	<1.2 mg/L, >3.5 mg/L	<1.0 mg/L, >4.0 mg/L
MDN3	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
MDN4	Distribution	Chlorine	0.7 – 2.0 mg/L	<0.4, >3.0 mg/L	< 0.2 mg/L, >4.0 mg/L
MDN5	Final pH (**COP**)	pH	7.5 – 8.3	7.0 – 8.4	6.5 – 8.5
MDN6	Fluoridation	Fluoride	1 mg/L (leaving WTP, leaving reservoir and throughout distribution system)	< 0.9 mg/L for >24hrs > 1.1 mg/L	>1.5 mg/L, <0.9 mg/L for >72hrs 0.0 mg/L for >24hrs
MDN7	Distribution (**OCP**)	Turbidity	<1.0	>1.0	>4.0

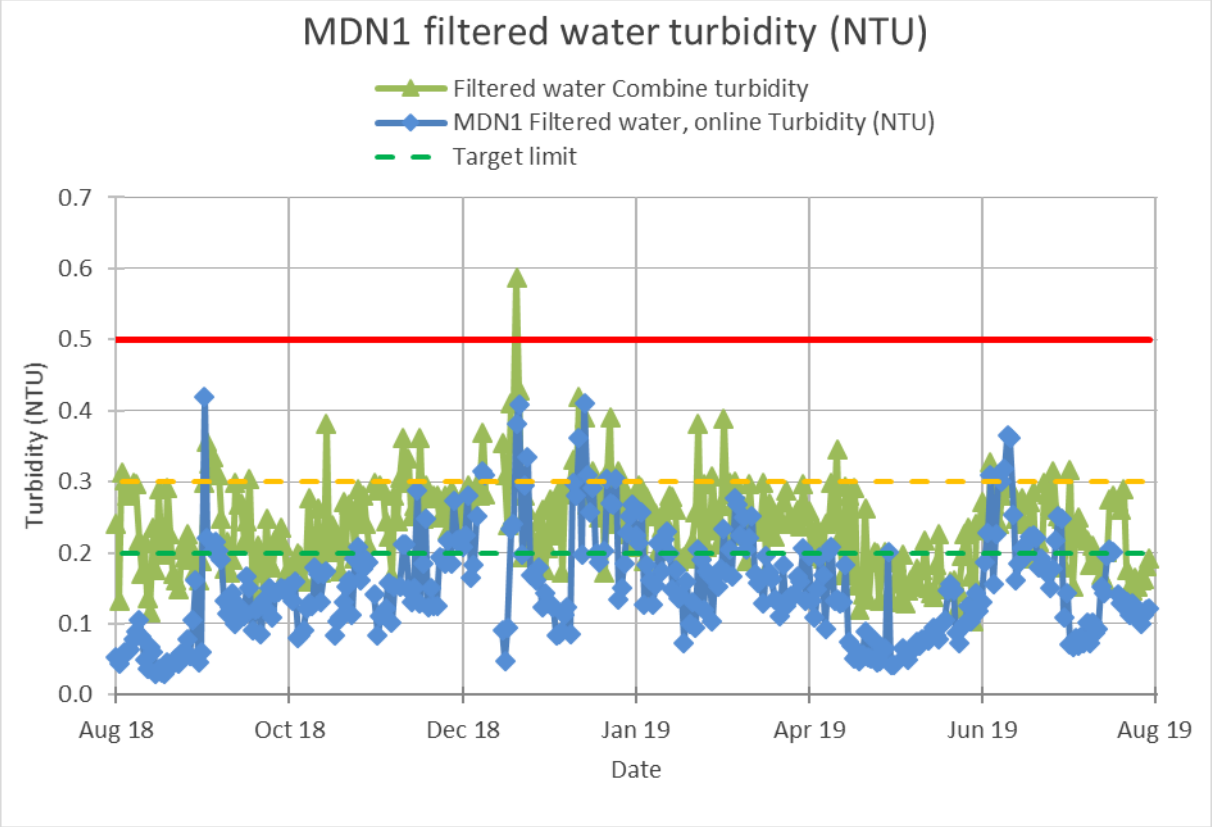
Table 7-2. Summary of critical control points changes – Mendooran

Date	CCP	Limit	Old	New	Reason for change
8 March 2019 Water Quality Meeting	MDN2 Disinfection	Target	1.5- 2.5 mg/L	1.5- 3.0 mg/L	To reflect upper operational values in target levels.
		Alert Level	<1.2 mg/L, >3.0 mg/L	<1.2 mg/L, >3.5 mg/L	
	MDN6 Distribution	Target	0.8 – 1.2 mg/L	0.7 – 2.0 mg/L	

Critical control point performance for the reporting period is graphed in Figure 7-2, Figure 7-3, Figure 7-4, Figure 7-5 and Figure 7-6.

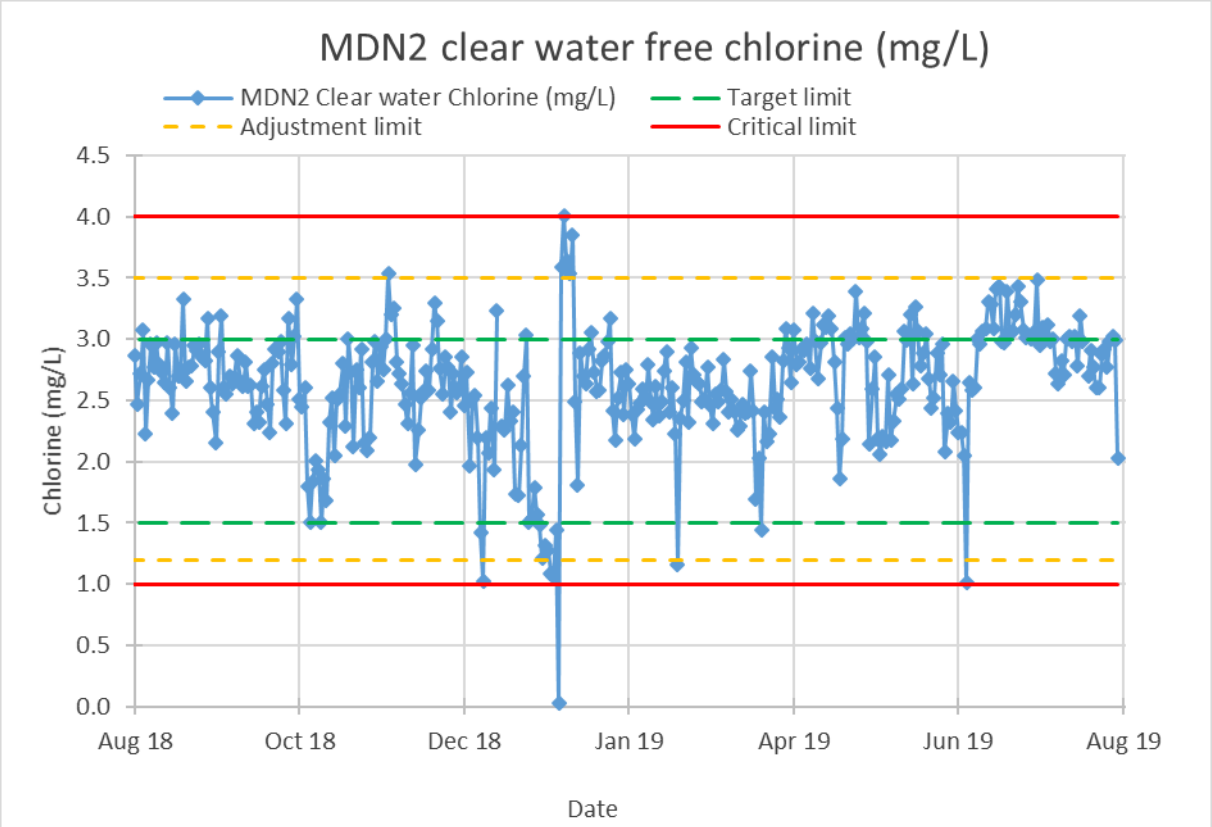
Inspections of the reservoir CCP are not currently being undertaken. Development of a reservoir inspection SOP is included as an action item in the improvement plan and is currently in progress.

Figure 7-2: Filtered water turbidity (MDN1) – Mendooran



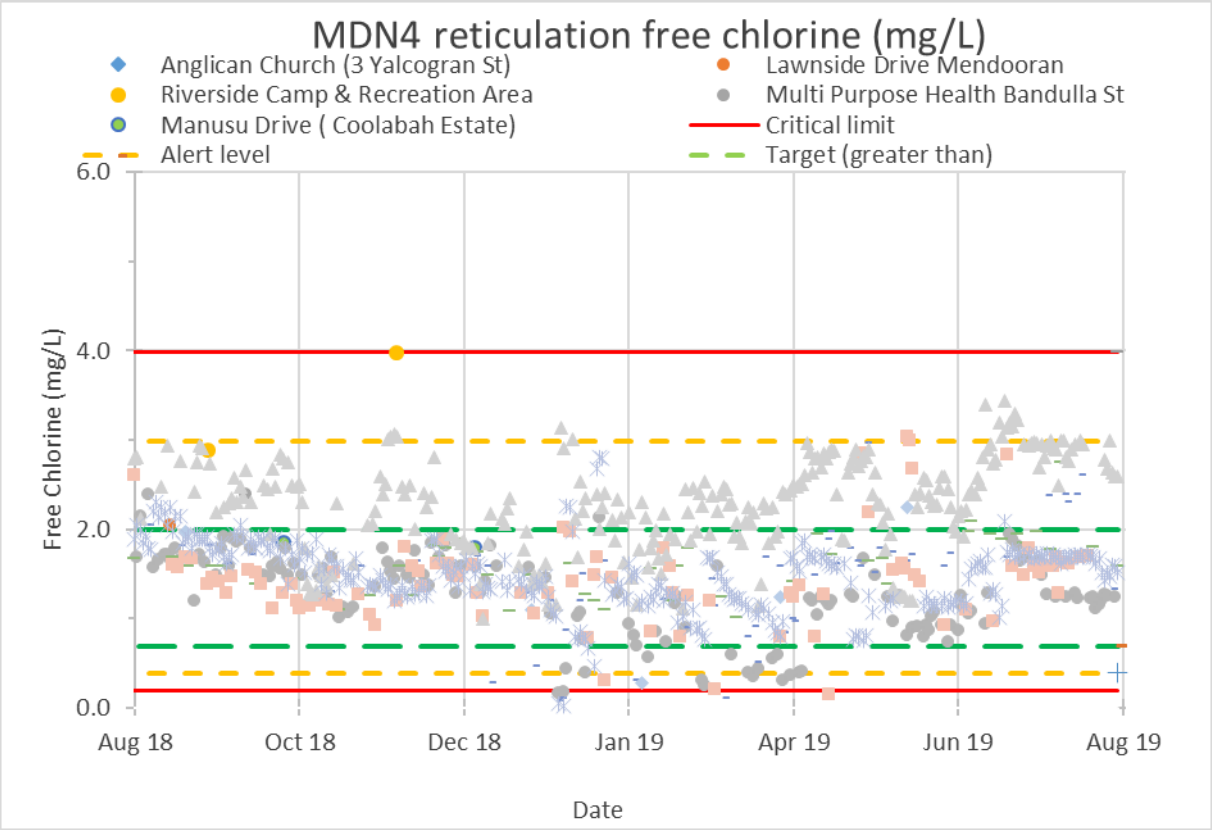
Source: *Mendooran operational monitoring spreadsheet*

Figure 7-3: Clear water free chlorine (MDN2) – Mendooran



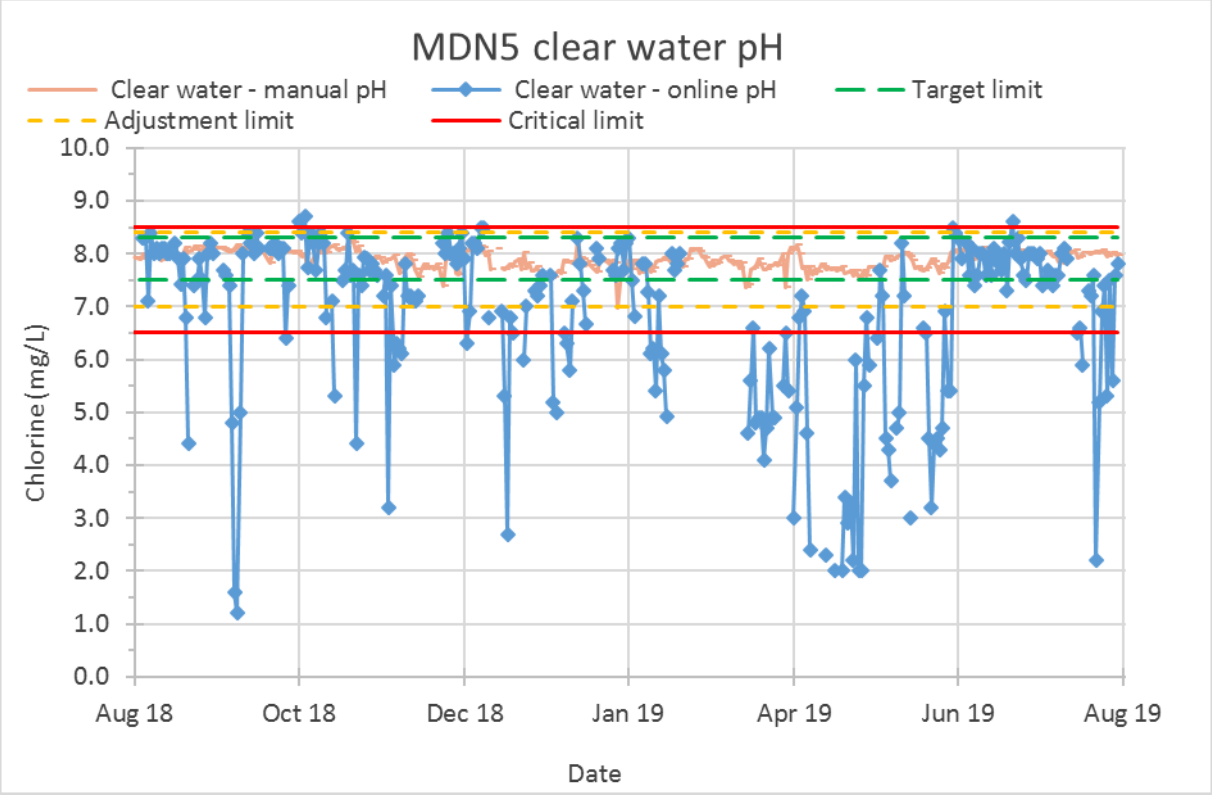
Source: *Mendooran operational monitoring spreadsheet*

Figure 7-4: Reticulation free chlorine (MDN4) – Mendooran



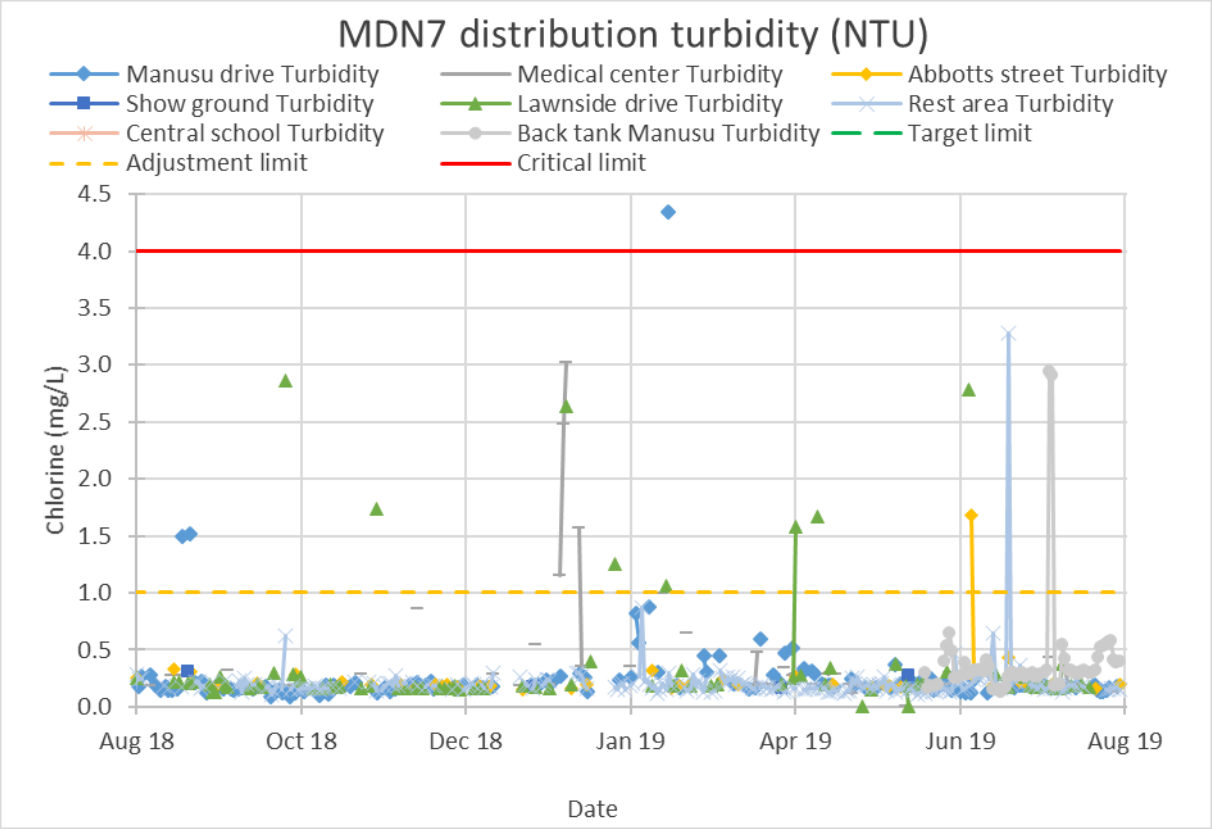
***Source**: Mendooran operational monitoring spreadsheet*

Figure 7-5: Clear water pH (MDN5) – Mendooran



***Source**: Mendooran operational monitoring spreadsheet*

Figure 7-6: Reticulation turbidity (MDN7) – Mendooran



***Source**: Mendooran operational monitoring spreadsheet*

7.2 Critical limit exceedance

A summary of critical limit exceedances for Mendooran water supply system is shown in Table 7-3.

There were issues with the pH clear water analyser, with any readings above 8 reading incorrectly. The analyser was externally calibrated and unable to be fixed. The analyser has since been replaced (outside the reporting period).

Table 7-3. Critical limit exceedances – Mendooran

Date	MDN1 Filtration	MDN2 Disinfection	MDN3 Reservoirs	MDN4 Distribution Cl	MDN5 pH (COP)	MDN6 Fluoridation	MDN7 Distribution NTU (OCP)	Reason	Immediate correction	Preventative measures
11/12/18	0.62							Filter breakthrough due to algae growth in the sedimentation lagoon	Checked backwash, chemical dosing; repeated BW: switch supplies (using off-line lagoon) Engaged specialist to troubleshoot. Dosed polymer onto filters; dosed PACl in lagoon and	Changed to river water (nutrients from the bore water, due to past aquifer contamination, were assumed to have caused the issue). Test raw water for nutrients. Regularly test on-
20/12/18	0.60									

Date	MDN1 Filtration	MDN2 Disinfection	MDN3 Reservoirs	MDN4 Distribution Cl	MDN5 pH (COP)	MDN6 Fluoridation	MDN7 Distribution NTU (OCP)	Reason	Immediate correction	Preventative measures
									settled water; reduced plant flow rate. Tested for algae in river & on-line lagoon	line lagoon for algae; investigate use of 'Phoslock' for bore water source; determine if/under which conditions bore water can be used in future (e.g. aeration)
5/1/19		0.03		0.17				Chlorine blockage	Cleaned lines Increased chlorine dose	Maintenance of chlorine line
6/1/19				0.12						
7/1/19		4.01		0.18				Try to increase chlorine in retic		
14/2/19							4.34		Flushed	
7/3/19				0.11				Caused by lack of turnover	Flushed	Develop flushing schedule; flush when alert is reached
15/4/19				0.16						
27/5/19					8.5					
23/5/19					8.5					

7.3 Water quality

This section includes a review of water quality data for the Mendooran water supply system from the reporting period, 1 August 2018 to 31 July 2019, including data collected as part of the NSW Health drinking water monitoring system program.

7.3.1 Data collection

The Mendooran scheme operational water quality monitoring plan is shown in Table 7-4.

Table 7-4. Monitoring undertaken for Mendooran water supply system

Process	CCP/COP/OCP	Parameter	Units	Frequency
Raw water		pH		Daily
		Turbidity	NTU	Daily
		Manganese	mg/L	Weekly
		Iron	mg/L	Weekly
Settled water		pH		Daily
		Colour		Daily
		Turbidity	NTU	Daily
Filtered water		pH	NTU	Daily
	MDN1	Turbidity	NTU	Daily
	MDN1	Turbidity	NTU	Online
Clear water	MDN5 (COP)	pH		Daily / online
		Turbidity	NTU	Daily
	MDN2	Chlorine	mg/L	Daily
		Manganese	mg/L	Daily
		Iron	mg/L	Daily

Process	CCP/COP/OCP	Parameter	Units	Frequency
	MDN4	Free Chlorine	mg/L	Weekly
Reticulation		pH		Weekly
	MDN7 (OCP)	Turbidity	NTU	Weekly

7.3.2 Water quality issues

Monitoring of Mendooran water supply detected exceptions against the ADWG aesthetic guidelines for high levels of total dissolved solids, total hardness and turbidity. There were also two occasions where total coliforms were detected.

7.4 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 7-5. There was one water quality in January 2019 complaint of sandy water.

Table 7-5. Summary of water quality customer complaints / enquiries – Mendooran

Complaints/Enquires	Type	Number
Water Quality	Enquiry	1
Water Meter	Enquiry	11
Water leak	Enquiry	6
Water restrictions	Enquiry	4
Water (pressure / lack of water)	Enquiry	2

7.5 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Mendooran water supply system in the reporting period.

7.6 Reservoir inspections

Details of reservoir inspections undertaken from August 2018 to July 2019 are shown in Table 7-6. Informal visual inspections of the reservoirs by the WTP operators were also undertaken approximately on a daily basis.

Table 7-6. Summary of reservoir inspections - Mendooran

Date	Reservoirs inspected	Findings	Corrective actions
2/03/2019	Mendooran Cobra St Reservoir	The entry hatch has no raised or sealed edge and bird faecal material is present on the platform area - the overhead rescue system is attractive to roosting birds, so this faecal issue will be an ongoing problem until the entry hatch is upgraded.	The entry hatch has been upgraded and the centre roof vent area has been sealed off.
24/06/2019	Mendooran WTP CWT	The CWT has been effectively sealed against contamination ingress.	-
29/4-3/5/19	Mendooran Reservoir Coolabah No. 1	Installed new access hatch to seal against contamination ingress.	-
29/4-3/5/19	Mendooran Reservoir Coolabah No. 2	Installed new access hatch to seal against contamination ingress.	-
29/4-3/5/19	Mendooran	Installed new access hatch and filling of	-

Date	Reservoirs inspected	Findings	Corrective actions
	Reservoir Coolabah No. 3	gaps to seal against contamination ingress.	

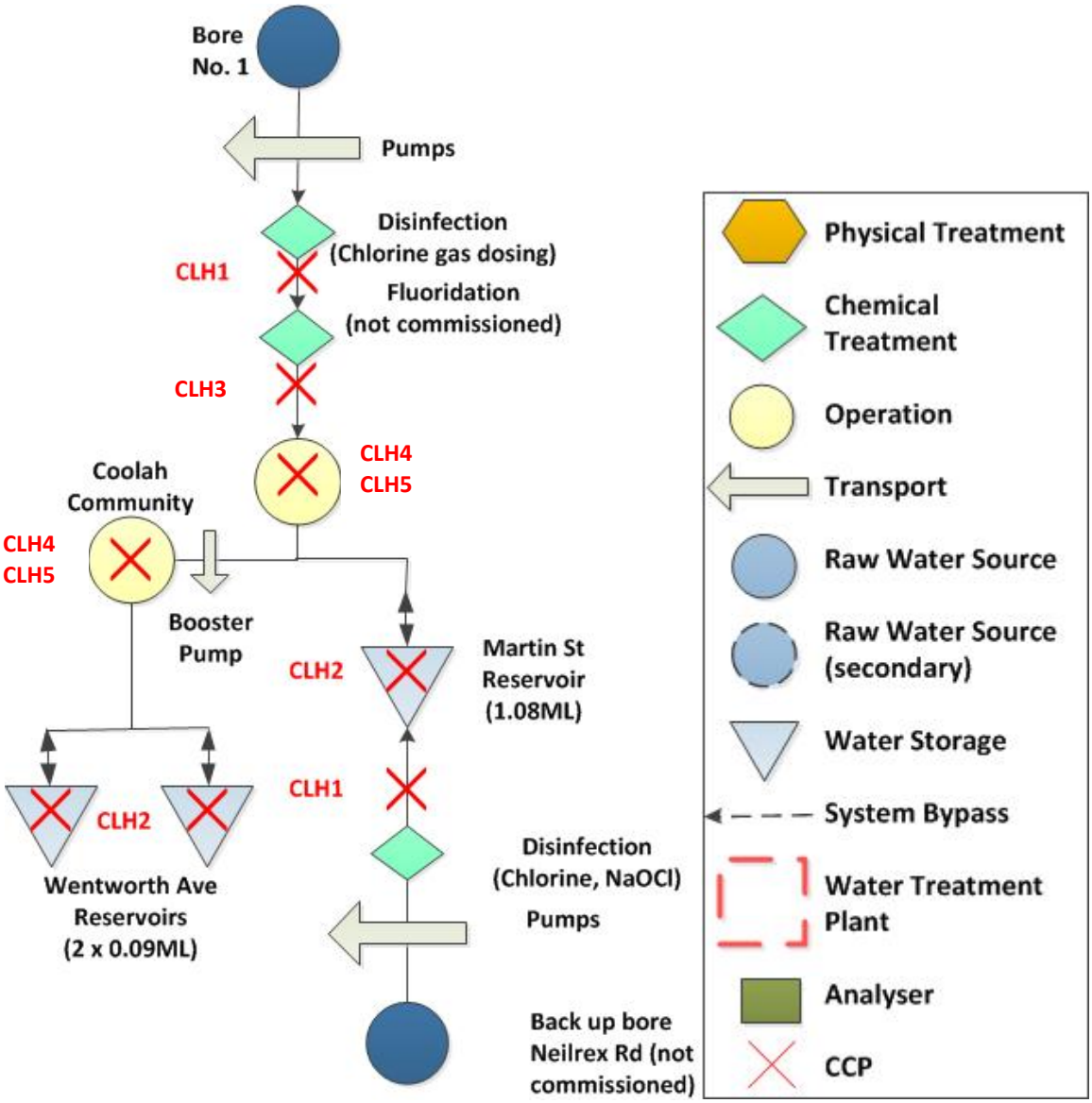
8 Coolah

8.1 Scheme summary

The Coolah water supply system comprises:

- Source water: Bore
- Chlorination disinfection only (gas); fluoridation not yet commissioned
- Number of residential connections: 393
- Number of non-residential connections: 94

Figure 8-1: Water supply flow diagram – Coolah



Improvement works undertaken from August 2018 to July 2019 for the Coolah water supply include:

- New Bore
- Sealing of Coolah bore
- Coolah reservoirs refurbishments
- Telemetry Upgrades
- Upgrades to chlorine room

8.2 Critical control points

The CCPs for Coolah are shown in Table 8-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 8-2.

Table 8-1. Summary of critical control points – Coolah

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
CLH1	Disinfection (gas)	Chlorine	1.0 – 2.2 mg/L	<0.7 mg/L, >3.0 mg/L	<0.4 mg/L, >4.0 mg/L
CLH2	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
CLH3	Fluoridation	Fluoride	1 mg/L (leaving WFP, leaving reservoir and throughout distribution system)	0.9 mg/L for >24hrs 1.1 mg/L	<0.9 mg/L for >72hrs >1.5 mg/L 0.0 mg/L for >24hrs
CLH4	Distribution	Chlorine	1.0 – 2.0 mg/L	<0.7 mg/L, >3.0 mg/L	< 0.2 mg/L, >4.0 mg/L
CLH5	Distribution **(OCP)**	Turbidity	<1.0 NTU	>1.0 NTU	>4.0 NTU

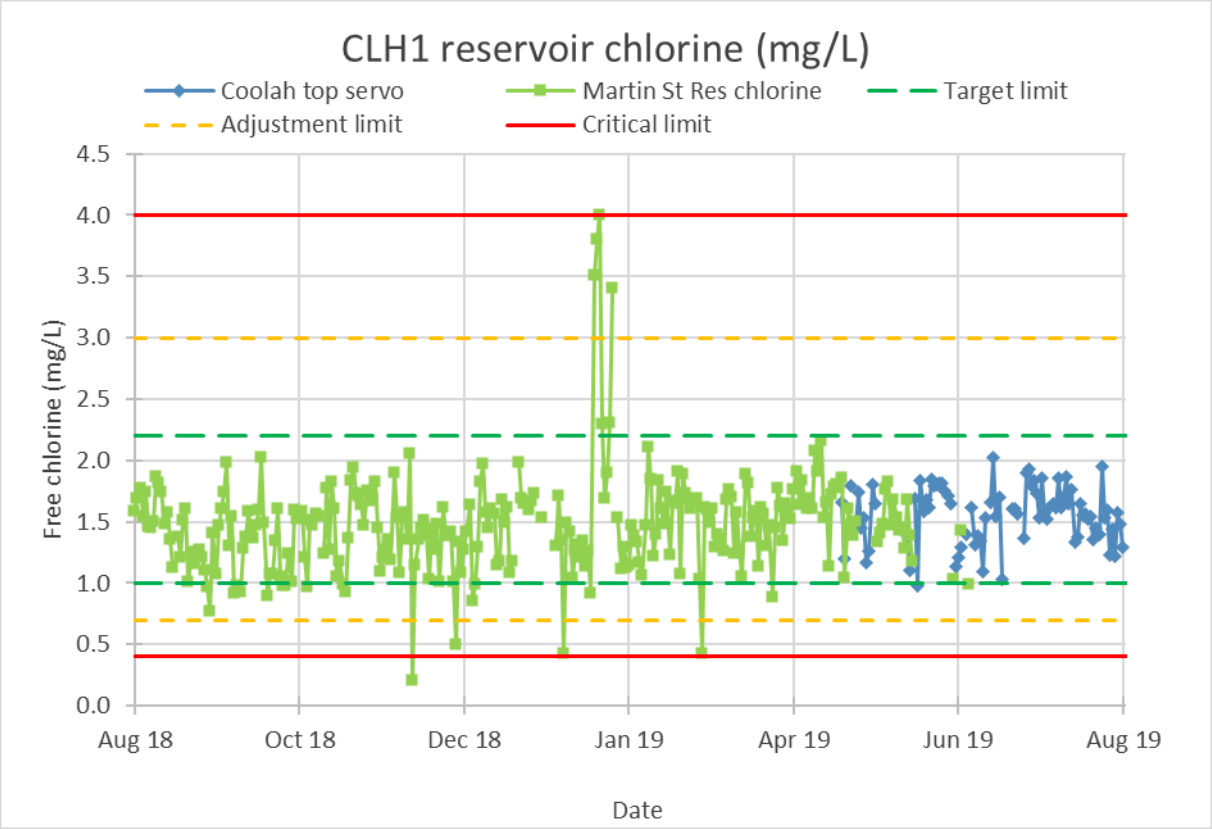
Table 8-2. Summary of critical control points changes – Coolah

Date	CCP	Limit	Old	New	*Reason for change*
8 March 2019 Water Quality Meeting	CLH1 Disinfection	Target	1.5 – 1.8 mg/L	1.0 – 2.2 mg/L	To reflect operational values in target/alert levels, new low critical limit of 0.4 mg/L still allows for a CT of 18 min*mg/L.
		Alert Level	<1.3 mg/L, >2.0 mg/L	<0.7 mg/L, >3.0 mg/L	
		Critical Limit	<0.8 mg/L, >4.0 mg/L	<0.4 mg/L, >4.0 mg/L	
	CLH4 Distribution	Target	1.0 – 1.2 mg/L	1.0 – 2.0 mg/L	To reflect operational values in target/alert levels and have one low critical limit of 0.2 mg/L across all systems.
		Alert Level	<0.9 mg/L, >2.0 mg/L	<0.7 mg/L, >3.0 mg/L	
		Critical Limit	<0.5 mg/L, >4.0 mg/L	<0.2 mg/L, >4.0 mg/L	

Critical control point performance for the reporting period is graphed in Figure 8-2, Figure 8-3 and Figure 8-4.

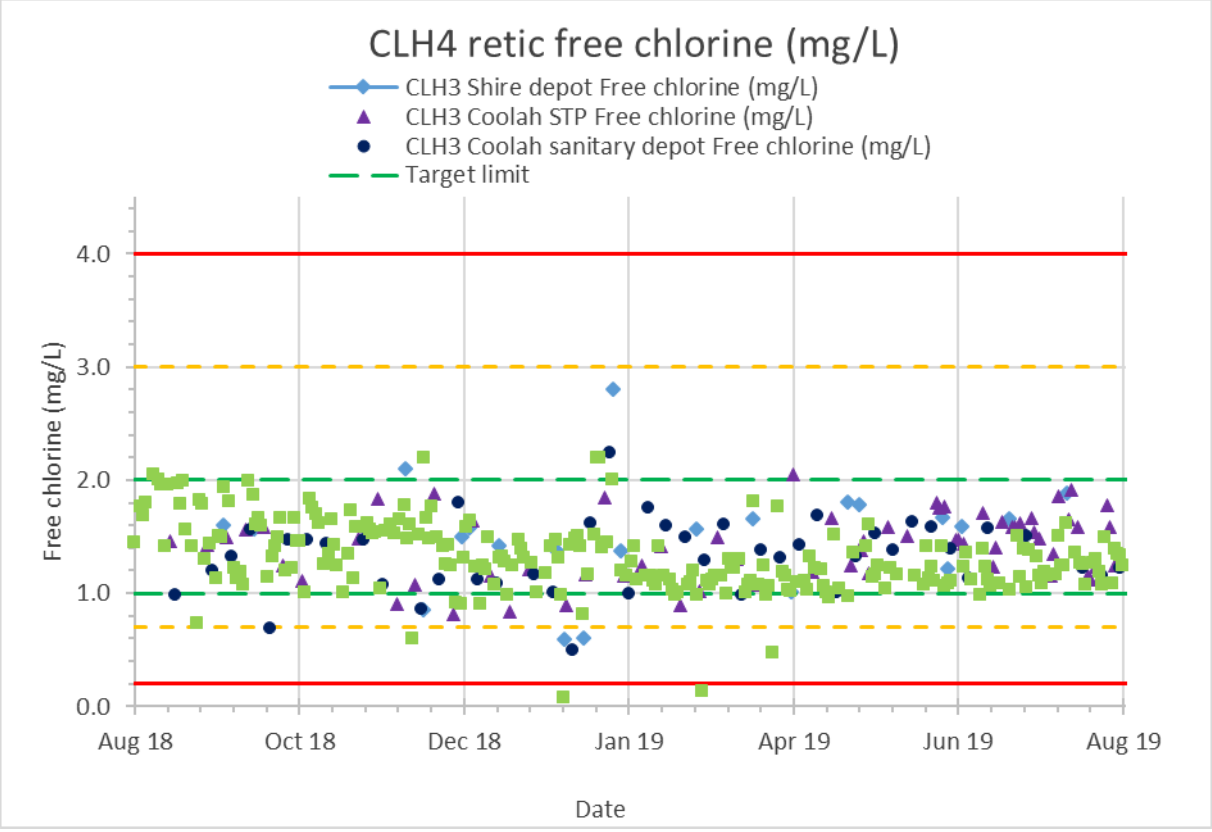
The fluoridation plant was offline during the reporting period.

Figure 8-2: Chlorine disinfection (CLH1) – Coolah



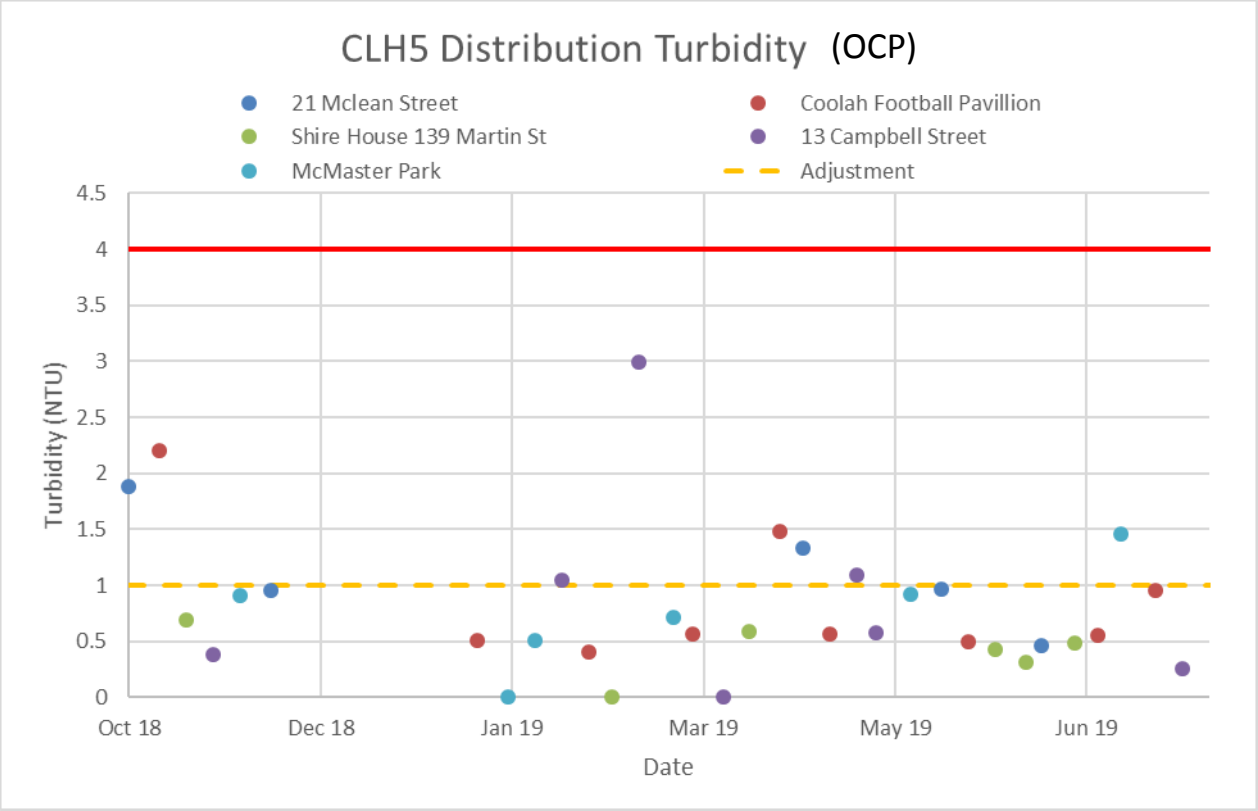
***Source**: Coolah operational monitoring spreadsheet*

Figure 8-3: Reticulation free chlorine (CLH4) – Coolah



***Source**: Coolah operational monitoring spreadsheet*

Figure 8-4: Reticulation turbidity (CLH5) – Coolah



Source: *2018 and 2019 Verification monitoring spreadsheets*

8.3 Critical limit exceedance

Table 8-3. Critical limit exceedances – Coolah

Date	CLH1 Disinfection	CLH2 Reservoirs	CLH3 Distribution Cl	CLH4 Fluoridation	CLH5 Distribution NTU (OCP)	Reason	Immediate correction	Preventive Action
12/11/18	0.2					Lack of chlorine Campbell St	Changed bottle over to almost empty bottle	Ensure adequate supply of chlorine in future; purchase of scales; installation of online chlorine analyser in retic (Chloroclam) sending SMS alarms
17/1/19						Possums in reservoir	Remove animals from reservoirs	Re-establish reservoir integrity
27/2/19			0.11			Sampling error	Staff training	Staff training

8.4 Water quality

This section includes a review of water quality data for the Coolah water supply system from the reporting period, 1 August 2018 to 31 July 2019, including data collected as part of the NSW Health drinking water monitoring system program.

8.4.1 Data collection

The Coolah scheme operational water quality monitoring plan is shown in Table 8-4.

Table 8-4. Monitoring undertaken for Coolah water supply system

Process	Critical Control Points	Parameter	Units	Frequency
Martin St res	CLH4	Free chlorine	mg/L	24/7 via Chloroclam
		pH		Daily
Coolah top servo	CLH1	Free chlorine	mg/L	Daily
		pH		Daily
		ntu		Daily
Wentworth Ave Resrevoir	CLH4	Free chlorine	mg/L	3/week
		pH		3/week
		NTU		3/week
Coolah Shire depot	CLH4	Free chlorine	mg/L	Twice weekly
		pH		Twice weekly
		NTU		Twice weekly
Coolah STP	CLH4	Free chlorine	mg/L	Weekly
		pH		Weekly
Coolah sanitary depot	CLH4	Free chlorine	mg/L	Weekly
		pH		Weekly

8.4.2 Water quality issues

E. coli was detected on 15 January in the Coolah water supply system. A boil water alert was issued on the 17 January (refer to section 8.6 for further details). Chlorine was increased as a result leading to high chlorine levels in the reservoir.

Monitoring also detected low free chlorines (two samples) and total coliforms (three samples). Exceptions against the ADWG aesthetic guidelines for total hardness was detected on two occasions.

8.5 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 8-5. There was one water quality complaints of unusable water in May 2019.

Table 8-5. Summary of water quality customer complaints / enquiries – Coolah

Complaints/Enquires	Type	Number
Water Quality	Complaints	1
Water Main (leaks /bursts)	Enquiry	21
	Enquiry	5
Water (pressure / lack of water)	Complaints	1
Water restrictions	Enquiry	1
Water Meter	Enquiry	52

8.6 Water quality incidents/emergencies

A summary of incidents in the Coolah water supply are shown in Table 8-6

Table 8-6. Summary of incident and emergencies, recommendations and preventive actions

Details of incident/emergency	Investigation recommendations	Preventive action undertaken
E. coli detected in Coolah reservoir on 17 January 2019 Boil water alert	Possums were found in the reservoir	Cleaning and vermin proofing of reservoirs Reservoir inspection SOP in progress

8.7 Reservoir inspections

Details of reservoir inspections undertaken from August 2018 to July 2019 are shown in Table 8-7. Informal visual inspections of the reservoirs by the operators were also undertaken approximately on a daily basis.

Table 8-7. Summary of reservoir inspections - Coolah

Date	Reservoirs inspected	Findings	Corrective actions
20/02/2019	Coolah Martin St Reservoir	The inspection and cleaning of this reservoir was requested due to a poor sample being taken. Significant water quality risks were present around this reservoir.	The identified issues have been rectified. New access hatch installed.
05/02/2019	Coolah Wentworth Ave No. 1 Reservoir	No water quality issues noted. Entry hatch needs lock.	Entry hatch is now locked.
05/02/2019	Coolah Wentworth Ave No. 2 Reservoir	No water quality issues noted. Entry hatch needs lock.	Entry hatch is now locked.

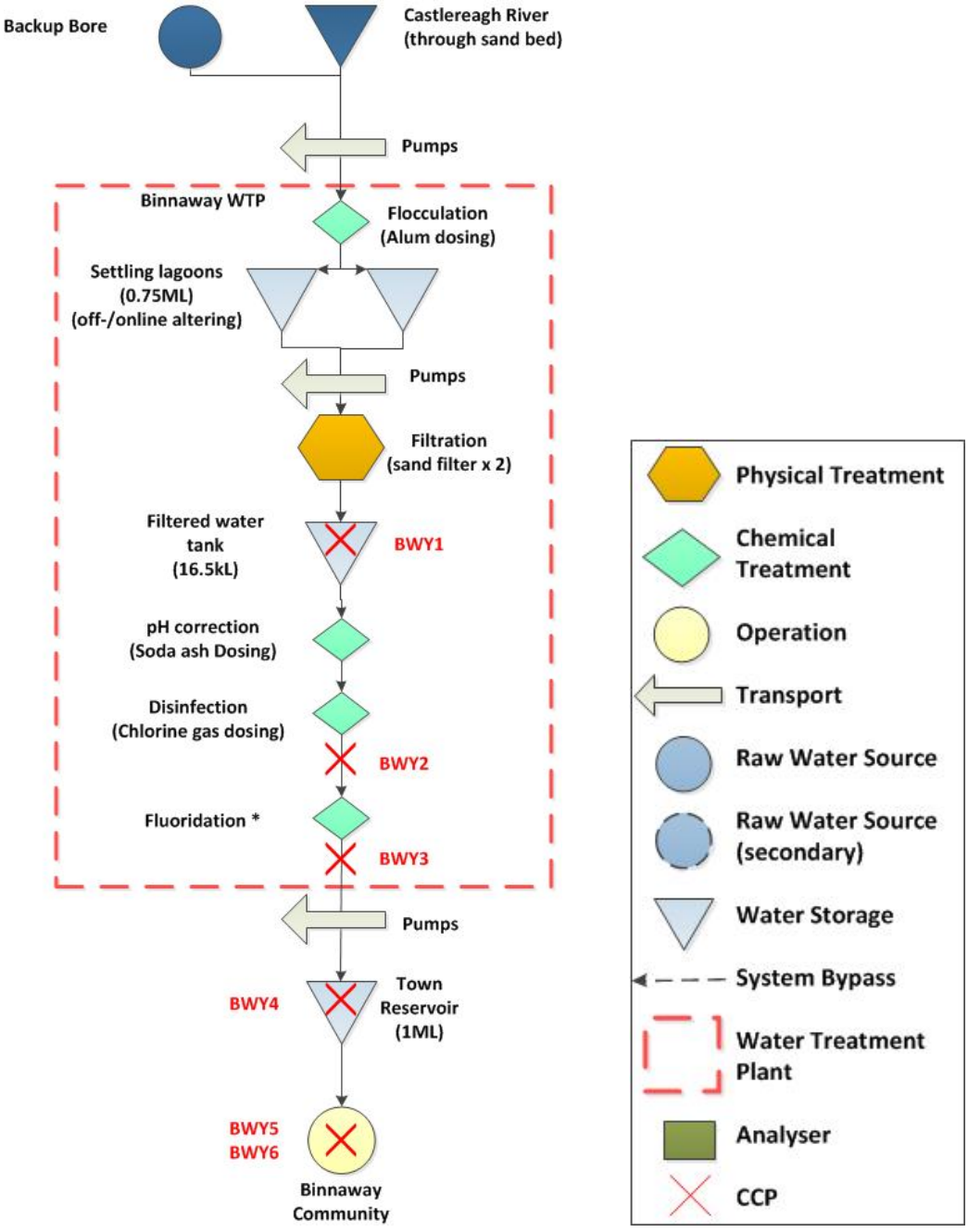
9 Binnaway

9.1 Scheme summary

The Binnaway water supply system comprises:

- Source water: Castlereagh River
- Treatment: WTP with flocculation (alum), sedimentation (x2 lagoons), sand bed filtration (x2 filters), pH correction (soda ash), chlorine gas disinfection and fluoridation (currently off-line).
- Number of residential connections: 289
- Number of non-residential connections: 1

Figure 9-1: Water supply flow diagram – Binnaway



Improvement works undertaken from August 2018 to July 2019 for the Binnaway water supply include:

- New Bore
- Telemetry Upgrades
- Clear water tank & reservoir upgrades
- Upgrades to chlorine room

9.2 Critical control points

The CCPs for Binnaway are shown in Table 9-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 9-2.

Table 9-1. Summary of critical control points – Binnaway

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
BWY1	Filtration	Turbidity	<0.2 NTU	>0.3 NTU	>0.5 NTU
BWY2	Disinfection (gas)	Chlorine	2.0 mg/L – 3.2 mg/L	<1.5 mg/L, >3.6 mg/L	<1.0 mg/L, > 4.0 mg/L
BWY3	Fluoridation	Fluoride	1 mg/L (leaving WFP, leaving reservoir and throughout distribution system)	< 0.9 mg/L for >24hrs > 1.1 mg/L	<0.9 mg/L for >72hrs >1.5 mg/L 0.0 mg/L for >24hrs
BWY4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
BWY5	Distribution	Chlorine	0.8 – 2.0 mg/L	< 0.5 mg/L, >2.5 mg/L	< 0.2 mg/L, >4.0 mg/L
BWY6	Distribution (**OCP**)	Turbidity	<1.0 NTU	>1.0 NTU	>4.0 NTU

Table 9-2. Summary of critical control points changes – Binnaway

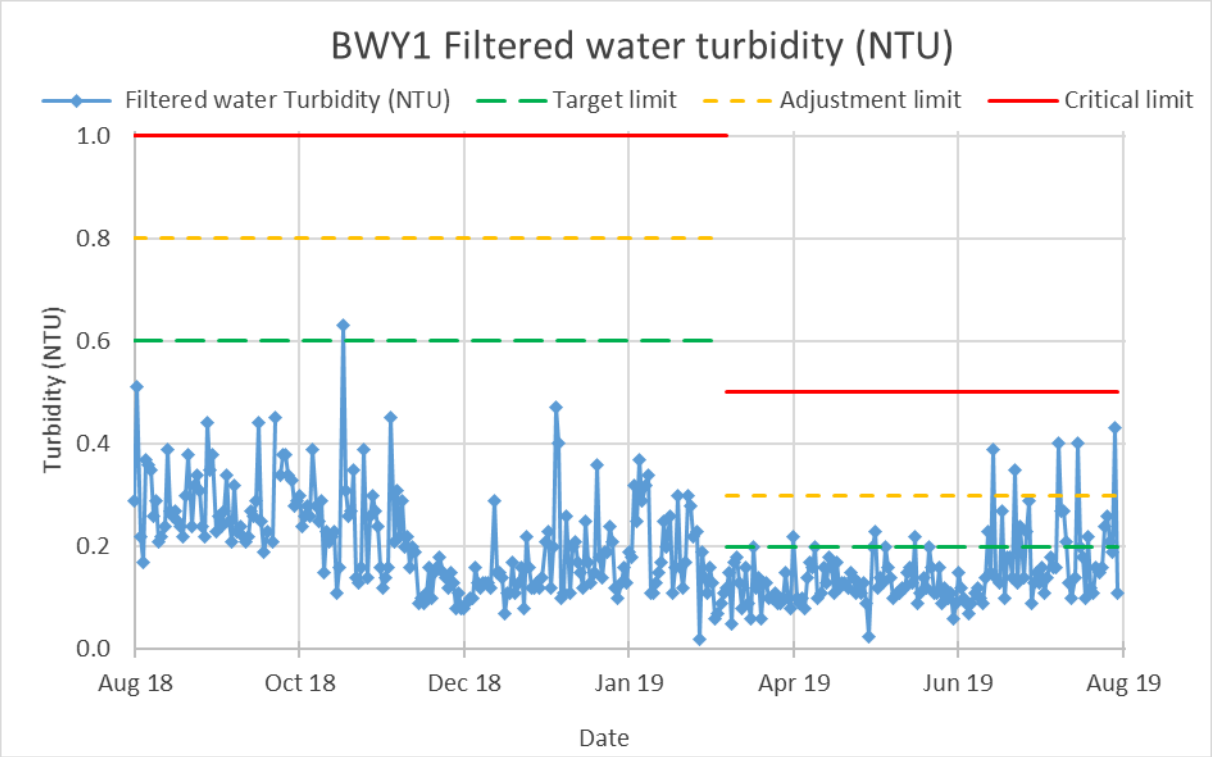
Date	CCP	Limit	Old	New	Reason for change
8 March 2019 Water Quality Meeting	BWY2 Disinfection	Target	1.8 mg/L - 2.0 mg/L	2.0 mg/L – 3.2 mg/L	Upper target level now in line with operational levels.
		Alert Level	<1.5 mg/L, >2.5 mg/L	<1.5 mg/L, >3.6 mg/L	
	BWY1 Filtration	Target	< 0.6 NTU	< 0.2 NTU	In line with Guidance
		Adjustment	> 0.8 NTU	> 0.3 NTU	
		Critical	> 1.0 NTU	> 0.5 NTU	

Critical control point performance for the reporting period is graphed in Figure 9-2, Figure 9-3, Figure 9-4 and Figure 9-5.

Inspections of the reservoir CCP are not currently being undertaken. Development of a reservoir inspection SOP is included as an action item in the improvement plan and is currently in progress.

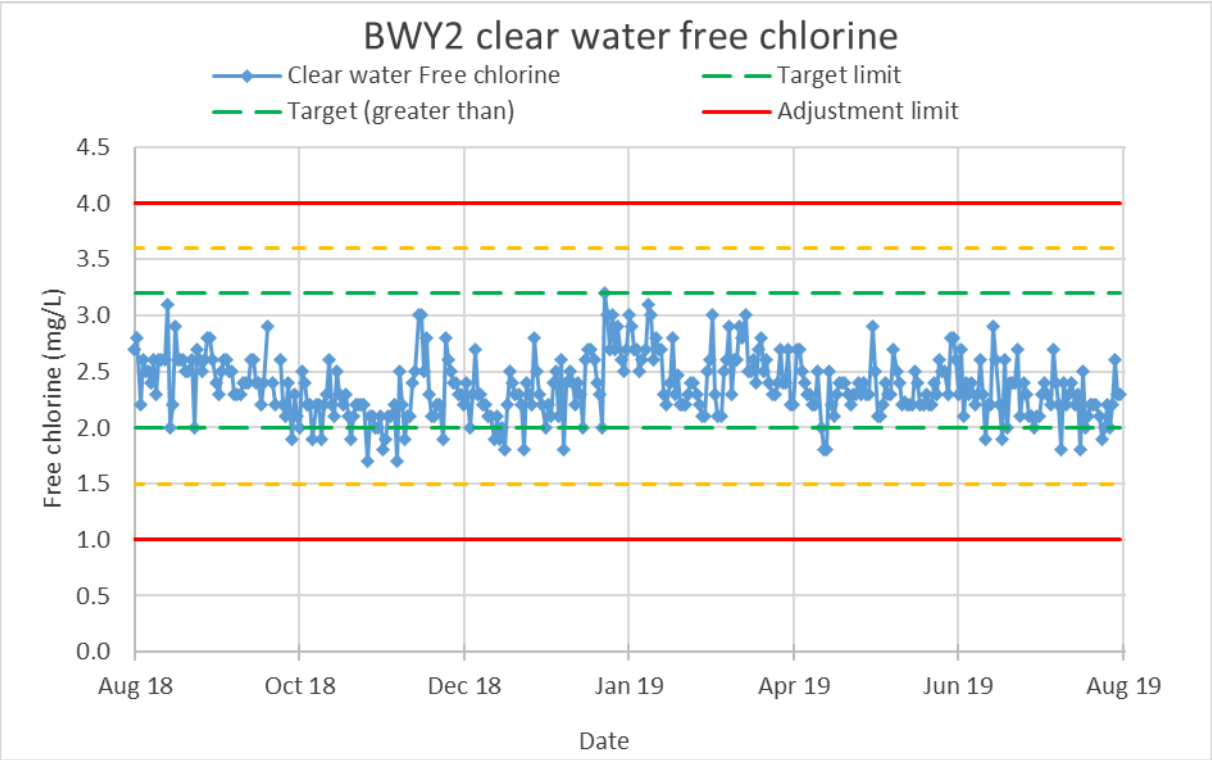
The fluoridation plant was offline during the reporting period.

Figure 9-2: Filtered water turbidity (BWY1) – Binnaway



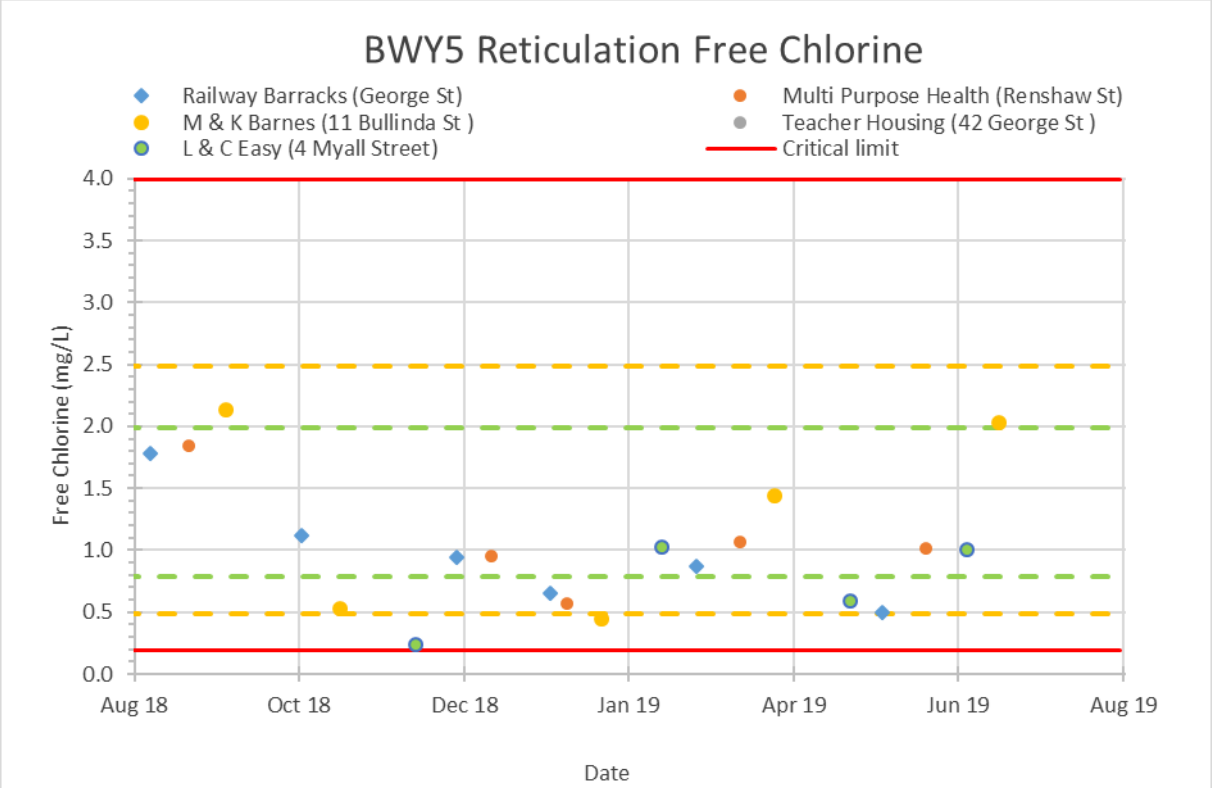
***Source**: Binnaway operational monitoring spreadsheet*

Figure 9-3: Clear water free chlorine (BWY2) – Binnaway



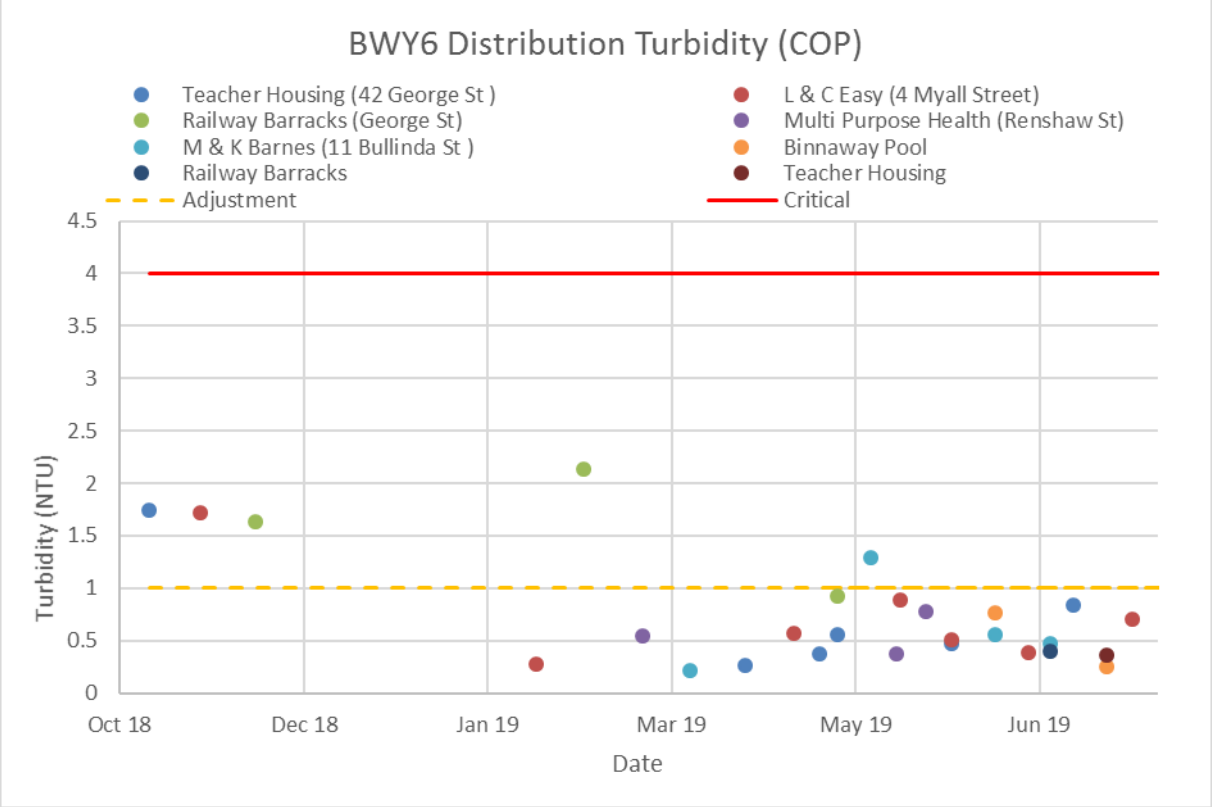
***Source**: Binnaway operational monitoring spreadsheet*

Figure 9-4: Distribution free chlorine (BWY5) – Binnaway



***Source**: Binnaway operational monitoring spreadsheet*

Figure 9-5: Distribution turbidity (BWY6) – Binnaway



***Source:** 2018 and 2019 Verification monitoring spreadsheets*

9.3 Critical limit exceedance

No CCP exceptions were recorded for Binnaway during the reporting period.

No formal CCP reservoir inspections were undertaken.

9.4 Water quality

This section includes a review of water quality data for the Binnaway water supply system from the reporting period, 1 August 2018 to 31 July 2019, including data collected as part of the NSW Health drinking water monitoring system program.

9.4.1 Data collection

The Binnaway scheme operational water quality monitoring plan is shown in Table 8-4.

Table 9-3. Monitoring undertaken for Binnaway water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Raw water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
Settled water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
		Temp		Daily
Filtered water	BWY1	Turbidity	NTU	Daily
		Colour	HU	Daily
		Free chlorine	mg/L	Daily
		pH		Daily
Clear water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
	BWY2	Free chlorine	mg/L	Daily
Reticulation	BWY5	Free chlorine	mg/L	Weekly
		pH		Weekly
	BWY6 (OCP)	Turbidity	NTU	Weekly

9.4.2 Water quality issues

Monitoring of Binnaway water supply detected exceptions with ADWG aesthetic guidelines exceptions for total dissolved solids, total hardness, pH and sodium, there were no ADWG health guideline exceptions. There was one occasion where total coliforms were detected.

9.5 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 9-4. There were 2 water quality complaints concerning dirty water in Binnaway (August and October 2018).

Table 9-4. Summary of water quality customer complaints / enquiries – Binnaway

Complaints/Enquires	Type	Number
Water Quality	Complaints	2
Water (pressure / lack of water)	Enquiry	1
Water restrictions (leaks /bursts)	Enquiry	1

Complaints/Enquires	Type	Number
Water Main (leaks /bursts)	Enquiry	1
Water Meter	Enquiry	13

9.6 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Binnaway water supply system in the reporting period.

9.7 Reservoir inspections

Details of reservoir inspections undertaken from August 2018 to July 2019 are shown in Table 3-7.

Informal visual inspections of the reservoirs by the WTP operators were also undertaken approximately on a daily basis.

Table 9-5. Summary of reservoir inspections - Binnaway

Date	Reservoirs inspected	Findings	Corrective actions
3/02/209	Binnaway Reservoir	The entry hatch is unsealed around the edges and leaves and debris are entering via the unsealed ridge caps.	This tank still needs to be renovated. Project planning and budgeting is in progress.

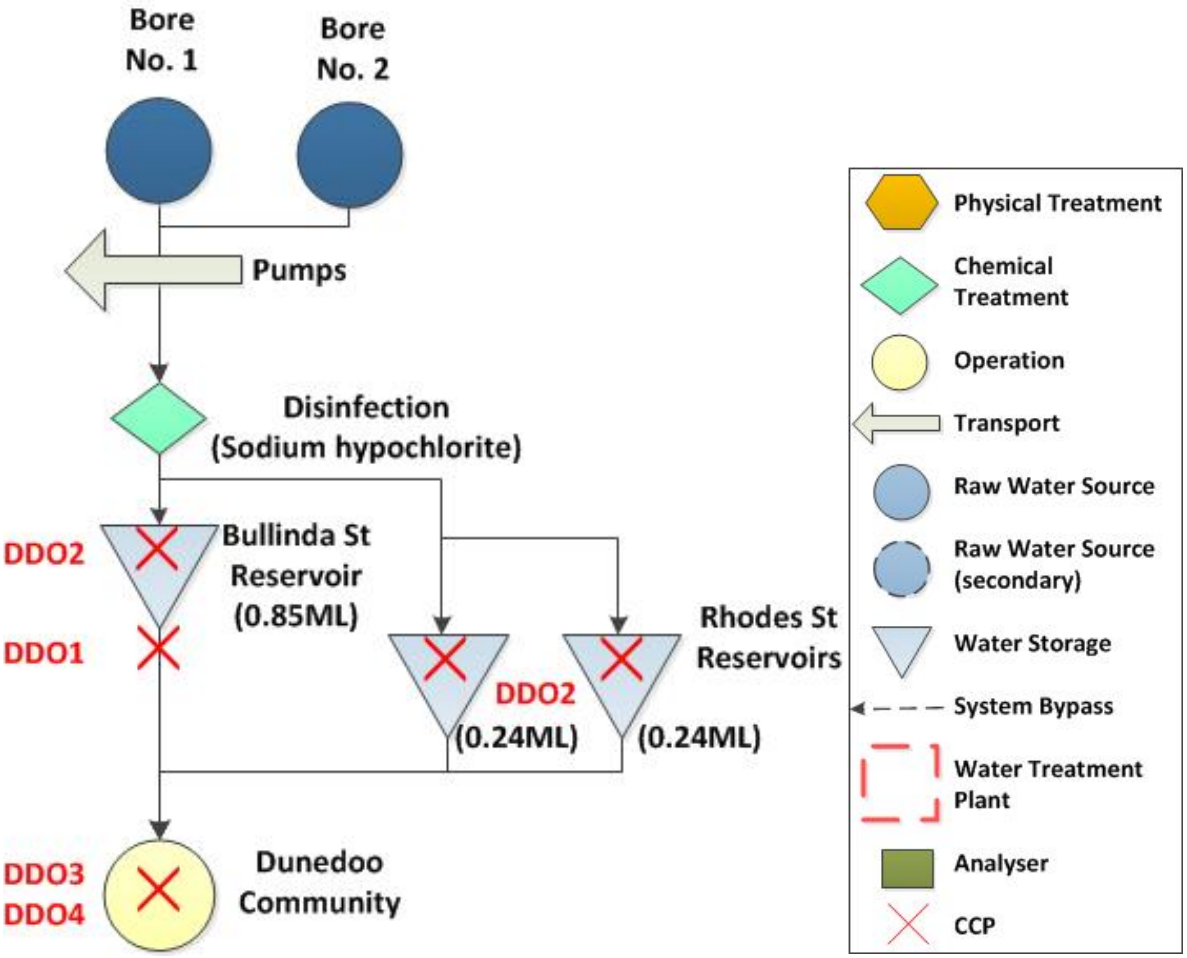
10 Dunedoo

10.1 Scheme summary

The Dunedoo water supply system comprises:

- Source water: Bore
- Chlorination disinfection only (NaOCl); fluoridation not needed due to natural occurrence
- Number of residential connections: 388
- Number of non-residential connections: 81

Figure 10-1: Water supply flow diagram – Dunedoo



Improvement works undertaken from August 2018 to July 2019 for the Dunedoo water supply include:

- Telemetry Upgrades
- Reservoir upgrades
- Upgrades to chlorine room

10.2 Critical control points

The CCPs for Dunedoo are shown in Table 10-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 10-2.

Table 10-1. Summary of critical control points and critical operational points – Dunedoo

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
DDO1	Disinfection (hypo)	Chlorine	1.1 – 2.2 mg/L	<0.9 mg/L, >3.0 mg/L	<0.7 mg/L, >4.0 mg/L
DDO2	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
DDO3	Distribution	Chlorine	1.0 – 2.0 mg/L	<0.5 mg/L, >3.0 mg/L	< 0.2 mg/L, >4.0 mg/L
DDO4	Distribution (**OCP**)	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

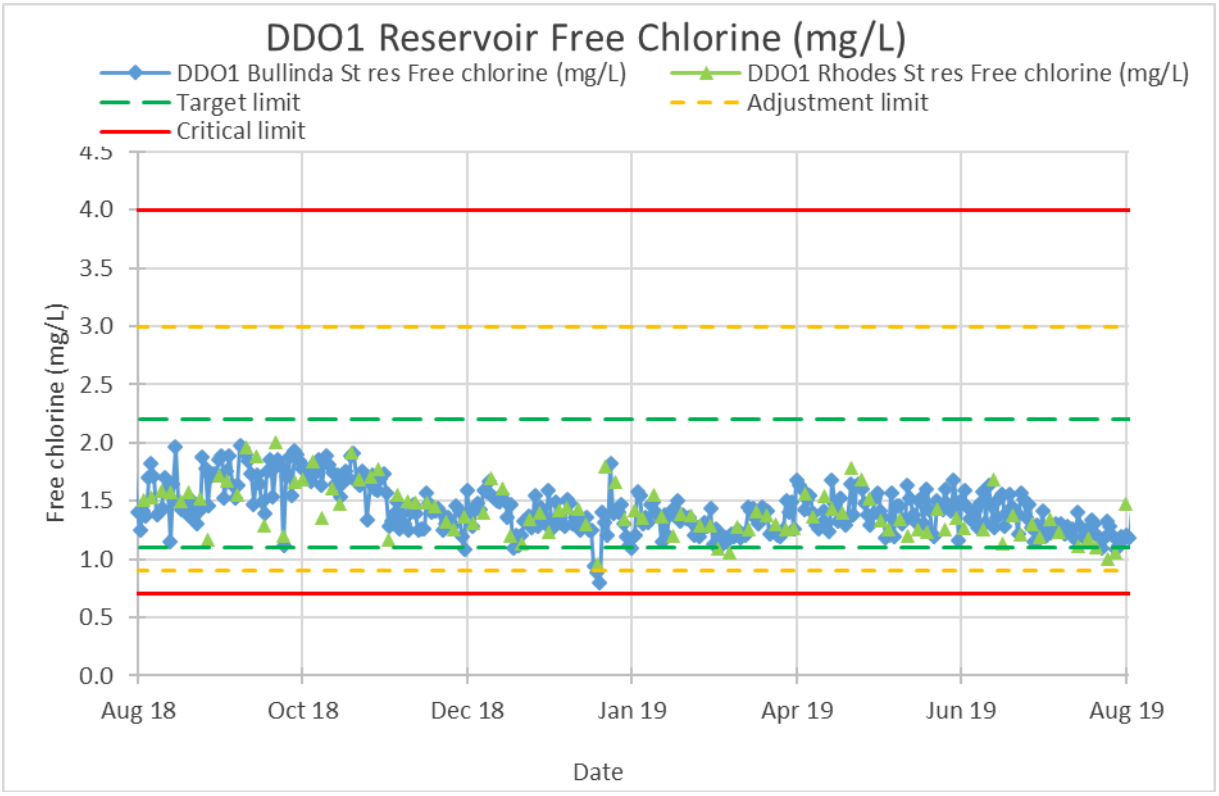
Table 10-2. Summary of critical control points changes – Dunedoo

Date	CCP	Limit	Old	New	Reason for change
8 March 2019 Water Quality Meeting	DDO1 Disinfection	Target	1.5 – 1.8 mg/L	1.1 – 2.2 mg/L	To reflect operational values
		Alert Level	<1.2 mg/L, >2.5 mg/L	<0.9 mg/L, >3.0 mg/L	
		Critical Limit	<1.0 mg/L, >4.0 mg/L	<0.7 mg/L, >4.0 mg/L	Critical limit of 0.7 mg/L still allows for a CT of >15 min*mg/L.
	DDO3 Distribution	Target	1.0 – 1.5 mg/L	1.0 – 2.0 mg/L	To reflect operational values
		Alert Level	<0.9 mg/L, >2.5 mg/L	<0.5 mg/L, >3.0 mg/L	
		Critical Limit	<0.5 mg/L, >4.0 mg/L	<0.2 mg/L, >4.0 mg/L	To have one low critical limit of 0.2 mg/L across all systems.

Critical control point performance for the reporting period is graphed in Figure 10-2, Figure 10-3 and Figure 10-4.

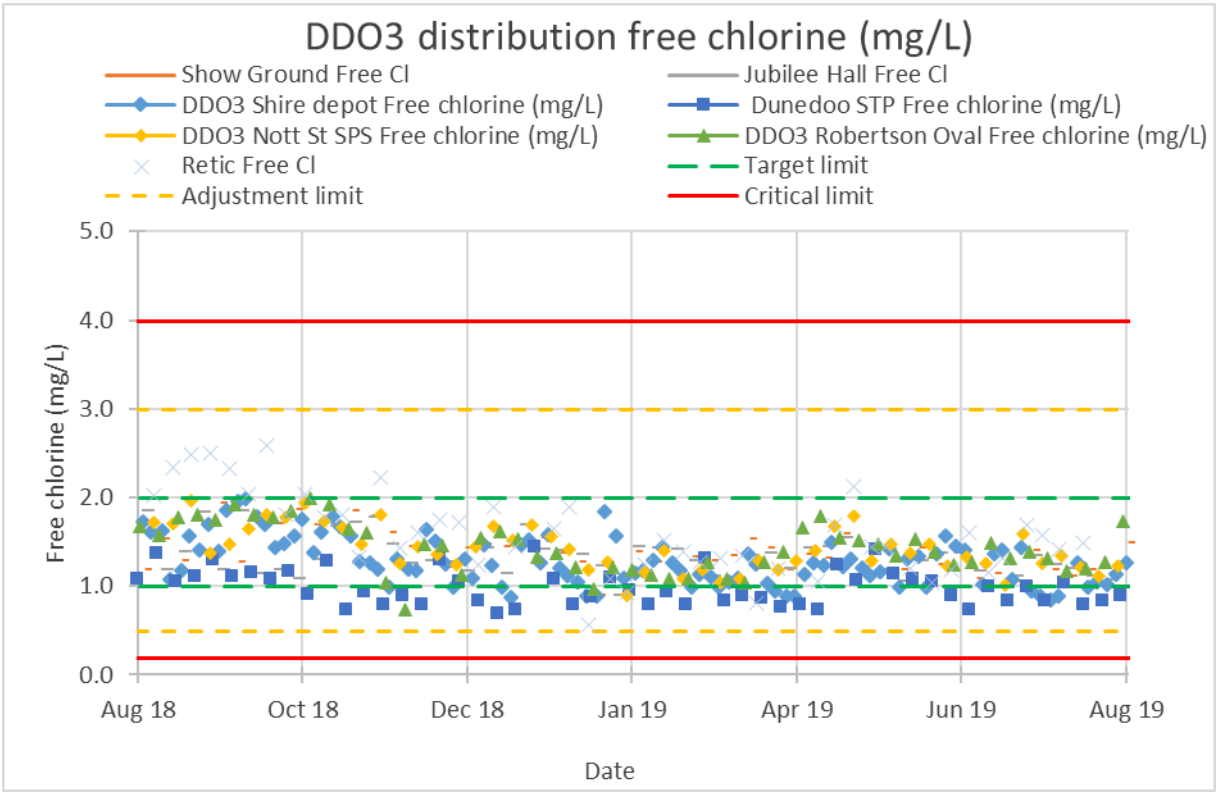
Inspections of the reservoir CCP are not currently being undertaken. Development of a reservoir inspection SOP is included as an action item in the improvement plan and is currently in progress.

Figure 10-2: Reservoir free chlorine (DDO1) – Dunedoo



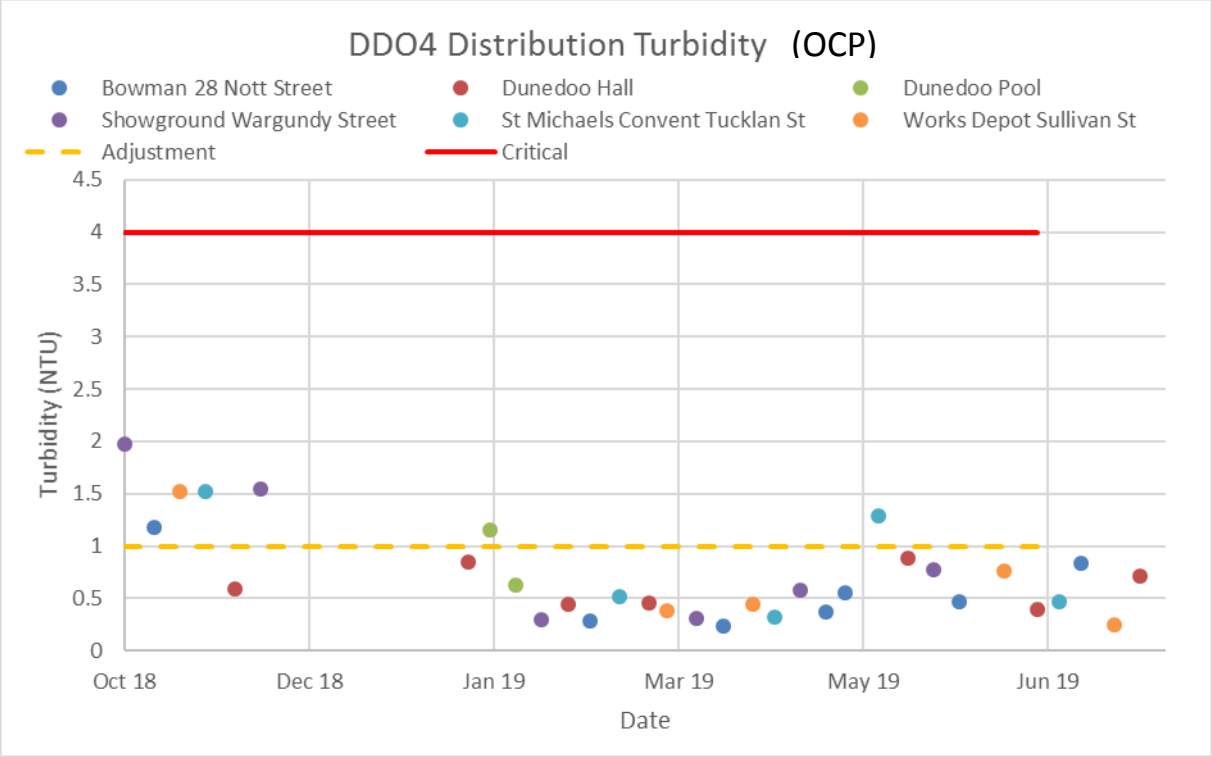
***Source**: Binnaway operational monitoring spreadsheet*

Figure 10-3: Distribution free chlorine (DDO3) – Dunedoo



***Source**: Binnaway operational monitoring spreadsheet*

Figure 10-4: Distribution turbidity (DDO4) – Dunedoo



Source: *2018 and 2019 Verification monitoring spreadsheets*

10.3 Critical limit exceedance

There were no CCP exceptions for the Dunedoo water supply system. Inspections of the reservoir CCP are not currently being undertaken.

10.4 Water quality

This section includes a review of water quality data for the Dunedoo water supply system from the reporting period, 1 August 2018 to 31 July 2019, including data collected as part of the NSW Health drinking water monitoring system program.

10.4.1 Data collection

The Dunedoo scheme operational water quality monitoring plan is shown in Table 10-3.

Table 10-3. Monitoring undertaken for Dunedoo water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Reservoir	DDO1	Free chlorine	mg/L	Daily
		pH		Daily
Reticulation	DDO3	Free chlorine	mg/L	Weekly
		pH		Weekly
	DDO4 (OCP)	Turbidity		

10.4.2 Water quality issues

Monitoring of Dunedoo water supply detected two exception ADWG aesthetic guidelines exceptions for total dissolved solids and total hardness. There were also two occasions where total coliforms were detected.

10.5 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 10-4.

Table 10-4. Summary of water quality customer complaints / enquiries – Dunedoo

Complaints/Enquires	Type	Number
Water Main (leaks /bursts)	Enquiry	14
Water (pressure / lack of water)	Enquiry	3
Water Meter	Enquiry	15

10.6 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Dunedoo water supply system in the reporting period.

10.7 Reservoir inspections

Details of reservoir inspections undertaken from August 2018 to July 2019 are shown in Table 10-5.

Informal visual inspections of the reservoirs by the WTP operators were also undertaken approximately on a weekly basis.

Table 10-5. Summary of reservoir inspections - Dunedoo

Date	Reservoirs inspected	Findings	Corrective actions
04/02/2019	Dunedoo – Rhodes No. 1 Reservoir	The roof is at risk of failure due to the corrosion on the rafters and design. There is a significant amount of bird faeces on the roof and platform areas which are unsealed	The entry hatch edges have been mastic sealed and the roof sheet edges have also been sealed off.
04/02/2019	Dunedoo – Rhodes No. 2 Reservoir	The roof is at risk of failure due to the corrosion on the rafters and design. There is a significant amount of bird faeces on the roof and platform areas which are unsealed.	The roof edges have been sealed.
02/02/2019	Dunedoo - Bullinda Reservoir	No water quality issues noted.	New access hatch installed.

11 Staff development and training

A summary of training undertaken by water staff from 1 August 2018 to 31 July 2019 is shown in Table 11-1.

Table 11-1. Summary of staff training

Row Labels	Name
AQF3 Chemical Handling Accreditation – SpraySmart	Jason Rand
	Matthew Gilbert
	Scott Watton
Asbestos Awareness	Jason Rand
Certificate III Water Operations – TAFE (completed)	David Birdling
Code of conduct – Local Government Professionals	Andrew Park
	Cornelia Wiebels
	David Birdling
	Dean Lewin
	Graham Richardson
	Jason Rand
	Martin Gordon
	Matthew Gilbert

Row Labels	Name
	Scott Stanley
	Scott Watton
	Selina Xu
Enter and work in confined spaces – TAFE	Cornelia Wiebels
	Graham Richardson
	Andrew Milford
	Andrew Park
	David Birdling
	Jason Rand
	Martin Gordon
	Matthew Gilbert
	Scott Watton
Introduction to Project Management - LGNSW	Cornelia Wiebels
Part 1 – Chemical Dosing Systems – DPI Water	Graham Richardson
	Martin Gordon
Part 1 – Wastewater Treatment Operations – DPI Water	Martin Gordon
	Andrew Park
	David Birdling
Work safely at heights – TAFE	Andrew Milford
	Cornelia Wiebels
	Graham Richardson
	Jason Rand
	Martin Gordon
	David Birdling
	Matthew Gilbert

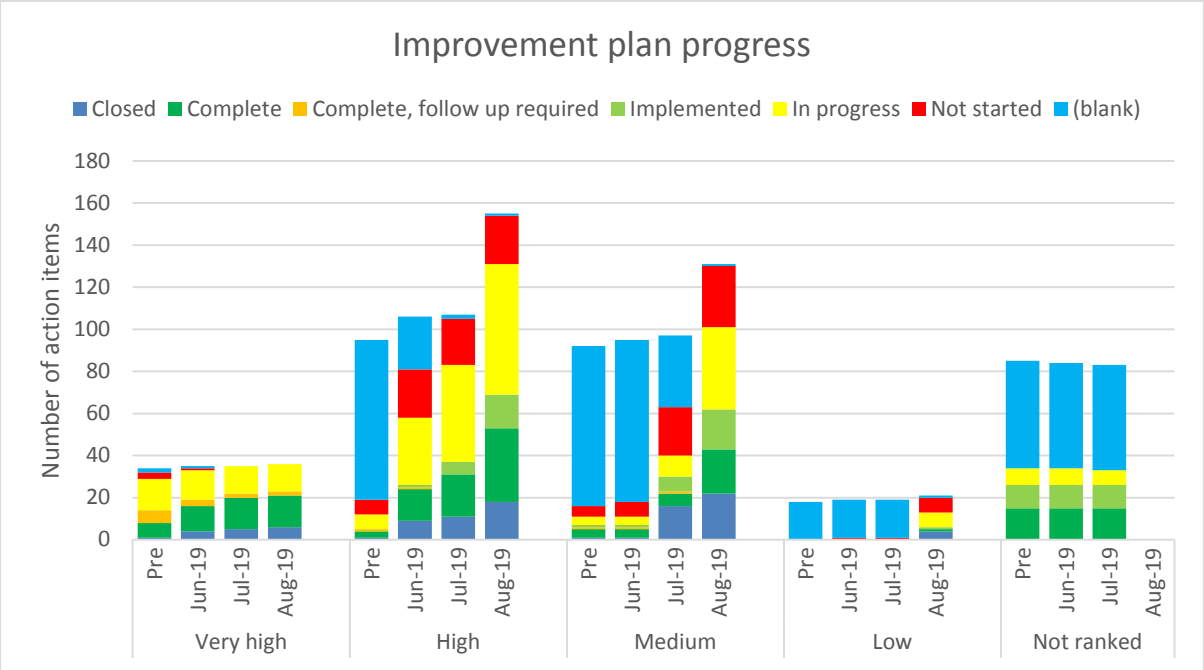
12 DWMS continuous improvement plan

Councils improvement plan was consolidated and then reviewed in three facilitated meetings (June, July and August 2019). The current water quality improvement plan is attached to this report

Table 12-1. Water quality improvement plan status

Row Labels	Closed	Complete / implemented	Complete, follow up required	In progress	Not started
Very high	6	15	2	13	
High	18	51		62	23
Medium	23	40		39	29
Low	4	2		7	7
Total	**51**	**108**	**2**	**121**	**59**

Figure 12-1: Improvement plan progress



13 Review of DWMS implementation

A summary of DWMS reviews is included in Table 13-1.

Table 13-1. Summary of reviews

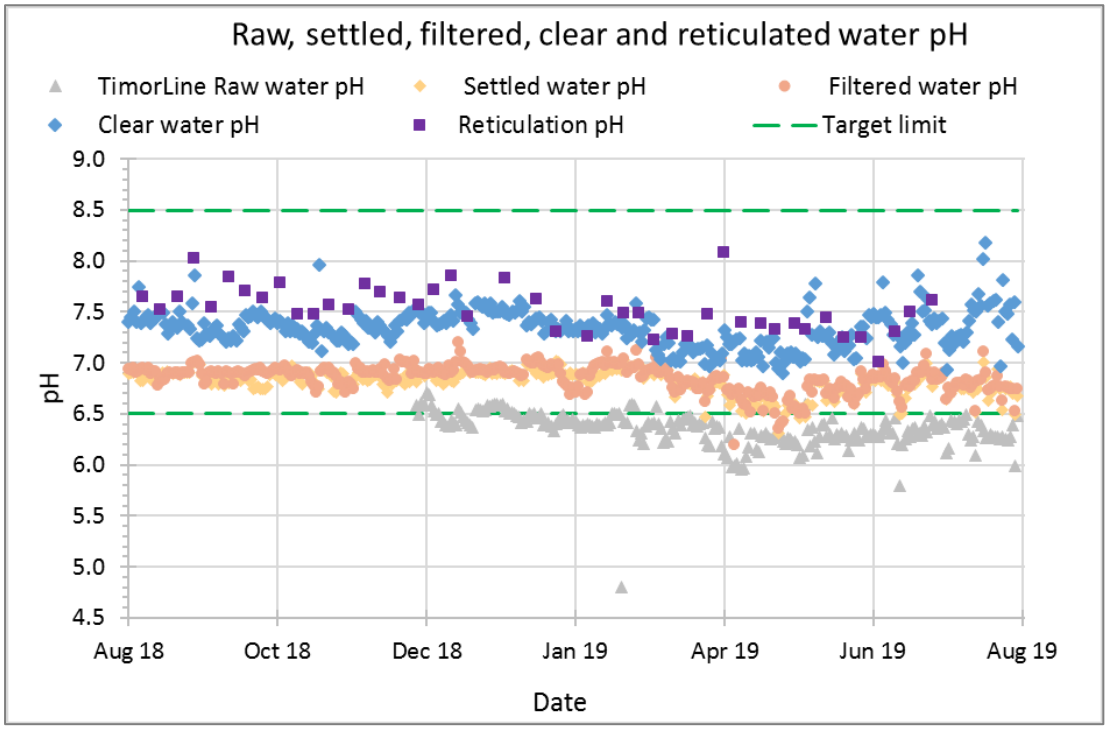
Date	Attendance	Scope	Findings	Actions
25/1/2019	Council, NSW Health, NSW DIPE	Water quality review meeting	Review of water quality data,	
1/03/2019	Council, NSW DIPE	Water quality review meeting	CCPs were reviewed and updated Review of water quality data	
28/6/2019	Atom Consulting, Council, NSW Health, NSW DIPE	Review of water quality improvement plan (very high- and high-level priority actions)	Progress of actions reviewed	Timelines and responsibility assigned
30/07/2019	Atom Consulting, Council	Review of water quality improvement plan (high and medium priority actions)	Progress of actions reviewed	Timelines and responsibility assigned

Appendix A Coonabarabran water quality data

A.1 Water quality graphs

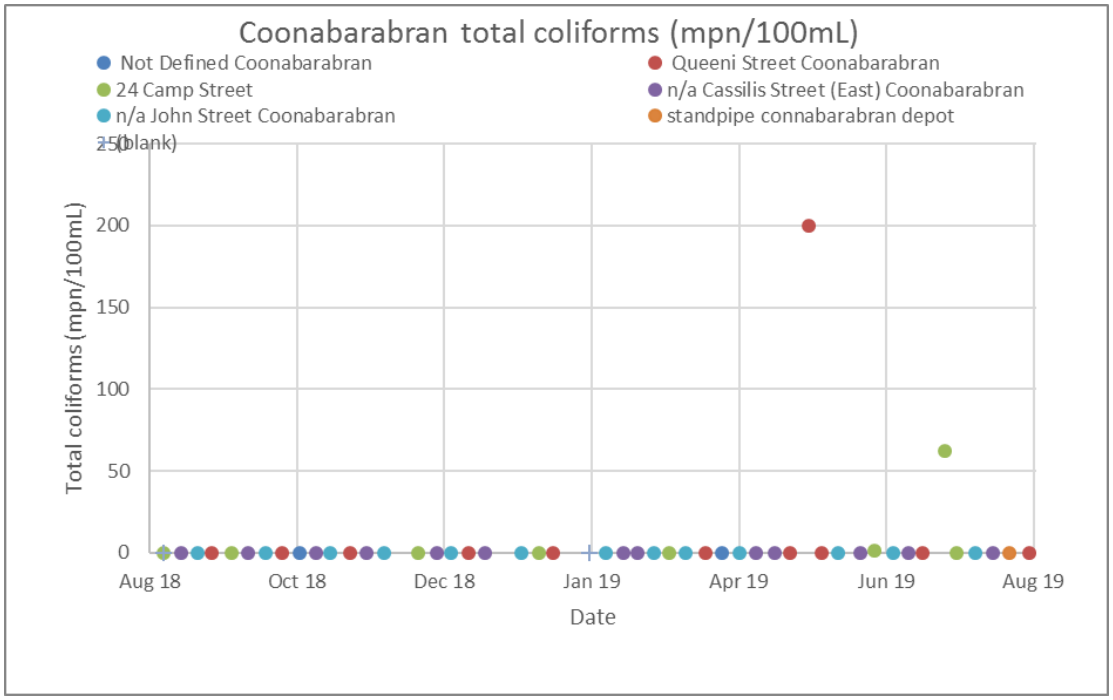
A.1.1 Operational monitoring graphs

Figure A-1. Coonabarabran pH



A.1.2 NSW Health verification monitoring graphs

Figure A-2. Coonabarabran total coliforms



A.2 Water quality data summary

Table A-1. Coonabarabran operational monitoring data summary

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Raw Water Quality								
Timor line Raw water	Turbidity (NTU)	0.13	0.87	4.50			247	
Timor line Raw water	Colour (HU)	0.00	0.00	0.00			247	
Timor Line Raw water	pH	4.80	6.35	6.71			247	
Settled Water Quality								
Settled water	Turbidity (NTU)	0.14	0.62	2.80			365	
Settled water	Colour (HU)	0.00	0.00	0.00			365	
Settled water	pH	6.31	6.82	7.13			363	
Filtered Water Quality								
Filtered water	Turbidity (NTU)	0.02	0.28	0.51		0.7	365	CBN1
Filtered water	Colour (HU)	0.00	0.00	0.00			365	
Filtered water	pH	6.20	6.85	7.20			364	
Treated Water Quality								
Clear water	Turbidity (NTU)	0.29	0.58	2.04		1.0	365	
Clear water	Colour (HU)	0.00	0.00	0.00			365	
Clear water	pH	6.90	7.34	8.18			364	
Clear water	Free chlorine (mg/L)	1.60	2.60	3.70	1.5	4.0	365	CBN2
Clear water	Fluoride (mg/L)	0.00		0.00		1.5	0	CBN3
Bugaldie	Free chlorine (mg/L)	0.65	2.06	3.30	1.0	4.0	41	BUG1
Kenebri	Free chlorine (mg/L)	0.81	1.92	2.60	1.0	4.0	42	KBI1
Reticulation Monitoring								
WSC Admin (John St)	Free Chlorine (mg/L)	0.45	1.38	2.28	0.2	4.0	14	CBN5
WSC Admin (John St)	Total Chlorine (mg/L)	0.55	1.83	2.53			8	
WSC Admin (John St)	pH	7.01	7.53	8.08			14	
Small Home Queenie Street	Free Chlorine (mg/L)	0.52	1.41	2.02	0.2	4.5	5	CBN5
Small Home Queenie Street	Total Chlorine (mg/L)	0.63	1.59	2.31			5	
Small Home Queenie Street	pH	7.33	7.46	7.62			5	
24 Camp Street (Galvin)	Free Chlorine (mg/L)	0.00	0.71	1.50	0.2	4.5	9	CBN5
24 Camp Street (Galvin)	Total Chlorine (mg/L)	0.45	0.70	0.81			4	
24 Camp Street (Galvin)	pH	7.23	7.48	7.79			10	
Cooinda Hospital (Neate St)	Free Chlorine (mg/L)	1.01	1.76	2.60	0.2	4.5	10	CBN5
Cooinda Hospital (Neate St)	Total Chlorine (mg/L)	1.36	1.95	2.70			4	

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Cooinda Hospital (Neate St)	pH	7.25	7.50	7.84			10	

Source: Coonabarabran operational monitoring spreadsheet

A.2.1 Verification monitoring

For the new WTP Verification data taken from the NSW Health database, from 1 August 2018 to 31 July 2019 was analysed for the Coonabarabran water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table A-2.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange.

Table A-2. Coonabarabran verification monitoring data summary

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Exceptions	
Aluminium (mg/L)	0.2	A	0.02	0.02	0.04	0.04	0.04	3	0	0%
Antimony (mg/L)	0.003	H	0.001	0.001	0.001	0.001	0.001	3	0	0%
Arsenic (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	3	0	0%
Barium (mg/L)	2	H	0.02	0.02	0.02	0.03	0.03	3	0	0%
Boron (mg/L)	4	H	0.05	0.05	0.05	0.05	0.05	3	0	0%
Cadmium (mg/L)	0.002	H	0.0003	0.0003	0.0003	0.0003	0.0003	3	0	0%
Calcium (mg/L)			19	19	22	22	22	3	0	0%
Chloride (mg/L)	250	A	12	12	16	16	16	3	0	0%
Chromium (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	3	0	0%
Copper (mg/L)	2	H	0.003	0.003	0.003	0.007	0.008	3	0	0%
E. coli	0	H	0	0	0	0	0	53	0	0%
Fluoride (mg/L)	1.5	H	0.05	0.05	0.05	0.05	0.05	4	0	0%
Free chlorine (mg/L)[1]			0.43	0.59	1.4	2.3	2.6	52	0	0%
Iodine (mg/L)			0.01	0.01	0.02	0.02	0.02	3	0	0%
Iron (mg/L)	0.3	A	0.01	0.01	0.04	0.04	0.04	3	0	0%
Lead (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	3	0	0%
Magnesium (mg/L)	-		4.7	4.7	4.7	4.8	4.9	3	0	0%
Manganese (mg/L)	0.5	H	0.003	0.003	0.007	0.007	0.007	3	0	0%
Mercury (mg/L)	0.001	H	0.0001	0.0001	0.0001	0.0001	0.0001	3	0	0%
Molybdenum (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	3	0	0%
Nickel (mg/L)	0.02	H	0.005	0.005	0.005	0.005	0.005	3	0	0%
Nitrate (mg/L)	50	H	1.0	1.0	1.0	1.0	1.0	3	0	0%
Nitrite (mg/L)	3	H	0.05	0.05	0.05	0.05	0.05	3	0	0%
pH	8.5	A	7.0	7.2	7.5	7.9	8.2	57	0	0%
Selenium (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	3	0	0%
Silver (mg/L)	0.1	H	0.001	0.001	0.001	0.001	0.001	3	0	0%
Sodium (mg/L)	180	A	10	10	13	13	13	3	0	0%
Sulfate (mg/L)	250	A	11	11	15	15	15	3	0	0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Exceptions	
Temperature (oC)			22	22	23	28	31	32	10	0
Total Chlorine (mg/L)	5	H	0.1	0.6	1.6	2.6	2.9	54	0	0%
Total Coliforms (cfu/100 mL)			0	0	0	0	200	53	3	6%
Total Dissolved Solids (TDS) (mg/L)	600	A	103	103	103	104	104	3	0	0%
Total Hardness as CaCO3 (mg/L)[2]	200	A	67	68	75	75	75	3	0	0%
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.5	0.5	0.5	3	0	0%
Turbidity (NTU)	5	A	0.1	0.1	0.8	1.4	1.5	37	0	0%
Uranium (mg/L)	0.017	H	0.003	0.003	0.003	0.003	0.003	3	0	0%
Zinc (mg/L)	3	A	0.005	0.005	0.005	0.010	0.010	3	0	0%

Source: NSW Health Water Quality Monitoring database

Note 1: The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2: ADWG recommend 200 mg/L hardness as CaCO3 as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

Appendix B Baradine water quality data

B.1 Water quality graphs

B.1.1 Operational monitoring graphs

Figure B-1. Baradine treated water pH

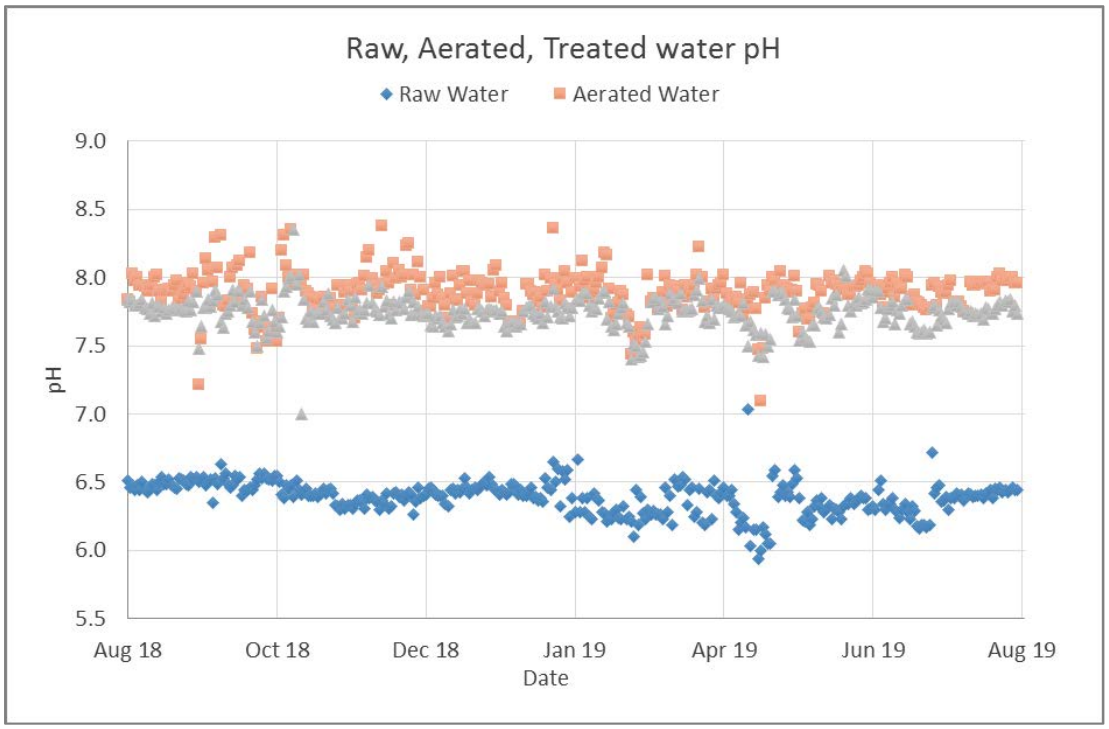


Figure B-2. Baradine reticulation pH

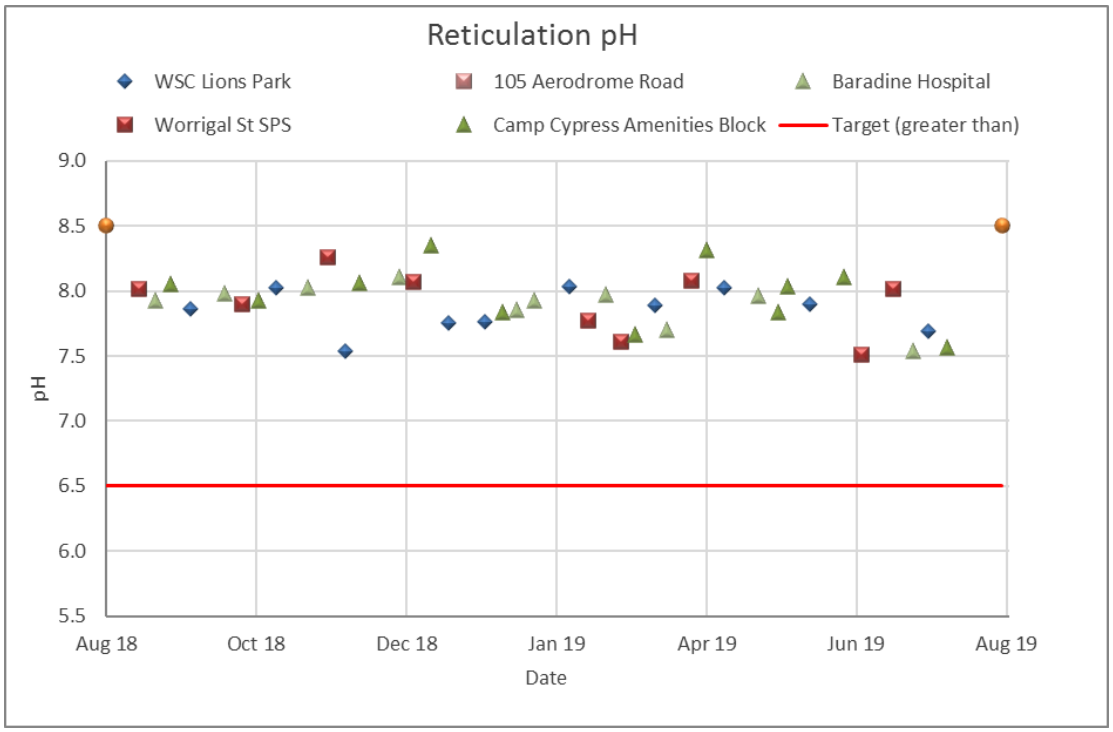
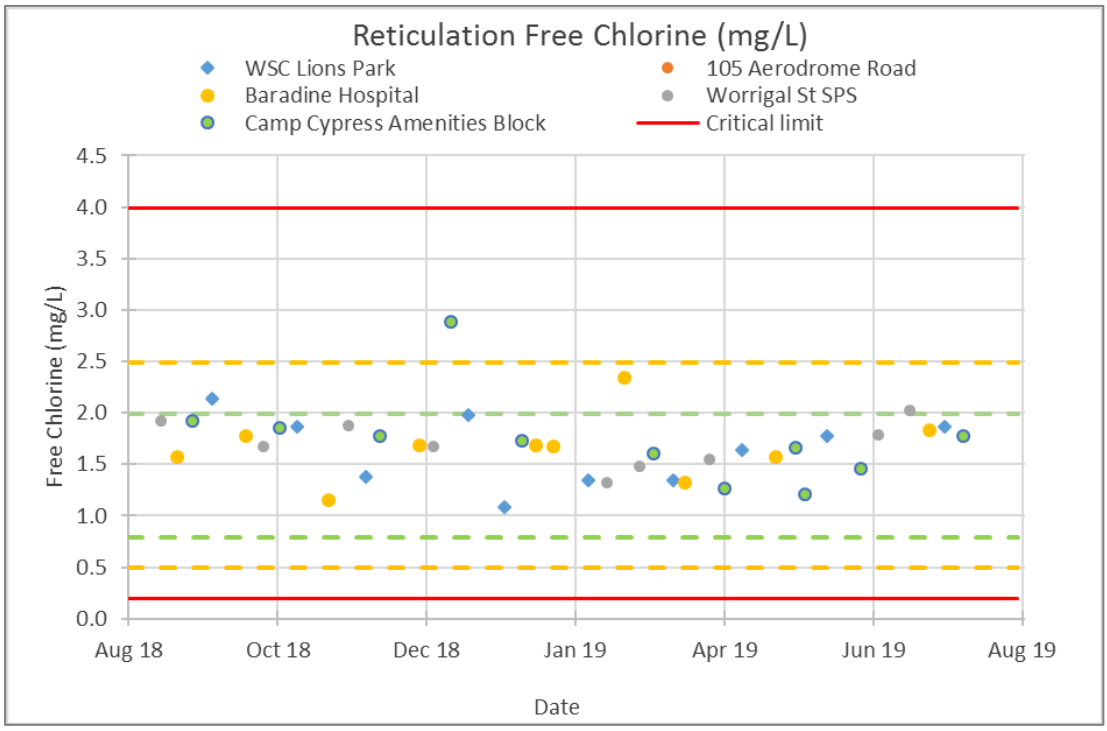


Figure B-3. Baradine reticulation free chlorine



B.1.2 Verification monitoring graphs

Figure B-4. Baradine verification total coliforms

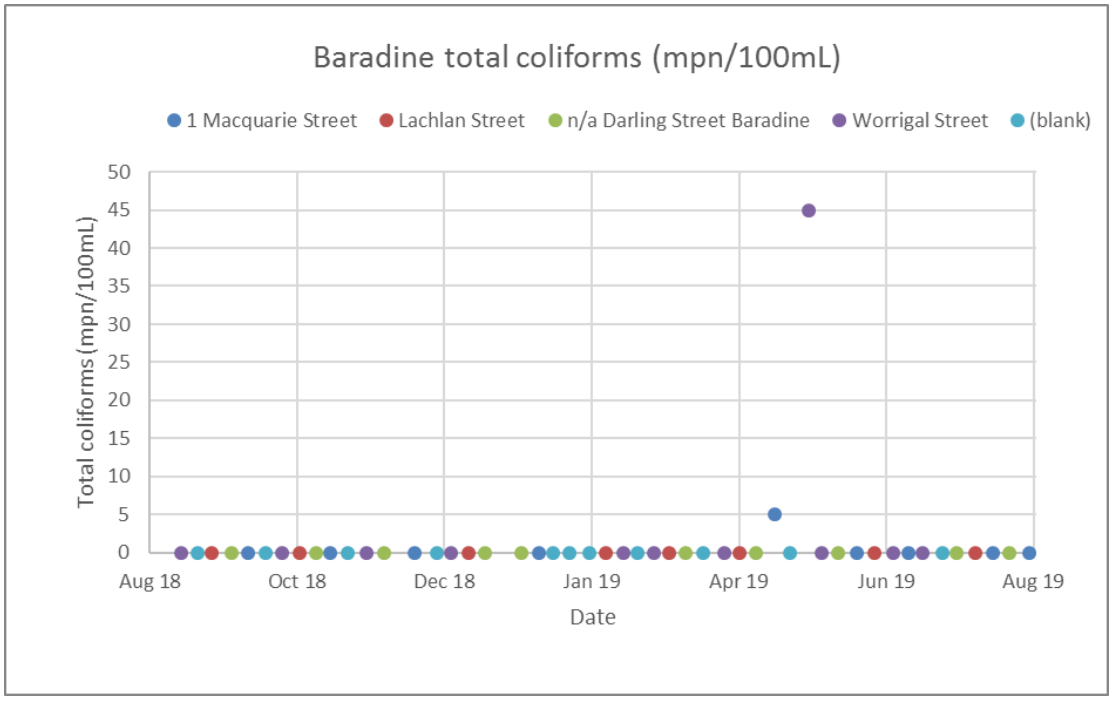
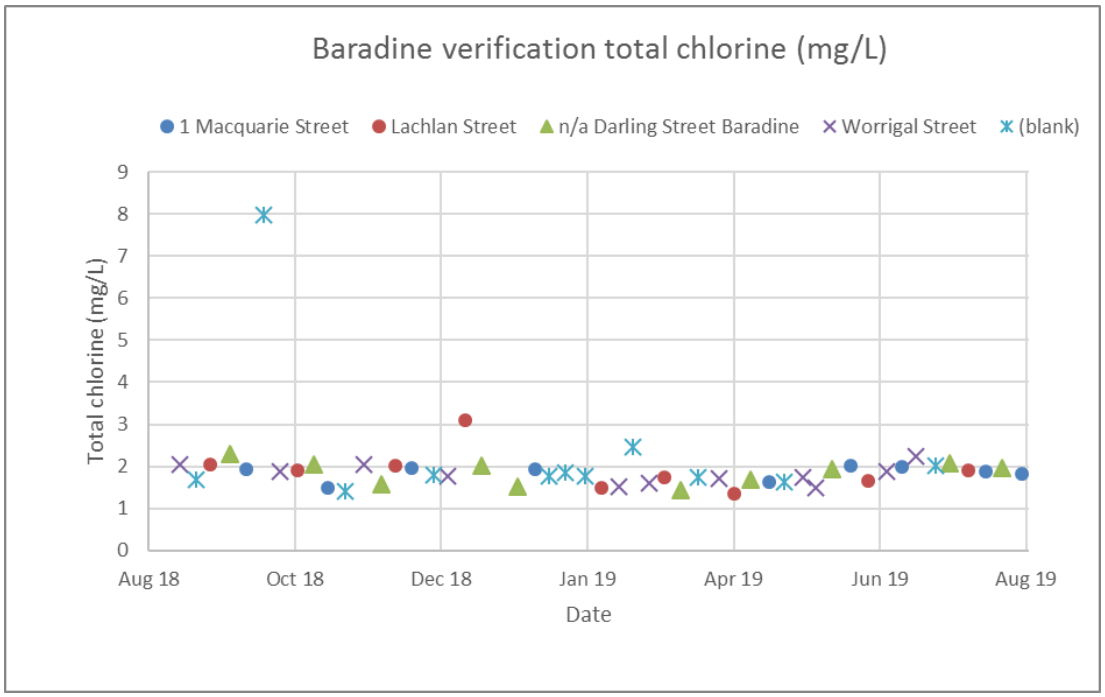


Figure B-5. Baradine verification total chlorine



B.2 Water quality data summary

Table B-1. Baradine operational monitoring data summary

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Raw Water	pH	5.94	6.39	7.03			364	
Aerated Water	pH	7.09	7.89	8.38			364	
Treated water	pH	7.00	7.75	8.35			364	
Treated Water	Free Chlorine (mg/L)	1.09	1.64	2.30	1.00	4.00	364	BDN2
Treated Water	Turbidity (NTU)	0.00	0.20	0.83		0.80	363	BDN1
Reticulation	Free Chlorine (mg/L)	0.90	1.77	2.90	0.20	4.00	20	BDN5
WSC Lions Park	Free Chlorine (mg/L)	1.10	1.65	2.15	0.20	4.00	10	BDN5
WSC Lions Park	Total Chlorine (mg/L)	1.44	1.80	2.29			10	
WSC Lions Park	pH	7.54	7.85	8.03			10	
Baradine Hospital	Free Chlorine (mg/L)	1.16	1.67	2.35	0.20	4.00	10	BDN5
Baradine Hospital	Total Chlorine (mg/L)	1.40	1.85	2.45			10	
Baradine Hospital	pH	7.54	7.90	8.10			10	
Worrigal St SPS	Free Chlorine (mg/L)	1.33	1.71	2.04	0.20	4.00	9	BDN5
Worrigal St SPS	Total Chlorine (mg/L)	1.51	1.86	2.25			9	

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Worrigal St SPS	pH	7.51	7.91	8.26			9	
Camp Cypress Amenities Block	Free Chlorine (mg/L)	1.22	1.75	2.90	0.20	4.00	11	BDN5
Camp Cypress Amenities Block	Total Chlorine (mg/L)	1.35	1.90	3.10			11	
Camp Cypress Amenities Block	pH	7.56	7.97	8.35			11	
1 Maccquarie street	Free Chlorine (mg/L)	0.90	1.59	1.82	0.20	4.00	11	BDN5
1 Maccquarie street	Total Chlorine (mg/L)	1.49	1.78	1.95			11	
1 Maccquarie street	pH	7.88	8.00	8.15			11	

Source: Baradine operational monitoring spreadsheet

B.2.1 Verification monitoring

For the new WTP Verification data taken from the NSW Health database, from 1 August 2018 to 31 July 2019 was analysed for the Baradine water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table B-2.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange.

Table B-2. Baradine verification monitoring data summary

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Excep-tions	
Aluminium (mg/L)	0.2	A	0.06	0.06	0.09	0.10	0.1	3	0	0%
Antimony (mg/L)	0.003	H	0.0005	0.0005	0.0005	0.0005	0.0005	3	0	0%
Arsenic (mg/L)	0.01	H	0.0005	0.0005	0.0005	0.0005	0.0005	3	0	0%
Barium (mg/L)	2	H	0.10	0.10	0.10	0.11	0.11	3	0	0%
Boron (mg/L)	4	H	0.05	0.05	0.05	0.05	0.05	3	0	0%
Cadmium (mg/L)	0.002	H	0.0003	0.0003	0.0003	0.0003	0.0003	3	0	0%
Calcium (mg/L)			7.7	7.8	8.4	9.2	9.3	3	0	0%
Chloride (mg/L)	250	A	34	34	35	36	36	3	0	0%
Chromium (mg/L)	0.05	H	0.0025	0.0025	0.0025	0.0025	0.0025	3	0	0%
Copper (mg/L)	2	H	0.0025	0.0025	0.0025	0.025	0.027	3	0	0%
E. coli	0	H	0	0	0	0	0	49	0	0%
Fluoride (mg/L)	1.5	H	0.13	0.13	0.14	0.149	0.15	3	0	0%
Free chlorine (mg/L)[1]			0.9	1.2	1.7	2.1	2.9	50	0	0%
Iodine (mg/L)			0.02	0.02	0.02	0.03	0.03	3	0	0%
Iron (mg/L)	0.3	A	0.02	0.02	0.05	0.06	0.06	3	0	0%
Lead (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	3	0	0%
Magnesium (mg/L)	-		4.3	4.4	5.1	5.3	5.3	3	0	0%
Manganese (mg/L)	0.5	H	0.0025	0.0028	0.0050	0.0095	0.0100	3	0	0%
Mercury (mg/L)	0.001	H	0.0	0.0	0.0	0.0	0.0	3	0	0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Excep-tions	
Molybdenum (mg/L)	0.05	H	0.0025	0.0025	0.0025	0.0025	0.0025	3	0	0%
Nickel (mg/L)	0.02	H	0.005	0.005	0.005	0.005	0.005	3	0	0%
Nitrate (mg/L)	50	H	0.5	0.5	0.5	0.5	0.5	3	0	0%
Nitrite (mg/L)	3	H	0.05	0.05	0.05	0.05	0.05	3	0	0%
pH	8.5	A	7.0	7.5	8.0	8.3	8.4	53	0	0%
Selenium (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	3	0	0%
Silver (mg/L)	0.1	H	0.001	0.001	0.001	0.001	0.001	3	0	0%
Sodium (mg/L)	180	A	56	58	72	72	72	3	0	0%
Sulfate (mg/L)	250	A	4	4	4	4	4	3	0	0%
Temperature (oC)			23	23	24	29	32	33	10	10
Total Chlorine (mg/L)	5	H	1.4	1.5	1.9	2.4	8.0	50	1	2%
Total Coliforms (cfu/100 mL)			0	0	0	0	45	49	2	4%
Total Dissolved Solids (TDS) (mg/L)	600	A	193	194	202	206	206	3	0	0%
Total Hardness as CaCO3 (mg/L)[2]	200	A	37	38	43	44	44.1	3	0	0%
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.5	1.0	1.0	3	0	0%
Turbidity (NTU)	5	A	0.10	0.23	0.61	1.9	3.6	37	0	0%
Uranium (mg/L)	0.017	H	0.003	0.003	0.003	0.003	0.003	3	0	0%
Zinc (mg/L)	3	A	0.005	0.005	0.005	0.01	0.01	3	0	0%

Source: NSW Health Water Quality Monitoring database

Note 1: The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

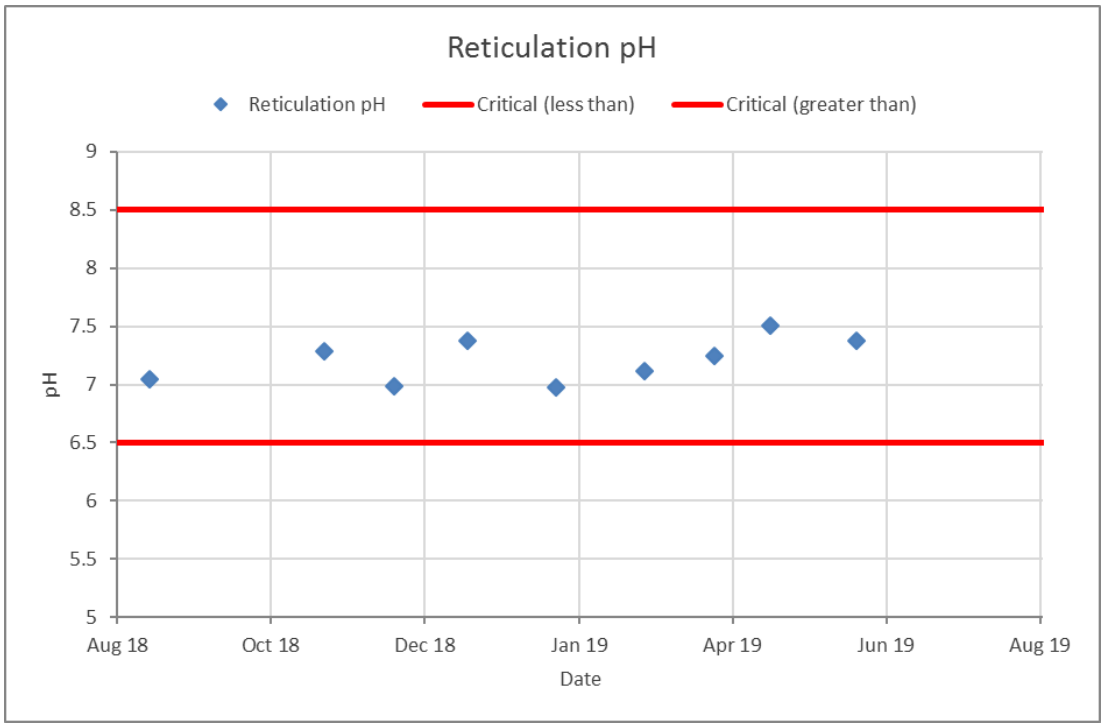
Note 2: ADWG recommend 200 mg/L hardness as CaCO3 as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

Appendix C Kenebri water quality data

C.1 Water quality graphs

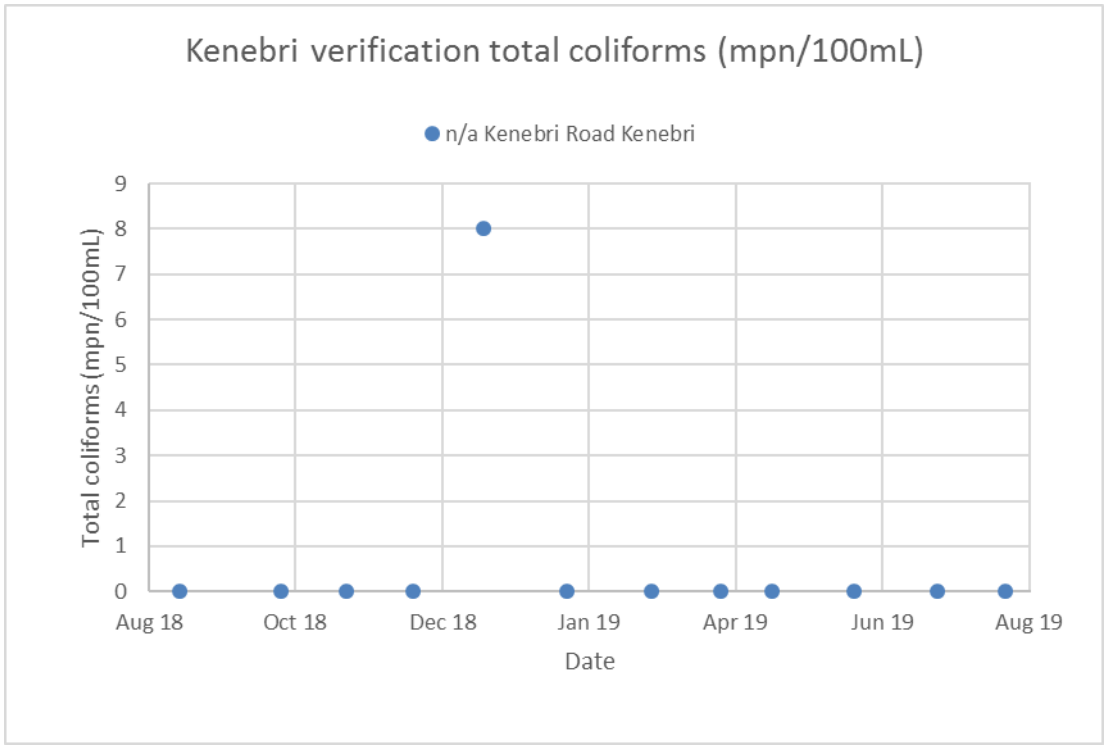
C.1.1 Operational monitoring graphs

Figure C-1. Kenebri reticulation pH



C.1.2 Verification monitoring graphs

Figure C-2. Kenebri verification total coliforms



C.2 Water quality data summary

Table C-1. Kenebri operational monitoring data summary

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Reservoir	Free chlorine (mg/L)	1.10	2.28	5.20	1.0	4	16	KBI1
Kenebri (Coonabarabran spreadsheet)	Free chlorine (mg/L)	0.81	1.92	2.60	1.0	4	42	KBI1
Reticulated Water Quality								
GM Stubbs	Free Chlorine (mg/L)	0.08	1.29	2.49	0.20	4	5	KBI3
GM Stubbs	Total Chlorine (mg/L)	0.10	1.60	3.15			6	
GM Stubbs	pH	6.95	7.15	7.38			5	
Van't Hag	Free Chlorine (mg/L)	0.00	2.18	5.27	0.20	4	8	KBI3
Van't Hag	Total Chlorine (mg/L)	0.00	2.00	4.65			7	
Van't Hag	pH	6.99	7.21	7.52			8	

Source: Kenebri operational monitoring spreadsheet

C.2.1 Verification monitoring

For the new WTP Verification data taken from the NSW Health database, from 1 August 2018 to 31 July 2019 was analysed for the Kenebri water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table C-2.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange.

Table C-2. Kenebri verification monitoring data summary

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Excep-tions	
Aluminium (mg/L)	0.2	A	0.01	0.01	0.01	0.02	0.02	2	0	0%
Antimony (mg/L)	0.003	H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0	0%
Arsenic (mg/L)	0.01	H	0.00	0.00	0.00	0.00	0.00	2	0	0%
Barium (mg/L)	2	H	0.2	0.2	0.2	0.3	0.3	2	0	0%
Boron (mg/L)	4	H	0.1	0.1	0.1	0.1	0.1	2	0	0%
Cadmium (mg/L)	0.002	H	0	0	0	0	0	2	0	0%
Calcium (mg/L)	-		15	15	18	20	21	2	0	0%
Chloride (mg/L)	250	A	180	180	182	183	183	2	0	0%
Chromium (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Copper (mg/L)	2	H	0.003	0.003	0.007	0.012	0.012	2	0	0%
E. coli	0	H	0.00	0.00	0.00	0.00	0.00	12	0	0%
Fluoride (mg/L)	1.5	H	0.2	0.2	0.2	0.2	0.2	2	0	0%
Free chlorine (mg/L)[1]			0.1	0.2	1.4	2.9	3.2	11	1	9%
Iodine (mg/L)			0.1	0.1	0.1	0.1	0.2	2	0	0%
Iron (mg/L)	0.3	A	0.04	0.04	0.05	0.05	0.05	2	0	0%
Lead (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Excep-tions	
Magnesium (mg/L)	-		7.2	7.3	8.4	9.5	9.6	2	0	0%
Manganese (mg/L)	0.5	H	0.0	0.0	0.0	0.0	0.0	2	0	0%
Mercury (mg/L)	0.001	H	0.000	0.000	0.000	0.000	0.000	2	0	0%
Molybdenum (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Nickel (mg/L)	0.02	H	0.01	0.01	0.01	0.01	0.01	2	0	0%
Nitrate (mg/L)	50	H	1.0	1.1	1.5	2.0	2.0	2	0	0%
Nitrite (mg/L)	3	H	0.1	0.1	0.1	0.1	0.1	2	0	0%
pH	8.5	A	7.0	7.0	7.3	7.6	7.7	13	0	0%
Selenium (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Silver (mg/L)	0.1	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Sodium (mg/L)	180	A	121	123	138	152	154	2	0	0%
Sulfate (mg/L)	250	A	11	11	11	11	11	2	0	0%
Temperature (oC)			30	30	30	31	32	32	2	0
Total Chlorine (mg/L)	5	H	0.1	0.2	1.9	3.3	3.4	11	0	0%
Total Coliforms (cfu/100 mL)			0.0	0.0	0.0	3.6	8.0	12	1	8%
Total Dissolved Solids (TDS) (mg/L)	600	A	474	476	492	508	510	2	0	0%
Total Hardness as CaCO3 (mg/L)[2]	200	A	78	78	79	81	81	2	0	0%
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.8	1.0	1.0	2	0	0%
Turbidity (NTU)	5	A	0.1	0.2	0.8	1.0	1.0	9	0	0%
Uranium (mg/L)	0.017	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Zinc (mg/L)	3	A	0.01	0.01	0.03	0.04	0.04	2	0	0%

Source: NSW Health Water Quality Monitoring database

Note 1: The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

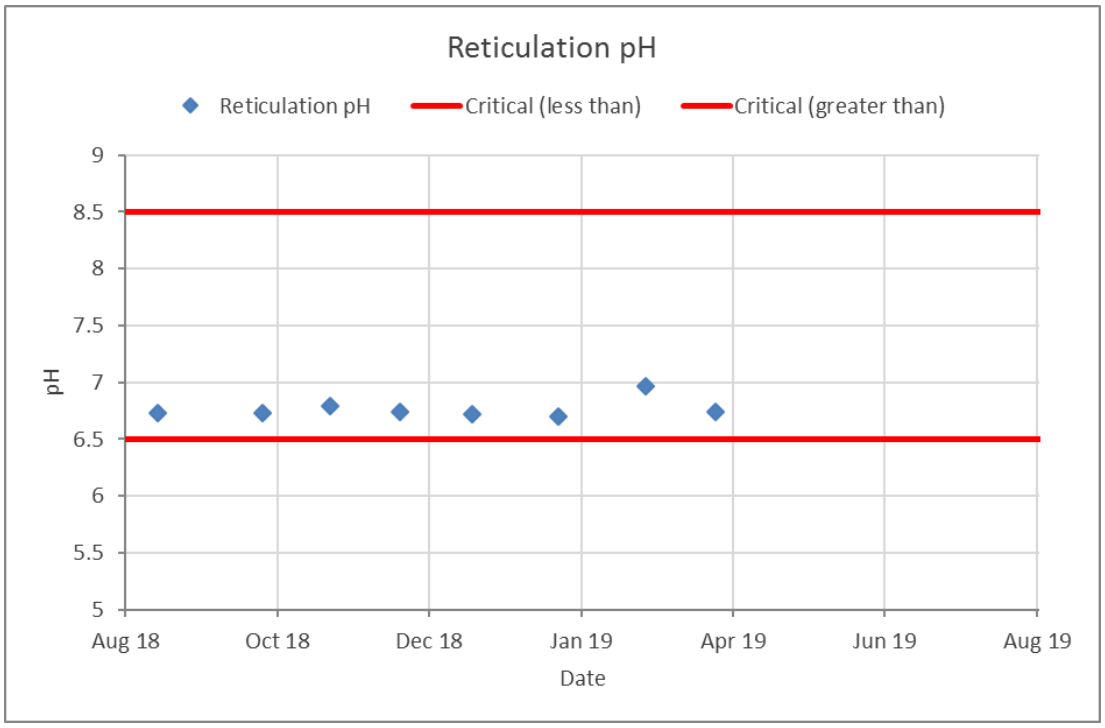
Note 2: ADWG recommend 200 mg/L hardness as CaCO3 as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

Appendix D Bugaldie water quality data

D.1 Water quality graphs

D.1.1 Operational monitoring graphs

Figure D-1. Bugaldie reticulation pH



D.1.2 Verification monitoring graphs

Figure D-2. Bugaldie verification iron

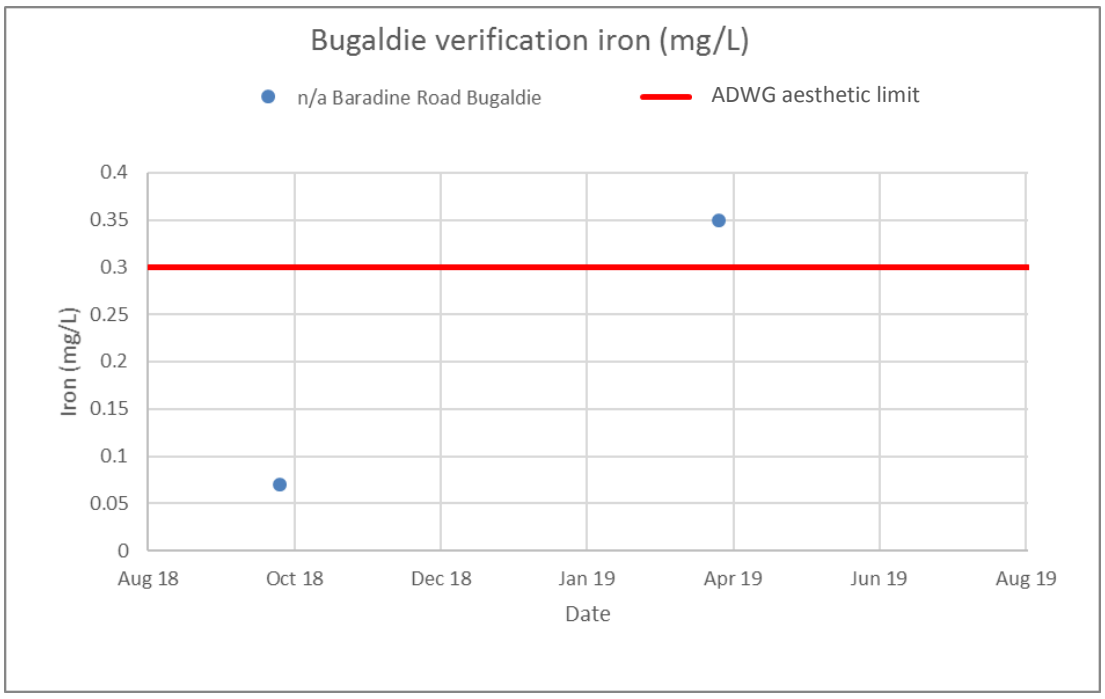
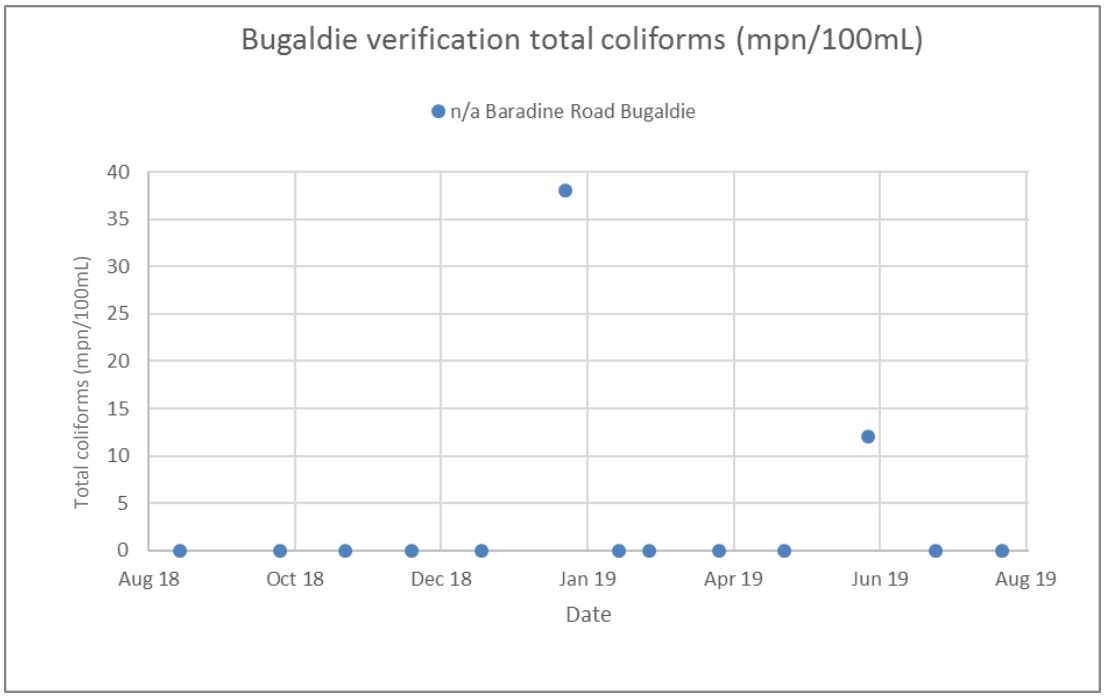


Figure D-3. Bugaldie verification total coliforms



D.2 Water quality data summary

Table D-1. Bugaldie operational monitoring data summary

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Reservoir	Free chlorine (mg/L)	1.10	2.28	5.20	1.0	4	16	KBI1
Bugaldie (Coonabarabran spreadsheet)	Free chlorine (mg/L)	0.65	2.06	3.30	1.0	4	41	BUG1
Reticulated Water Quality								
GM Stubbs	Free Chlorine (mg/L)	0.08	1.29	2.49	0.2	4	5	KBI 3
GM Stubbs	Total Chlorine (mg/L)	0.10	1.60	3.15			6	
GM Stubbs	pH	6.95	7.15	7.38			5	
Van't Hag	Free Chlorine (mg/L)	0.00	2.18	5.27	0.2	4	8	KBI 3
Van't Hag	Total Chlorine (mg/L)	0.00	2.00	4.65			7	
Van't Hag	pH	6.99	7.21	7.52			8	

Source: Bugaldie operational monitoring spreadsheet

D.2.1 Verification monitoring

For the new WTP Verification data taken from the NSW Health database, from 1 August 2018 to 31 July 2019 was analysed for the Bugaldie water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table D-2.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange.

Table D-2. Bugaldie verification monitoring data summary

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Excep-tions	
Aluminium (mg/L)	0.2	A	0.01	0.01	0.02	0.03	0.03	2	0	0%
Antimony (mg/L)	0.003	H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0	0%
Arsenic (mg/L)	0.01	H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0	0%
Barium (mg/L)	2	H	0.09	0.09	0.10	0.10	0.10	2	0	0%
Boron (mg/L)	4	H	0.05	0.05	0.05	0.05	0.05	2	0	0%
Cadmium (mg/L)	0.002	H	0.0003	0.0003	0.0003	0.0003	0.0003	2	0	0%
Calcium (mg/L)	-		15	15	16	16	17	2	0	0%
Chloride (mg/L)	250	A	43	43	45	46	46	2	0	0%
Chromium (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Copper (mg/L)	2	H	0.01	0.01	0.02	0.02	0.02	2	0	0%
E. coli	0	H	0	0	0	0	0	13	0	0%
Fluoride (mg/L)	1.5	H	0.27	0.27	0.28	0.28	0.28	2	0	0%
Free chlorine (mg/L)[1]			1.4	1.5	2.3	4.1	4.2	12	0	0%
Iodine (mg/L)			0.02	0.02	0.03	0.03	0.03	2	0	0%
Iron (mg/L)	0.3	A	0.07	0.08	0.21	0.34	0.35	2	1	50%
Lead (mg/L)	0.01	H	0.001	0.001	0.002	0.003	0.003	2	0	0%
Magnesium (mg/L)	-		12	12	13	14	14	2	0	0%
Manganese (mg/L)	0.5	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Mercury (mg/L)	0.001	H	0.0001	0.0001	0.0001	0.0001	0.0001	2	0	0%
Molybdenum (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Nickel (mg/L)	0.02	H	0.005	0.005	0.005	0.005	0.005	2	0	0%
Nitrate (mg/L)	50	H	1.00	1.05	1.50	1.95	2.00	2	0	0%
Nitrite (mg/L)	3	H	0.05	0.05	0.05	0.05	0.05	2	0	0%
pH	8.5	A	6.6	6.6	6.7	7.2	7.5	15	0	0%
Selenium (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Silver (mg/L)	0.1	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Sodium (mg/L)	180	A	31	32	37	41	42	2	0	0%
Sulfate (mg/L)	250	A	2	2	2	2	2	2	0	0%
Temperature (oC)			23	23	23	25	31	32	4	0
Total Chlorine (mg/L)	5	H	1.7	1.9	2.7	4.8	4.8	12	0	0%
Total Coliforms (cfu/100 mL)			0	0	0	22	38	13	2	15%
Total Dissolved Solids (TDS) (mg/L)	600	A	178	179	184	188	189	2	0	0%
Total Hardness as CaCO3	200	A	85	86	92	98	98.6	2	0	0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Excep-tions	
(mg/L)[2]										
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.8	1.0	1.0	2	0	0%
Turbidity (NTU)	5	A	0.3	0.5	1.1	6.0	6.4	9	2	22%
Uranium (mg/L)	0.017	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Zinc (mg/L)	3	A	0.08	0.08	0.08	0.08	0.08	2	0	0%

Source: NSW Health Water Quality Monitoring database

Note 1: The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2: ADWG recommend 200 mg/L hardness as CaCO3 as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

Appendix E Mendooran water quality data

E.1 Water quality graphs

E.1.1 Operational monitoring graphs

Figure E-1. Mendooran operational pH

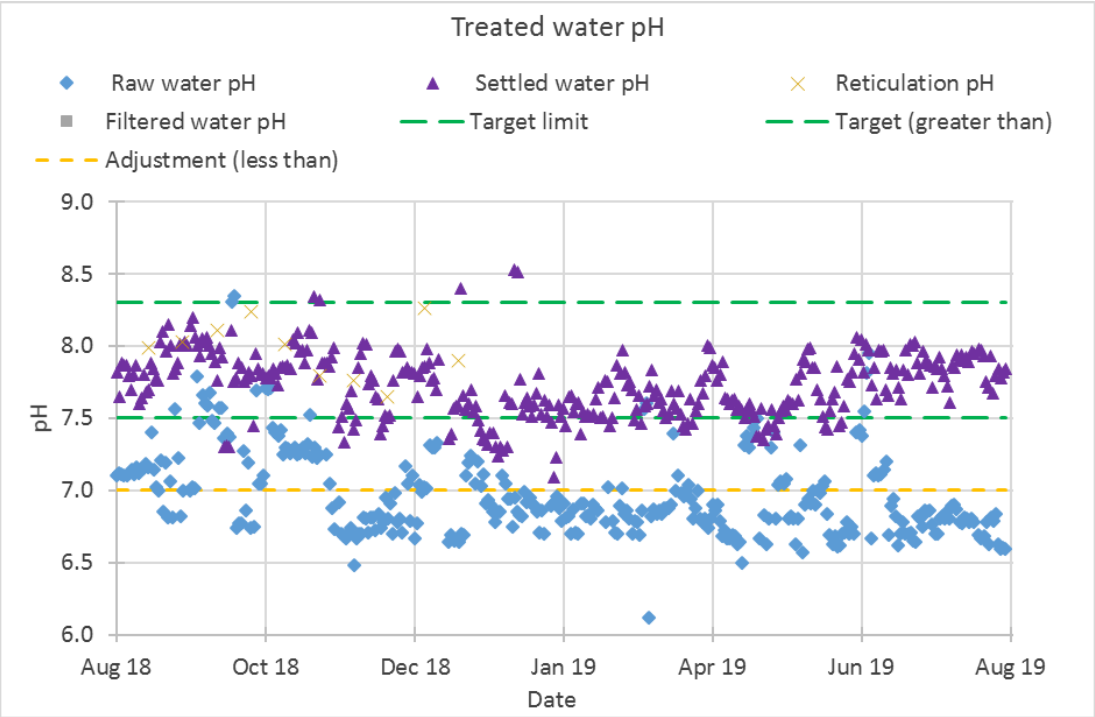
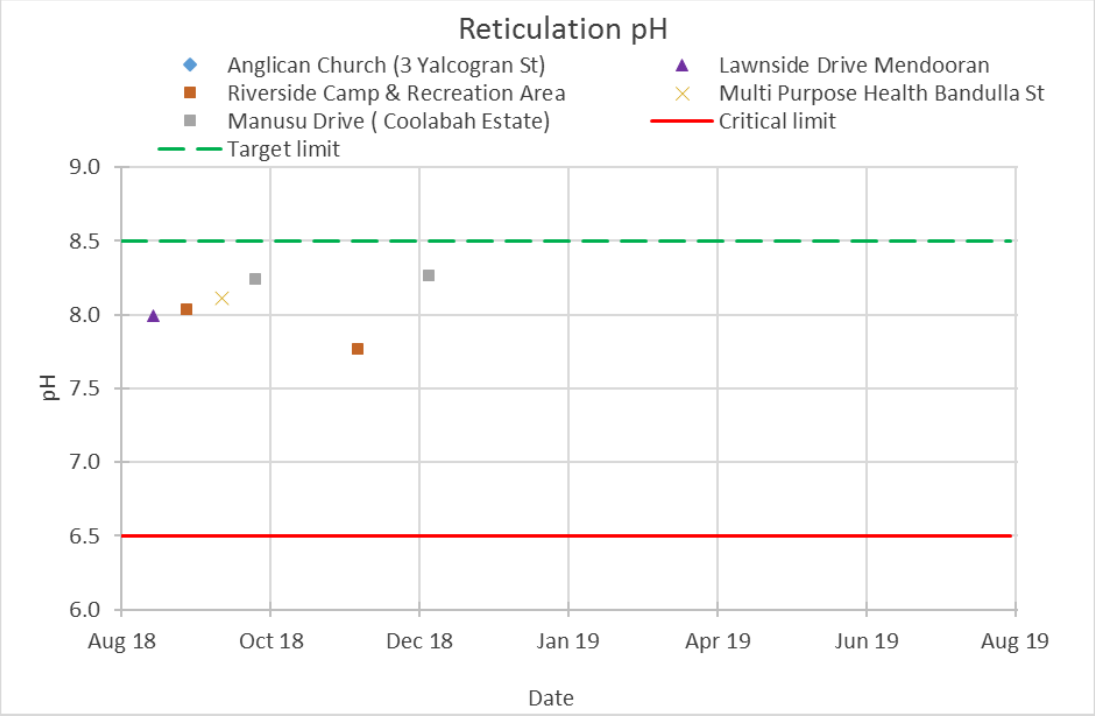


Figure E-2. Mendooran reticulation pH



E.1.2 Verification monitoring graphs

Figure E-3. Mendooran verification total coliforms

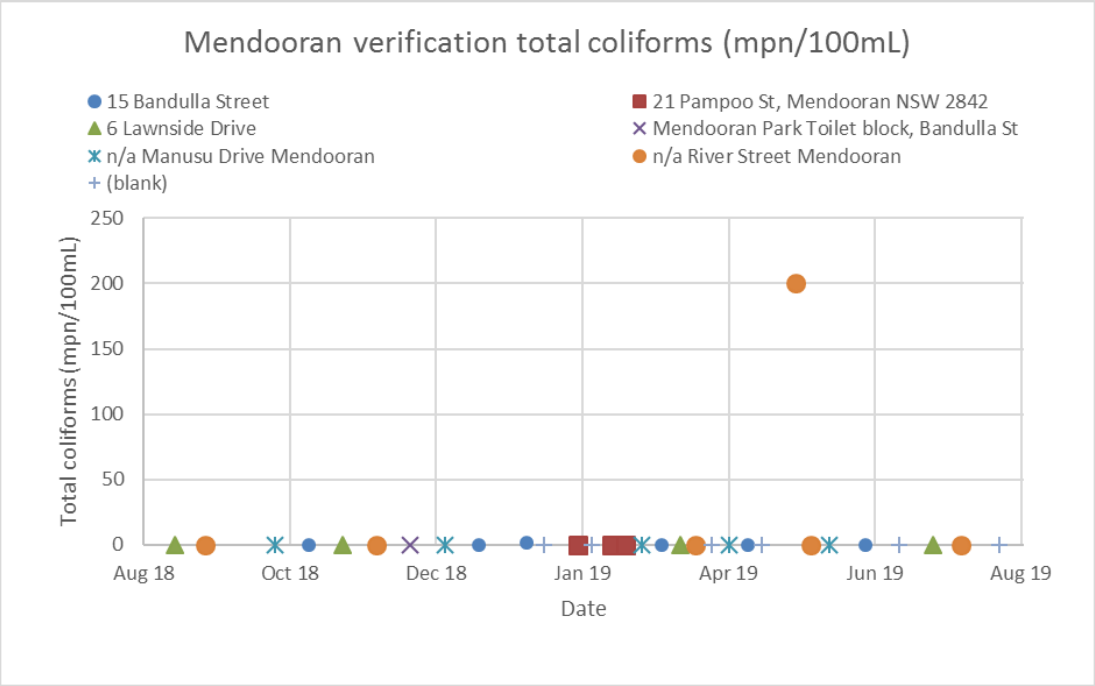


Figure E-4. Mendooran verification TDS

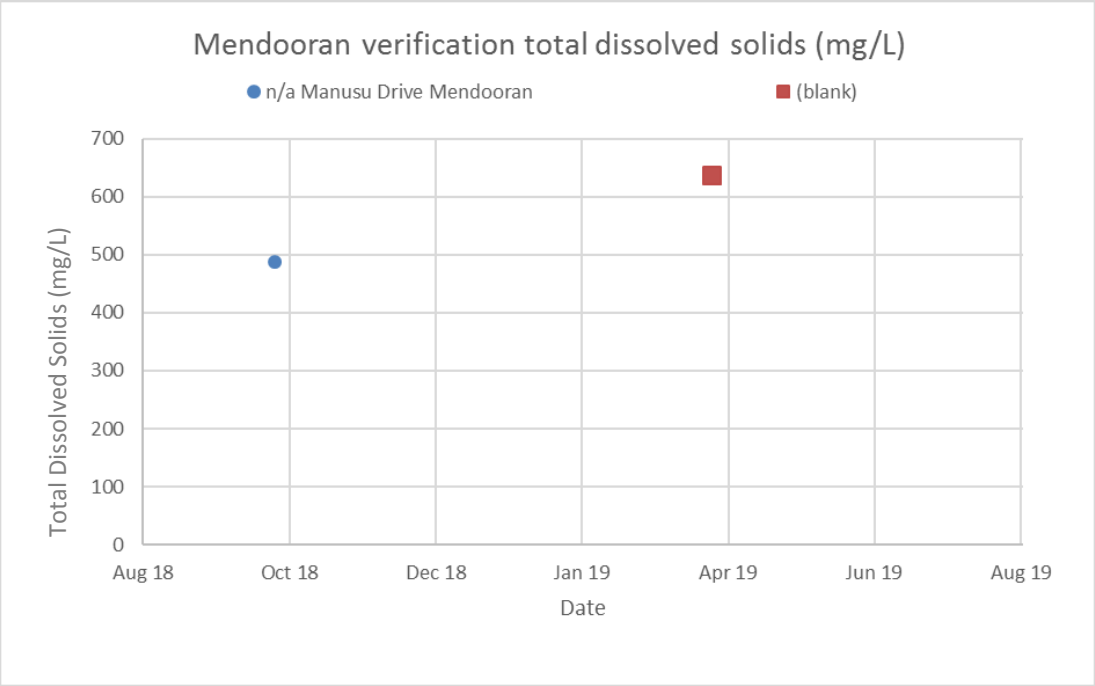
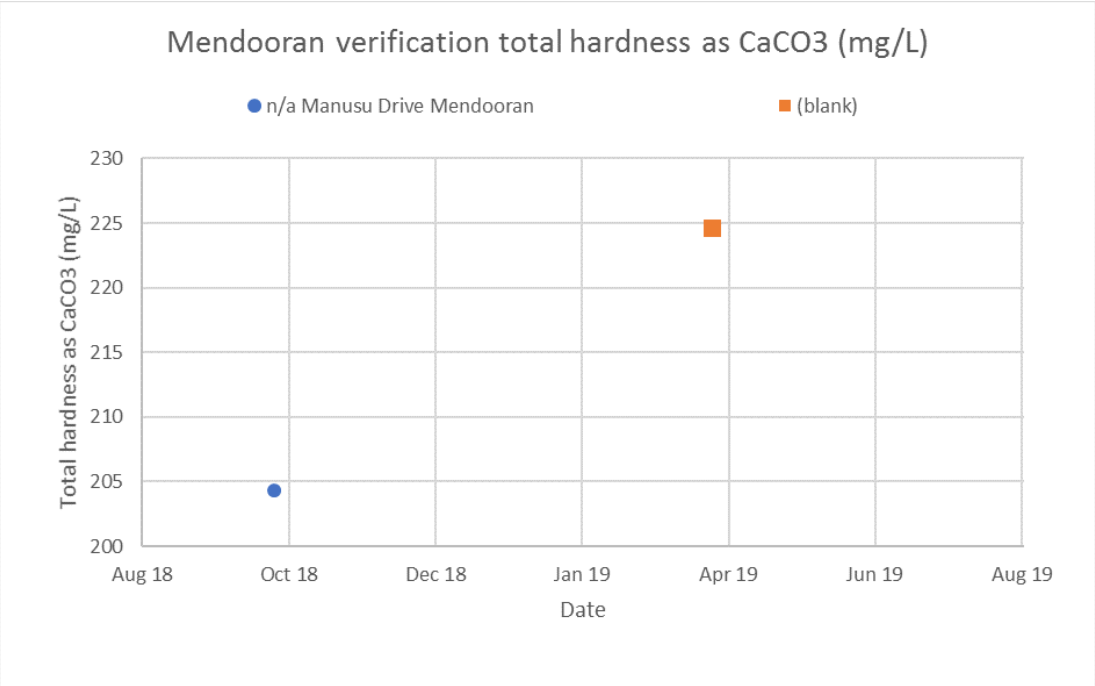


Figure E-5. Mendooran verification hardness



E.2 Water quality data summary

Table E-1. Mendooran operational monitoring data summary

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Raw Water Quality								
Raw water	pH	6.12	6.97	8.35			347	
Raw water	Turbidity (NTU)	0.16	7.13	61.5			346	
Raw water	Manganese (mg/L)	0.30	0.64	1.39			15	
Raw water	Iron (mg/L)	0.03	0.56	2.08			15	
Chemical dosing rates								
Pre dose	PAC-AC (mg/L)	15.00	25.01	45.0			354	
Settled water	pH	7.09	7.73	8.53			360	
Filtered water, online	Turbidity (NTU)	0.03	0.15	0.42		0.5	348	MDN1
Clear Water Quality								
Clear water - manual	pH	6.98	7.89	8.28	6.5	4.0	360	
Clear water - manual	Chlorine (mg/L)	0.03	2.62	4.01	1.0	4.0	363	MDN2
Clear water - manual	Manganese (mg/L)	0.01	0.04	0.13			7	
Clear water - manual	Iron (mg/L)	0.00	0.02	0.12			7	
Reticulation Water Quality								
Lawnside Drive Mendooran	Free Chlorine (mg/L)	2.06	2.06	2.06	0.2	4.0	1	MDN4
Lawnside Drive Mendooran	Total Chlorine (mg/L)	2.36	2.36	2.36			1	
Lawnside Drive Mendooran	pH	7.99	7.99	7.99			1	
Riverside Camp & Recreation Area	Free Chlorine (mg/L)	2.89	3.44	3.99	0.2	4.0	2	MDN4

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Riverside Camp & Recreation Area	Total Chlorine (mg/L)	3.54	4.14	4.73			2	
Riverside Camp & Recreation Area	pH	7.76	7.90	8.03			2	
Multi Purpose Health Bandulla St	Free Chlorine (mg/L)	2.41	2.41	2.41	0.2	4.0	1	MDN4
Multi Purpose Health Bandulla St	Total Chlorine (mg/L)	2.79	2.79	2.79			1	
Multi Purpose Health Bandulla St	pH	8.11	8.11	8.11			1	
Manusu Drive (Coolabah Estate)	Free Chlorine (mg/L)	1.80	1.83	1.86	0.2	4.0	2	MDN4
Manusu Drive (Coolabah Estate)	Total Chlorine (mg/L)	1.97	2.01	2.05			2	
Manusu Drive (Coolabah Estate)	pH	8.24	8.25	8.26			2	
Back Tank Manusu Free Chlorine	Free Chlorine (mg/L)	0.17	1.28	2.40	0.2	4.0	148	MDN4
Back Tank Manusu pH	pH	6.78	8.22	8.44				
Lawnside drive Free Chlorine	Free Chlorine (mg/L)	0.16	1.47	3.05	0.2	4.0	92	MDN4
Lawnside drive Turbidity	Turbidity (NTU)	0.13	0.37	2.86	1.0	4.0	84	
Sport Ground Free Chlorine	Free Chlorine (mg/L)	0.25	1.30	2.19	0.2	4.0	16	MDN4
Sport Ground Turbidity	Turbidity (NTU)	0.16	0.98	9.80	1.0	4.0	16	
Royal Hotel (15 Bandulla Street)	Free Chlorine (mg/L)	1.20	1.20	1.20	0.2	4.0	1	MDN4
Royal Hotel (15 Bandulla Street)	Total Chlorine (mg/L)	1.36	1.36	1.36			1	
Royal Hotel (15 Bandulla Street)	pH	8.01	8.01	8.01			1	

Source: Mendooran operational monitoring spreadsheet

E.2.1 Verification monitoring

For the new WTP Verification data taken from the NSW Health database, from 1 August 2018 to 31 July 2019 was analysed for the Mendooran water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table E-2.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange.

Table E-2. Mendooran verification monitoring data summary

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Excep-tions	
Aluminium (mg/L)	0.2	A	0.01	0.011	0.02	0.029	0.03	2	0	0%
Antimony (mg/L)	0.003	H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0	0%
Arsenic (mg/L)	0.01	H	0.00	0.00	0.00	0.00	0.00	2	0	0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Excep-tions	
Barium (mg/L)	2	H	0.10	0.11	0.15	0.19	0.20	2	0	0%
Boron (mg/L)	4	H	0.05	0.05	0.05	0.05	0.05	2	0	0%
Cadmium (mg/L)	0.002	H	0	0	0	0	0	2	0	0%
Calcium (mg/L)	-		37	37	40	43	44	2	0	0%
Chloride (mg/L)	250	A	197	199	219	239	241	2	0	0%
Chromium (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Copper (mg/L)	2	H	0.005	0.006	0.015	0.024	0.025	2	0	0%
E. coli	0	H	0.00	0.00	0.00	0.00	0.00	31	0	0%
Fluoride (mg/L)	1.5	H	0.1	0.1	0.1	0.1	0.1	2	0	0%
Free chlorine (mg/L)[1]			0.4	0.6	1.8	3.5	4.0	31	0	0%
Iodine (mg/L)			0.0	0.0	0.0	0.0	0.0	2	0	0%
Iron (mg/L)	0.3	A	0.01	0.01	0.01	0.02	0.02	2	0	0%
Lead (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Magnesium (mg/L)	-		27.2	27.3	27.7	28.1	28.1	2	0	0%
Manganese (mg/L)	0.5	H	0.003	0.003	0.004	0.006	0.006	2	0	0%
Mercury (mg/L)	0.001	H	0.0001	0.0001	0.0001	0.0001	0.0001	2	0	0%
Molybdenum (mg/L)	0.05	H	0.0025	0.0025	0.0025	0.0025	0.0025	2	0	0%
Nickel (mg/L)	0.02	H	0.01	0.01	0.01	0.01	0.01	2	0	0%
Nitrate (mg/L)	50	H	0.5	0.5	0.8	1.0	1.0	2	0	0%
Nitrite (mg/L)	3	H	0.1	0.1	0.1	0.1	0.1	2	0	0%
pH	8.5	A	6.7	7.4	7.8	8.2	8.3	32	0	0%
Selenium (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Silver (mg/L)	0.1	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Sodium (mg/L)	180	A	118	119	123	128	128	2	0	0%
Sulfate (mg/L)	250	A	11	12	19	25	26	2	0	0%
Temperature (oC)			20	20	21	27	32	34	10	0%
Total Chlorine (mg/L)	5	H	0.4	0.7	2.0	4.5	4.7	31	0	0%
Total Coliforms (cfu/100 mL)			0.0	0.0	0.0	1.0	200.0	31	2	6%
Total Dissolved Solids (TDS) (mg/L)	600	A	487	495	562	630	637	2	1	50%
Total Hardness as CaCO3 (mg/L)[2]	200	A	204	205	214	224	225	2	2	100 %
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.5	0.5	0.5	2	0	0%
Turbidity (NTU)	5	A	0.22	0.3	0.6	3.6	8.4	26	1	4%
Uranium (mg/L)	0.017	H	0.0025	0.0025	0.0025	0.0025	0.0025	2	0	0%
Zinc (mg/L)	3	A	0.0100	0.0105	0.0150	0.0195	0.0200	2	0	0%

Source: NSW Health Water Quality Monitoring database

Note 1: The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

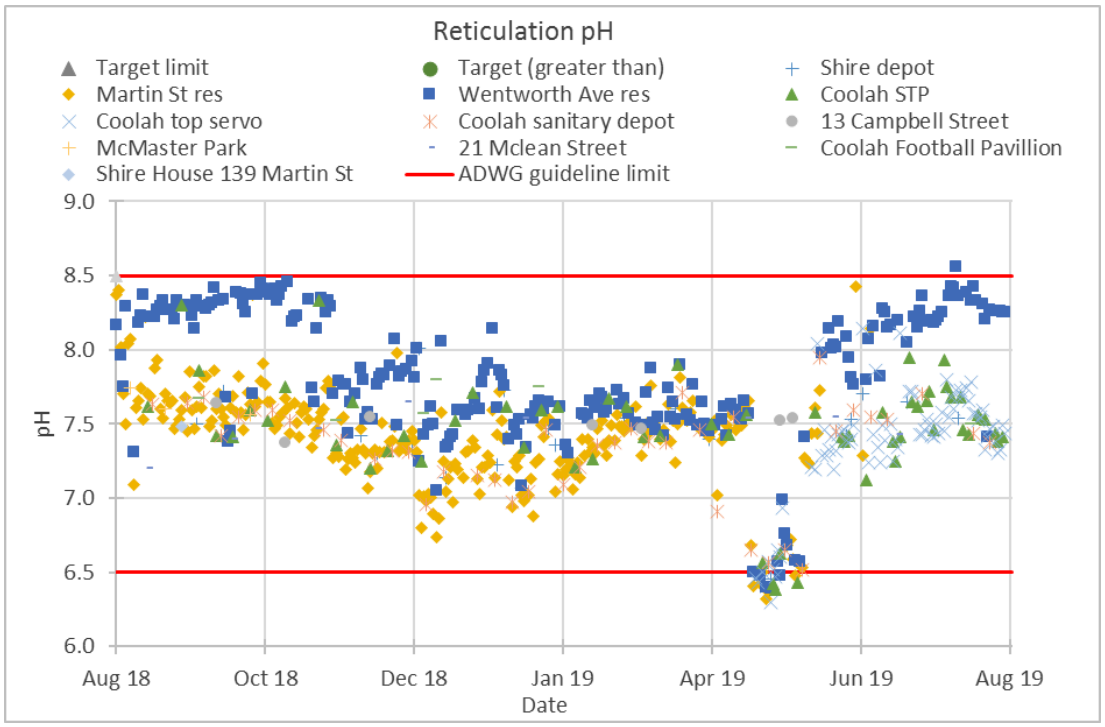
Note 2: ADWG recommend 200 mg/L hardness as CaCO3 as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

Appendix F Coolah water quality data

F.1 Water quality graphs

F.1.1 Operational monitoring graphs

Figure F-1. Coolah reticulation pH



F.1.2 Verification monitoring graphs

Figure F-2. Coolah verification *E. coli*

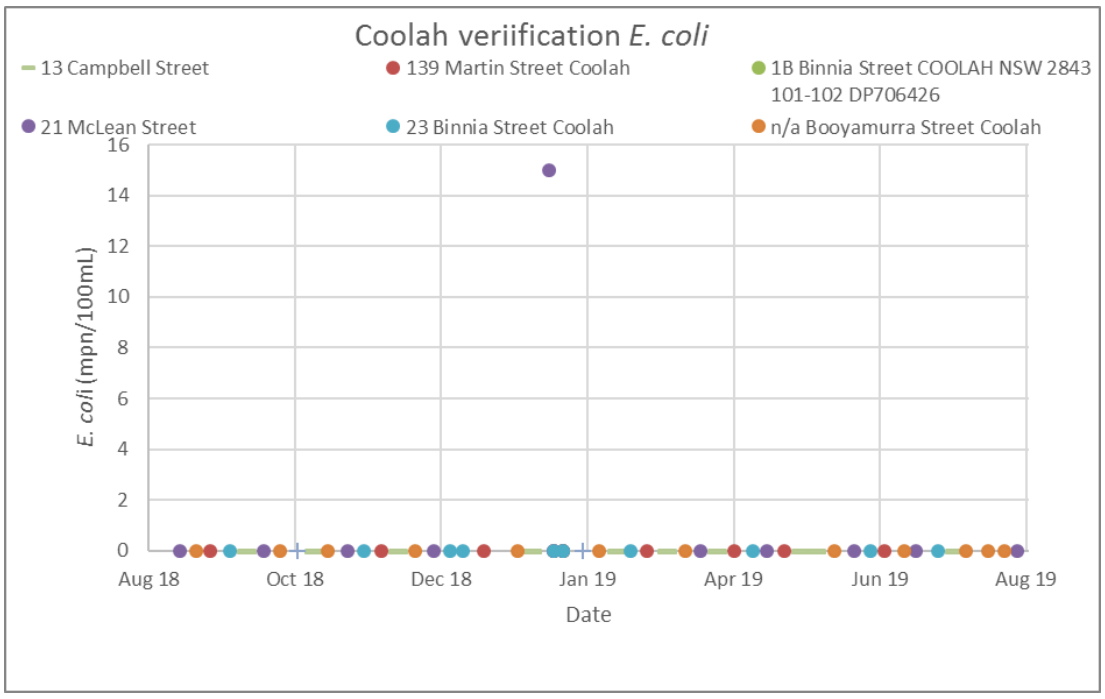


Figure F-3. Coolah verification total coliforms

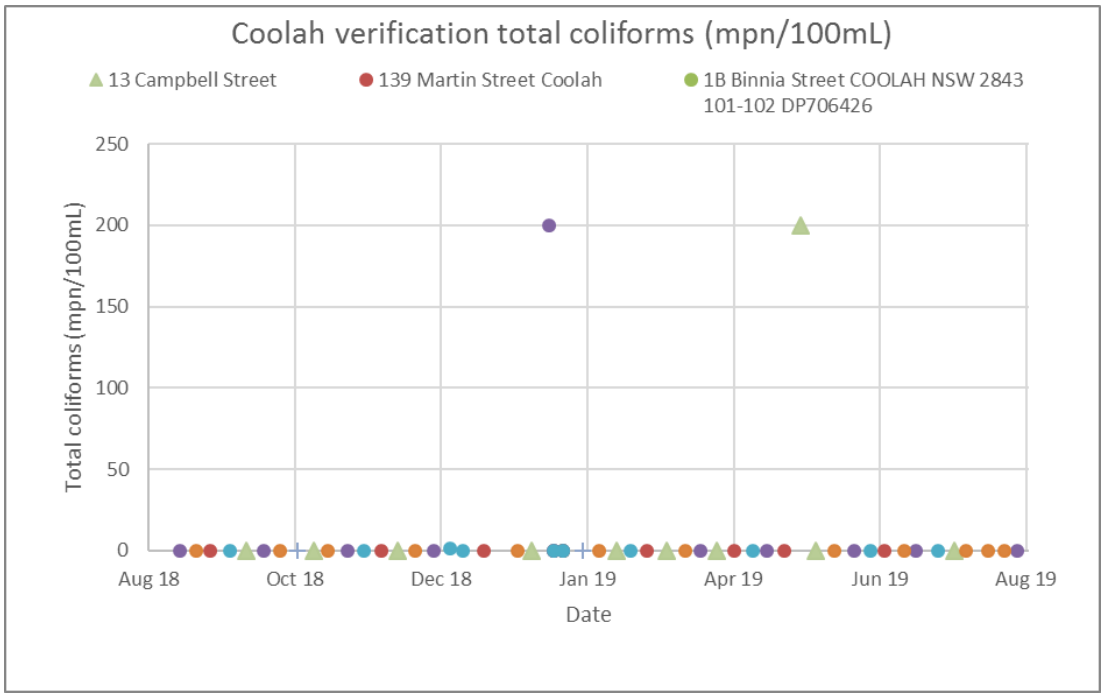
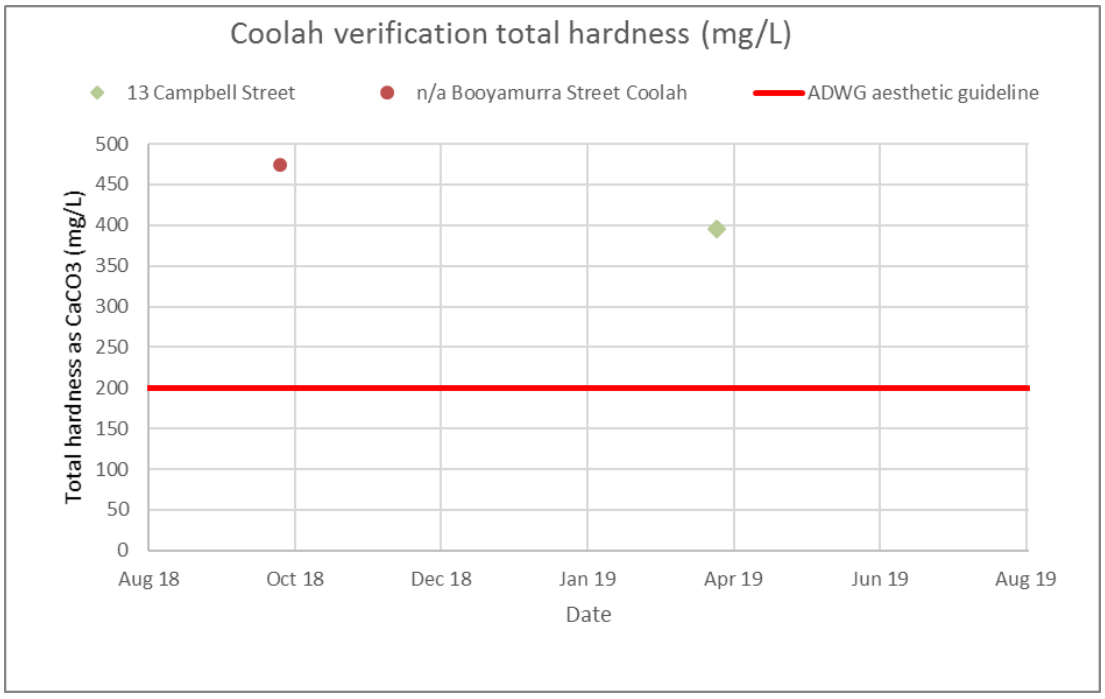


Figure F-4. Coolah verification total hardness



F.2 Water quality data summary

Table F-1. Coolah operational monitoring data summary

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Reservoir Water Quality								
Coolah top servo	Free chlorine	0.98	1.56	2.02	0.4	4.0	82	CLH1
Coolah top servo	pH	6.30	7.38	8.14	6.5	8.5	79	

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Coolah top servo	NTU	0.81	0.91	1.01			2	
Reticualed Water Quality								
Martin St res	Free chlorine (mg/L)	0.20	1.48	4.00	0.4	4.0	274	CLH4
Martin St res	pH	6.32	7.40	8.43	6.5	8.5	276	
Wentworth Ave res	Free chlorine (mg/L)	0.08	1.32	2.20	0.4	4.0	235	CLH4
Wentworth Ave res	Turbidity (NTU)	0.26	0.85	1.99		5.0	9	
Shire depot	Free chlorine (mg/L)	0.59	1.51	2.80	0.2	4.0	22	CLH4
Shire depot	pH	-	-	-			-	
Coolah STP	Free chlorine (mg/L)	0.81	1.42	2.05	0.2	4.0	65	CLH4
Coolah STP	pH	6.38	7.46	8.33	6.5	8.5	63	
Coolah sanitary depot	Free chlorine (mg/L)	0.50	1.33	2.24	0.2	4.0	43	CLH4
Coolah sanitary depot	pH	6.52	7.33	7.95	6.5	8.5	43	
13 Campbell Street	Free Chlorine (mg/L)	1.31	1.77	2.17	0.2	4.0	6	CLH4
13 Campbell Street	Total Chlorine (mg/L)	0.06	1.72	2.59			7	
13 Campbell Street	pH	7.37	7.51	7.64			7	
McMaster Park	Free Chlorine (mg/L)	0.98	1.93	2.53	0.2	4.0	11	CLH4
McMaster Park	Total Chlorine (mg/L)	1.10	2.09	2.63			11	
McMaster Park	pH	7.56	7.63	7.74			3	
21 Mclean Street	Free Chlorine (mg/L)	0.98	1.85	2.35	0.2	4.0	8	CLH4
21 Mclean Street	Total Chlorine (mg/L)	1.14	2.07	2.59			8	
21 Mclean Street	pH	7.20	7.47	7.65			8	
Coolah Football Pavillion	Free Chlorine (mg/L)	1.28	1.63	2.10	0.2	4.0	6	CLH4
Coolah Football Pavillion	Total Chlorine (mg/L)	1.31	1.84	2.40			6	
Coolah Football Pavillion	pH	7.50	7.64	7.80			6	
Shire House 139 Martin St	Free Chlorine (mg/L)	1.70	1.70	1.70	0.2	4.0	1	CLH4
Shire House 139 Martin St	Total Chlorine (mg/L)	1.89	1.89	1.89			1	
Shire House 139 Martin St	pH	7.48	7.48	7.48			1	
Sewer treatment plant	Free Chlorine (mg/L)	-		-			-	
Sewer treatment plant	Total Chlorine (mg/L)	-		-			-	
Sewer treatment plant	pH	-		-			-	
Hospital	Free Chlorine (mg/L)	-		-			-	
Hospital	Total Chlorine (mg/L)	0.00	0.00	0.00			0	
Hospital	pH	0.00	0.00	0.00			0	
Coolah Football Pavillion	Total Chlorine (mg/L)	7.37	7.37	7.37			12	
Coolah Football Pavillion	NTU	0.00	0.00	0.00			0	

Source: Coolah operational monitoring spreadsheet

F.2.1 Verification monitoring

For the new WTP Verification data taken from the NSW Health database, from 1 August 2018 to 31 July 2019 was analysed for the Coolah water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became

'0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table F-2.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange.

Table F-2. Coolah verification monitoring data summary

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Exceptions	
Aluminium (mg/L)	0.2	A	0.005	0.005	0.005	0.005	0.005	2	0	0%
Antimony (mg/L)	0.003	H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0	0%
Arsenic (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Barium (mg/L)	2	H	0.02	0.02	0.02	0.02	0.02	2	0	0%
Boron (mg/L)	4	H	0.05	0.05	0.05	0.05	0.05	2	0	0%
Cadmium (mg/L)	0.002	H	0.0003	0.0003	0.0003	0.0003	0.0003	2	0	0%
Calcium (mg/L)	-		67	68	72	76	76	2	0	0%
Chloride (mg/L)	250	A	58	58	58	58	58	2	0	0%
Chromium (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Copper (mg/L)	2	H	0.07	0.07	0.08	0.09	0.09	2	0	0%
E. coli	0	H	0	0	0	0	15	56	1	2%
Fluoride (mg/L)	1.5	H	0.05	0.05	0.05	0.05	0.05	2	0	0%
Free chlorine (mg/L)[1]			0.0	1.0	2.0	2.6	3.0	56	2	4%
Iodine (mg/L)			0.01	0.01	0.01	0.01	0.01	2	0	0%
Iron (mg/L)	0.3	A	0.005	0.005	0.005	0.005	0.005	2	0	0%
Lead (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Magnesium (mg/L)	-		55	56	62	68	69	2	0	0%
Manganese (mg/L)	0.5	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Mercury (mg/L)	0.001	H	0.0001	0.0001	0.0001	0.0001	0.0001	2	0	0%
Molybdenum (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Nickel (mg/L)	0.02	H	0.005	0.005	0.005	0.00500	0.005	2	0	0%
Nitrate (mg/L)	50	H	5	5	5	5	5	2	0	0%
Nitrite (mg/L)	3	H	0.05	0.05	0.05	0.05	0.05	2	0	0%
pH	8.5	A	7.2	7.4	7.5	7.8	8.1	58	0	0%
Selenium (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Silver (mg/L)	0.1	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Sodium (mg/L)	180	A	30	31	35	40	40	2	0	0%
Sulfate (mg/L)	250	A	5	5	5	5	5	2	0	0%
Temperature (oC)			20	20	21	28	33	34	11	0
Total Chlorine (mg/L)	5	H	0.1	1.1	2.2	2.9	3.2	56	0	0%
Total Coliforms (cfu/100 mL)			0	0	0	0	200	56	3	5%
Total Dissolved Solids (TDS) (mg/L)	600	A	464	466	480	494	496	2	0	0%
Total Hardness as CaCO3 (mg/L)[2]	200	A	395	399	435	470	474	2	2	100%
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.5	0.5	0.5	2	0	0%
Turbidity (NTU)	5	A	0.1	0.2	0.6	1.9	3.0	40	0	0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Exceptions	
Uranium (mg/L)	0.017	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Zinc (mg/L)	3	A	0.03	0.03	0.04	0.04	0.04	2	0	0%

Source: NSW Health Water Quality Monitoring database

Note 1: The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2: ADWG recommend 200 mg/L hardness as CaCO3 as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

Appendix G Binnaway water quality data

Water quality graphs

G.1.1 Operational monitoring graphs

Figure G-1. Binnaway treated water colour

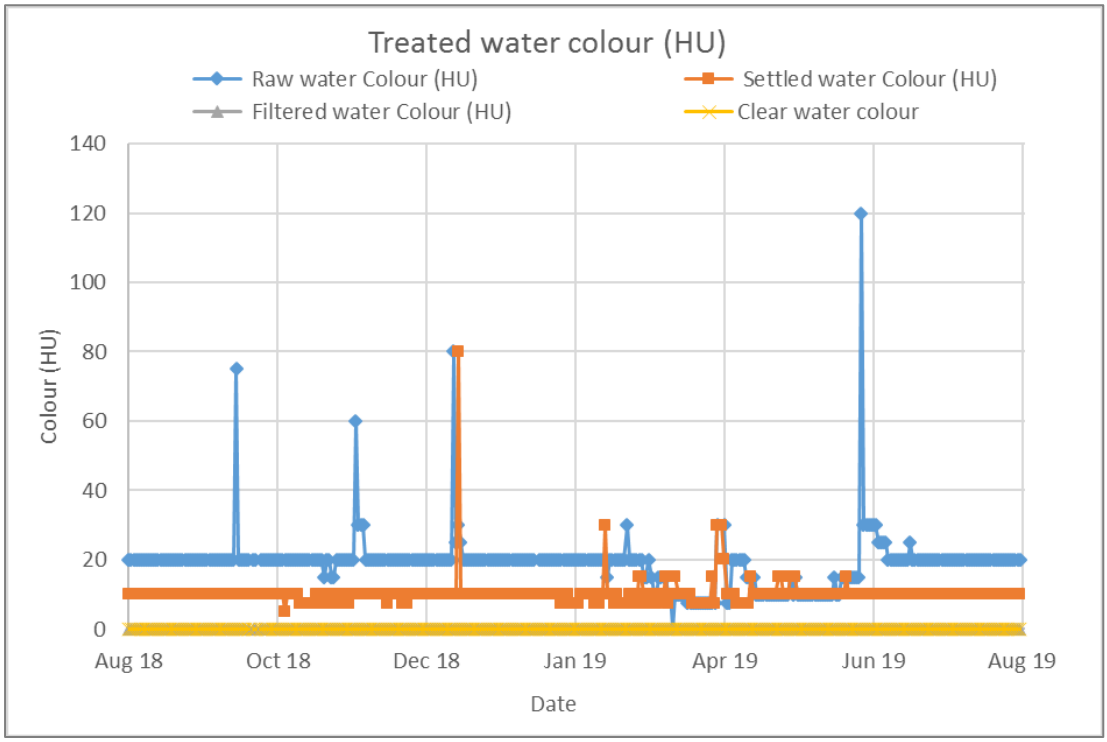


Figure G-2. Binnaway raw water pH

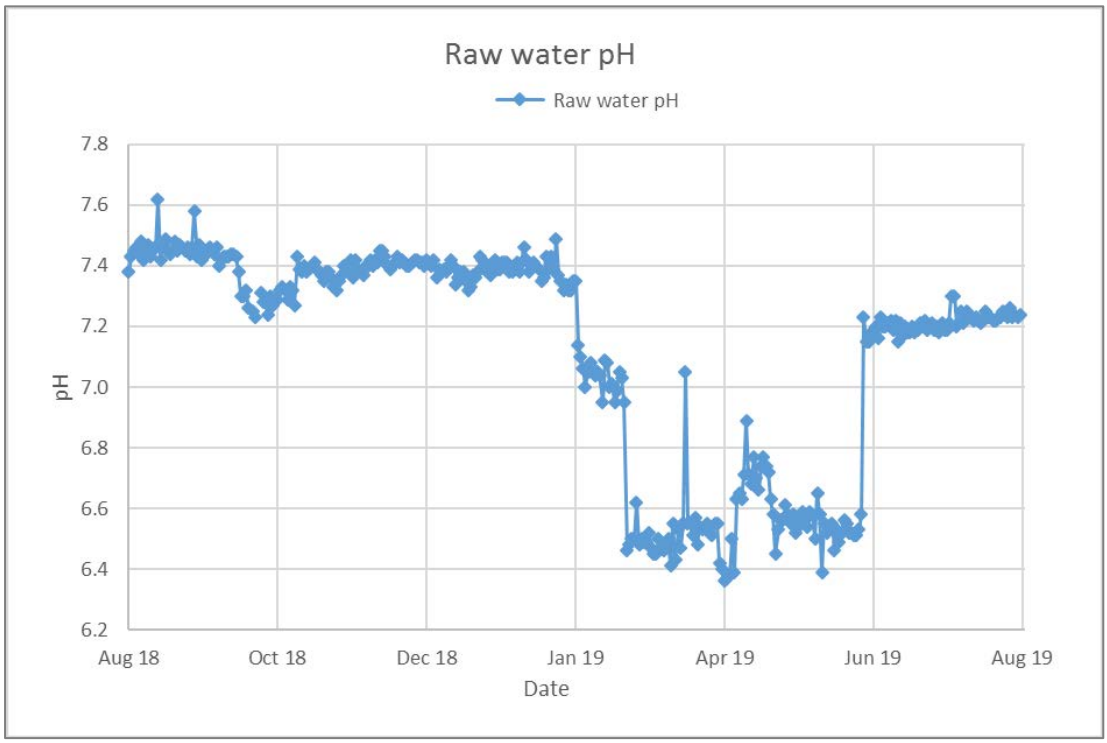
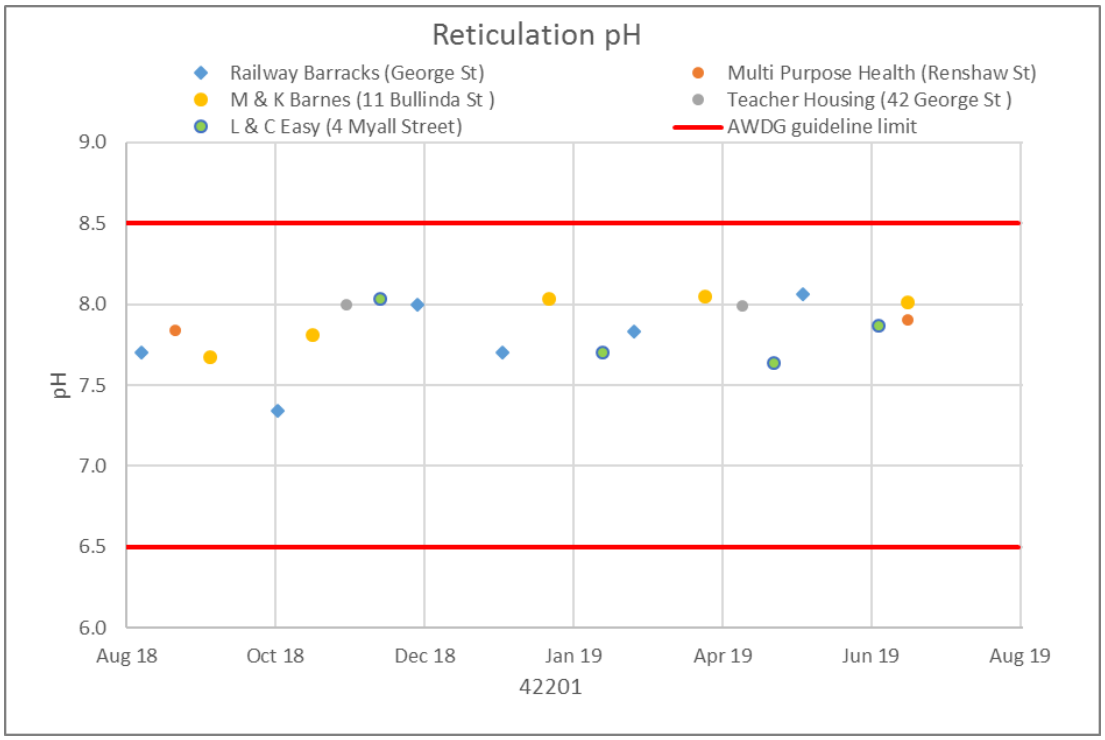


Figure G-3. Binnaway reticulation pH



G.1.2 Verification monitoring graphs

Figure G-4. Binnaway verification sodium

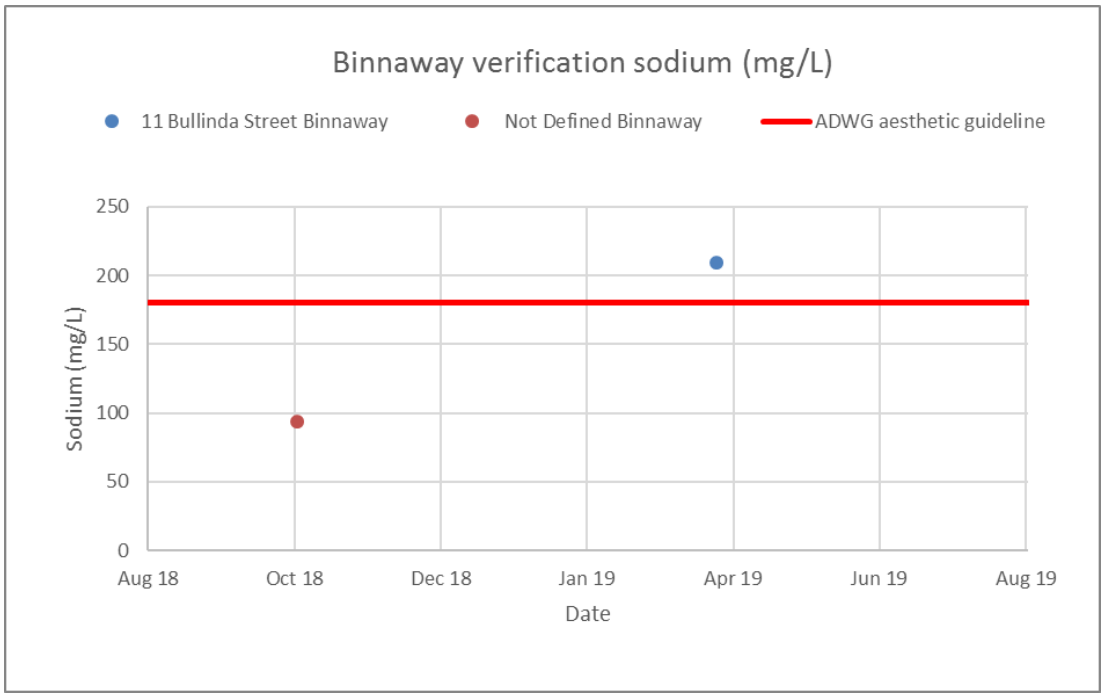


Figure G-5. Binnaway verification total coliforms

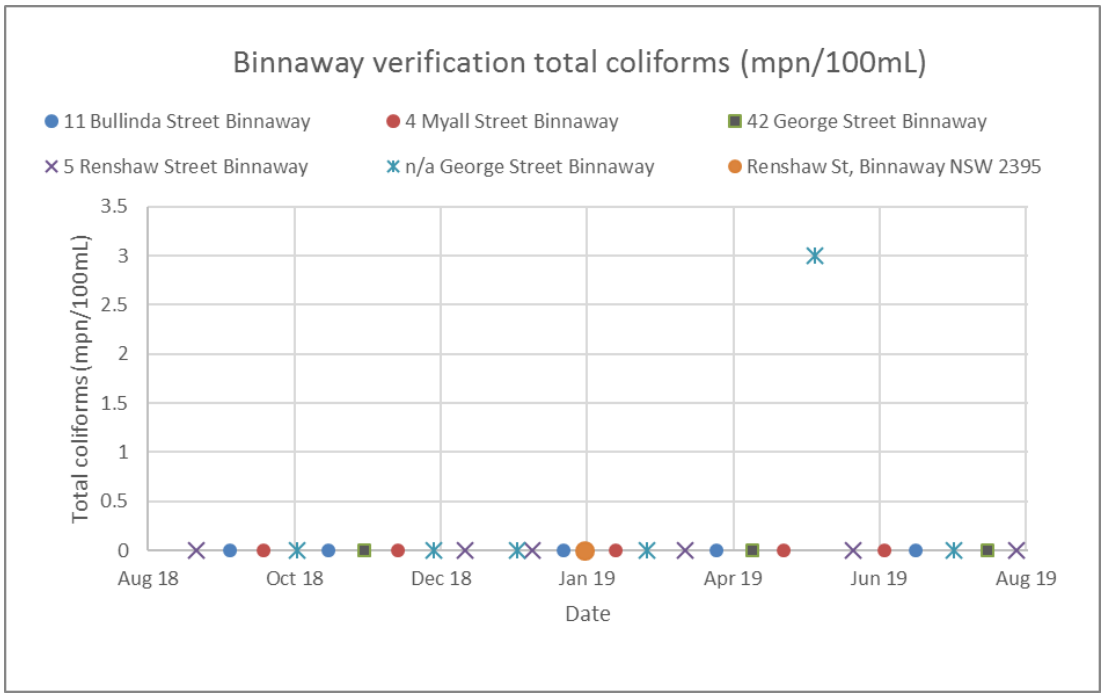


Figure G-6. Binnaway verification TDS

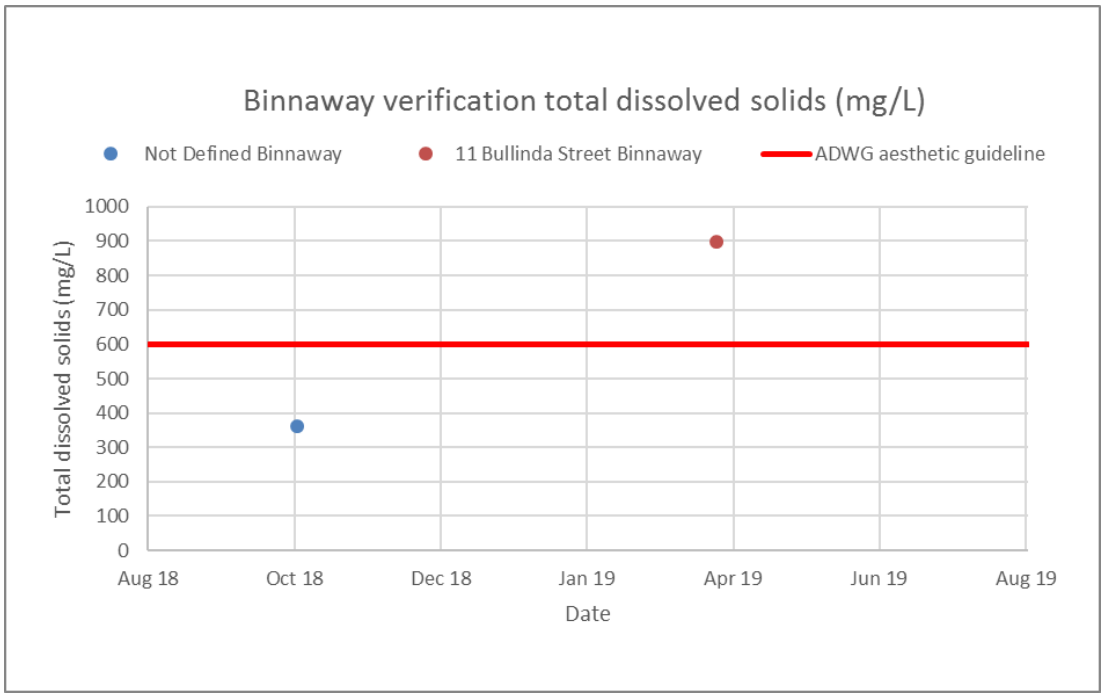
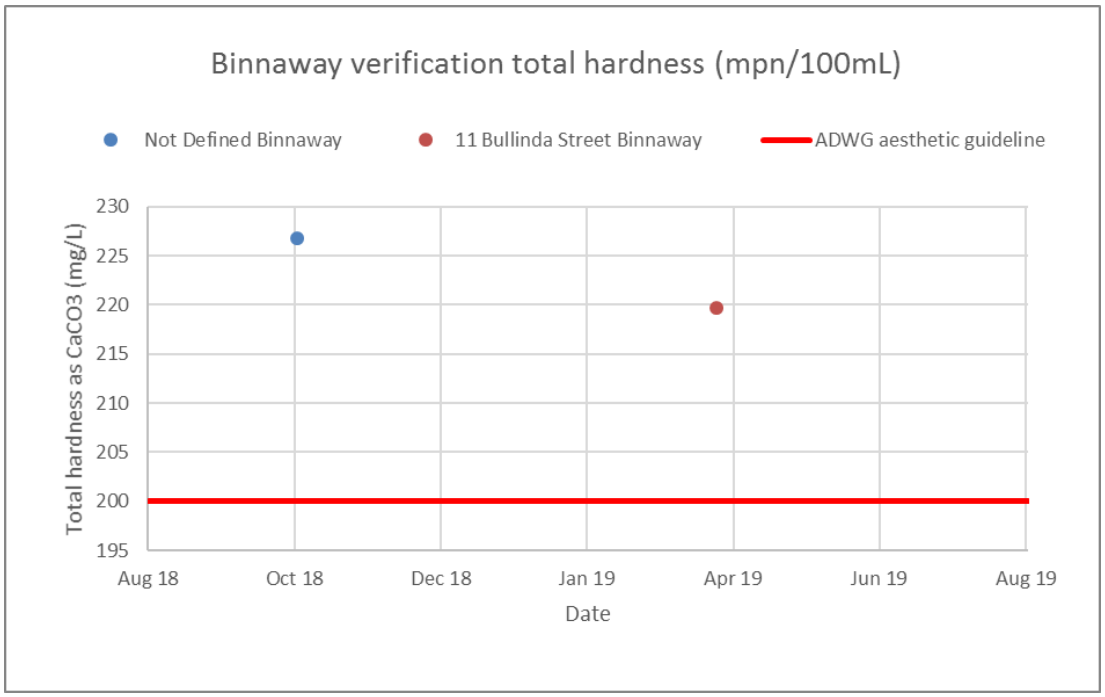


Figure G-7. Binnaway verification total hardness



G.2 Water quality data summary

Table G-1. Binnaway operational monitoring data summary

Process	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Raw Water Quality								
Raw water	Turbidity (NTU)	0.43	2.65	84.6			392	
Raw water	Colour (HU)	7.50	19.26	120.0			390	
Raw water	pH	6.36	7.13	7.62			394	
Settled Water Quality								
Settled water	Turbidity (NTU)	0.13	1.47	16.5			394	
Settled water	Colour (HU)	5.00	10.22	80.0			394	
Settled water	pH	6.50	6.90	7.42			395	
Filtered Water Quality								
Filtered water	Turbidity (NTU)	0.02	0.20	0.85			395	
Filtered water	Colour (HU)	0.00	0.00	0.00			395	
Filtered water	pH	6.46	6.87	7.20			395	
Clear Water Quality								
Clear water	Colour (HU)	0.00	0.00	0.00			395	
Clear water	pH	6.93	7.58	8.27			395	
Clear water	Turbidity (NTU)	0.11	0.28	0.67		0.5	395	BWY1
Clear water	Free Chlorine (mg/L)	1.70	2.38	3.20	1.0	4.0	395	BWY2
Reticulation								
Railway Barracks (George St)	Free Chlorine	0.51	1.06	1.79	0.2	4.0	7	BWY5

Process	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
	(mg/L)							
Railway Barracks (George St)	Total Chlorine (mg/L)	0.81	1.29	1.87			7	
Railway Barracks (George St)	pH	7.34	7.77	8.06	6.5	8.5	7	
Multi Purpose Health (Renshaw St)	Free Chlorine (mg/L)	0.58	1.10	1.85			5	BWY5
Multi Purpose Health (Renshaw St)	Total Chlorine (mg/L)	0.79	1.50	2.22			5	
Multi Purpose Health (Renshaw St)	pH	7.84	7.87	7.90			2	
M & K Barnes (11 Bullinda St)	Free Chlorine (mg/L)	0.45	1.37	2.14			6	BWY5
M & K Barnes (11 Bullinda St)	Total Chlorine (mg/L)	0.67	1.67	2.48			6	
M & K Barnes (11 Bullinda St)	pH	7.67	7.89	8.05			6	
Teacher Housing (42 George St)	Free Chlorine (mg/L)	0.64	1.03	1.41			2	BWY5
Teacher Housing (42 George St)	Total Chlorine (mg/L)	0.73	1.21	1.69			2	
Teacher Housing (42 George St)	pH	7.99	8.00	8.00			2	
L & C Easy (4 Myall Street)	Free Chlorine (mg/L)	0.25	0.72	1.03			4	BWY5
L & C Easy (4 Myall Street)	Total Chlorine (mg/L)	0.45	0.92	1.49			4	
L & C Easy (4 Myall Street)	pH	7.64	7.81	8.03			4	

Source: Binnaway operational monitoring spreadsheet

G.2.1 Verification monitoring

For the new WTP Verification data taken from the NSW Health database, from 1 August 2018 to 31 July 2019 was analysed for the Binnaway water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table G-2.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange.

Table G-2. Binnaway verification monitoring data summary

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Exceptions	
Aluminium (mg/L)	0.2	A	0.005	0.005	0.008	0.010	0.010	2	0	0%
Antimony (mg/L)	0.003	H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0	0%
Arsenic (mg/L)	0.01	H	0.0005	0.0005	0.0008	0.0010	0.0010	2	0	0%
Barium (mg/L)	2	H	0.1	0.1	0.2	0.3	0.3	2	0	0%
Boron (mg/L)	4	H	0.05	0.05	0.08	0.10	0.10	2	0	0%
Cadmium (mg/L)	0.002	H	0.0003	0.0003	0.0003	0.0003	0.0003	2	0	0%
Calcium (mg/L)	-		40	40	41	42	42	2	0	0%
Chloride (mg/L)	250	A	94	97	126	155	158	2	0	0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Exceptions	
Chromium (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Copper (mg/L)	2	H	0.003	0.003	0.012	0.020	0.021	2	0	0%
E. coli	0	H	0	0	0	0	0	26	0	0%
Fluoride (mg/L)	1.5	H	0.1	0.2	0.4	0.7	0.7	2	0	0%
Free chlorine (mg/L)[1]			0.3	0.5	0.9	2.0	2.1	26	0	0%
Iodine (mg/L)			0.01	0.01	0.02	0.03	0.03	2	0	0%
Iron (mg/L)	0.3	A	0.005	0.005	0.008	0.010	0.010	2	0	0%
Lead (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Magnesium (mg/L)	-		29	29	30	30	30	2	0	0%
Manganese (mg/L)	0.5	H	0.003	0.006	0.036	0.067	0.070	2	0	0%
Mercury (mg/L)	0.001	H	0.0001	0.0001	0.0001	0.0001	0.0001	2	0	0%
Molybdenum (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Nickel (mg/L)	0.02	H	0.005	0.005	0.005	0.005	0.005	2	0	0%
Nitrate (mg/L)	50	H	0.5	0.5	0.8	1.0	1.0	2	0	0%
Nitrite (mg/L)	3	H	0.05	0.07	0.28	0.48	0.50	2	0	0%
pH	6.5 - 8.5	A	1.4	7.4	7.8	8.0	8.1	28	1	4%
Selenium (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Silver (mg/L)	0.1	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Sodium (mg/L)	180	A	94	100	152	203	209	2	1	50%
Sulfate (mg/L)	250	A	0.5	3.5	30.8	58.0	61.0	2	0	0%
Temperature (oC)			25	25	25	29	35	36	6	0
Total Chlorine (mg/L)	5	H	0.5	0.6	1.2	2.2	2.5	25	0	0%
Total Coliforms (cfu/100 mL)			0	0	0	0	3	26	1	4%
Total Dissolved Solids (TDS) (mg/L)	600	A	363	390	631	872	899	2	1	50%
Total Hardness as CaCO3 (mg/L)[2]	200	A	220	220	223	226	227	2	2	100 %
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.8	1.0	1.0	2	0	0%
Turbidity (NTU)	5	A	0.05	0.2	0.6	1.8	2.1	19	0	0%
Uranium (mg/L)	0.017	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Zinc (mg/L)	3	A	0.01	0.01	0.01	0.01	0.01	2	0	0%

Source: NSW Health Water Quality Monitoring database

Note 1: The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2: ADWG recommend 200 mg/L hardness as CaCO3 as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

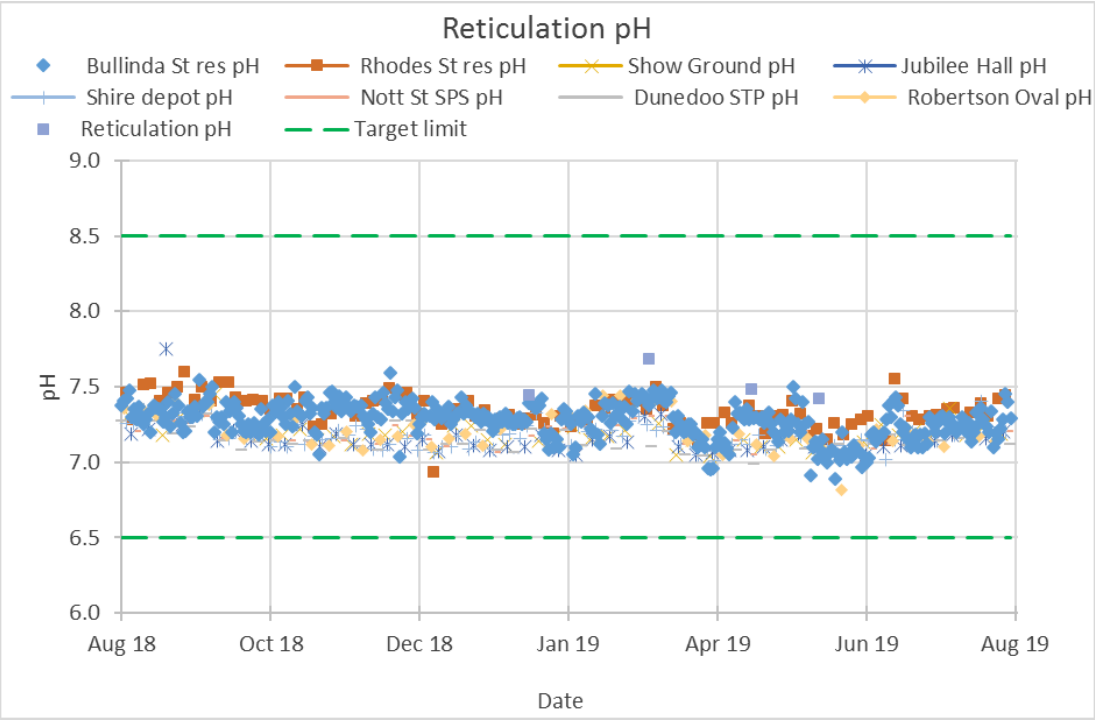
*This is a suspected typography error

Appendix H Dunedoo water quality data

H.1 Water quality graphs

H.1.1 Operational monitoring graphs

Figure H-1. Dunedoo reticulation pH



H.1.2 Verification monitoring graphs

Figure H-2. Dunedoo verification total coliforms

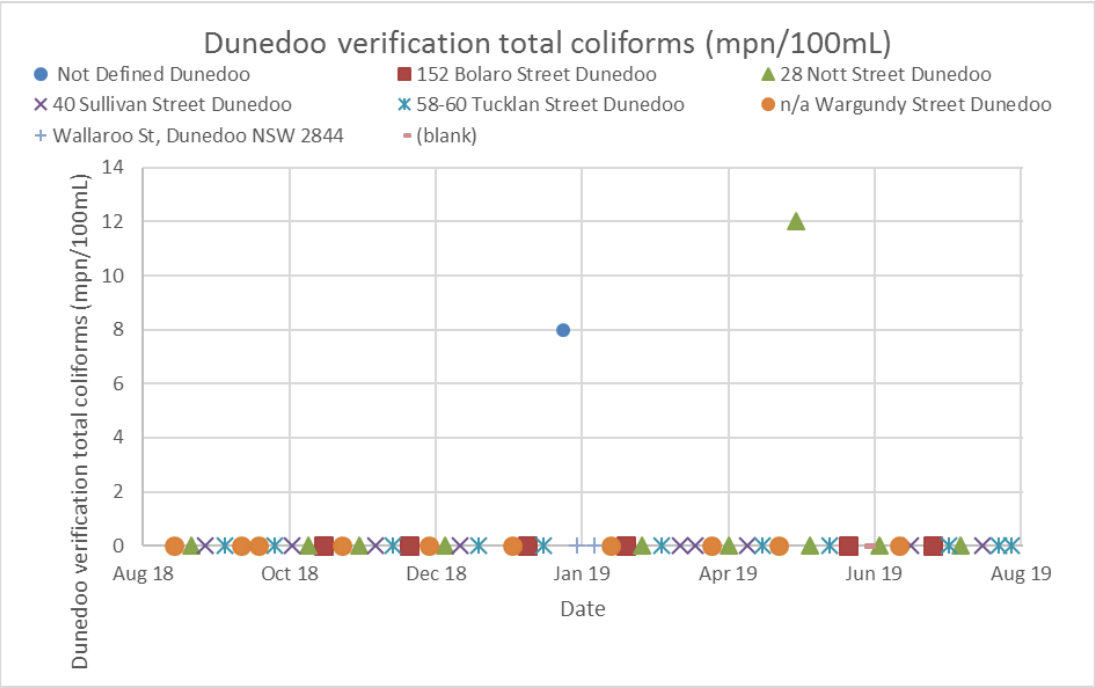


Figure H-3. Dunedoo verification total hardness

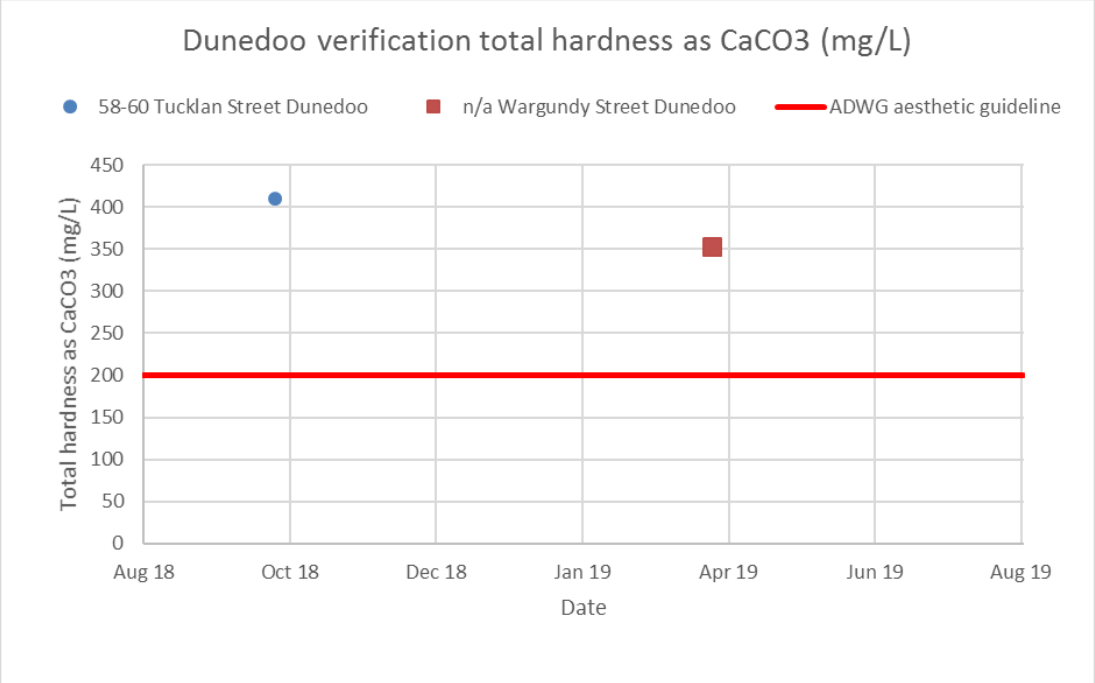
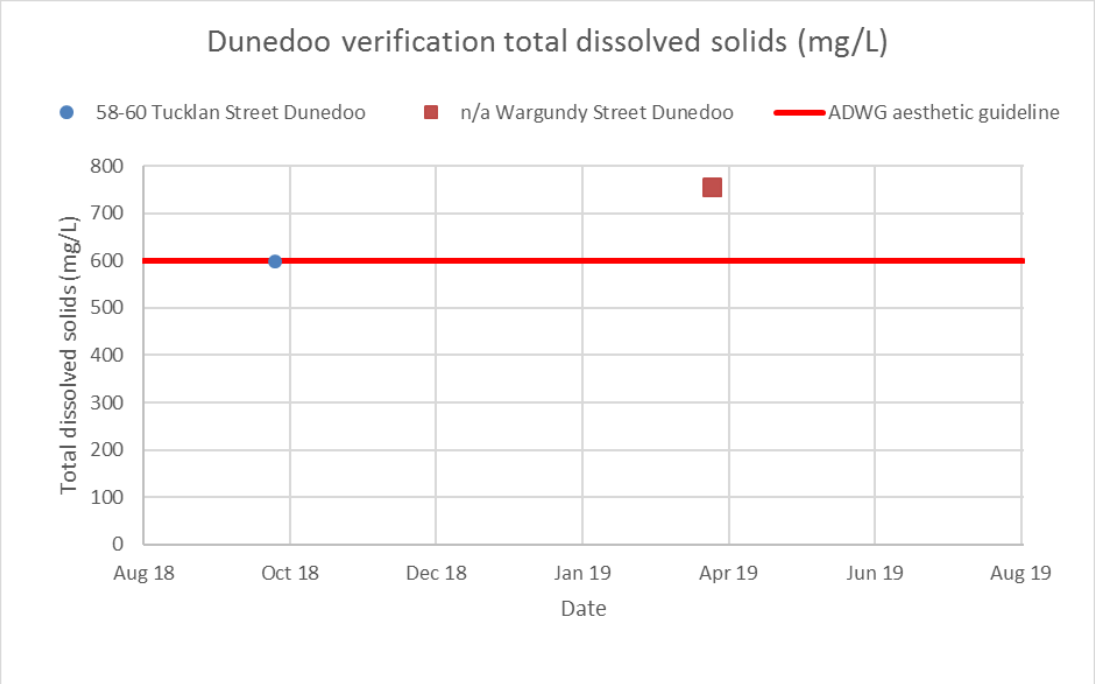


Figure H-4. Dunedoo verification TDS



H.2 Water quality data summary

Table H-1. Dunedoo operational monitoring data summary

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Reservoir Water Quality								

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Bullinda St res	Free chlorine (mg/L)	0.80	1.43	1.98	0.7	4.0	364	DDO1
Bullinda St res	pH	6.89	7.28	7.59			364	
Rhodes St res	Free chlorine (mg/L)	0.96	1.41	2.00	0.7	4.0	102	DDO1
Rhodes St res	pH	6.93	7.34	7.60			102	
Reticulated Water Quality								
Shire depot	Free chlorine (mg/L)	0.85	1.30	1.99	0.7	4.0	102	DDO3
Shire depot	pH	7.01	7.18	7.40			102	
Nott St SPS	Free chlorine (mg/L)	0.90	1.43	1.97	0.2	4.0	52	DDO3
Nott St SPS	pH	7.05	7.18	7.36			52	
Dunedoo STP	Free chlorine (mg/L)	0.70	1.00	1.46	0.2	4.0	53	DDO3
Dunedoo STP	pH	6.99	7.15	7.45			53	
Robertson Oval	Free chlorine (mg/L)	0.75	1.44	2.00	0.2	4.0	52	DDO3
Robertson Oval	pH	6.82	7.21	7.44			52	
Dunedoo Hall	Turbidity	0.00	0.51	0.89			6	

Source: Dunedoo operational monitoring spreadsheet

H.2.1 Verification monitoring

For the new WTP Verification data taken from the NSW Health database, from 1 August 2018 to 31 July 2019 was analysed for the Dunedoo water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table H-2.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange.

Table H-2. Dunedoo verification monitoring data summary

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Exceptions	
Aluminium (mg/L)	0.2	A	0.005	0.005	0.008	0.01	0.01	2	0	0%
Antimony (mg/L)	0.003	H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0	0%
Arsenic (mg/L)	0.01	H	0.00	0.00	0.00	0.00	0.00	2	0	0%
Barium (mg/L)	2	H	0.08	0.08	0.08	0.09	0.09	2	0	0%
Boron (mg/L)	4	H	0.1	0.1	0.1	0.1	0.1	2	0	0%
Cadmium (mg/L)	0.002	H	0	0	0	0	0	2	0	0%
Calcium (mg/L)	-		62	62	65	68	69	2	0	0%
Chloride (mg/L)	250	A	169	170	181	192	193	2	0	0%
Chromium (mg/L)	0.05	H	0.003	0.003	0.004	0.005	0.005	2	0	0%
Copper (mg/L)	2	H	0.022	0.022	0.027	0.031	0.031	2	0	0%
E. coli	0	H	0.00	0.00	0.00	0.00	0.00	50	0	0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5th %ile	Median	95th %ile	Max	Samples	Exceptions	
Fluoride (mg/L)	1.5	H	0.5	0.5	0.6	0.6	0.6	2	0	0%
Free chlorine (mg/L)[1]			0.6	0.9	1.5	2.5	3.0	50	0	0%
Iodine (mg/L)			0.1	0.1	0.1	0.1	0.1	2	0	0%
Iron (mg/L)	0.3	A	0.01	0.01	0.01	0.01	0.01	2	0	0%
Lead (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Magnesium (mg/L)	-		48.3	48.7	53.0	57.3	57.8	2	0	0%
Manganese (mg/L)	0.5	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Mercury (mg/L)	0.001	H	0.0001	0.0001	0.0001	0.0001	0.0001	2	0	0%
Molybdenum (mg/L)	0.05	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Nickel (mg/L)	0.02	H	0.01	0.01	0.01	0.01	0.01	2	0	0%
Nitrate (mg/L)	50	H	1.0	1.1	2.0	2.9	3.0	2	0	0%
Nitrite (mg/L)	3	H	0.1	0.1	0.1	0.1	0.1	2	0	0%
pH	8.5	A	7.1	7.2	7.4	7.7	7.9	52	0	0%
Selenium (mg/L)	0.01	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Silver (mg/L)	0.1	H	0.001	0.001	0.001	0.001	0.001	2	0	0%
Sodium (mg/L)	180	A	77	79	98	117	119	2	0	0%
Sulfate (mg/L)	250	A	20	20	21	22	22	2	0	0%
Temperature (oC)			21	21	22	28	33	33	12	0
Total Chlorine (mg/L)	5	H	0.5	0.9	1.7	2.8	3.2	50	0	0%
Total Coliforms (cfu/100 mL)			0.0	0.0	0.0	0.0	12.0	50	2	4%
Total Dissolved Solids (TDS) (mg/L)	600	A	598	606	678	749	757	2	1	50%
Total Hardness as CaCO3 (mg/L)[2]	200	A	353	355	381	406	409	2	2	100%
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.5	0.5	0.5	2	0	0%
Turbidity (NTU)	5	A	0.2	0.3	0.6	1.5	1.5	37	0	0%
Uranium (mg/L)	0.017	H	0.003	0.003	0.003	0.003	0.003	2	0	0%
Zinc (mg/L)	3	A	0.03	0.03	0.04	0.04	0.04	2	0	0%

Source: NSW Health Water Quality Monitoring database

Note 1: The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2: ADWG recommend 200 mg/L hardness as CaCO3 as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.