KEMPSEY
Shire Council

Drinking Water Management System

Water Quality Annual Report

July 2022-June 2023

Document control

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Approved by	Wes Trotter, Director Utilities Kempsey Shire Council

Report Revision History

Version	Date	Details	Review
0.1	31/05/2024	First Draft	**Internal – Kempsey Shire Council** John Nelson – Water and Sewer Operations Manager Daniel Ford - Technical Officer, Water and Sewer Operations Bobbie Brenton – Water Quality Officer, Water and Sewer Operations
0.2	11/06/2024	Second Draft	**Internal - Kempsey Shire Council** Andrew Miller – Group Manager Water and Sewer Wes Trotter - Director Utilities
0.3	13/06/2024	Final Draft	**External - North Coast Public Health Unit** David Basso – North Coast Public Health Unit

1.0	17/06/2024	Final	**North Coast Public Health Unit and Kempsey Shire Council Yearly DWMS Review meeting**
			• **North Coast Public Health Unit**
			  ○ Melissa Bouboulas - North Coast Public Health Unit
			  ○ David Basso – North Coast Public Health Unit
			• **Kempsey Shire Council**
			  ○ Wes Trotter - Director Utilities
			  ○ Andrew Miller – Group Manager Water and Sewer
			  ○ John Nelson – Water and Sewer Operations Manager
			  ○ Scott Brown – Team Leader Water Process
			  ○ Bobbie Brenton – Water Quality Officer

Executive Summary

Kempsey Shire Council (Council) manages 8 water supply systems, providing drinking water to Kempsey - Lower Macleay (KLM), Crescent Head, Hat Head, South West Rocks, Stuarts Point, Willawarrin, Bellbrook, and the Thunggutti Aboriginal Community.
Council has developed this report as part of its requirements to perform an annual evaluation and review of the performances of its water supply systems. The evaluation and review are based on the current regulatory framework, reporting requirements and guidelines of the Australian Drinking Water Guidelines (ADWG) (ADWG; 2011); along with reporting requirements of NSW Health that includes a yearly document submission to the local Public Health Unit (PHU), NSW Health.

This report covers the period of 1 of July 2022 to 30 of June 2023 and satisfies the reporting (Element 10), evaluation (Element 11) and review and continual improvement (Element 12) requirements of Councils Drinking Water Management System (DWMS).

DWMS document review

A desktop internal review was conducted in May 2023 for the DWMS Overall Manual, Sub plans (8 separate supply systems) and the Water Quality Incident Response and Reporting plan (WQIRRP). Identified updates, included adjustments to Critical Control Points (CCPs) standard operating procedures (SOPs), monitoring frequencies and key stakeholder contact information.

An Internal audit conducted by Councils internal auditor was undertaken in September and October 2022. The objective was to review the effectiveness of key controls relating to drinking water management processes. Five observations were noted, 3 medium risk and 2 low risk.

Review and updates to the Risk Register and Implementation Plan (IP) were completed post 2022-2023 report period (workshops held in December 2023). Executive summary is discussed in “Continuous Improvement - Implementation Plan (IP).”

Supply summary and system upgrades

Stuarts Point reservoir refurbishment completed and commissioned for use in September 2022. The Frederickton reservoir was offline for refurbishment, completion details will be reported in the 2023/2024 annual report. Planning commenced for the Clybucca reservoir refurbishment. Work continues on applications for Section 60 endorsement options for the Kempsey and Lower Macleay, Crescent Head, Willawarrin and Bellbrook supply systems. Membrane cleaning system modifications continue in the South West Rocks supply.

Performance of critical control points (CCP)

Of Councils 8 water supply systems, 6 systems experienced CCP exceptions, Stuarts Point and Thunggutti had no exceptions in the reporting period.

One-hundred and five CCP exceptions were reported in 2022-2023. This is a decrease of 140 from the previous year.

Table E.1 - Critical Control Points Summary

Supply System	2021-2022			2022-2023			Difference between report years
	Alert	Critical	Total	Alert	Critical	Total	
Kempsey - Lower Macleay	7	0	7	47	2	49	**+42**
Crescent Head	18	2	20	7	3	10	**-10**
Hat Head	1	0	1	3	0	3	**+2**
South West Rocks	18	0	18	30	0	30	**+12**
Stuarts Point	0	0	0	0	0	0	**-**
Willawarrin	114	30	144	9	0	9	**-135**
Bellbrook	39	1	40	4	0	4	**-36**
Thunggutti	14	1	15	0	0	0	**-15**
Total	**211**	**34**	**245**	**100**	**5**	**105**	**-140**

Reservoir inspection programs

No breaches of integrity were detected during in house monthly CCP reservoir inspections.

Nine reservoirs have been clean and inspected by external contractors during this reporting period.

Water quality verification

Twenty-two ADWG and/or Water Quality Indicators (WQI) exceptions occurred from the combined NSW Health sponsored monitoring and Councils in house operational monitoring programs.

No total coliforms or E. coli colonies were detected in any of Councils 8 water supply systems.

Council received 3 nickel notifications that where above the ADWG from laboratory analysis. The South West Rocks supply had the majority of exceptions, all 11 being fluoride. The out of range fluoride (<0.9 mg/L) is accounted for by post non-operational periods where fluoride residuals within the network took time to return to targeted concentrations.

Total ADWG and WQI water quality exceptions by supply system is summarised in Table E.2.

Table E.2 Total ADWG and WQI water quality exceptions by supply system

	Kempsey Lower Macleay	Crescent Head	Hat Head	South West Rocks	Stuarts Point	Willawarrin	Bellbrook	Thunggutti	Total
NSW Health Program	2	0	0	9	0	1	1	0	**13**
Council Program	3	4	0	2	0	0	0	0	**9**
Total	**5**	**4**	**0**	**11**	**0**	**1**	**1**	**0**	**22**

Consumer enquiries.

Fifty-five customer enquiries were recorded across all supplies. The majority of enquiries were in the Kempsey – Lower Macleay supply; no customer enquiries were recorded in Bellbrook and Thunggutti supplies. Table E.3 provides a summary of costumer enquires.

Table E.3 Customer Enquires for Councils Water Supply Systems

Supply System	Dirty	Air or Cloudy	Taste & Odour	Loss of Supply	Illness	Total
Kempsey – Lower Macleay	11	5	2	27	0	**45**
Crescent Head	2	0	0	1	0	**3**
Hat Head	0	0	0	1	0	**1**
South West Rocks	0	1	0	0	0	**1**
Stuarts Point	1	0	0	0	0	**1**
Willawarrin	4	0	0	0	0	**4**
Bellbrook	0	0	0	0	0	**0**
Thunggutti	0	0	0	0	0	**0**
Total	**18**	**6**	**2**	**29**	**0**	**55**

Water quality incidents or emergency

Five Critical Limit exceptions were reported in 3 separate water quality incidents to the local North Coast Public Health Unit (NCPHU) at time of occurrence. This included a Boil Water Alert notice issued in the Crescent Head supply for 53hrs on 24/02/2023. Table E.4 provides a summary of the water quality results that triggered Councils Drinking Water Quality Incidents Response and Reporting Plan (DWQRP).

Table E.4 Water Quality Incident Trigger Results

Supply	Date of Event	Location	CCP Number	CCP Parameter	CCP Critical Limit	CCP Result
Kempsey Lower Macleay	14/11/2022 19/11/2022	Disinfection	CCP3	pH	<6.5 or >8.5 pH	6.48 pH 6.34 pH
Crescent Head	23/01/2023	Disinfection	CCP3	pH	<6.5 or >8.5 pH	8.53 pH
Crescent Head	24/02/2023	Disinfection	CCP3	Free Chlorine pH	<0.5 mg/L <6.5 or >8.5 pH	0.03 mg/L 8.79 pH

Monitoring programs

Pesticide and radiological monitoring from water supplies servicing Aboriginal communities (5 identified within the drinking water supply areas of Council) is funded by the NSW Aboriginal Communities Water and Sewer Program (ACWSP) and NSW Health Water Unit every 5 years.

The most recent pesticide monitoring commenced in January 2022. This program fell over 2 reporting years: 2021-2022 and 2022-2023; No pesticides were detected across the communities.

No radiological monitoring was conducted in 2022-2023.

The NSW Department of Planning and Environment (DPE) inspects the water supply at the Aboriginal communities at least yearly and checks water quality against ADWG and NSW Health recommended indicators for the tested parameters. All supplies at the time of inspections met water quality specifications, except for an inspection on the 21/06/2023 for the New Burnt Bridge Community where turbidity and colour was found to be outside of ADWG targets.

Staff training and development

Training and development programs completed by water personal during 2022-2023 are captured in Table E.5.

Table E.5 Summary of Completed Training during 2022-2023

Training	Water Process	Water Networks	Water Mechanical & Electrical	Water Management	Combined Total
Drinking Water Quality Incident Response & Reporting Plan	13	0	0	1	**14**
Monitor and operate fluoride addition processes	1	0	0	0	**1**
Operate Breathing Apparatus Training	3	6	4	0	**13**
Working Safely at Heights	8	4	7	0	**19**
Working safely near live electrical apparatus as a non-electrical worker	8	8	4	1	**21**
Low Voltage Rescue and CPR	1	1	8	0	**10**
Level 2B and 2C Initial Training - Overhead and Underground	0	0	1	0	**1**
First Aid Certificate	10	6	1	0	**17**
Combined Total	**44**	**25**	**25**	**2**	**96**

Continuous Improvement - Implementation Plan (IP)

Since the establishment of the DWMS in 2014, the Implementation plan (IP) has been reviewed yearly by the Risk Management Team in conjunction with the Risk Register. Table E.6 provides the status of the IP at the end of 2022-2023 report year (review undertaken in December 2023).

Table E.6. Implementation Plan progress status based on risk value

Residual Risk	Removed	Completed	Standing Items	In progress	Ongoing (Long term actions)	Not Started	New	Tasks Remaining
Very High	0	0	0	6	3	0	0	**9**
High	3	1	7	24	5	1	0	**37**
Medium	2	3	0	12	8	3	0	**23**
Low	4	1	3	6	7	1	0	**22**
Total	**9**	**5**	**10**	**48**	**23**	**5**	**0**	**86**

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Tables

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1. Report Purpose

The *Public Health Act 2010* (NSW) requires that "*a supplier of drinking water must establish, and adhere to, a quality assurance program that complies with the requirements prescribed by the regulations*".

The NSW Guidelines for Drinking Water Management Systems (NSW Ministry of Health 2013) provides guidance on the implementation of a Drinking Water Management System, in accordance with the *Public Health Act 2010* (NSW) and the *Public Health Regulation 2012* (NSW). These Guidelines are based on the Framework for Management of Drinking Water Quality, as outlined in the Australian Drinking Water Guidelines (ADWG) (NRMMC, NHMRC 2011).

This report provides a summary of Councils annual review of the performance of its water supply systems, for the 12-month period form 1 July 2022 to 30 June 2023.

It has been prepared to support; reporting (Element 10), evaluation (Element 11) and review and continual improvement (Element 12) requirements of the Councils DWMS.

This report includes the following areas:

- DWMS document review
- Supply summary and upgrades
- Performance of critical control points
- Reservoir inspection programs
- Water quality verification
- Water quality incidents or emergency
- Customer enquiries
- Monitoring programs
- Staff development and training
- Continuous improvement - implementation plan (IP)

2. DWMS Document Review

The NSW Guidelines for DWMS require that all water suppliers review their DWMS and major components on an annual basis.

Councils DWMS Risk Management Team undertakes annual internal reviews on the following DWMS documents.

- Overall Manual
- Sub plans (8 separate supply systems)
- Water Quality Incident Response and Reporting plan (WQIRRP)
- Risk Register
- Implementation Plan (IP)

Based on the review outcomes, identified components are actioned and documented.

Table 2.1 summarizes Councils internal document review during 2022-2023.

Table 2.1 DWMS Document Revision History

Document	Version & Date	Updates	Date Submitted to NSW Health
Overall Manual	4.6 13 June 23	Yearly internal review (desktop) May 2023 Update: Acronyms, stakeholder contacts & KSC position titles. Details revised in Sections 4.4, 5.2, 10.1, and 10.2.	13 July 2023
Water Quality Incident Response and Reporting Plan	1.3 13 June 23	Update Emergency stakeholder names and contacts, KSC position titles, Appendix E and Appendix F (Boil water templates)	13 July 2023
Subplans & CCP Procedures		Note: Updates to Tables 3 and CCPs will commence at the start of the 2023-2024 reporting period	
Kempsey and Lower Macleay	1.3 13 June 23	KSC position tiles, Table 7 - KSC Operational Monitoring Sample locations and CCP3 SOP pH protocols & CCP protocols for water fill stations during boil water alerts	
Crescent Head	1.3 13 June 23	KSC position titles, CCP3 SOP pH protocols & CCP protocols for water fill stations during boil water alerts	13 July 2023
Hat Head	1.3 13 June 23	As per Crescent Head supply update	
South West Rocks	1.3 13 June 23	As per Crescent Head supply update	
Stuarts Point	1.3 13 June 23	As per Crescent Head supply update	
Willawarrin	1.3 13 June 23	As per Crescent Head supply update	
Bellbrook	1.3 13 June 23	As per Crescent Head supply update	
Thunggutti	1.3 13 June 23	As per Crescent Head supply update	
Risk Assessment	2.8 6 Dec 23	Review by Councils DWMS Risk Team and Water & Sewer Maintenance and Network Managers, and Senior Water Operator. Minor/desktop review only, Update of Controls and Proposed actions from "Removed" completed IP actions	2022-2023 Annual Report and Review meeting
Implementation Plan	10.0 11 Dec 23	Review by the DWMS Risk Team, Water & Sewer Maintenance and Network Managers, and Senior Water Operator	2022-2023 Annual Report and review meeting

Councils internal review program performs audits at least once every 5 years, focusing on Councils inhouse systems and to meet compliance with the ADWG framework.

This audit was conducted in September and October 2022. The objective was to review the effectiveness of key controls relating to drinking water management processes. Table 2.2. provides an overview of the key audit findings.

Table 2.2 Internal Review Program Audit Report Dashboard

Internal Audit Report Dashboard	
Audit name	Drinking Water Management System
Reason for audit	Maintaining good water quality for its residents is a key objective of Council. The DWMS Manual requires an internal audit of the DWMS every five years.
Value proposition	Identification of a few key risks and issues that require management attention.

Overall conclusion	
• Adequate control environment in most areas. • Moderate risk improvement opportunities identified, which require corrective action.	Improvement opportunity
Strengths and good practices	
• Diligent and professional Water Quality Officer overseeing and implementing system and process improvements • DWMS Manual and annual reports are up to date • DWMS Risk Team established, and monitoring activities carried out as required • Risk assessments, improvement plans and audits undertaken as required • Critical Control Point (CCP) alerts and incidents investigated and followed-up proactively and reported to state government as required • Key documents related to each DWMS element are saved in well labelled folders in a Teams site • No issues detected with several key DWMS elements including policies, incidents, awareness raising, training, research. Data quality information matches in key reports. • Water Outlook system administrative (super) users are accurate	Good practice

Observations		**Risk Rating**
1	Review and Update Standard Operating Procedures	Medium Risk
2	Conduct Water Tests According to DWMS Sub Plans	Medium Risk
3	Develop Drinking Water Quality Reporting Procedure	Medium Risk
4	Monthly DWMS Reports	Low Risk
5	Calibrate Water Testing Equipment	Low Risk

External reviews of Councils DWMS occur either on a 5 year basis or when deemed necessary by Council and/or NSW Health.

VIRIDIS Consultants facilitated an external review in May 2018; this was finalised in June 2019 and adopted by Council in August 2019.

3. Supply Summary and Upgrades

Kempsey Shire Council is located on the north coast of NSW, covering an area of 3,380 square kilometres, between the Pacific Ocean to the east, Five Day Creek in the west, Grassy Head to the north and Kundabung to the south.

Council manages 8 water supply systems, providing drinking water to:

- Kempsey - Lower Macleay (KLM), (includes the Lower Macleay towns and surrounding areas of Frederickton, Smithtown, Gladstone, Kinchela, and Jerseyville)
- Crescent Head

- Hat Head
- South West Rocks
- Stuarts Point
- Willawarrin
- Bellbrook
- Thunggutti Aboriginal Community

Figure 3. provides locality map of each of the Councils supply systems and Table 3.1 provides a summary of each of the water supply systems and any upgrades that have occurred during the reporting year.

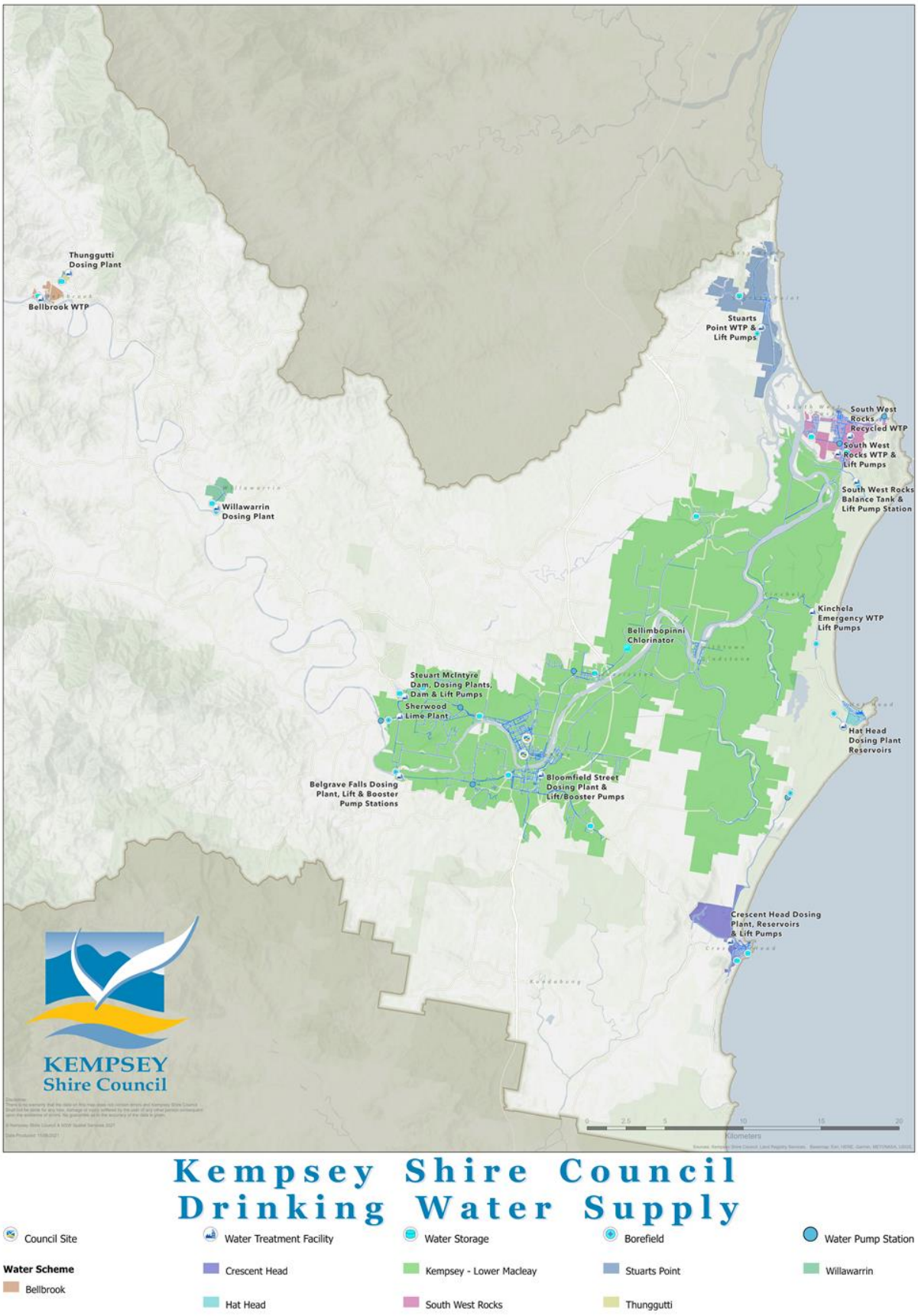

Figure 3. Kempsey Shire Water Supplies

Table 3.1. Councils Drinking Water Supply Systems Summary

Supply System	Source Water	Treatment	Treatment Cap	Population serviced	Towns & Communities supplied	System upgrades in 2022/23
Kempsey and Lower Macleay	Groundwater, Sherwood (from the Macleay River)	Gas chlorine for disinfection and lime dosing for pH correction.	20 ML/day	~20 461	Kempsey Frederickton Gladstone Smithtown Kinchela Jerseyville and surrounding rural regions as depicted on Figure 2.1 New Burnt Bridge and Greenhill Aboriginal Communities	Frederickton reservoir renewal program (In progress) Additional Notes: Working on application for Section 60 Endorsement for Option assessment and procurement for preparation of Concept Design.
	Steuart McIntyre Dam (Emergency Supply) From Groundwater Sherwood	Aeration and Ultrasound for Algae Control, Chlorine (Sodium hypochlorite) dosing for disinfection.	38.1 ML/day			
Crescent Head	Groundwater, Maguires Crossing Hat Head National Park	Lime and CO2 dosing for increasing alkalinity and pH correction. Gas chlorination for disinfection.	2.6 ML/day	~1500 permanent population ~4500 holiday population	Crescent Head Loftus Road Aboriginal Community	No additional upgrades Additional Notes: Section 60 endorsed options decommissioning of the temporary storage tank to facilitate construction of New WTP.
Hat Head	Groundwater, Hat Head National Park	Aerator for iron removal, soda ash for pH correction and chlorine gas for disinfection.	2.6 ML/day	~350 permanent population ~2000 holiday population	Hat Head	No additional upgrades
South West Rocks	Groundwater, Hat Head National Park	Aeration, membrane filtration, coagulation, lime for pH correction, chlorine (sodium hypochlorite) and fluoridation.	6 ML/day	~5700 permanent population ~15 000 holiday population	South West Rock Figtree Aboriginal Community	Ongoing membrane renewal and associated system modifications

Supply System	Source Water	Treatment	Treatment Cap	Population serviced	Towns & Communities supplied	System upgrades in 2022/23
Stuarts Point	Groundwater	Ferric dosing for coagulation and Iron and arsenic removal, sand filtration and chlorine gas for disinfection.	2.7 ML/day	~1000 permanent population ~4000 holiday population	Stuarts Point Fishermans Reach Grassy Head	Reservoir relined apart of the reservoir renewal program Commissioned for use in September 2022
Willawarrin	Surface water from Macleay River (bore on edge of river for gravel bed extraction)	Chlorine (sodium hypochlorite) dosing. Soda ash for pH correction	200 kL/day	~130	Willawarrin	No additional upgrades Additional notes: Ongoing planning of land acquisition for design and Construction of a new WTP.
Bellbrook	Surface water from Macleay River (bore within river for gravel bed extraction)	Multi-media filtration including arsenic removal, coagulation, soda ash for pH correction and chlorine (sodium hypochlorite) dosing.	140 kL/day	~100	Bellbrook	No additional upgrades Additional notes: Ongoing planning of WTP augmentation
Thunggutti	Surface water from creek (bore on edge of river for gravel bed extraction)	Chlorine (sodium hypochlorite) dosing. Soda ash for pH correction	110 kL/day	~120	Thunggutti Aboriginal Community	New dedicated rising main connecting WTP to reservoirs and interconnections to reservoirs and reticulation system.

4. Critical Control Points

A Critical Control Point (CCP) is defined as an "*activity, procedure or process at which control can be applied, and which is essential to prevent a hazard or reduce it to an acceptable level*" (NSW Ministry of Health 2013). These may be processes such as selective abstraction of raw water, filtration, disinfection, or reservoir integrity. For each CCP, a parameter, such as chlorine residual, can be measured to verify the effectiveness of the process or identify when corrective action is required.

Operational Target, Alert Level and Critical Limits are determined for each CCP parameter to identify normal and out of normal operational conditions, where:

- **Operational Target** identifies the normal operational conditions,
- **Alert Level** indicates that the parameter is outside the normal conditions and corrective action may be required.
- **Critical Limit**, if exceeded, indicates that process control has been lost and safe water quality can no longer be guaranteed.

4.1 Data Collection and Monitoring

Monitoring of CCPs is undertaken throughout Councils 8 supply systems, as per the requirements of Councils Drinking Water Management System (DWMS). System specific CCP Standard Operating Procedures (SOP) Tables (Appendix A) have been established for:

- CCP1 - Abstraction from groundwater (Turbidity),
- CCP1 - Abstraction from Steuart Macintyre Dam – Emergency Supply (Turbidity along with Algae, Toxins, Taste and Odour)
- CCP2 - Filtration (Turbidity)
- CCP3 - Disinfection (Free Chlorine and pH)
- CCP4 - Fluoridation (South West Rocks at WTP and Gregory St Reservoir)
- CCP5 - Reservoirs (Reservoir Integrity)

Monitoring includes sample collection and analysis using laboratory and field instruments and real-time monitoring of online instrumentation for pre and post treated water via telemetry.

4.2 Non-Compliant Data

The CCP exceptions, either Alert Level or Critical Limit, are managed by the Water Operators by undertaking corrective actions following the CCP Standard Operating Procedures (SOP) Tables (Appendix A) and through communications with the Team Leader Water Process.

Water Operators enter operational monitoring results into Councils WaterOutlook data management system specific to each supply. If an entered result is outside of the targeted CCP operational range, WaterOutlook automatically records and notifies via email the Water Operators and Water Management team of the CCP exception (either Alert Level or Critical Limit). This email notification triggers the Water Operator to complete an "Incident Report" also within WaterOutlook.

WaterOutlook assigns the incident report an "Incident Batch Number" for future reference and sends out an email copy of the report to the Water Operators and the Water Management Team. The incident report provides a record of the reason for the exception, the corrective actions undertaken and whether any further actions are required to ensure this exception does not occur again.

WaterOutlook tabulates CCP exceptions for each supply into “Monthly Run Reports” these reports are further tabulated within WaterOutlook to produce “Water Quality Special Reports.” The Water Quality Special Reports displays all monthly exceptions for each supply into a single table, tabulates a combined CCP monthly total and a running “year to date” (financial year) total. The CCP tables are used for reporting purposes to Council Management and to external stakeholders as required (Annual DWMS Water Quality report).

For reporting purposes Alert Levels and Critical Limits are recorded as a discrete number, i.e., once a CCP falls outside of the Alert Level range and is in the Critical Limit range it is recorded at a Critical Limit only and is not counted in the Alert Level totals.

4.3 Reporting

One hundred and five CCP exceptions were reported in 2022-2023 from 8085 tests. This is a decrease from the previous year 245 CCPs.

Five exceptions were reported as a Critical Limit and 100 exceptions were at an Alert Level.

Of Councils 8 water supply systems, 6 systems experienced CCP exceptions, Stuarts Point and Thunggutti water supplies had no exceptions in the reporting period.

CCP exceptions for the year are outlined in the supply systems in which they occur, except for:

- CCP1 - Abstraction from Steuart McIntyre Dam (Algae, Toxins, Taste and Odour); when not in use the monitoring details are outlined in Section 9 – Monitoring Programs
- CCP5 Reservoir inspections which is outlined in Section 5 – Reservoir Inspections
- Critical Limits are outlined in Section 7 – Water Quality Incident or Emergency

CCP supply discussions reference the details provided in Table 4.1 and individual supply system CCP monitoring data graphs.

CCP summary tables for each supply system are provided in Appendix A.

Table 4.1 Summary of Critical Control Point exceptions 2022-2023

Alert and Critical CCP Break-up per Supply - System Financial Year To Date
01 Jul 2022 - 30 Jun 2023
Report run date: 14 Jul 2023

		CCP1 - Abstraction		CCP2 - Filtration		CCP3 - Disinfection				CCP4 - Fluoridation						Totals		
	Operational Sheets Supply System	Turbidity Raw Bore Water ALERT LEVEL	Turbidity Raw Bore Water CRITICAL LIMIT	Turbidity ALERT LEVEL	Turbidity CRITICAL LIMIT	Free Chlorine ALERT LEVEL	Free Chlorine CRITICAL LIMIT	pH ALERT LEVEL	pH CRITICAL LIMIT	Fluoride ALERT LEVEL > 1.2mg/L Leaving WTP	Fluoride ALERT LEVEL <0.9mg/L for >72hrs Leaving WTP	Fluoride CRITICAL LIMIT Leaving WTP	Fluoride ALERT LEVEL >1.2mg/L Gregory St Outlet	Fluoride ALERT LEVEL <0.9mg/L for >72hrs Gregory St Outlet	Fluoride CRITICAL LIMIT Gregory St Outlet	ALERT LEVEL	CRITICAL LIMIT	Combined Total
Kempsey & Lower Macleay	Number of Exceedances	0	0			0	0	47	2							47	2	49
	Number of Tests	352	352			364	364	363	363							1079	1079	1079
	Rate of Exceedance	0%	0%			0%	0%	12.9%	0.6%							4.4%	0.2%	4.5%
Crescent Head	Number of Exceedances	0	0			0	1	7	2							7	3	10
	Number of Tests	357	357			363	363	363	363							1083	1083	1083
	Rate of Exceedance	0%	0%			0%	0.3%	1.9%	0.6%							0.6%	0.3%	0.9%
Hat Head	Number of Exceedances	0	0			0	0	3	0							3	0	3
	Number of Tests	251	251			250	250	250	250							751	751	751
	Rate of Exceedance	0%	0%			0%	0%	1.2%	0%							0.4%	0%	0.4%
South West Rocks	Number of Exceedances	2	0	0	0	1	0	0	0	0	0	0	0	27	0	30	0	30
	Number of Tests	351	351	352	352	362	362	362	362	274	274	274	279	279	279	1980	1980	1980
	Rate of Exceedance	1%	0%	0%	0%	0.3%	0%	0%	0%	0%	0%	0%	0%	10%	0%	1.5%	0%	1.5%
Stuarts Point	Number of Exceedances	0	0	0	0	0	0									0	0	0
	Number of Tests	234	234	248	248	252	252									734	734	734
	Rate of Exceedance	0%	0%	0%	0%	0%	0%									0%	0%	0%
Willawarrin	Number of Exceedances	4	0			1	0	4	0							9	0	9
	Number of Tests	278	278			362	362	362	362							1002	1002	1002
	Rate of Exceedance	1%	0%			0.3%	0%	1%	0%							0.9%	0%	0.9%
Bellbrook	Number of Exceedances	3	0	0	0	1	0	0	0							4	0	4
	Number of Tests	154	154	171	171	188	188	188	188							701	701	701
	Rate of Exceedance	2%	0%	0%	0%	0.5%	0%	0%	0%							0.6%	0%	0.6%
Thunggutti	Number of Exceedances	0	0			0	0	0	0							0	0	0
	Number of Tests	247	247			254	254	254	254							755	755	755
	Rate of Exceedance	0%	0%			0%	0%	0%	0%							0.0%	0%	0.0%
Totals	**Number of Exceedances**	**9**	**0**	**0**	**0**	**3**	**1**	**61**	**4**	**0**	**0**	**0**	**0**	**27**	**0**	**100**	**5**	**105**
	Number of Tests	**1872**	**1872**	**771**	**771**	**2395**	**2395**	**2142**	**2142**	**274**	**274**	**274**	**279**	**279**	**279**	**8085**	**8085**	**8085**
	Rate of Exceedance	**0.5%**	**0.0%**	**0%**	**0%**	**0.1%**	**0.04%**	**2.8%**	**0.2%**	**0%**	**0%**	**0%**	**0%**	**9.7%**	**0%**	**1.2%**	**0.1%**	**1.3%**

Note 1: Multiple exceptions occurring on the same day are recorded as discrete events at each CCP point as they occur. The Total Alert Level, Critical Limit and Combined Yearly Total is the sum of each discrete exception occurrence on any given day from each individual category.
Note 2: Once a CCP exceeds the Alert Level value it is recorded at a Critical Limit only and is not counted in the Alert Level totals.

4.3.1 Kempsey - Lower Macleay (KLM) Supply System

Monitoring data for each of the Kempsey - Lower Macleay supply systems CCPs is shown in Figures 4.3.1a, 4.3.1b and 4.3.1c.

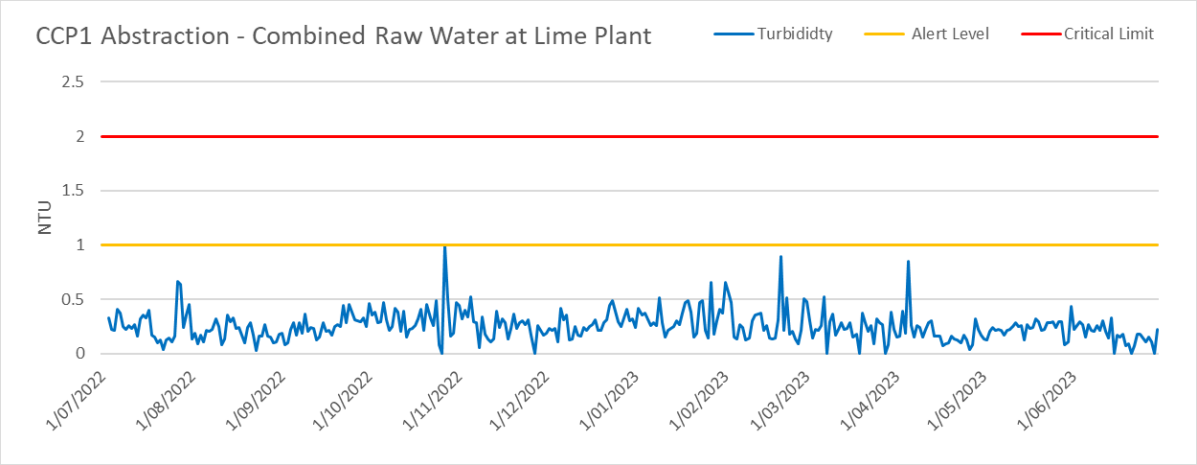

Figure 4.3.1a - CCP 1 Abstraction – Turbidity at combined raw water Lime Plant

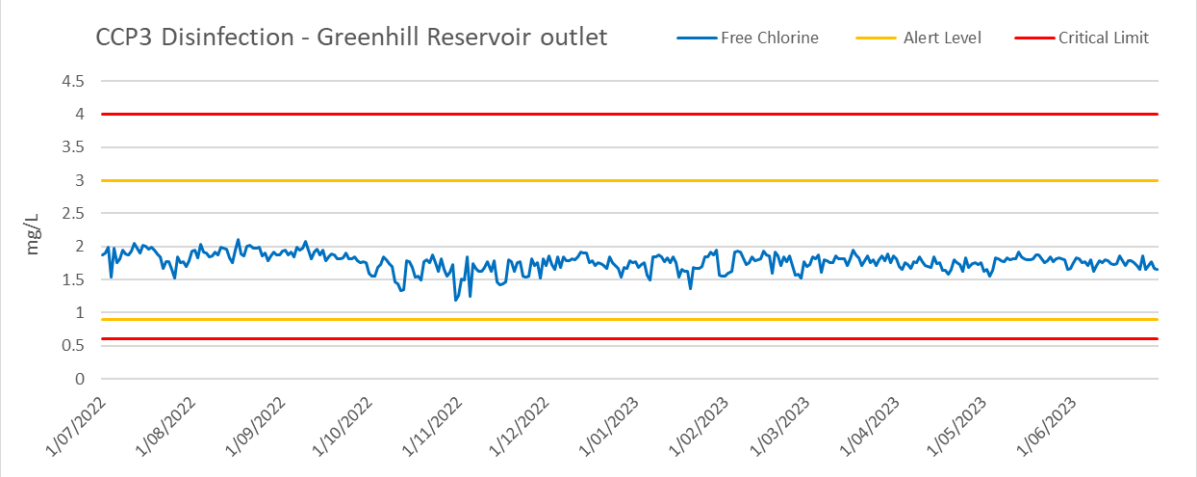

Figure 4.3.1b CCP3 Disinfection – Free Chlorine at Greenhill Reservoir outlet

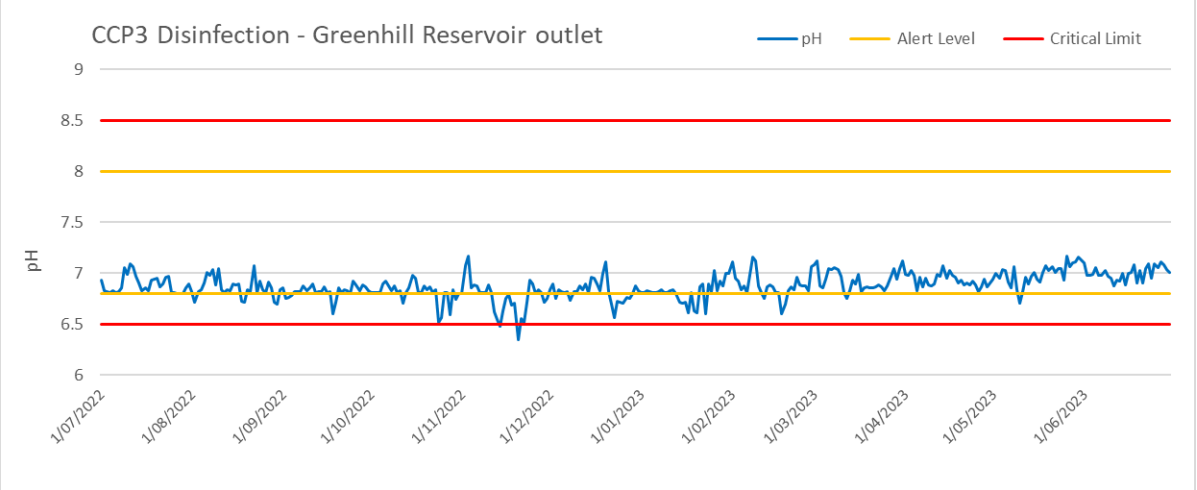

Figure 4.3.1c CCP3 Disinfection – pH at Greenhill Reservoir outlet

Two pH Critical Limit exceptions occurred during 1 event in the Kempsey - Lower Macleay supply during the 2022-2023 reporting year (Table 4.1 and 4.3.1c). This event is outlined in Section 7 – Water Quality Incident or Emergency.

Forty-seven Alert Level exceptions occurred from 1079 samples. (Table 4.1 and Figure 4.3.1c).

All exceptions where a low Alert Level at CCP3 pH (<6.8 pH) Contributing factors include:

- Increased humidity from persistent and ongoing unusually high wet weather impacting powdered lime consistency.
    - Lime blockages in delivery shute
    - Uneven lime distribution (rat holing) in the delivery hopper
    - Multiple agitator breakdowns and stator pump faults from increased run times to reduce blockages and ratholing events.

Corrective actions involved:

- Clearing blockages as they occur and daily checks of dosing equipment and screw feeder
- Regular acid cleans and replacing dosing line
- Adjustments to float in mixer
- Repairs / replacement of pump stator,
- Repairs to the agitator

4.3.2 Crescent Head Supply System

Monitoring data for each of the Crescent Head supply systems CCPs is shown in Figures 4.3.2a. 4.3.2b and 4.3.2c.

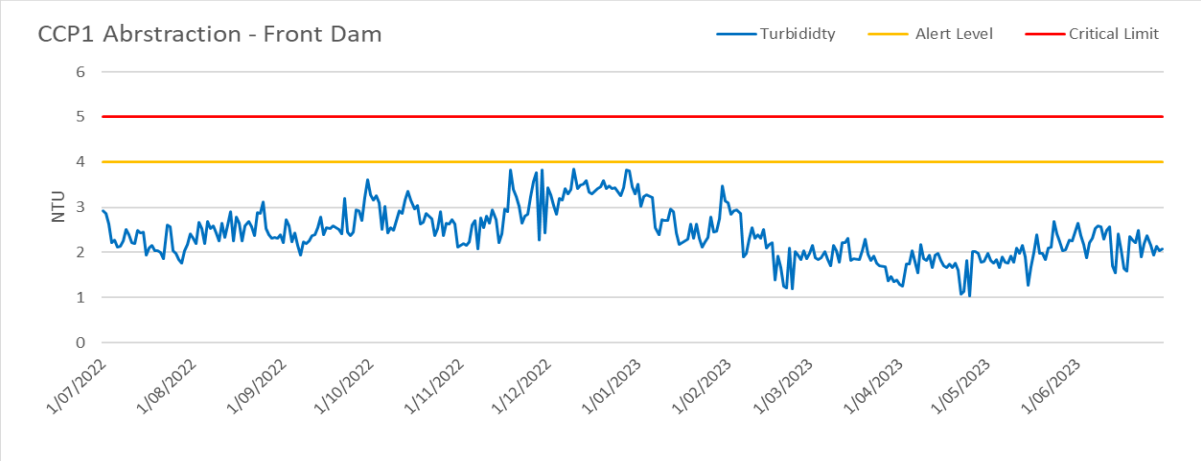

Figure 4.3.2a - CCP 1 Abstraction – Turbidity at Front Dam

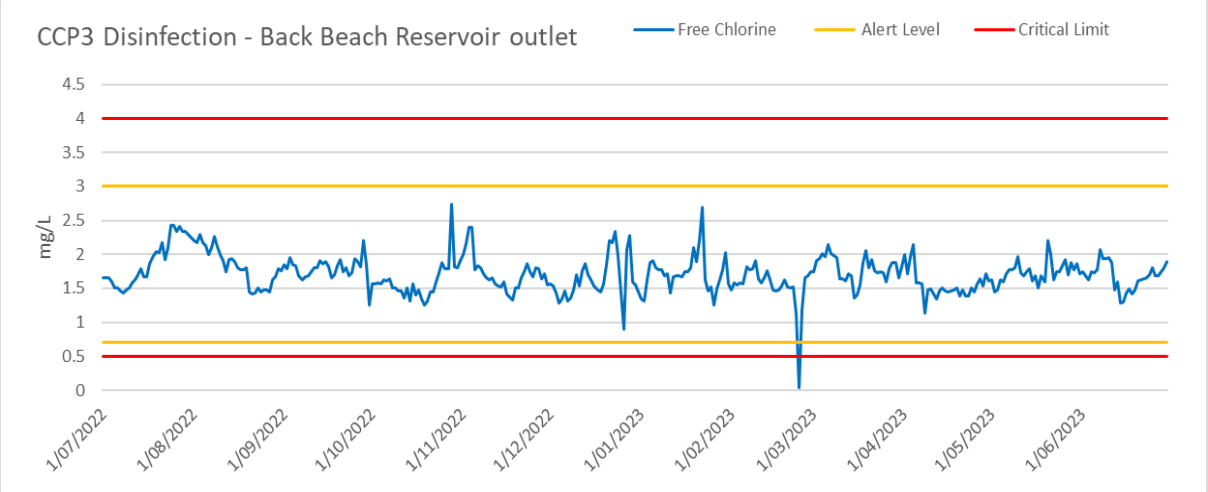

Figure 4.3.2b CCP3 Disinfection – Free Chlorine at Back Beach Reservoir outlet

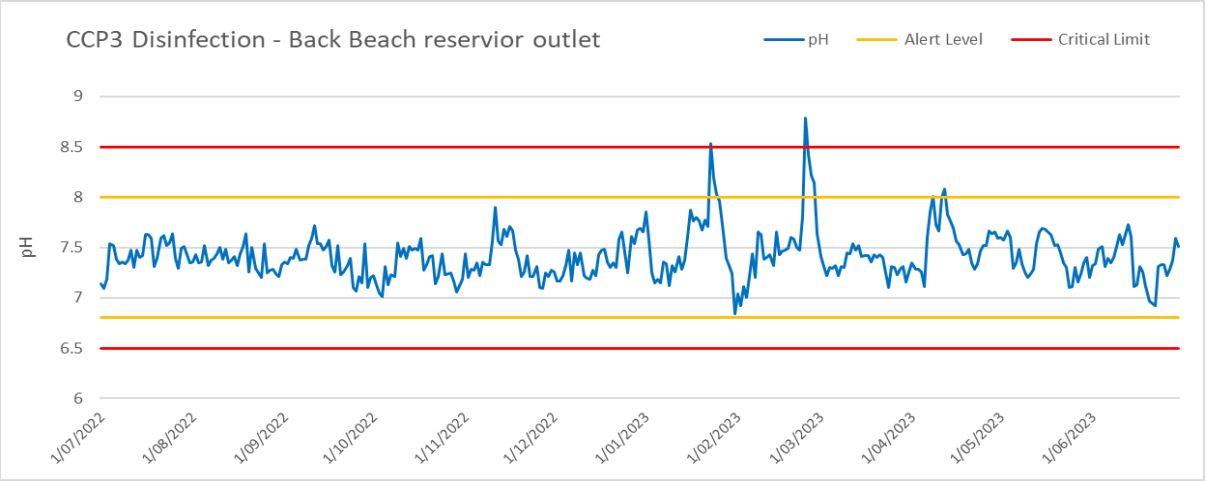

Figure 4.3.2c CCP3 Disinfection – pH at Back Beach Reservoir outlet

Three Critical Limits exceptions occurred during 2 separate events in the Crescent Head supply in 2022-2023, (Table 4.1, Figure 4.3.2b and Figure 4.3.2c). The exceptions (1 low Free Chlorine and 2 high pH) are discussed in section 7 Water Quality Incident or Emergency.

Seven Alert Level exceptions (all CCP3 – Disinfection, pH) occurred from 1083 tests. Five of these are associated with the 2 Critical Limit events. The remaining 2 occurred in April 2023. (Table 4.1 and Figure 4.3.2c).

- CCP3 – Disinfection: pH >8.0 pH, 2 occurrences
    - 7/04/2023, 8.01 pH & 14/04/2023, 8.08 pH

The 2 marginal high pH Alert Levels were caused by a faulty wire behind the control board which forced the lime dosing setting to 100%. Once repaired and settings adjusted, pH returned to operational targets.

4.3.3 Hat Head Supply System

Monitoring data for each of the Hat Head supply systems CCPs is shown in Figures 4.3.3a, 4.3.3b and 4.3.3c.

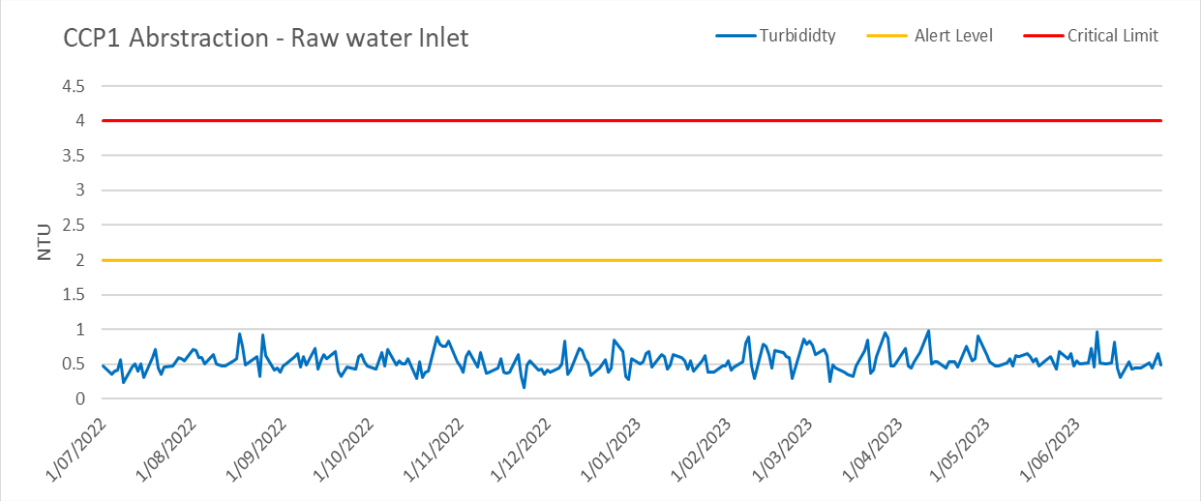

Figure 4.3.3a - CCP 1 Abstraction – Turbidity at Raw water inlet

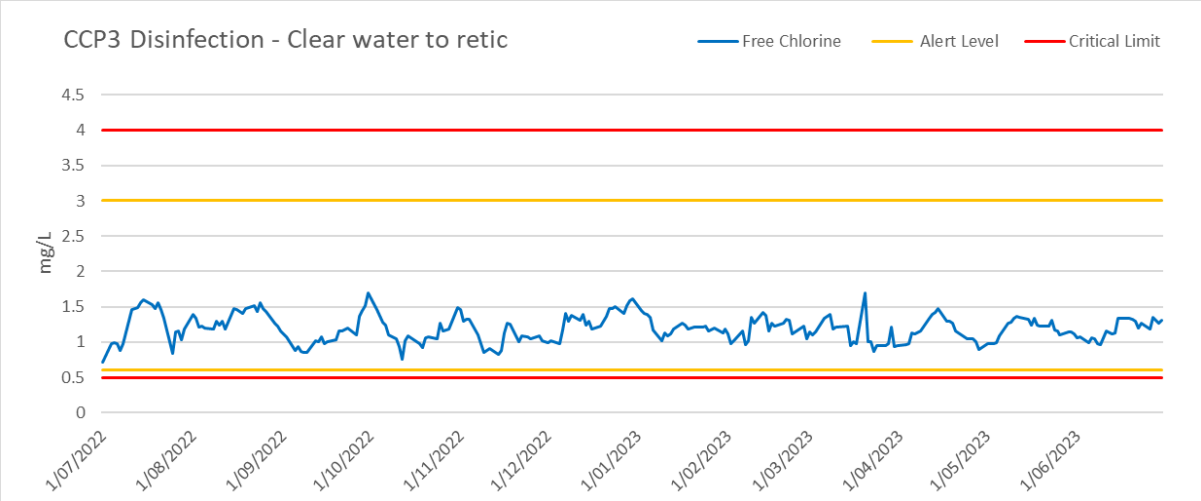

Figure 4.3.3b CCP3 Disinfection – Free Chlorine Clear water to retic

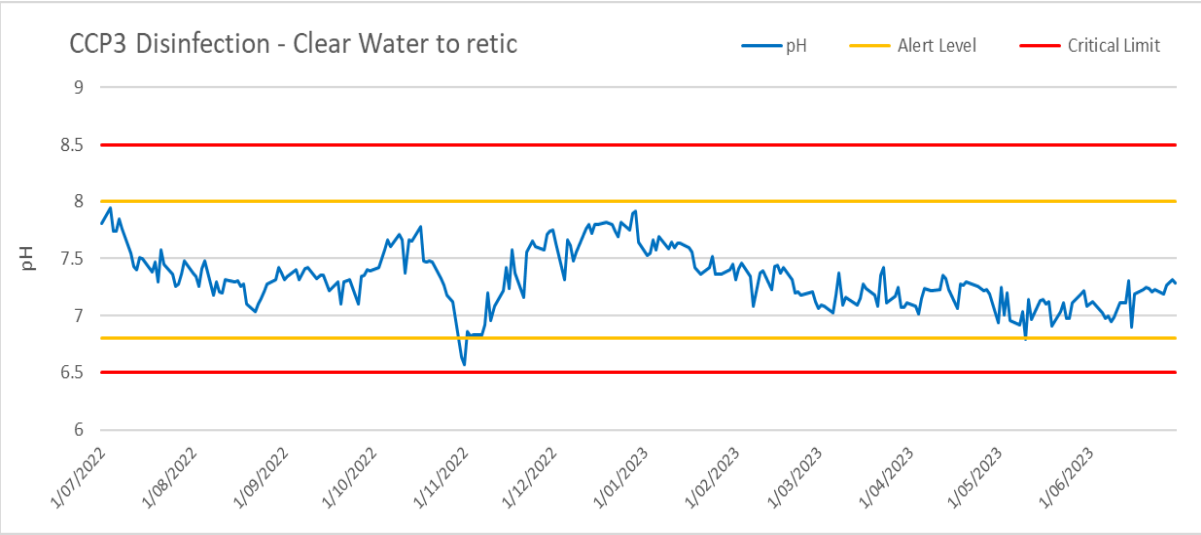

Figure 4.3.3c CCP3 Disinfection – pH Clear water to retic

No Critical Limit exceptions occurred in the Hat Head supply during the 2022-2023 reporting year (Table 4.1 and Figures 4.3.3a, 4.3.3b and 4.3.3c).

Three Alert Limits occurred from 751 tests. (Table 4.1 and Figure 4.3.3c).

- CCP3 – Disinfection: pH, <6.8 pH, 3 occurrences
  - 31/10/2022, 6.64 pH & 1/11/2022, 6.57 pH
  - 10/05/2023, 6.79 pH

A break in the soda ash line caused the 2 low pH results on the 31/10/2022 and 1/11/2022; once repaired pH returned to operating targets.

The marginal low pH result on the 10/05/2022 is from instrument variation between operators, pH results the day prior recorded at 7.04 pH and post 7.17 pH.

4.3.4 South West Rocks Supply System

Monitoring data for each of the South West Rocks supply system CCPs is shown in Figures 4.3.4a, 4.3.4b, 4.3.4c, 4.3.4d and 4.3.4e.

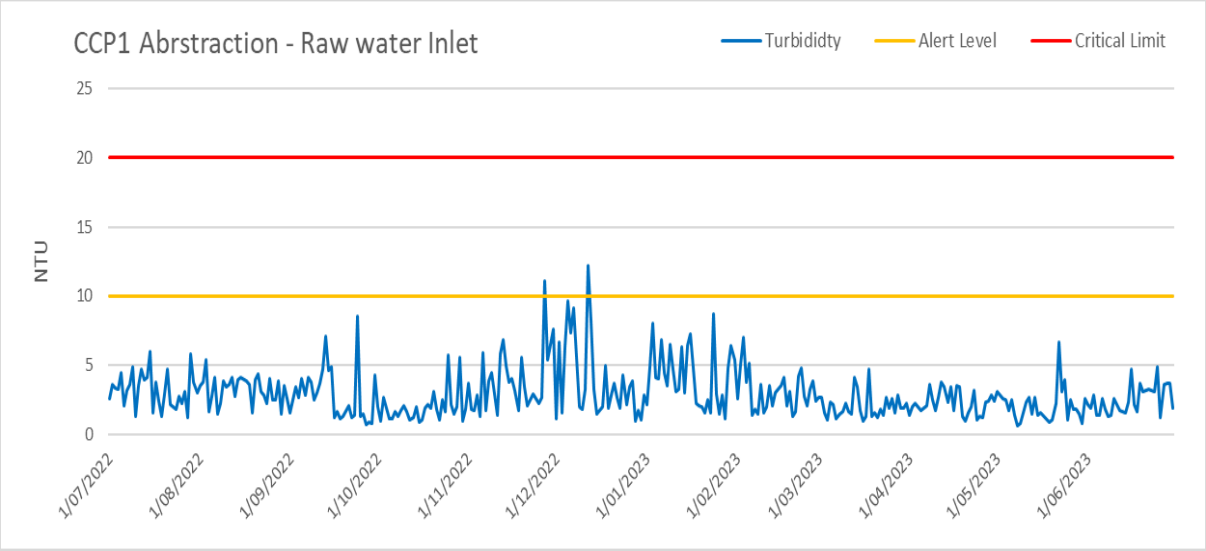

Figure 4.3.4a - CCP 1 Abstraction – Turbidity at Raw water inlet

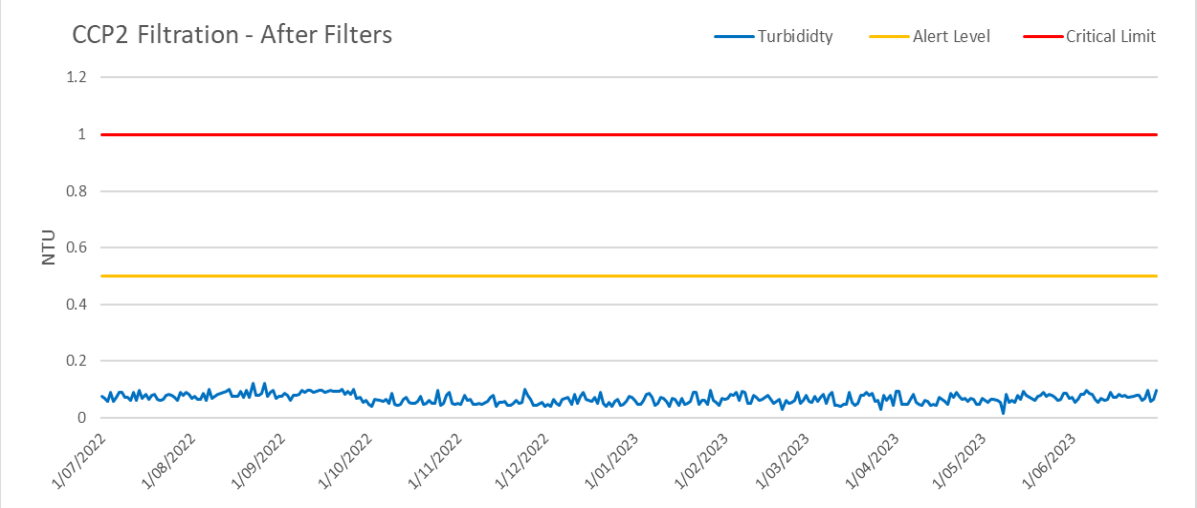

Figure 4.3.4b - CCP 2 Filtration – Turbidity after filters

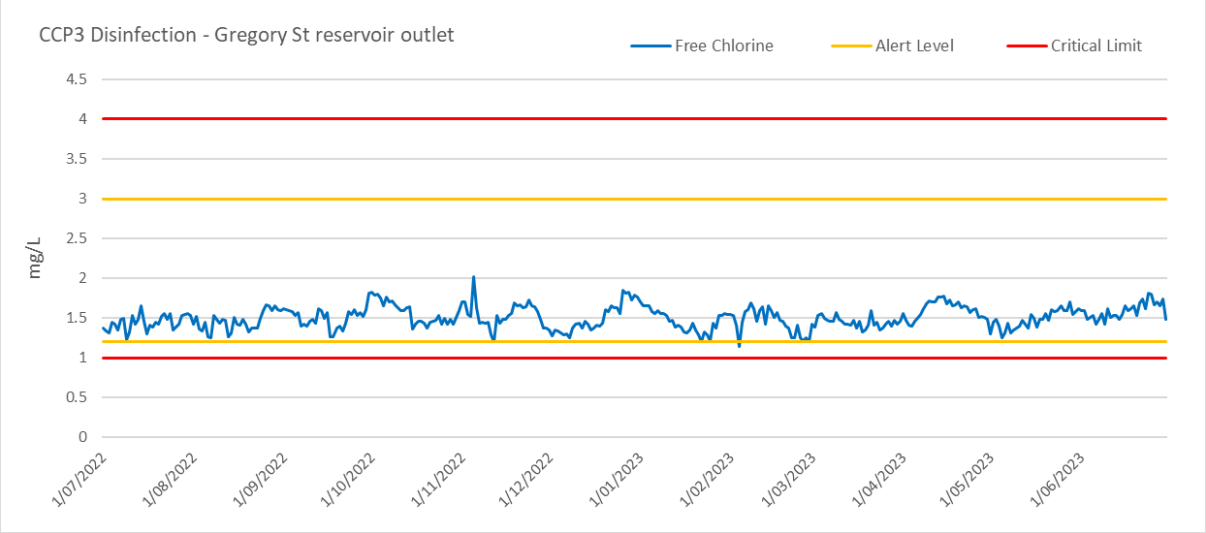

Figure 4.3.4c CCP3 Disinfection – Free Chlorine Gregory Street Reservoir outlet

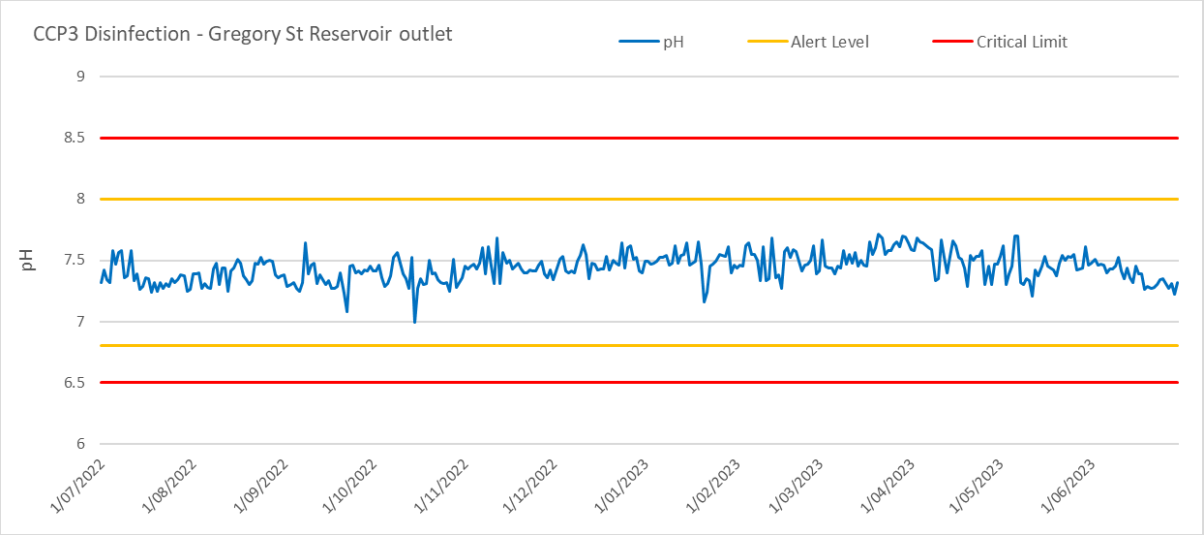

Figure 4.3.4d CCP3 Disinfection – pH Gregory Street Reservoir outlet

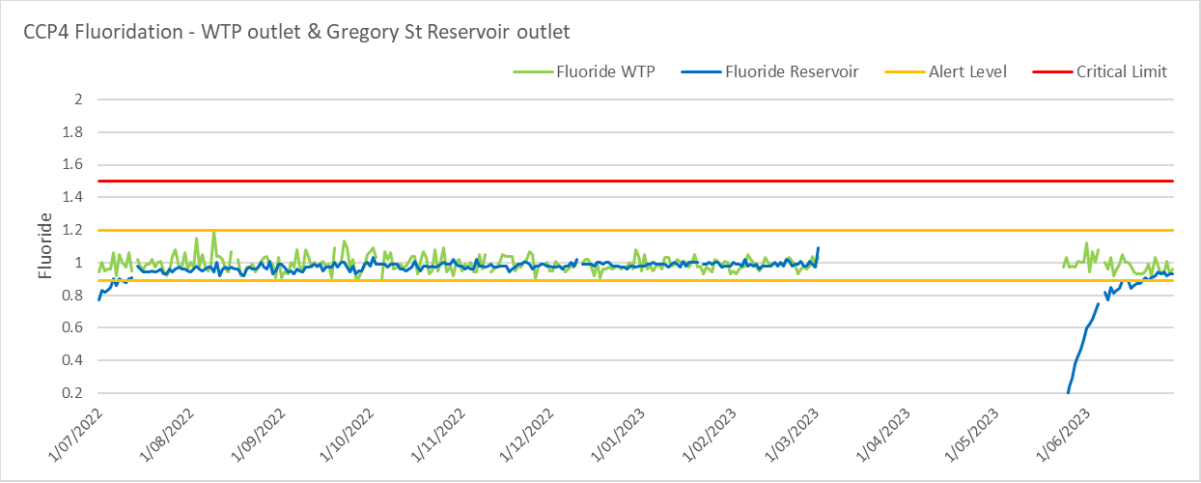

Figure 4.3.4e CCP4 Fluoridation – WTP outlet & Gregory Street Reservoir outlet

No Critical Limits occurred in the South West Rocks supply during the 2022 – 2023 reporting year (Table 4.1 and Figures 4.3.4a, 4.3.4b, 4.3.4c, 4.3.4d and 4.3.4e).

Thirty Alert Level exceptions occurred from 1980 tests. (Table 4.1, Figure 4.4.4a, Figure 4.4.4c and Figure 4.4.4e)

- CCP1 – Abstraction: turbidity > 10 NTU, 2 occurrences
    - 27/11/2022, 11.1 NTU
    - 12/12/2022, 12.2 NTU

Both turbidity Alert Levels were due to an increase of flow from the borefield to the WTP to accommodate increased water demand. The increased flow descaled sediment build up within the raw water pipeline. No break through occurred; the increased turbidity was filtered out at the membrane filter barrier (CCP2, Figure 4.4.4b).

- CCP3 – Disinfection: free chlorine <1.2 mg/L, 1 occurrence
    - 4/02/2023, 1.14 mg/L

The marginal low Alert Level free chlorine result is attributed to the degassing of the chlorine dosing pumps at the WTP for routine maintenance. Dosing rate was increased, and system retuned to operation targets with 24hrs.

- CCP4 – Fluoride: Fluoride <0.9 mg/L, 27 occurrences
    - 1/07/2022 to 5/07/2022, 5 events of <0.9mg/L
    - 27/05/2023 to 20/06/2023, 22 events of <0.9 mg/L

The 5 low fluoride results in early July are a carryover form the 2021-2022 report year from a solenoid failure at the fluoride batch tank on the 4th June 2022. Fluoridation resumed on the 17th June. Fluoride levels remained <0.9 mg/L until early July 2023 due the combination of fluoride dilution into the large volume of receiving water stored in Gregory Street reservoir and lower demands during winter which delayed the turnover of the reservoir.

A coupling failure on the fluoride dosing pump occurred on the 3rd March 2023. Form 5 notification to NSW Health was sent on 5th March 2023 for the system not dosing for >24 hrs. Logistic delays on the replacement parts halted repair until the 24th May 2023. CCP4 testing at the Gregory Street reservoir outlet resumed on the 25th May 2023 with fluoride concentrations not returning to >0.9 mg/L until the 21st June 2023 due to dilution impacts of large volume of receiving water stored in the reservoir and lower water demands during winter which delayed the turnover of Gregory Street reservoir. NSW Health was notified via email on 25th May on the recommencement of fluoridation and the expected time frame of fluoride operation targets being met.

4.3.5 Stuarts Point Supply System

Monitoring data for each of the Stuarts Point supply systems CCPs is shown in Figures 4.3.5a, 4.3.5b and 4.3.5c.

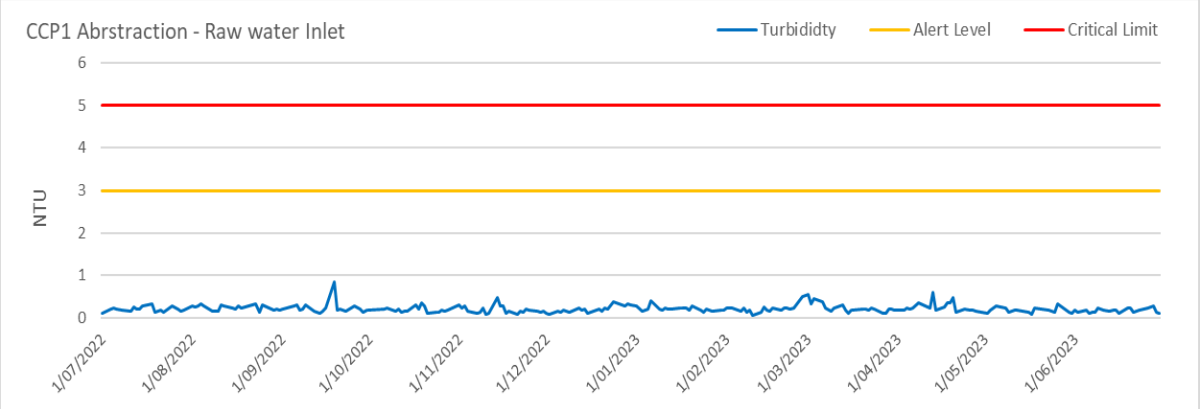

Figure 4.3.5a - CCP 1 Abstraction – Turbidity at Raw water inlet

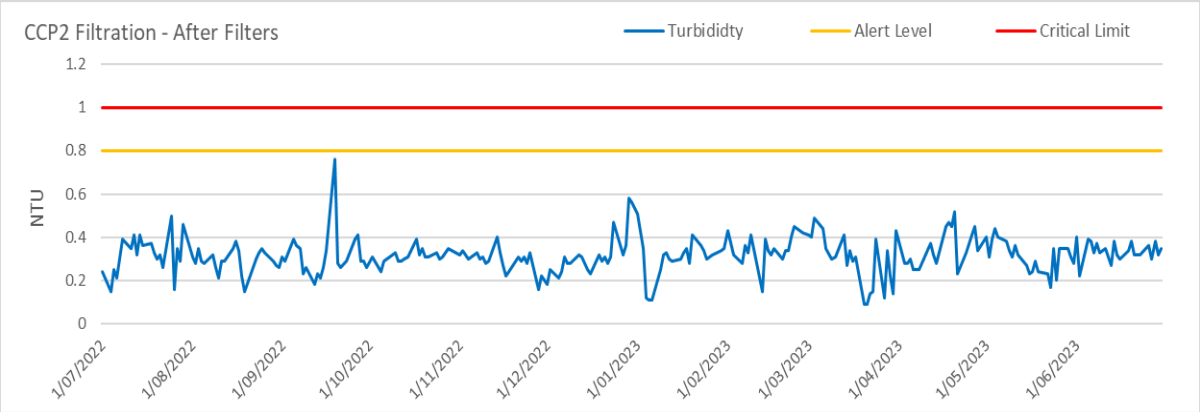

Figure 4.3.5b - CCP 2 Filtration – Turbidity after filters

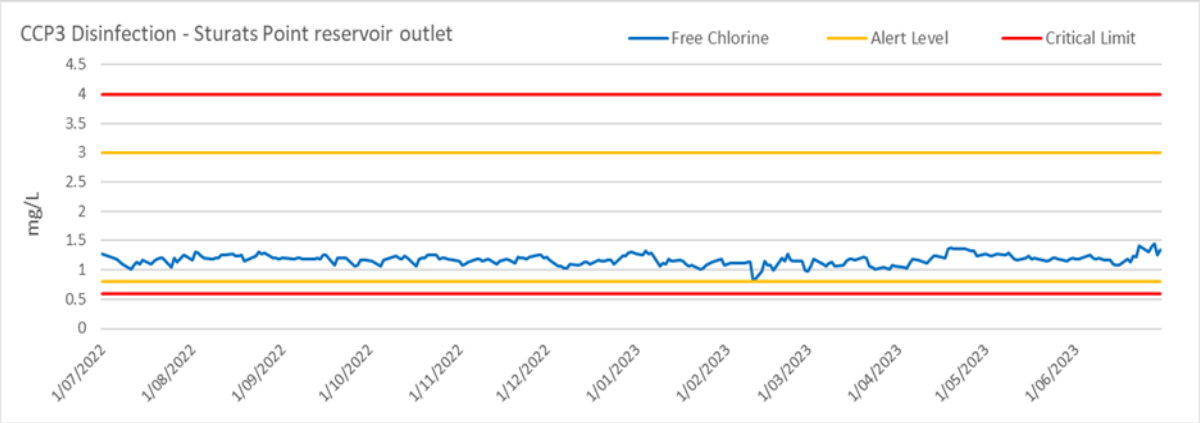

Figure 4.3.5c CCP3 Disinfection – Free Chlorine Gregory Street Reservoir outlet

No Critical Limit or Alert Level exceptions occurred in the Stuarts Point supply during the 2022-2023 reporting year (Table 4.1 and Figures 4.3.5a, 4.3.5b and 4.3.5c). This supply has not recorded any exceptions for the past 5 reporting years.

4.3.6 Willawarrin Supply System

Monitoring data for each of the Willawarrin supply systems CCPs is shown in Figures 4.3.6a, 4.3.6b and 4.3.6c. Water carting to this supply is from KLM, this occurs intermittently during wet weather events when source water quality degrades outside of operational targets.

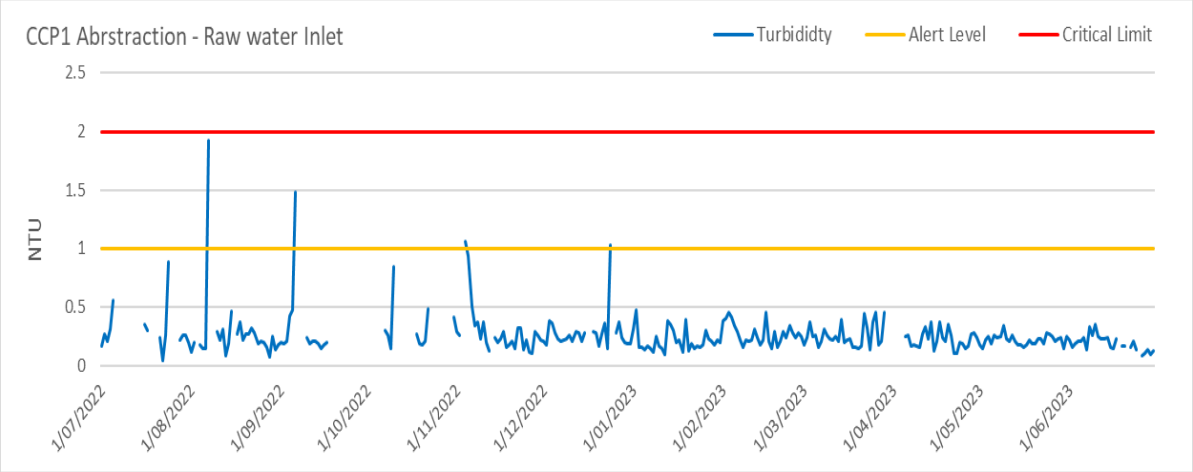

Figure 4.3.6a - CCP 1 Abstraction – Turbidity at Raw water inlet

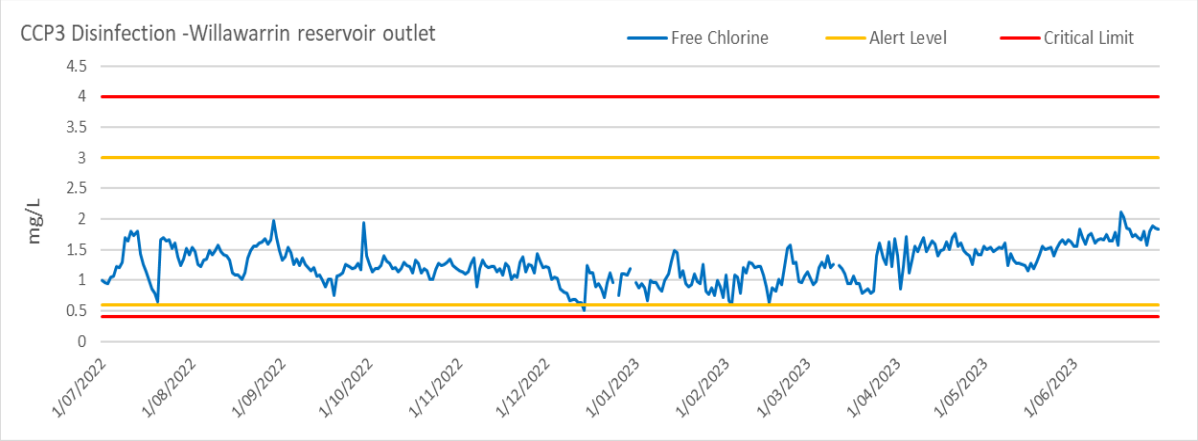

Figure 4.3.6b CCP3 Disinfection – Free Chlorine Willawarrin Reservoir outlet

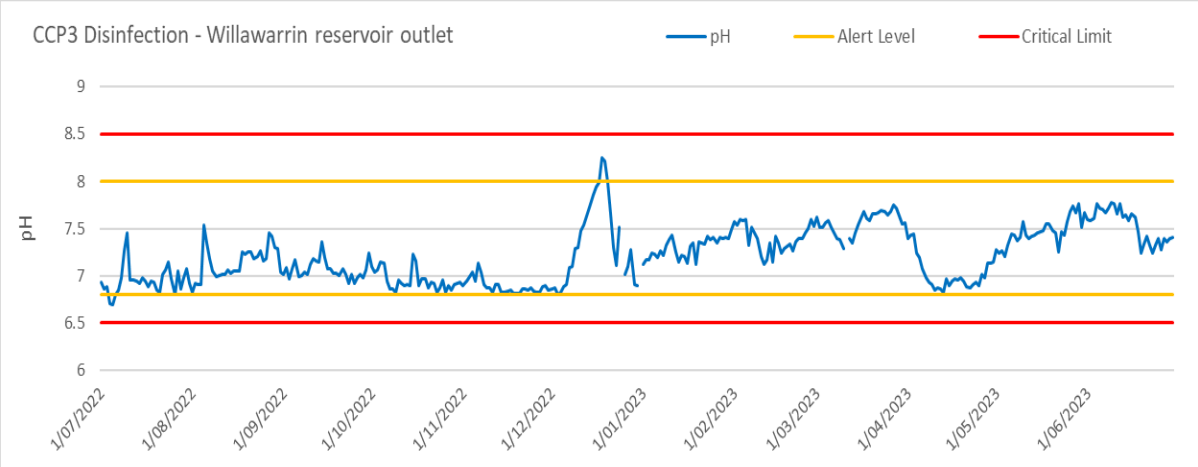

Figure 4.3.6c CCP3 Disinfection – pH Willawarrin Reservoir outlet

No Critical Limit exceptions occurred in the Willawarrin supply during the 2022-2023 reporting year (Table 4.1 and Figures 4.3.6a, 4.3.6b and 4.3.6c). This is a significant decrease from the 30 recorded Critical Limits events reported on in the previous year (KSC 2021-2022).

Nine Alert Level CCP exceptions occurred from 1002 tests (Table 4.1 and Figures 4.3.6b and 4.3.6c)

- CCP1 – Abstraction: Turbidity >1 NTU, 4 occurrences

- 7/8/2022, 1.92 NTU
- 6/9/2022, 1.48 TU
- 4/11/2022, 1.06 NTU
- 24/12/2022, 1.03 NTU

All CCP1 Alert Level turbidity exceptions were the result of wet weather events where the river source water increases in turbidity. Standard operational procedures of isolation, monitoring of source water and when applicable over extended periods of wet water supplementary water carting to the supply.

- CCP3 – Disinfection: Free Chlorine < 0.6 mg/L, 1 occurrence
  - 14/12/2022, 0.51 mg/L

A fault with the dosing pump caused this low Alert Level CCP3 exception. Rectifying actions involved a system reset, degassing of the line and a calculated slug dosed of 700mL of sodium hypochlorite to increase free chlorine residuals leaving the reservoir.

- CCP3 – Disinfection: pH <6.8 pH, 2 occurrences & pH >8.0 pH, 2 occurrences
  - 4/07/2022, 6.71 pH & 5/07/2022, 6.69 pH
  - 18/12/2022, 8.25 pH & 19/12/2022, 8.22 pH

The 2 low pH Alert Levels exceptions were caused from an electrical fault to the peristaltic pump. Once repaired and a slight increase in dosing rates, the system returned to operational targets on the 6th July.

The 2 high Alert Level pH exceptions are linked to the low free chlorine CCP reported on the 14/12/2022. Along with the actions to rectify the low free chlorine the pH dose rate was also increased. Over the next 3 days pH gradually rose, the opportunity to the reset pH dose rate when a CCP result of 7.99 pH on 17/12/2022 was missed; the first of the 2 exceptions was recorded on the 18/12/2022 this is when the dose rate was adjusted, and further adjustments made on the 19/12/2022.

4.3.7 Bellbrook Supply System

Monitoring data for each of the Bellbrook supply system CCPs is shown in Figures 4.6.7a, 4.6.7b, 4.6.7c and 4.6.7d. Water carting to this supply is from KLM, this occurs intermittently during wet weather events when source water quality degrades outside of operational targets.

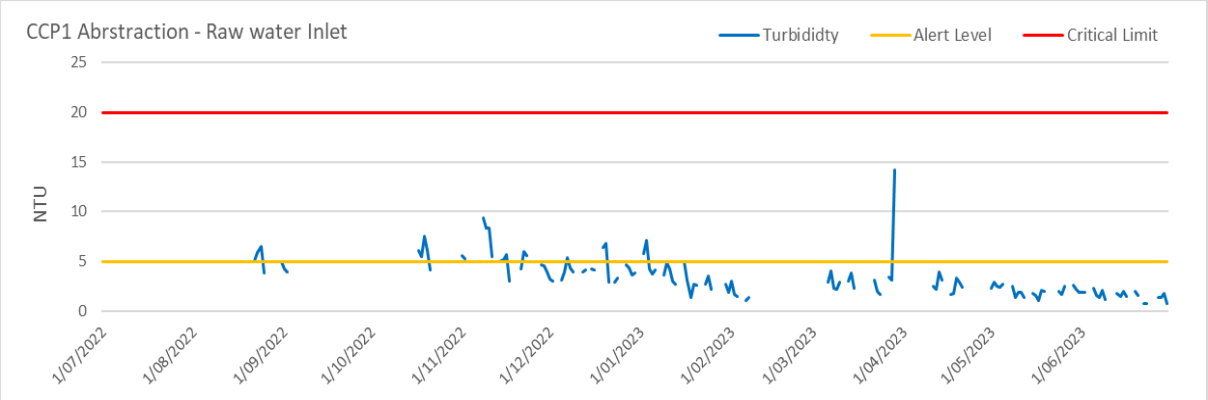

Figure 4.3.7a - CCP 1 Abstraction – Turbidity at Raw water inlet

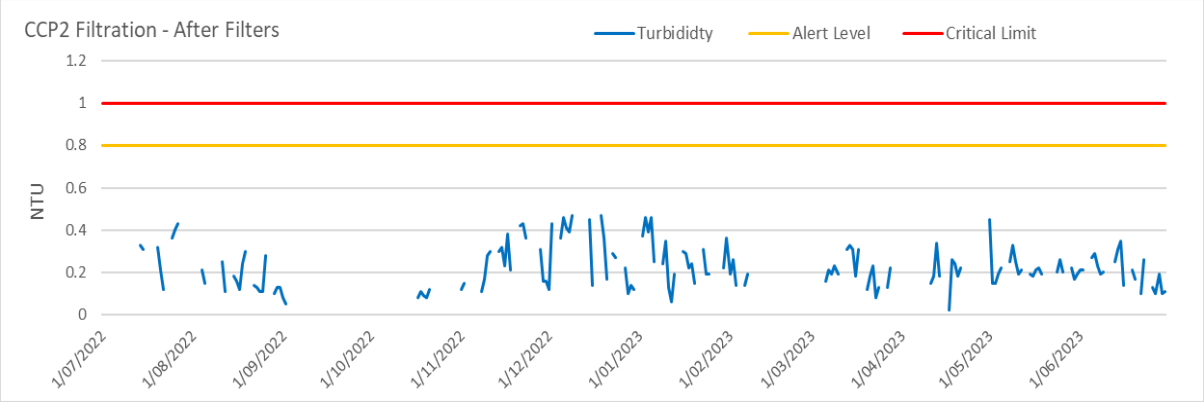

Figure 4.3.7b - CCP 2 Filtration – Turbidity after filters

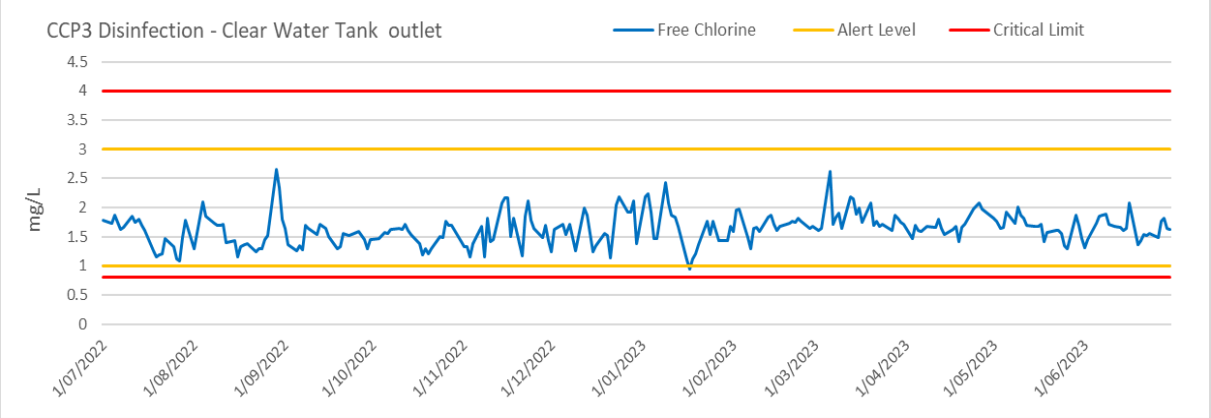

Figure 4.3.7c - CCP3 Disinfection – Free Chlorine Clear water tank outlet

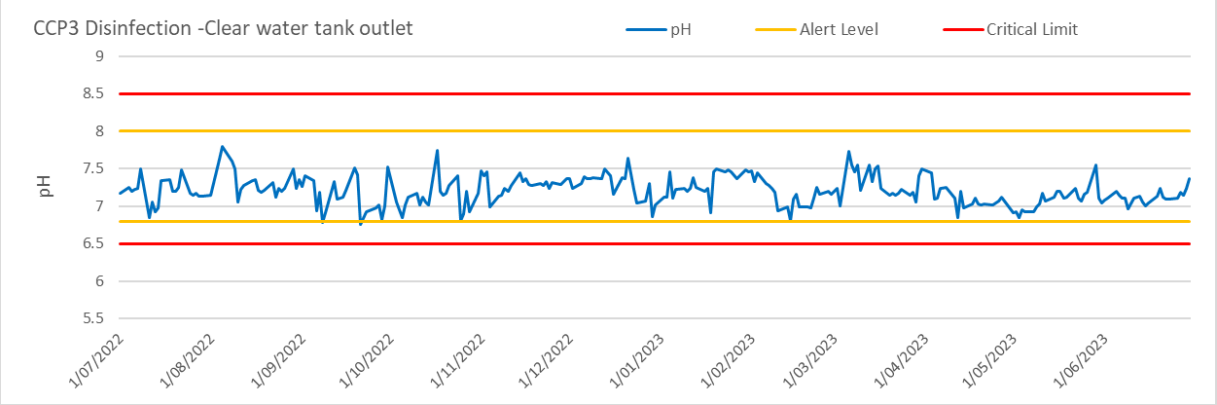

Figure 4.6.7d CCP3 Disinfection – pH Clear water tank outlet

No Critical Limit exceptions occurred in the Bellbrook supply during 2022-2023 reporting year. (Table 4.1 and Figures 4.3.7a, 4.3.7b & 4.3.7c).

Four Alert Level CCP exceptions occurred from 701 tests (Table 4.1 and Figures 4.3.7a and 4.3.6b)

- CCP1 – Abstraction: Turbidity >10 NTU, 3 occurrences
  - 15/08/2022, 11.6 NTU & 17/08/2022, 10.1 NTU
  - 29/03/2023, 14.2 NTU

All CCP1 Alert Level turbidity exceptions were the result of wet weather events where the river source water increases in turbidity. Standard operational procedures of isolation, monitoring of

source water and when applicable over extended periods of wet water supplementary water carting to the supply.

- CCP3 – Disinfection: Free Chlorine <1.0 mg/L, 1 occurrence
    - 17/01/2023, 0.94 mg/L

No direct underlying cause was found for the marginal low free chlorine result, corrective actions to increase free chlorine residuals included a fresh batch of sodium hypochlorite and a slight increase to the dosing rate. This return the CCP back to operational targets within a few hours.

4.3.8 Thunggutti Supply System

Monitoring data for the Thunggutti supply system CCPs is shown in Figures 4.3.8a, 4.3.8b and 4.3.8c.

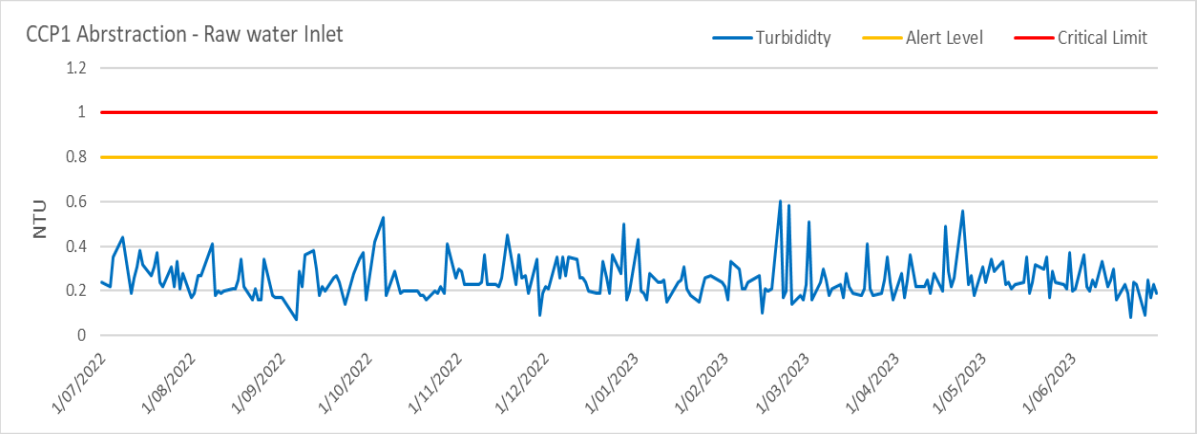

Figure 4.3.8a - CCP 1 Abstraction – Turbidity at Raw water inlet

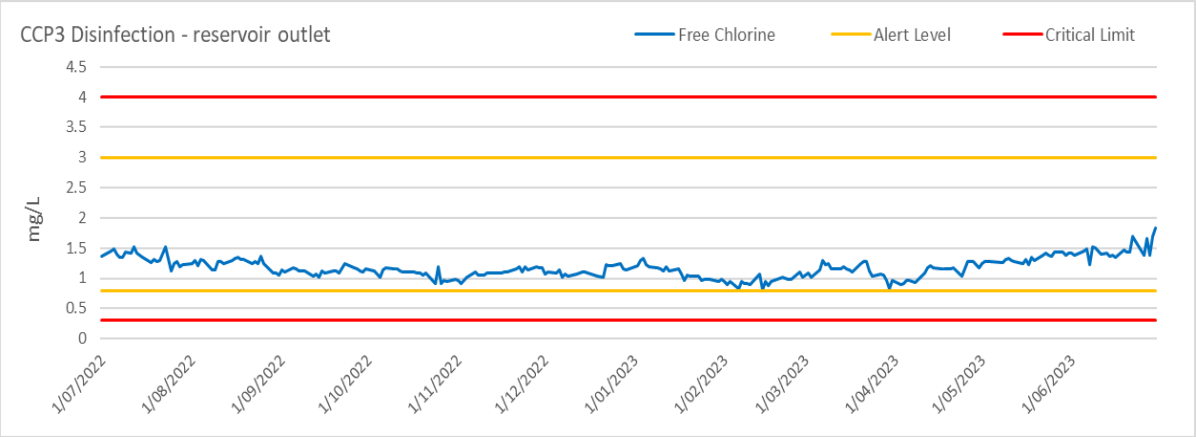

Figure 4.3.8b - CCP3 Disinfection – Free Chlorine Thunggutti Reservoir outlet

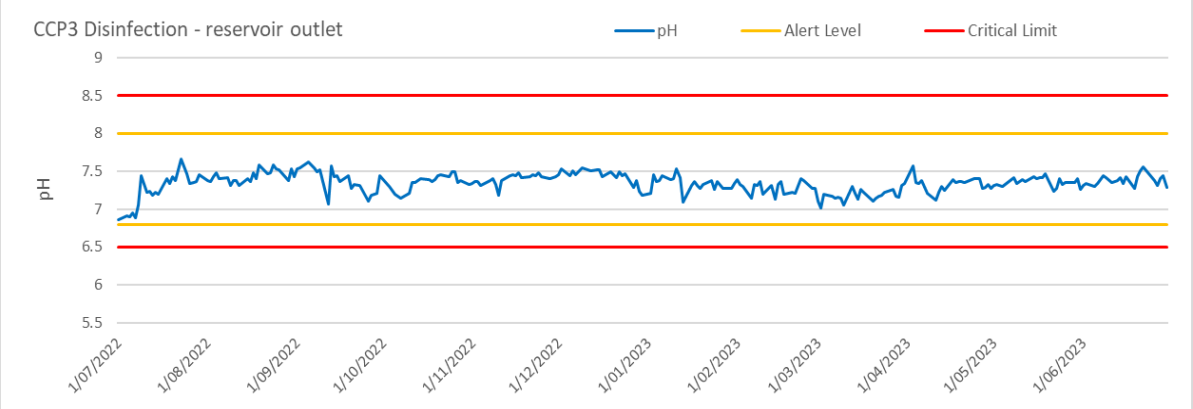

Figure 4.3.8c - CCP3 Disinfection – Free Chlorine Thunggutti Reservoir outlet

No Critical Limit or Alert Level exceptions occurred in the Thunggutti supply during the 2022-2023 reporting year (Table 4.1 and Figures 4.3.8a, 4.3.8b and 4.3.8c).

5. Reservoir Inspections

Council has fifteen (15) above ground storage reservoirs and manages two (2) reservoirs in the Thunggutti supply as part of the NSW ACWSP. Maintaining Reservoir integrity is included as a CCP for each of Councils water supplies, as this is the last point of contact with the water where control can be affected prior to the network. Maintaining reservoir integrity is critical to a water supply system, to ensure that no contaminants, such as vermin, stormwater, or bird faeces, can freely access the treated stored water. Cleaning and inspection of the reservoirs is crucial to ensure that water quality is not compromised.

5.1 Data Collection and Monitoring

Councils' reservoirs are inspected monthly by operational staff who complete the "Reservoir Inspection Check List" that is a function of the WaterOutlook program. Any reported issues trigger email notification to the Water Management Team. Tracking of completed inspections can be viewed in a generated "Reservoir Inspection" report which also provides a link to the physical report via individual report batch number. Any breach of integrity detected during Monthly Inspections would be reported as a CCP Critical Limit exception and reported to the local PHU.

Reservoirs are also inspected by contractors on a 2-yearly rotation. (previously every 3 years), (Thunggutti yearly) for cleaning and detailed internal and external integrity inspections. These findings are collated, reported, and tracked within the contractor's web database "ASAM RT."

5.2 Reporting

No breaches of integrity were detected during inhouse monthly CCP reservoir inspections.

Nine reservoirs (John Lane, Potters Hill, Clybucca, Hat Head reservoir 2, Stuarts Point, Willawarrin, Bellbrook, and Thunggutti reservoirs 1 and 2) have been clean and inspected by external contractors during this reporting period.

Table 5.1 provides programmed schedule for Councils external contractors and inspection program.

Table 5.1 Reservoir Schedule for external contractor inspections and cleaning

Reservoir	Report Year last inspected	Date Last Inspected & cleaned	Next Due Date Inspection & clean	Comments
Kempsey - Lower Macleay Supply				
Green Hill	2017-2018	12/02/2018*	12/02/2020	Overdue - Unable to complete internal inspections or cleans due to safety concerns
John Lane	2022-2023	04/10/2022	01/10/2024	
Potters Hill	2022-2023	08/10/2022	08/10/2024	
Billy Goat Hill	2018-2019	26/10/2018	26/10/2022	Scheduled for 29/11/2023
Frederickton	2018-2019	26/10/2018	26/10/2022	Scheduled for 29/11/2023 after refurbishment completed
Clybucca	2022-2023	06/10/2022	06/10/2024	
Crescent Head Supply				
Back Beach	2021-2022	25/10/2021	25/10/2023	Scheduled for 29/11/2023
Big Nobby	2021-2022	15/11/2021	15/11/2025	
Hat Head				
Reservoir 1	2021-2022	28/10/2021	28/10/2023	
Reservoir 2	2022-2023	07/10/2022	07/10/2024	
South West Rocks Supply				
Gregory Street	2021-2022	29/10/2021	29/10/2023	
New Entrance	2021-2022	27/10/2021	27/10/2023	
Stuarts Point Supply				
Stuarts Point	2022-2023	06/10/2022	06/10/2024	Major refurbishment completed in Sept 2022
Willawarrin Supply				
Willawarrin	2022-2023	05/10/2022	05/10/2024	
Bellbrook Supply				
Bellbrook	2022-2023	05/10/2022	05/10/2024	
Thunggutti				
Reservoir 1	2022-2023	05/10/2022	05/10/2023	
Reservoir 2	2022-2023	05/10/2022	05/10/2024	

*External inspection only

6. Water Quality Verification

The Australian Drinking Water Guidelines (ADWG) (NHMRC 2011) provide an authoritative reference that defines what is safe and good water quality and how this can be achieved and assured, using the latest and best available scientific evidence. The ADWG provide detailed information on the measurable characteristics of drinking water, including microbiological, physical and chemical aspects, and these are grouped into two different types:

- A **health guideline** value – that is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption.

- An **aesthetic guideline** value – that is the concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, such as, appearance, taste and odour.

Additional Water Quality Indicators (WQI) recommended by NSW Health include Total Coliforms and Free Chlorine residuals.

- A positive Total Coliforms result when used in operational monitoring, may indicate inadequate treatment, breakdowns in system integrity, or the presence of biofilms.
- Low Free Chlorine of <0.2mg/L is an indication that disinfection of the system may be compromised or lost.

Fluoride is monitored as per the Fluoridation Code (NSW Health 2018); an overdosing incident is the result of the fluoride concentration exceeding 1.5 mg/L in the treated water entering the network and operational exceptions (WQI) is defined by any failure to maintain the fluoride concentration above 0.9 mg/L. The ADWG health limit is 1.5 mg/L.

6.1 Data Collection and Monitoring

Council participates in NSW Health's sponsored Drinking Water Monitoring Program; network monitoring is undertaken on a routine basis to ensure that Council's customers receive safe and acceptable water quality.

Council tests drinking water for 32 health and aesthetic parameters, and other recommended WQI characteristics. These samples are taken from 25 sample sites within the Councils area of operation, all of which are post-treatment.

The water quality characteristics that are monitored as part of this program are specified by NSW Health. Council liaises with NSW Health regarding the total number of samples required for each supply system and the frequency of collection; a yearly sampling schedule is produced by Council to ensure the expected frequency of sampling is met.

Results are recorded in the NSW Drinking Water Database and reported against the ADWG and WQI. A summary of the water quality data for each supply system, obtained directly from the NSW Drinking Water Database is provided in Appendix C.

In addition to monitoring undertaken as part of NSW Health's Drinking Water Monitoring Program, Council also independently monitors water quality parameters as part of our daily operations (pre- and post-treatment in each water supply system). Results are recorded within WaterOutlook for each supply.

6.2 Non-Compliant data

For the NSW Health sponsored monitoring, NSW Forensic & Analytical Science Services (FASS) Laboratory advises Council via email of any ADWG health and/or WQI guideline limit exceptions including positive results for microbiological tests (Total Coliforms and E. coli). Upon receiving email notification Council performs an internal investigation that involves confirmation of water quality at the exception location and from the supply reservoir, checking for potential sources of contamination i.e., breaks and repairs and if required a flush of mains. A resample is collected for confirmational laboratory analysis, and the local PHU is notified (initial phone call and follow up emails).

The WaterOutlook application triggers an alert for anomalies found outside of the ADWG and WQI in relation to the daily operations monitoring. Water Operators complete a report within WaterOutlook (cause, action, preventive measures) with email notification sent to the Water Management Team. Monthly ADGW/WQI reports are produced within WaterOutlook that tabulates results into the system that they occurred, providing a monthly total with a running "year to date" totals for each supply. External communication to the local PHU of daily results is limited to the Annual DWMS Water Quality report or if there is a gross and/or consistent exceedance.

6.3 Reporting

Twenty-two ADWG and WQI exceptions across both reporting platforms were recorded across Councils water supply systems (Figure 6). The ADWG and WQI non-compliant results are discussed in the supply systems in which they occurred with reference to Figure 6, Tables 6.1 and 6.2 and Appendix C.

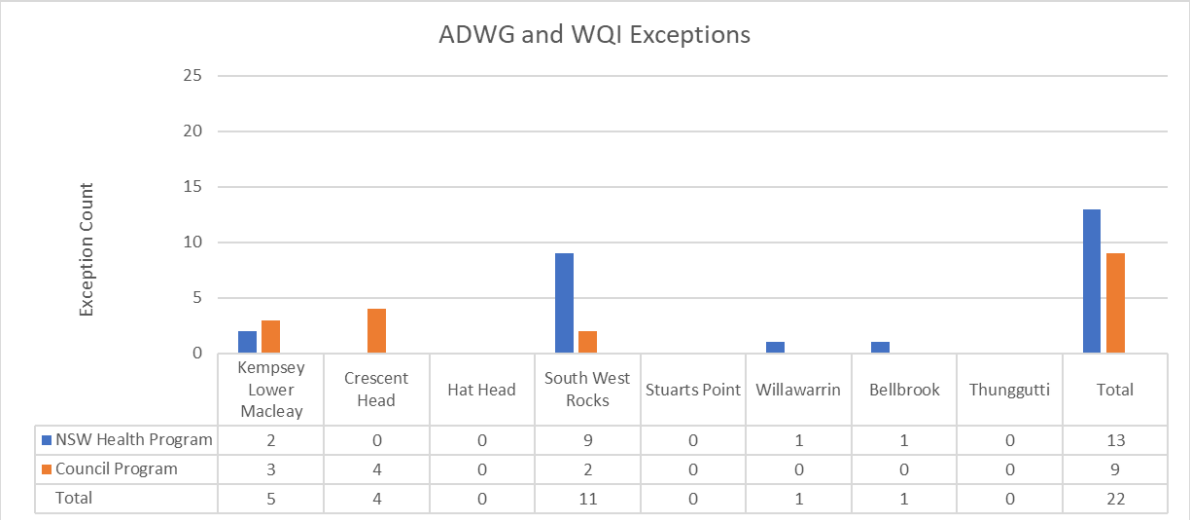

Figure 6: Total ADWG and WQI exception 2022-2023

Table 6.1 ADWG and WQI non-compliances - NSW Health sponsored monitoring program

KEMPSEY Shire Council	ADWG and WQI non-compliances - NSW Health Sponsored Monitoring Program						
	Total Coliforms *	Free Chlorine**	pH	Turbidity	Fluoride ***	Nickel	Total
Supply Area	No detection (WQI)	< 0.2 mg/L (WQI)	< 6.5 – > 8.5 (A)	>5 NTU (A)	<0.9 - >1.2 mg/L (WQI)	> 0.02 mg/L (H)	
Kempsey & Lower Macleay	0	0	1	0		1	**2**
Crescent Head	0	0	0	0		0	**0**
Hat Head	0	0	0	0		0	**0**
South West Rocks	0	0	0	0	9	0	**9**
Stuarts Point	0	0	0	0		0	**0**
Willawarrin	0	0	0	0		1	**1**
Bellbrook	0	0	0	0		1	**1**
Thunggutti	0	0	0	0		0	**0**
Combined Total	**0**	**0**	**1**	**0**	**9**	**3**	**13**

*Total Coliform no ADWG set however a positive result is an indicator for further investigation.
**Free Chorine no minimum ADWG set however minimum level of 0.2 mg/L recommend for maintaining disinfection.
*** Fluoride levels based on Fluoride code (WQI); Health ADWG set at >1.5 mg/L
A – Aesthetic ADWG
H - Health ADWG
WQI – No ADWG available, reporting value are based on best practice or codes of practice

Table 6.2 ADWG and WQI non-compliances - Operational monitoring program

Supply Systems ADWG and Water Quality Indicators Exceptions for YTD (Reported from July 2022 to June 2023) 01 Jun 2023 - 30 Jun 2023 Report run date: Friday, 14 July 2023									
		WO Captured Parameters							
	Operational Sheets Supply System	Chlorine (Free)* (WQI)	Chlorine (Total) (H)	pH (A)	Turbidity (A)	Fluoride** (WQI/H)	Iron (A)	Manganese*** (A/H)	Combined Total
Kempsey & Lower Macleay	Number of Exceedances	0	0	3	0		0	0	3
	Number of Tests	2171	2498	2168	2535		0	0	9372
	Rate of Exceedance	0%	0%	0.14%	0%		0%	0%	0.03%
Crescent Head	Number of Exceedances	1	0	0	0		3	0	4
	Number of Tests	749	1112	749	1110		73	45	3838
	Rate of Exceedance	0.13%	0%	0%	0%		4.11%	0%	0.10%
Hat Head	Number of Exceedances	0	0	0	0		0	0	0
	Number of Tests	150	489	239	488		21	13	1400
	Rate of Exceedance	0%	0%	0%	0%		0%	0%	0%
South West Rocks	Number of Exceedances	0	0	0	0	2	0	0	2
	Number of Tests	616	977	615	977	56	28	19	3288
	Rate of Exceedance	0%	0%	0%	0%	3.57%	0%	0%	0.06%
Stuarts Point	Number of Exceedances	0	0	0	0		0	0	0
	Number of Tests	254	506	506	506		15	14	1801
	Rate of Exceedance	0%	0%	0%	0%		0%	0%	0%
Willawarrin	Number of Exceedances	0	0	0	0		0	0	0
	Number of Tests	66	428	66	427		7	7	1001
	Rate of Exceedance	0%	0%	0%	0%		0%	0%	0%
Bellbrook	Number of Exceedances	0	0	0	0		0	0	0
	Number of Tests	280	280	280	279		7	6	1132
	Rate of Exceedance	0%	0%	0%	0%		0%	0%	0%
Thunggutti	Number of Exceedances	0	0	0	0		0	0	0
	Number of Tests	34	288	34	288		7	7	658
	Rate of Exceedance	0%	0%	0%	0%		0%	0%	0%
Totals	**Total number of Exceedances**	**1**	**0**	**3**	**0**	**2**	**3**	**0**	**9**
	Total number of Tests	**4320**	**6578**	**4657**	**6610**	**56**	**158**	**111**	**22490**
	Total rate of Exceedances	**0.02%**	**0%**	**0.06%**	**0%**	**3.57%**	**1.90%**	**0%**	**0.04%**

*Free Chorine no minimum ADWG set however minimum WQI level of 0.2 mg/L recommend for maintaining disinfection.
**Fluoride levels based on Fluoride code; WQI to maintain concentration in supply ≥ 0.9mg/L but <1.2 mg/L (Health ADWG set at 1.5mg/L)
*** Manganese has both Aesthetic and Health ADWG values
A – Aesthetic ADWG
H - Health ADWG
WQI –Guidelines are based on Codes of Practice or recommendations from NSW Health

6.3.1 Kempsey - Lower Macleay (KLM) Supply System

No bacteriological (Total Coliforms or E. coli) exceptions were reported (Table 6.1 and Appendix C: Table C.1); in the KLM supply during 2022-2023.

The KLM supply had 5 ADWG exceptions across both reporting platforms. Four of which were ADWG aesthetic and 1 ADGW health. (Figure 6, Tables, 6.1 and 6.2 and Appendix C; Table C.1).

- Four pH ADWG aesthetic ≤6.5pH
  - 30/08/2022 at KS01-125 Kinchela St, result of 6.37pH
  - 23/09/2022 at KS01-128 Aldavilla Zone, result of 6.45pH
  - 24/10/2022 at KS01-347 Innes St and KS01-123 Smith St, results of 6.48pH and 6.43pH respectively

KLM intermittently has pH correction challenges. Seasonal increased humidity causes inconsistent product texture that's impacts accuracies in dose delivery and/or mechanical breakdowns suspends the targeted dosing concentrations as commented on in Section 4.3.1. Kempsey Lower Macleay Supply System. Post pH testing across the KLM reticulation after each of the non-conformities

returned results within the ADWG, indicating that the system recovers quickly after corrective actions.

- Single nickel ADWG health >0.02 mg/L
    - 14/03/2023 at KS01-347 Inness St, results of 0.042 mg/L

Nickel resampling was performed on the 28/03/2023, the secondary results (0.015 mg/L) meet the ADWG health limits. Ongoing actions to eliminating potential sources of nickel when sampling in the network has included:

- Replacement of sampling taps to a brass composite with a lower nickel content.
- Consultation with NSW Health in sample methodology changes. Sampling chemistry before Microbiology to reduce delamination of nickel (and other chemicals) from potential over heating tap fixtures during microbiological disinfection protocols.

6.3.2 Crescent Head Supply System

No bacteriological (Total Coliforms or E. coli) exceptions were reported (Table 6.1 and Appendix C: Table C.2); in the Crescent Head supply during 2022-2023.

This supply recorded 3 ADWG aesthetic exceptions and a single WQI exception. All exceptions were reported from Councils monitoring program. (Figure 6 and Table 6.2).

- One free chlorine WQI <0.2mg/L
    - 24/02/2023 at KS05-121 Community Hall, result of 0.09 mg/L.

This low free chlorine result is linked to a Boil Water Alert that is discussed in Section 7.

- Three total iron ADWG aesthetic >0.3mg/L, all occurring at the Back Beach reservoir outlet
    - 17/11/2023, result of 0.36 mg/L.
    - 18/11/2023, result of 0.36 mg/L.
    - 23/11/2023, result of 0.31 mg/L.

The marginal ADWG aesthetic total iron exceptions in November coincided with the end of life of the geo bag that is used as an iron reduction method to combat the naturally high iron concentrations in the source water. Council increased chlorine dosing to help the oxidisation of iron and to ensure disinfection was maintained across the supply. Testing in the reticulation confirmed disinfection was maintained and no iron breakthrough occurred. The geo bag was replaced on the 23/11/2023, iron results returned within ADWG parameters on the 24/11/2023.

6.3.3 Hat Head Supply System

No bacteriological (Total Coliforms or E. coli) exceptions or chemistry exceptions were reported in the Hat Head supply during 2022-2023. (Figure 6, Tables 6.1 and 6.2 and Appendix C: Table C.3).

6.3.4 South West Rocks Supply System

No bacteriological (Total Coliforms or E. coli) exceptions were reported (Table 6.1 and Appendix C: Table C.2); in the South West Supply during 2022-2023.

Eleven Fluoride WQI exceptions were reported from both reporting platforms. Two via operational monitoring and 9 from the NSW Health Fluoride operational monitoring protocols. (Figure 6, Tables 6.1 and 6.2 and Appendix C: Table C.4)

- Two Fluoride WQI <0.9 mg/L (Operational monitoring)
    - 05/07/2022 at KS07-123 New Entrance (0.76 mg/L) & KS07-126 Little Bay (0.7 mg/L)

The 2 above low fluoride WQI results are a follow on from an CCP4 alert level that occurred at the tail end of the 2021-2022 reporting year when the fluoride dosing system was turn off. The non-operational status of the fluoride system lowered fluoride concentrations in the reticulation. When fluoride dosing recommenced on the 17th June 2022, it took 3 weeks for fluoride concentrations to return to ≥0.9 mg/L. Additional detail of this event is discussed in Sections 4.3.4. South West Rocks Supply Systems.

- Nine Fluoride WQI <0.9mg/L (Form 4, weekly 2-point fluoride monitoring)
    - 01/06/2023 at KS07-125 Water Treatment Plant (0.52mg/L) & KS07-127 Little Bay (0.56mg/L
    - 08/06/2023 at KS07-124 The Boatshed (0.51 mg/L) & KS07-122 Horseshoe Bay (0.72 mg/L)
    - 13/06/2023 at KS07-126 Little Bay (0.81 mg/L) & KS07-123 New Entrance (0.84 mg/L)
    - 22/7/06/2023 at KS07-124 The Boatshed (0.77mg/L) & KS07-121 Primary School (0.88 mg/L)
    - 26/06/2023 at KS07-128 Cardwell St (0.89 mg/L)

The 9 low fluoride WQI results are a linked to the June 2023 CCP4 alert level as discussed in Section 4.3.4 South West Rocks Supply Systems. The non-operational status of the fluoride system lowered fluoride concentrations in the reticulation. When testing recommenced, it took 3 weeks for fluoride concentrations to return to >0.9 mg/L.

6.3.5 Stuarts Point Supply System

No bacteriological (Total Coliforms or E. coli) exceptions or chemistry exceptions were reported in the Stuarts Pont supply during 2022-2023. (Figure 6, Tables 6.1 and 6.1 and Appendix C: Table C.5).

6.3.6 Willawarrin Supply System

No bacteriological (Total Coliforms or E. coli) exceptions were reported in the Willawarrin supply during 2022-2023 (Table 6.1 and Appendix C: Table C.6).

A single ADWG health exception was reported from the NSW Health monitoring program (Figure 6, Tables 6.1 and Appendix C: Table C.6).

- Nickel ADWG health >0.02mg/L
    - 07/03/2023 at KS04-122 St Thomas Church, result of 0.0512 mg/L.

Nickel resampling was performed on the 21/03/2023, the secondary results (0.0199 mg/L) met the ADWG health limit. Commentary on re-occurring Nickel events is outlined in the discussion of 6.3.1 Kempsey-Lower Macleay Supply System.

6.3.7 Bellbrook Supply System

No bacteriological (Total Coliforms or E. coli) exceptions were reported (Table 6.1 and Appendix C: Table C.7); in the Bellbrook supply during 2022-2023.

A single ADWG health exception was reported from the NSW Health monitoring program (Figure 6, Table 6.1 and Appendix C: Table C.7).

- Nickel ADWG health >0.02mg/L
    - 04/04/2023 at KS03-121 St James Church, result of 0.0299 mg/L.

Nickel resampling was performed on the 18/04/2023, the secondary results (<0.0004 mg/L) meet the ADWG health limit. Commentary on re-occurring Nickel events is outlined in the discussion of 6.3.1 Kempsey-Lower Macleay Supply System.

6.3.8 Thunggutti Supply System

No bacteriological (Total Coliforms or E. coli) exceptions or chemistry exceptions were reported in the Thunggutti supply during 2022-2023. (Figure 6, Tables 6.1 and 6.1 and Appendix C: Table C.8).

The Thunggutti supply is a part of the ACWSP overseen by DPE, water quality is reported on at the quarterly meetings; This program is further discussed in section 9.2 Aboriginal Communities Water and Sewer Program.

7. Water Quality Incident or Emergency

A water quality incident or emergency is an event where a controlled response is required to ensure that Council continues to protect public health. Although preventative strategies, such as CCP SOPs have been developed by Council, some events cannot be anticipated or controlled.

Councils Drinking Water Quality Incident Response and Reporting Plan (DWQIRRP) ensures these events have a managed response to ensure the incident is responded to fast and adequately. This includes timely notification to the local PHU and other stakeholders, along with corrective actions to return the system to normal operation. Investigations and a debrief occur following the event, and preventative actions are implemented to reduce the risk of the event re-occurring.

Council recorded 5 Critical Limits in 3 separate incidents for this reporting period, these are summarised in Table 7.1.

Table 7.1 Water Quality Incident or Emergency Summary

Details of incident/emergency	Actions undertaken
November 2022 – Kempsey Lower Macleay Supply Mechanical failure of screw feeder of the pH correction dosing mechanism saw 2 x **low** pH CCP3 Critical Limits. The first critical limit occurred on the 14/11/2022 (6.48 pH) with a secondary Critical limit occurring on the 20/11/2022 (6.34 pH). **Additional Background information** Multiple low Alert level pH exceptions recorded in preceding months due to unidentified ongoing mechanical problems with the agitation mechanisms of the lime dosing systems. This had secondary implications of the lime not remaining in loose powder form.	14/11/2022 – ~06:39 Notification of Critical Limit via WaterOutlook. CCP3 pH Critical Limit SOP followed • Site visit to inspect asset by GMWS, WSOM & TLW • Hopper cleaned out, refilled and drop test performed. 15/11/2022 • 6am Dosing plant inspected by WO, rathole in hopper observed, continued checks throughout the day • Mechanical fitters programmed to complete repair on 17/11/2022 17/11/2022 • Meeting between key water personnel of progress of rectifying measures and chase out outstanding incident reports • Email notification sent to PHU with CCP Critical Limit details and actions undertaken to date

Details of incident/emergency	Actions undertaken
Resulting in ongoing problems of "ratholing" in the delivery hooper due to the lime sticking and/or clumping on the hooper walls causing under dosing. Increased humidity from persistent wet weather additionally affected lime quality Immediately preceding and during this incident **11** Alert Level low pH events were recorded between 12th and 23rd November 2022.	• Repairs delayed due to resourcing of spare components. 20/11/2022 – Second low pH CCP3 Critical Limit • Continue with frequents checks of the dosing system throughout the day until mechanical repairs completed 23/11/2022 • Mechanical repairs completed **Corrective and Preventive actions** • TLW to perform Toolbox talk with WO's on requirements of Incident report timeframes • TLW to perform toolboxes to WO's on procedures of completion of Work Orders after phone communication, also high priority added to all CCP locations • TLW to perform toolboxes to WO's on recording date and time in dairy of communication to Mechanical and Electrical • WQO to perform toolbox on CCPs for Mechanical, Instrumental and Electrical teams
January 2023 – Crescent Head Supply Hand held instrumentation sensor drift resulting in the recording and reporting of inaccurate pH readings on the 23/01/2023 pH CCP3 high Critical Limit of 8.53pH, 24th & 25th January high pH Alert Levels of 8.19 pH & 8.03 pH respectively.	23/01/2023 -~14:44 Notification of Critical Limit via WaterOutlook. CCP3 pH Critical Limit followed SOP followed • Confirmation of testing results • pH dosing turned down • Investigated borefield water transfer • Investigation of instrumentation error - raw water to Reservoir outlets indicated an increase result of +0.4 pH and +0.82 pH respectively from previous days results: Instrument error likely cause. • Confirmation Free Chlorine within operational targets out of Reservoirs and in reticulation. • Phone notification to the PHU, likely false critical limit breach due to inaccurate pH results 24/01/2023 - ~ 06:30 WO operators tested CH systems with duplicate instrumentation. • Confirmed different pH probes indicated difference in results of + 0.44 pH, secondary confirmation tests between different probes performed in the KLM supply confirmed fading pH probe with a difference of +0.71 pH. 25/01/2023 • Email to LPHU of detailed incident report **Corrective and Preventive actions** • TLW Toolbox talk with Operators on requirements to cross check and challenge pH probes against standards at least weekly or as required based on out of spec readings and ensure pH buffers are at all WTPs. • TLW Review and update Instrumentation calibration SOP • WSOM, TLW & WQO Complete the Setup of Water Outlook to enable the capture of calibration comments and records. • WQO to update pH CCP SOP to include "check instrument is operating within +/- 0.02 of reference standards, if not calibrate and retest to confirm results

Details of incident/emergency	Actions undertaken
February 2023 – Crescent Head Supply Boil Water Alert. The chlorination pump at the Water Treatment Plant was left isolated after maintenance, causing unchlorinated water being pumped to Back Beach Reservoir for 48 hours. The non-chlorinated water was identified on the 24/02/2023 during routine water testing at the Back Brack reservoir, where a CCP3 Low Critical Limit result for Free Chlorine (0.03mg/L) was reported.	24/02/2023 to 26/02/2023 • From ~ 10:30 CCP3 Free Chlorine Critical Limit SOP Followed, • PHU unit notified ~11:30 (PHU notified NSW Health Water Unit) • Activation of Councils DWQIRRP. • ~13:30 Boil Water Alert issued by KSC and supported by NCPHU and NSW Health Water Unit. • Incident Controlled by the GMWS supported by the WQO until ~16:00 on 26/02/2023 when the BWA was lifted by KSC and supported by NCPHU and NSW Health Water Unit 28/02/2023 • Post incident investigation, and staff interviews commence, root cause of incident confirmed. 16/03/2023 - Incident debrief with all Council internal stakeholders. • Deep dive of Council responses and actions across multiple departments. • Root cause analyses in the identification of multiple procedural shortfalls. • 21 outstanding corrective and preventive actions were documented. 31/05/2023 – Post Incident debrief with NCPHU and NSW Health Water Unit. • Review of Councils responses in the identification and management of the emergency event. • 21 outstanding corrective and preventive actions confirmed

8. Customer Enquiries

Water quality and loss of service enquiries are received by Councils Customer Services Section. The enquires are entered and tracked via Councils front of house records management system, which includes automated notification to the responsible delegate for actioning within Councils Service Standard timeframes. Investigation findings and any resolving actions are documented against the service request.

Table 8.1 provides a summary of the customer enquiries for each of Councils water supplies.

Table 8.1 Customer Enquires for Councils Water Supply Systems

Supply System	Dirty	Air or Cloudy	Taste & Odour	Loss of Supply	Illness	Annual Total
Kempsey & Lower Macleay	11	5	2	27	0	45
Crescent Head	2	0	0	1	0	**3**
Hat Head	0	0	0	1	0	**1**
South West Rocks	0	1	0	0	0	**1**
Stuarts Point	1	0	0	0	0	**1**
Willawarrin	4	0	0	0	0	**4**
Bellbrook	0	0	0	0	0	**0**
Thunggutti	0	0	0	0	0	**0**

Combined Total	**18**	**6**	**2**	**29**	0	**55**

Fifty-five customer service enquires (Table 8.1) were recorded for this reporting year. The majority of these (45) were in the KLM supply.

No customer enquiries were recorded in the Bellbrook and Thunggutti water supplies.

Dirty water (18) and Loss of supply (29) accounted for the majority of the enquires.

The main contributing elements to received customer enquiries across the reported categories were from broken mains/pipes and programmed asset renewal projects.

Standard corrective measures include:

- investigation on site
- liaising with customer for additional information
- asset repair/replacement where required
- flushing of mains for minimum of 15min or until ADGW targets are met
- confirmation of onsite water quality testing (Chorine residuals, pH and Turbidity)
- Where deemed necessary sample collection for laboratory analyses to assist in root cause diagnosis including processes of elimination.

9. Monitoring Programs

9.1 Steuart McIntyre Dam (SMD) Algae Monitoring Program

Algae, along with Methylisoborneol (MIB) & Geosmin (Taste and Odour) samples are collected by Council on a routine basis and form a CCP component when SMD is in use. This sampling program, designed in 2016 and updated in June 2019, considers local conditions, historic data and aligns with the Blue-Green Algae Alert Level Framework. Samples are sent to the Port Macquarie-Hastings Council Laboratory for analysis. Appendix B, Figures B.1 and B.2 depicts monitoring data from 2015 to the end of this reporting period for Cyanobacteria Biovolumes, Phytoplankton groupings, and taste and odour compounds.

9.2 Aboriginal Communities Water & Sewage Program (ACWSP)

Five Aboriginal Communities are identified within the drinking water supply areas of Council. Council partnerships with DPE and NSW Health to deliver the NSW ACWSP for the following communities:

- Thunggutti (Thunggutti supply)
- Greenhill (West Kempsey – KLM supply)
- New Burnt Bridge (South Kempsey – KLM supply)
- Loftus Rd (Crescent Head supply)
- Fig Tree (South West Rocks supply)

9.2.1 Pesticide Testing

Pesticide monitoring from water supplies servicing Aboriginal communities is funded by NSW Health; testing is conducted every 5 years.

Most current monitoring commenced in January 2022. This program fell over 2 reporting years: 2021-2022 and 2022-2023.

Table 9.1 provides a summary of the 2022-2023 portion of the monitoring program and when each community is next due to be monitored.

Pesticide analysis testing includes:

- Acidic Herbicides – Method CET8B
- Glyphosate – Method CET17A
- Organochlorine & Organophosphorus by LCMSMS – Method CET43A
- Organochlorine, Organophosphorus & Synthetic Pyrethroid Pesticides by GCMSM – Method CET7D
- Triazines/Phenylurea & Carbamates – Methods CET19C

Table 9.1 Pesticide Monitoring at Aboriginal communities

Community	Water Supply System	Sample Location	Last Sampled	Comments	Scheduled Next
Thunggutti	Thunggutti	Network (KS09-121 Community Centre) Raw Water (Inlet to WTP)	July 2022 Aug to Dec 2022	No Pesticides Detected from 1 sample No Pesticides Detected from 5 samples	January 2027
Loftus Road	Crescent Head	Network (KS05-321 Loftus Rd) Raw Water (Inlet to WTP)	Aug 2022 July 2022 Sept to Dec 2022	No Pesticides Detected from 1 sample No Pesticides Detected from 5 samples	January 2027
Fig Tree	South West Rocks	Network (KS07-125 WTP) Network (KS07-127 Figtree Community) Raw Water (Inlet to WTP)	July & Sept 2022 Aug 2022 Oct to Dec 2022	No Pesticides Detected from 2 samples No Pesticides Detected from 1 sample No Pesticides Detected from 3 samples	January 2027
Greenhill & New Burnt Bridge	KLM	Network (KS01-122 Armidale Rd) Raw Water (Inlet to WTP)	July & Nov 2022 Aug, Sept, Dec 2022	No Pesticides Detected from 2 samples No Pesticides Detected from 4 samples	January 2027

9.2.2 Radiological Testing

Radiological monitoring from water supplies servicing Aboriginal communities is funded by the ACWSP and is conducted every 5 years.

No monitoring was undertaken in this reporting period. Next monitoring is due in 2027.

9.2.3 Inspections and Water Quality Testing to ADWG

Along with pesticide and radiological monitoring, the water supply and sewerage systems at the Aboriginal communities are inspected by DPE. Inspections includes a water quality testing component that checks the supplied water meets the required ADWG and WQI for the tested parameters.

The Thunggutti community is inspected approximately every 4 months, and the Fig Tree, New Burnt Bridge, Greenhill, and Loftus Rd communities are inspected yearly (Table 9.3).

Table 9.2. DPE inspection water quality results

Community	Water Supply System	Sample Location	Date Inspected	Turbidity (NTU)	Free Chlorine (mg/L)	Total Chlorine (mg/L)	pH	Colour (pt/Co)
Fig Tree	South West Rocks	SPS R8	21/06/2023	0.12	0.55	0.58	7.70	3
New Burnt Bridge	KLM	SPS K26	21/06/2023	75*	1.25	1.25	7.49	553*
Greenhill	KLM	SPS K2	21/06/2023	0.36	1.70	1.76	7.25	7
Loftus Road	Crescent Head	SPS C4	21/062023	1.0	0.48	0.73	7.19	26
Thunggutti	Thunggutti	Network	08/09/2022 23/03/2023 21/06/2023	0.18 0.31 0.01	1.02 1.64 1.43	1.47 1.77 1.58	7.4 6.92 7.51	0 0 3

Note: * KSC contacted immediately of High NTU & pt/Co at New Burnt Bridge. Council extensively flushed service area & was rectified within 12 hours. Cause of issue is believed to have been excessive water main trauma due to firefighting appliances drawing water several days prior to testing. No dirty water customer enquires where reported during this period.

10. Staff Training and Development

Training and development for water personal are based on statuary requirements, position duties, operational needs, and industry best practices.

Minimum Certification requirements for Water Process Operators include:

- Certificate III in Water Industry Operations; Fluoridation certificate; Dam Safety Surveillance certificate and Operate and Control Liquefied Chlorine Gas certification.

Minimum Certification for the Water Networks personal include:

- Certificate III Water Industry Network or Operations.

Minimum Certification for the Water Mechanical and Electrical personal include:

- Trade certificates in either mechanical, electrical or instrumentation.

Additional identified training and development along with any recertification and/or verification of competencies (VOC) are conducted as required by either registered training providers (RTOs) or in house by subject matter experts.

Training and development is managed by Councils Human Resources department with records held within Councils Training Record Management System.

Council is committed in the training and development of a skilled work force and participates in State funded Traineeship programs for the Water Industry. Council takes on between 4 & 6 Water Operations Trainees each year and mentors and guides them through to achieve their Certificate III in Water Industry Operations certification.

Training and development programs completed by all water staff including the water management team during 2022-2023 is captured in Table 10.1.

Table 10.1. Completed Staff Training and Development Summary 2022-2023

Training	Water Process	Water Networks	Water Mechanical & Electrical	Water Management	Combined Total
Drinking Water Quality Incident Response & Reporting Plan	13			1	**14**
Monitor and operate fluoride addition processes	1				**1**
Operate Breathing Apparatus Training	3	6	4		**13**
Working Safely at Heights	8	4	7		**19**
Working safely near live electrical apparatus as a non-electrical worker	8	8	4	1	**21**
Low Voltage Rescue and CPR	1	1	8		**10**
Level 2B and 2C Initial Training - Overhead and Underground electrical			1		**1**
First Aid Certificate	10	6	1		**17**
Combined Total	**44**	**25**	**25**	**2**	**96**

11. Continuous Improvement – Implementation Plan

Councils Implementation Plan (IP) was developed as part of the DWMS to document the improvement actions identified during the detailed risk assessment of the drinking water supplies. The IP encompasses Element 12 of the DWMS and demonstrates Council's commitment to continual improvement of its water supply services from a quality and safety perspective.

Since completion of the DWMS in 2014 (a standalone excel document), the IP has been reviewed yearly by the Risk Management Team in conjunction with the Risk Register. Table 11.1 provides an overview of the IP reviews with a summary of progress of the actions and Table 11.2 depicts the progress of the IP actions based on their risk residual.

Any new actions that are identified in the Risk Register are added into the IP. As actions are completed their status is changed to "completed" and remain in the IP for one review cycle before being marked as "remove" and taken off the IP.

Table 11.1. Implementation Plan Review History

Review Date	Removed *	Completed	Standing Items**	In progress	Ongoing (long term action)	Not Started	Items Added	Total Ongoing
Nov 2014 & Jan 2015	4	7		49	Not Reported	111	23	**171**

Review Date	Removed *	Completed	Standing Items**	In progress	Ongoing (long term action)	Not Started	Items Added	Total Ongoing
Aug & Sept 2015	4	8		75	Not Reported	83	0	**157**
April 2016	N/A	N/A		N/A	N/A	N/A	16	**173**
March 2017	N/A	24		73	64	65	0	**202**
August 2018	14	54		51	27	28	0	**106**
Oct 2019	48	23		63	24	7	18	**112**
November 2020	19	20		68	23	6	12	**109**
October 2021	17	16	7	53	27	9	0	**96**
November 2022	18	11	8	51	25	7	0	**91**
December 2023	9	5	10	48	23	5	0	**86**

*Removed items are the number of items that have been completed in the previous year review. The figures from "Completed" and "Removed" between reviews may not match due to confirmation in the current review year that the task has been completed. If an item is deemed "not completed" its status is changed back into "in progress"
** Standing Items is a new category added from local PHU 2019-2020 Annual review meeting actions. Standing items are a constant action in the IP that have no end date.

Table 11.2. Progress on actions based on risk ranking

Residual Risk	Removed	Completed	Standing Items	In progress	Ongoing (Long term actions)	Not Started	New	Tasks Remaining
Very High	0	0	0	6	3	0	0	**9**
High	3	1	7	24	5	1	0	**37**
Medium	2	3	0	12	8	3	0	**23**
Low	4	1	3	6	7	1	0	**22**
Total	**9**	**5**	**10**	**48**	**23**	**5**	**0**	**86**

Eighty-six remain outstanding; 5 tasks were assessed as completed and 9 tasks removed from the IP (i.e., confirmed as completed from the previous year review) (Table 11.2).

Of the 9 removed tasks, 3 had a "high" risk ranking and of the 5 tasks assessed as completed, 1 "high" risk rating task was removed.

Nine "very high" risks tasks remain outstanding in the IP.

Table 11.3 provides a summary of the actions that have been completed during 2022-2023.

The IP outstanding actions is included as an embedded excel in Appendix E.

Table 11.3 Summary of Completed tasks in Implementation Plan

Action No.	Supply System	Residual Risk	Outstanding Actions	Date Added	Comments
2.12	All	M	SOP to be developed on the operation of the bores and recharge channel includes what to do in floods for bore selection	2012	23/12/2020 = Develop a flood response SOP that covers all supply systems 25/10/2022 - ongoing - TLW - to assign the development of a SOP 7/11/2022 - this will be captured in the operational SOP for Sherwood 11/12/23 - has been changed to complete. Can be removed next year.
4.01	All	L	Operators to ensure that reservoir inspections are occurring monthly as required, currently they are not occurring regularly	2014	Monthly inspection sheets are stored in F: Drive and Reviewed by WQO 21/11/2019 - this is also being transferred into WaterOutlook 10/2/2021 - Reservoir inspection reporting has been transferred into WaterOutlook, which generates reminders to the WO for completion - Lack of completion to be addressed at team meetings 25/10/2021 TLW and WQO run a report at least monthly (calendar reminders set) missing inspections are communicated to the operators - status changed to a standing Item 7/11/22 - standing item 20/06/2023 - Annual Review meeting with Health - process in place this item can be marked off as "Completed" 11/12/23 - has been changed to complete. Can be removed next year.
4.17	All	M	An audit of all chemical dosing interlocks for each treatment plant should be undertaken	2016	Already undertaken, actions to be followed up 21/11/2019 - Need to re-check all audit findings then develop & implemented any actions TLW, OC & MC - Need to re-check all audit findings then develop & implemented any actions 5/2/21 - to be looked at - refer to 2019 comments 18/10/2021 - SP needs further controls in place as there are no interlocks - other sites still need to be looked at - ongoing 7/11/22 - TLW and MC to work together to identify gaps 11/12/23 - have combined with 2.54 - completed off this line item, OK for removal
5.12	Th	L	Reservoir diagrams of all valves, taps, pipes, scouring options and interconnections required Separate scours for each reservoir required	2016	21/11/2019 - PE investigate scouring options at Reservoir 10/2/2021 Investigation yet to begin 18/10/21 - Basic design scoped and quoted. Project to be tables with DPIE 7/11/22 - Work has been approved to commence, equipment has been ordered. Project commencing soon. 11/12/23 – Completed
7.18	KLM	H	Review and update the SMD Bushfire prevention plan.	2021	need to confirm if this was this included as part of the annual DSEP review 7/11/22 - prevention plan not in the DSEP, there is a SMD fire management plan April 2020, this document will need to be reviewed and updated 11/12/23 - Complete, will get final paper work back in February. Can remove next year.

12. References

1. NSW Government (2010), *Public Health Act 2010,* NSW Government Parliamentary Counsel's Office.
2. NSW Ministry of Health (2013), *NSW Guidelines for Drinking Water Management Systems*, NSW Ministry of Health
3. NHMRC (2011) *Australian Drinking Water Guidelines,* National Water Quality Management Strategy, National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.
4. AECOM (2014), *Kempsey Shire Council Drinking Water Management System* AECOM, Sydney NSW
5. Aqualift (2014), *Kempsey and Lower Macleay Drinking Water Supply Description,* Aqualift Project Delivery, 2014
6. Census 2021 - 2021 Kempsey, Census All persons QuickStats | Australian Bureau of Statistics (abs.gov.au)
7. *Population Forecast for Kempsey Shire - http://forecast.id.com.au/kempsey/home*
8. NSW Government (2012), *Public Health Regulation 2012,* NSW Government Parliamentary Counsel's Office
9. NSW Health (2018) *New South Wales Code of Practice for Fluoridation of Public Water Supplies*, *Fluoridation of Public Water Supplies Act 1957,* NSW Health
10. Water Directorate (2014), Blue-Green Algae Management Protocols 2014, Water Directorate, 2014
11. VIRIDIS (2019), Drinking Water Management System - Overall Manual, prepared for Kempsey Shire Council by Viridis Consultants Pty Ltd.
12. Kempsey Shire Council (2023), DWMS Risk Register V.2.8. Kempsey Shire Council
13. Kempsey Shire Council (2023) DWMS Implementation Plan V.10. Kempsey Shire Council
14. Kempsey Shire Council (2021-2022) DWMS Annual Water Quality Report. Kempsey Shire Council
15. NSW Government (2023) Kempsey LALC Aboriginal Communities Water Supply and Sewerage Systems Periodical Inspection, Report and minutes, NSW Government, Department of Planning and Environment

Appendix A Summary of Critical Control Points (CCP) for each Supply System

Table A.1a CCP Kempsey and Lower Macleay Water Supply – Sherwood Lime Plant in use

System	CCP ID	Control Point	Indicator Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Kempsey and Lower Macleay	**Sherwood Lime Plant in use**								
	CCP1	Raw Water Abstraction	Turbidity	Combined bore water to Sherwood Lime Plant	Continuous online	<1 NTU	1 NTU	2 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit.
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine pH	Outlet of Reservoir – Greenhill	Daily grab	1.8 mg/L pH 7.5	<1.0 mg/L or > 3 mg/L pH <6.8 or >8.0	<0.6 mg/L or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.*t* is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). pH correction undertaken. Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoir	Reservoir integrity	All Reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Table A.1b CCP Kempsey and Lower Macleay Water Supply – SMD in use

System	CCP ID	Control Point	Indicator Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Kempsey and Lower Macleay	**Steuart McIntyre Dam in use**								
	CCP1	Raw Water Abstraction	Turbidity	Combined Bore Water to SM Dam Inlet Race	Continuous online / daily grab	<1 NTU	3 NTU	5 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load into SM Dam.
		Raw Water Abstraction	Turbidity	SM Dam outlet from Pre Transfer pump	Daily grab	<1 NTU	3 NTU	5 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit.
		Raw Water Abstraction	Taste & Odour MIB / Geosmin Algae Biovolumes (Toxins)	SM Dam Tower and SM Dam sites 1, 2, & 3	As per Algae Monitoring Plan	Not detectable Not detectable Below Detection Limit (<0.2 mm^{3}L^{-1})	N/A >2 ug/L Alert Level 1 (>0.2 - <0.6mm^{3}L^{-1})	N/A N/A Alert Level 2 (≥ 0.6 mm^{3}L^{-1})	Algae Biovolume critical limit is based on the Water Directorate Alert Level Framework for management of cyanobacteria in drinking water. Taste and Odour along with MIB and Geosmin has no set critical limit, as these indicators in detectable levels are aesthetic in nature and not health related.
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA

System	CCP ID	Control Point	Indicator Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
	CCP3	Disinfection	Free Chlorine pH	Outlet of Reservoirs – Greenhill, John Lane, Potters Hill	Daily grab	1.8 mg/L	<1.0 mg/L or > 3 mg/L	<0.6 mg/L or >4 mg/L	Lower chlorine critical limit ensures that C.*t* is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). No pH correction readily available. Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoir	Reservoir integrity	All Reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Table A.2 CCP Crescent Head Water Supply

Scheme	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Crescent Head	CCP1	Raw Water Abstraction	Turbidity	Front Dam	Daily grab	<1 NTU	4 NTU	5 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off manually at critical limit.
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine pH	Back Beach Reservoir Outlet	Daily grab	1.5 mg/L pH 7.5	<0.7 or >3 mg/L pH <6.8 or >8.0	<0.5 or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.*t* is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Note: Daily grab is taken 7 days/week

Table A.3 CCP Hat Head Water Supply

Scheme	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Hat Head	CCP1	Raw Water Abstraction	Turbidity	Raw Water at Collection Tank	Continuous online / grab sample	<1 NTU	2 NTU	4 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit.
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine	Clear water to retic leaving dosing plant	Continuous online / grab sample	1.2 mg/L pH 7.5	<0.7 or >3 mg/L pH <6.8 or >8.0	<0.5 or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.*t* is met at the monitoring location. Upper critical chlorine limit ensures that total chlorine does not get >5 mg/L (health limit). Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Upon advice from NSW Health. Ensures treated water does not get re-contaminated.

Note: Grab sample is taken daily (7 days/week). Raw Water Abstraction and Disinfection CCPs have continuous online monitoring.

Table A.4 CCP South West Rocks Water Supply

Scheme	CCP ID	Control Point	Indicator Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
South West Rocks	CCP1	Raw Water Abstraction	Turbidity	Inlet to WTP	Continuous online / daily grab	<5 NTU	10 NTU	20 NTU	Plant is shut off for turbidity >20 NTU for membrane protection. [Note: online result is verified with grab sample].
	CCP2	Filtration	Turbidity	After filters at WTP / on main after transfer pump	Continuous online / daily grab	<0.1 NTU	0.5 NTU	1 NTU	Critical limit ensures solids removal, and that effectiveness of chlorination is maintained. Protozoa risk is low as source is bores. [Note: online result is verified with grab sample].
	CCP3	Disinfection	Free Chlorine pH	Reservoir outlet	Daily grab	1.5 mg/L pH 7.5	<1.2 or >3 mg/L pH <6.8 or >8.0	<1 or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.*t* is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).
	CCP4	Fluoridation	Fluoride	Leaving WTP & Gregory St Res Outlet	Continuous online / daily grab	1 mg/L	<0.9 mg/L for >72 hrs OR >1.2 mg/L	>1.5 mg/L	One of the monitoring points is located downstream of dosing but prior to any reservoir/tank, as per Fluoridation Code. Critical limit is set at the health guideline value.
	CCP5	Reservoir	Reservoir integrity	All Reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Note: Grab sample is taken daily (7 days/week). Raw water abstraction, Filtration and Fluoridation CCPs have continuous online monitoring.

Table A.5 CCP Stuarts Point Water Supply

System	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Stuarts Point	CCP1	Raw Water Abstraction	Turbidity	Raw Water Sample point (prior to pH and pre-disinfection)	Grab sample	<0.5 NTU	3 NTU	5 NTU	Plant is shut off at critical limit.
	CCP2	Filtration	Turbidity	Post filtration (inlet to clearwater tank)	Continuous online / grab sample	<0.3 NTU	0.8 NTU	1 NTU	Critical limit ensures solids removal, and that effectiveness of chlorination is maintained. Protozoa risk is low as source is bores. [Note: online result is verified with grab sample].
	CCP3	Disinfection	Free Chlorine	Stuarts Point Reservoir Outlet	Continuous online / grab sample	1 mg/L	<0.8 or >3mg/L	<0.6 or >4 mg/L	Lower chlorine critical limit ensures that C.*t* is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). No pH correction undertaken. [Note: online result is verified with grab sample].
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Note: Grab sample is taken daily (7 days/week). Disinfection and Filtration CCPs have continuous online monitoring.

Table A.6 CCP Bellbrook Water Supply

System	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Bellbrook	CCP1	Raw Water Abstraction	Turbidity	Inlet to raw water tank	Continuous online / grab sample	<5 NTU	10 NTU for more than 20min	20 NTU	Plant is shut off for turbidity @20 NTU. [Note: online result is verified with grab sample].
	CCP2	Filtration	Turbidity	After filters at WTP	Continuous online /Grab sample	<0.5 NTU	0.8 NTU	1 NTU	Critical limit ensures solids removal, and that effectiveness of chlorination is maintained.
	CCP3	Disinfection	Free Chlorine pH	Clear water tank outlet	Continuous online / grab sample	1.5 mg/L pH 7.5	<1 or >3.0 mg/L pH <6.8 or >8.0	<0.8 or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.*t* is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). pH correction undertaken. Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG) [Note: online result is verified with grab sample].
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Note: Grab sample is taken 5/week (Mon-Fri). Raw Water Abstraction and Disinfection CCPs have continuous online monitoring.

Table A.7 CCP Willawarrin Water Supply

System	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Willawarrin	CCP1	Raw Water Abstraction	Turbidity	Raw water rising main prior to chlorine injection	Daily grab	<0.6 NTU	1 NTU	2 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit.
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine pH	Willawarrin reservoir outlet	Continuous online / daily grab	1 mg/L 7.5 pH	<0.6 or >3.0 mg/L <6.8 - >8.0 pH	<0.4 or >4 mg/L <6.5 – >8.5 pH	Lower critical chlorine limit ensures that C.*t* is met at the monitoring location. Upper critical chlorine limit ensures that total chlorine does not get >5 mg/L (health limit). No pH correction undertaken. [Note: online result is verified with grab sample].
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Upon advice from NSW Health. Ensures treated water does not get re-contaminated.

Note: Grab sample is taken daily (7 days/week). Disinfection CCP has continuous online monitoring.

Table A.8 Thunggutti Water Supply

System	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Thunggutti	CCP1	Raw Water Abstraction	Turbidity	Inlet to treatment plant	Continuous online / grab sample	<0.5 NTU	0.8 NTU	1 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit. [Note: online result is verified with grab sample].
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine pH	At reservoir outlet (bores should be run during off peak usage time – night)	Continuous online / Grab sample	1.0 mg/L 7.5 pH	<0.8 or >3.0 mg/L pH <6.8 or >8.0	<0.3 or >4 mg/L pH <6.5 or >8.5	Lower critical chlorine limit ensures that C.*t* is met at the monitoring location. Upper critical chlorine limit ensures that total chlorine does not get >5 mg/L (health limit). No pH correction undertaken. [Note: online result is verified with grab sample].
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Upon advice from NSW Health. Ensures treated water does not get contaminated.

Note: Grab sample is taken 5 days/week (Mon-Fri). Raw Water Abstraction and Disinfection CCPs have continuous online monitoring.

Appendix B Steuart McIntyre Dam Algae Monitoring

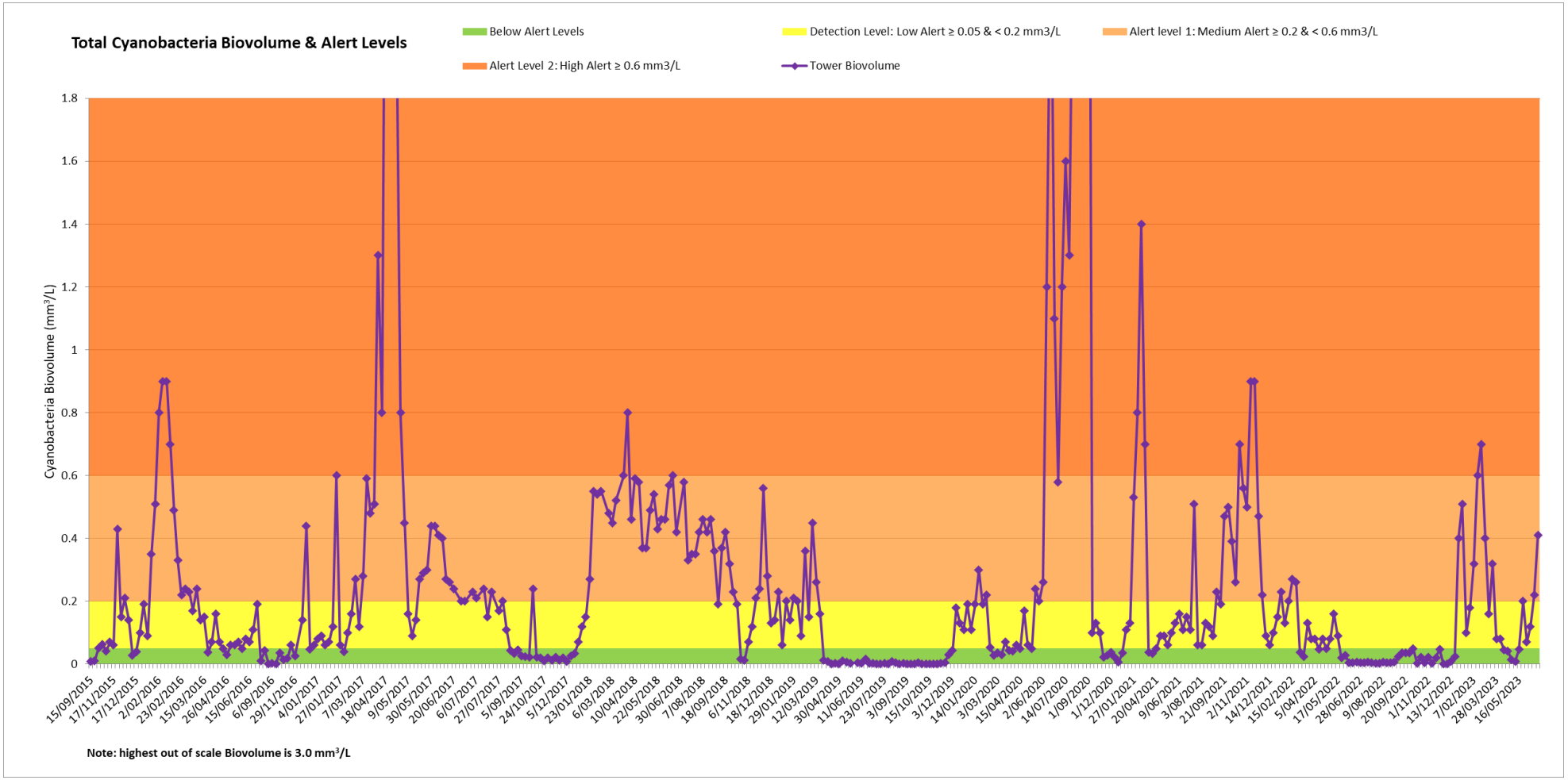

Figure B.1: Steuart McIntyre Dam Total Cyanobacteria Biovolume and Alert Levels (Sep 2015 to June 2023)

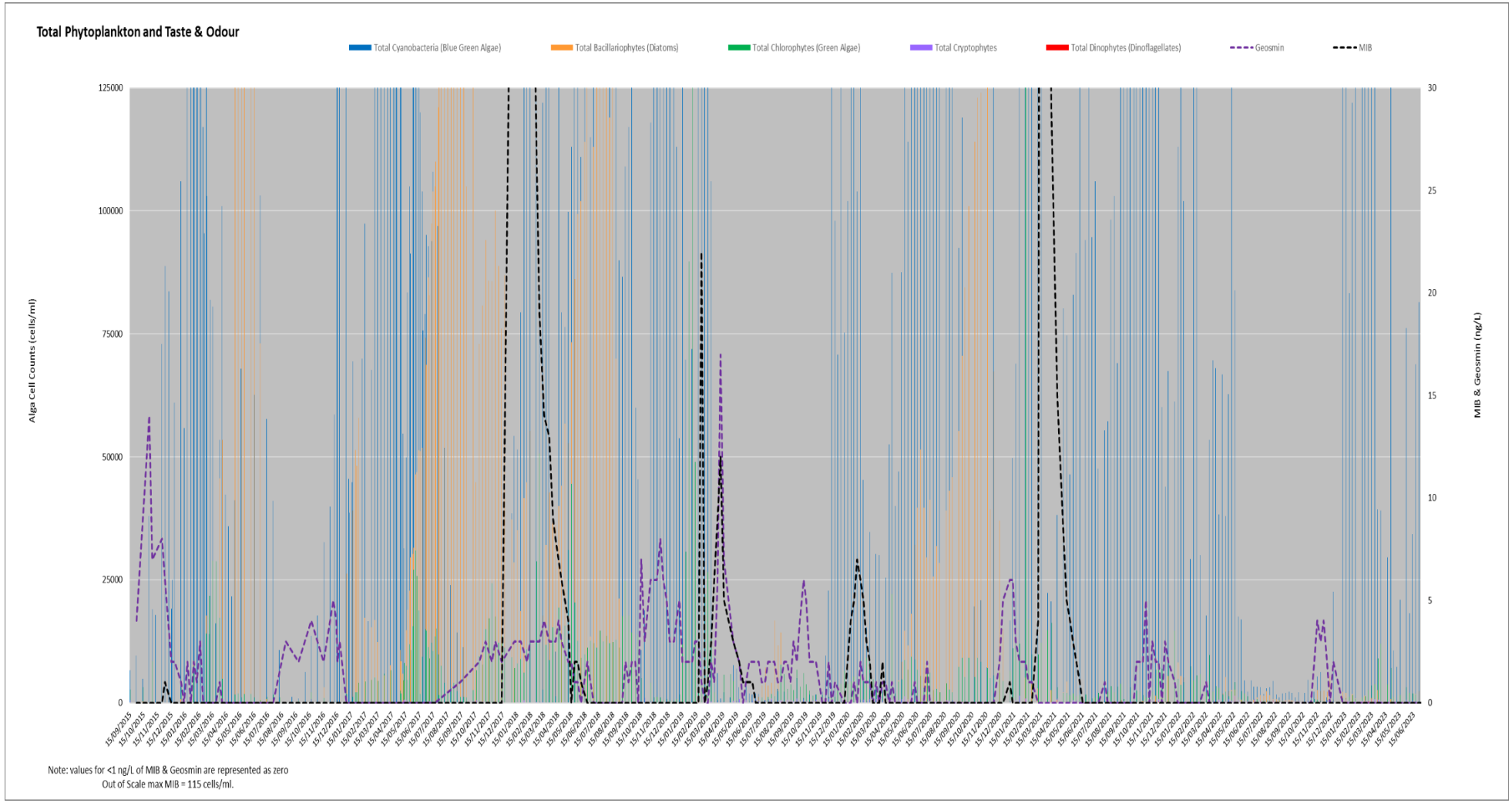

Figure B.2: Total Phytoplankton and Taste and Odour Results at Tower Intake (July 2015 to June 2023).

Appendix C Water Quality Verification Data

Data from Kempsey Shire Council network sampling sites is collected from the NSW Health Database covering the eight drinking water supply systems.

Results in each monitoring program (Physical-Chemical Monitoring, Microbiological Monitoring and Fluoride Monitoring) are attributed to specific sampling regimes.

Turbidity, pH and Fluoride are monitored in two sections, due to the difference in sampling regimes (indicated by the sample count) results of the analysts vary between monitoring programmes.

Fluoride is tested in all supply systems as a standard chemical test as a part of the Physical-Chemical Monitoring.

Fluoride Monitoring only occurs in the fluoride dosed supply system of South West Rocks.

Table C.1 Kempsey & Lower Macleay Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.02	0.01	0.03	14	0	100
Antimony	0.003	mg/L	0.0004	0.0002	0.0006	14	0	100
Arsenic	0.01	mg/L	0.0005	0.0005	0.0005	14	0	100
Barium	2	mg/L	0.0144	0.0104	0.021	14	0	100
Boron	4	mg/L	0.0219	0.0165	0.0268	14	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00005	14	0	100
Calcium	10000	mg/L	34.2	19.3	55.5	14	0	100
Chloride	250	mg/L	21	18	24	14	0	100
Chromium	0.05	mg/L	0.0020	0.0005	0.015	14	0	100
Copper	2	mg/L	0.0726	0.004	0.725	14	0	100
Fluoride	1.5	mg/L	0.0721	0.05	0.11	14	0	100
Iodine	0.5	mg/L	0.0257	0.01	0.23	14	0	100
Iron	0.3	mg/L	0.0179	0.01	0.03	14	0	100
Lead	0.01	mg/L	0.0007	0.0002	0.0015	14	0	100
Magnesium	10000	mg/L	7.55	5.47	9.18	14	0	100
Manganese	0.5	mg/L	0.0014	0.0005	0.0028	14	0	100
Mercury	0.001	mg/L	0.0004	0.0004	0.0004	14	0	100
Molybdenum	0.05	mg/L	0.0018	0.0001	0.0203	14	0	100
Nickel	0.02	mg/L	0.0037	0.0002	0.0.042	14	1	92.86
Nitrate	50	mg/L	5.1	3	8	14	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	14	0	100
pH	6.5 - 8.5		7.32	6.90	7.90	14	0	100
Selenium	0.01	mg/L	0.0035	0.0035	0.0035	14	0	100
Silver	0.1	mg/L	0.0001	0.0001	0.0001	14	0	100
Sodium	180	mg/L	16.4	15	19	14	0	100
Sulfate	250	mg/L	9.9	9	11	14	0	100
Total Dissolved Solids (TDS)	10000	mg/L	133	100	162	14	0	100
Total Hardness as CaCO3	200	mg/L	116.5	74.5	163.1	14	0	100
True Colour	15	Hazen Units	0.6	0.5	1	14	0	100
Turbidity	5	NTU	0.52	0.05	1.3	14	0	100
Uranium	0.02	mg/L	0.0001	0.00005	0.0001	14	0	100
Zinc	3	mg/L	0.02	0.01	0.05	14	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	155	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	155	0	100
Free Chlorine	0.2 - 5	mg/L	1.47	0.84	1.95	155	0	100
Total Chlorine	5	mg/L	1.62	0.93	2.21	155	0	100
pH	6.5 - 8.5		6.88	6.37	7.89	155	1	99.35
Temperature	30	C	20.8	14.8	27	155	0	100
Turbidity	5	NTU	0.56	0.09	2.1	155	0	100

Table C.2 Crescent Head Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.13	0.12	0.13	2	0	100
Antimony	0.003	mg/L	0.0001	0.00005	0.00005	2	0	100
Arsenic	0.01	mg/L	0.0005	0.0005	0.0005	2	0	100
Barium	2	mg/L	0.0047	0.0044	0.005	2	0	100
Boron	4	mg/L	0.0139	0.0136	0.0141	2	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00005	2	0	100
Calcium	10000	mg/L	10.6	9	12.1	2	0	100
Chloride	250	mg/L	46	44	48	2	0	100
Chromium	0.05	mg/L	0.001	0.001	0.001	2	0	100
Copper	2	mg/L	0.003	0.001	0.005	2	0	100
Fluoride	1.5	mg/L	0.05	0.05	0.05	2	0	100
Iodine	0.5	mg/L	0.01	0.01	0.01	2	0	100
Iron	0.3	mg/L	0.19	0.15	0.23	2	0	100
Lead	0.01	mg/L	0.0003	0.0003	0.0003	2	0	100
Magnesium	10000	mg/L	2.06	1.82	2.3	2	0	100
Manganese	0.5	mg/L	0.0053	0.0039	0.0066	2	0	100
Mercury	0.001	mg/L	0.0004	0.0004	0.0004	2	0	100
Molybdenum	0.05	mg/L	0.0001	0.0002	0.0002	2	0	100
Nickel	0.02	mg/L	0.0002	0.0002	0.0002	2	0	100
Nitrate	50	mg/L	0.5	0.5	0.5	2	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	2	0	100
pH	6.5 - 8.5		7.25	7.20	7.20	2	0	100
Selenium	0.01	mg/L	0.0035	0.0035	0.0035	2	0	100
Silver	0.1	mg/L	0.0001	0.0001	0.0001	2	0	100
Sodium	180	mg/L	18.5	17	20	2	0	100
Sulfate	250	mg/L	1	1	1	2	0	100
Total Dissolved Solids (TDS)	10000	mg/L	78	75	81	2	0	100
Total Hardness as CaCO3	200	mg/L	34.9	30	39.7	2	0	100
True Colour	15	Hazen Units	4.5	3	6	2	0	100
Turbidity	5	NTU	1.05	0.1	2	2	0	100
Uranium	0.02	mg/L	0.0001	0.0001	0.0001	2	0	100
Zinc	3	mg/L	0.25	0.02	0.03	2	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	55	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	55	0	100
Free Chlorine	0.2 – 5	mg/L	0.97	0.23	1.67	55	0	100
Total Chlorine	5	mg/L	1.20	0.36	2.04	55	0	100
pH	6.5 - 8.5		7.29	7.03	7.99	55	0	100
Temperature	30	C	20.9	14.3	27.3	55	0	100
Turbidity	5	NTU	1.73	0.88	2.82	54	0	100

Table C.3 Hat Head Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.14	0.13	0.14	2	0	100
Antimony	0.003	mg/L	0.0001	0.00005	0.00005	2	0	100
Arsenic	0.01	mg/L	0.001	0.001	0.001	2	0	100
Barium	2	mg/L	0.0122	0.0114	0.013	2	0	100
Boron	4	mg/L	0.0164	0.0158	0.017	2	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.0001	2	0	100
Calcium	10000	mg/L	1.9	1.8	1.9	2	0	100
Chloride	250	mg/L	76	73	79	2	0	100
Chromium	0.05	mg/L	0.0005	0.0005	0.0005	2	0	100
Copper	2	mg/L	0.003	0.003	0.003	2	0	100
Fluoride	1.5	mg/L	0.05	0.05	0.05	2	0	100
Iodine	0.5	mg/L	0.01	0.01	0.01	2	0	100
Iron	0.3	mg/L	0.18	0.17	0.19	2	0	100
Lead	0.01	mg/L	0.0005	0.0001	0.0008	2	0	100
Magnesium	10000	mg/L	3.96	3.49	4.44	2	0	100
Manganese	0.5	mg/L	0.0053	0.0053	0.0053	2	0	100
Mercury	0.001	mg/L	0.0004	0.0004	0.0004	2	0	100
Molybdenum	0.05	mg/L	0.0001	0.0001	0.0001	2	0	100
Nickel	0.02	mg/L	0.0002	0.0002	0.0002	2	0	100
Nitrate	50	mg/L	0.5	0.5	0.5	2	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	2	0	100
pH	6.5 - 8.5		7.40	7.30	7.50	2	0	100
Selenium	0.01	mg/L	0.0035	0.0035	0.0035	2	0	100
Silver	0.1	mg/L	0.0001	0.0001	0.0001	2	0	100
Sodium	180	mg/L	45	44	46	2	0	100
Sulfate	250	mg/L	7.5	7	8	2	0	100
Total Dissolved Solids (TDS)	10000	mg/L	123.5	114	133	2	0	100
Total Hardness as CaCO3	200	mg/L	21.0	19.1	22.8	2	0	100
True Colour	15	Hazen Units	4	3	5	2	0	100
Turbidity	5	NTU	0.13	0.05	0.2	2	0	100
Uranium	0.02	mg/L	0.0001	0.00005	0.00005	2	0	100
Zinc	3	mg/L	0.01	0.01	0.01	2	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	24	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	24	0	100
Free Chlorine	0.2 - 5	mg/L	1.05	0.55	1.54	24	0	100
Total Chlorine	5	mg/L	1.16	0.64	1.69	24	0	100
pH	6.5 - 8.5		7.40	7.13	7.67	24	0	100
Temperature	30	C	20.3	14.9	26.6	24	0	100
Turbidity	5	NTU	1.16	0.24	18.1	24	1	95.83

Table C.4 South West Rocks Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.03	0.02	0.04	13	0	100
Antimony	0.003	mg/L	0.0001	0.00005	0.00005	13	0	100
Arsenic	0.01	mg/L	0.001	0.001	0.001	13	0	100
Barium	2	mg/L	0.0133	0.0078	0.0165	13	0	100
Boron	4	mg/L	0.0157	0.0132	0.0189	13	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00005	13	0	100
Calcium	10000	mg/L	14.7	12.6	17.1	13	0	100
Chloride	250	mg/L	35.5	33	39	13	0	100
Chromium	0.05	mg/L	0.0007	0.0005	0.002	13	0	100
Copper	2	mg/L	0.0032	0.0005	0.008	13	0	100
Fluoride	1.5	mg/L	0.73	0.05	1.05	13	0	100
Fluoride (WU result)	1.5	mg/L	0.87	0.34	1	11	0	100
Fluoride Ratio	0.8 - 1.2	mg/L	1	0	2.12	12	2	83.33
Iodine	0.5	mg/L	0.011	0.01	0.02	13	0	100
Iron	0.3	mg/L	0.009	0.005	0.02	13	0	100
Lead	0.01	mg/L	0	0.0001	0..0014	13	0	100
Magnesium	10000	mg/L	1.86	0.98	2.14	13	0	100
Manganese	0.5	mg/L	0.0017	0.001	0.0031	13	0	100
Mercury	0.001	mg/L	0.0004	0.0004	0.0004	13	0	100
Molybdenum	0.05	mg/L	0.0004	0.0001	0.0026	13	0	100
Nickel	0.02	mg/L	0.0011	0.0002	0.0008	13	0	100
Nitrate	50	mg/L	0.6	0.5	1	13	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	13	0	100
pH	6.5 - 8.5		7.65	7.23	7.90	13	0	100
Selenium	0.01	mg/L	0.0035	0.0035	0.0035	13	0	100
Silver	0.1	mg/L	0.0001	0.0001	0.0001	13	0	100
Sodium	180	mg/L	20.8	19	23	13	0	100
Sulfate	250	mg/L	4.7	3	23	13	0	100
Total Dissolved Solids (TDS)	10000	mg/L	95.6	82	204	13	0	100
Total Hardness as CaCO3	200	mg/L	44.3	37.5	50.5	13	0	100
True Colour	15	Hazen Units	0.7	0.5	1	13	0	100
Turbidity	5	NTU	0.37	0.05	1.4	13	0	100
Uranium	0.02	mg/L	0.0001	0.00005	0.00005	13	0	100
Zinc	3	mg/L	0.01	0.01	0.02	13	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	62	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	62	0	100
Free Chlorine	0.2 - 5	mg/L	1.27	0.77	1.63	62	0	100
Total Chlorine	5	mg/L	1.40	0.80	1.81	62	0	100
pH	6.5 - 8.5		7.52	7.23	8.30	62	0	100
Temperature	30	C	20.9	15.6	26.6	62	0	100
Turbidity	5	NTU	0.31	0.05	4.6	62	0	100
Fluoride Operational Monitoring								
Fluoride (daily WU)	0.9 - 1.5	mg/L	0.99	0.9	1.19	245	0	100
Fluoride (weekly WU)	0.9 - 1.5	mg/L	0.95	0.51	1.02	72	9	87.5

Table C.5 Stuarts Point Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.006	0.005	0.01	10	0	100
Antimony	0.003	mg/L	0.0001	0.00005	0.0001	10	0	100
Arsenic	0.01	mg/L	0.001	0.0005	0.001	10	0	100
Barium	2	mg/L	0.0129	0.0104	0.147	10	0	100
Boron	4	mg/L	0.0196	0.0162	0.0231	10	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00005	10	0	100
Calcium	10000	mg/L	54.6	51	58.9	10	0	100
Chloride	250	mg/L	39.3	33	43	10	0	100
Chromium	0.05	mg/L	0.0011	0.0005	0.004	10	0	100
Copper	2	mg/L	0.0164	0.0005	0.034	10	0	100
Fluoride	1.5	mg/L	0.05	0.05	0.05	10	0	100
Iodine	0.5	mg/L	0.01	0.01	0.01	10	0	100
Iron	0.3	mg/L	0.038	0.01	0.1	10	0	100
Lead	0.01	mg/L	0.0012	0.0001	0.0024	10	0	100
Magnesium	10000	mg/L	3.30	3.04	3.63	10	0	100
Manganese	0.5	mg/L	0.0004	0.00015	0.0011	10	0	100
Mercury	0.001	mg/L	0.0004	0.0004	0.0004	10	0	100
Molybdenum	0.05	mg/L	0.001	0.0005	0.0152	10	0	100
Nickel	0.02	mg/L	0.002	0.0002	0.0152	10	0	100
Nitrate	50	mg/L	0.5	0.5	0.5	10	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	10	0	100
pH	6.5 - 8.5		7.7	7.4	8	10	0	100
Selenium	0.01	mg/L	0.0035	0.0035	0.0035	10	0	100
Silver	0.1	mg/L	0.0001	0.0001	0.0001	10	0	100
Sodium	180	mg/L	18.5	18	20	10	0	100
Sulfate	250	mg/L	5	5	5	10	0	100
Total Dissolved Solids (TDS)	10000	mg/L	172	158	190	10	0	100
Total Hardness as CaCO3	200	mg/L	150.02	140	161.5	10	0	100
True Colour	15	Hazen Units	0.8	0.5	1	10	0	100
Turbidity	5	NTU	0.27	0.05	0.7	10	0	100
Uranium	0.02	mg/L	0.0002	0.0001	0.0002	10	0	100
Zinc	3	mg/L	0.27	0.01	0.06	10	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	51	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	51	0	100
Free Chlorine	0.2 - 5	mg/L	1.03	0.80	1.34	51	0	100
Total Chlorine	5	mg/L	1.17	0.90	1.47	51	0	100
pH	6.5 - 8.5		7.34	6.98	7.63	51	0	100
Temperature	30	C	20.6	13.4	27.5	51	0	100
Turbidity	5	NTU	0.264	0.08	1.47	50	0	100

Table C.6 Willawarrin Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.01	0.005	0.02	15	0	100
Antimony	0.003	mg/L	0.0009	0.00005	0.0015	15	0	100
Arsenic	0.01	mg/L	0.0014	0.0005	0.003	15	0	100
Barium	2	mg/L	0.0011	0.0075	0.0163	15	0	100
Boron	4	mg/L	0.0157	0.0032	0.0255	15	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00005	15	0	100
Calcium	10000	mg/L	15.1	9.6	23	15	0	100
Chloride	250	mg/L	16.73	13	30	15	0	100
Chromium	0.05	mg/L	0.0026	0.0005	0.023	15	0	100
Copper	2	mg/L	0.0311	0.008	0.151	15	0	100
Fluoride	1.5	mg/L	0.0773	0.05	0.12	15	0	100
Iodine	0.5	mg/L	0.0127	0.01	0.02	15	0	100
Iron	0.3	mg/L	0.0113	0.005	0.04	15	0	100
Lead	0.01	mg/L	0.0006	0.0001	0.0013	15	0	100
Magnesium	10000	mg/L	5.01	3.77	6.8	15	0	100
Manganese	0.5	mg/L	0.016	0.0003	0.0433	15	0	100
Mercury	0.001	mg/L	0.0004	0.0004	0.0004	15	0	100
Molybdenum	0.05	mg/L	0.0032	0.00005	0.0355	15	0	100
Nickel	0.02	mg/L	0.0057	0.0002	0.0512	15	1	93.33
Nitrate	50	mg/L	1.766	0.5	6	15	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	15	0	100
pH	6.5 - 8.5		7.66	7.40	8.00	15	0	100
Selenium	0.01	mg/L	0.0035	0.0035	0.0035	15	0	100
Silver	0.1	mg/L	0.0001	0.0001	0.0001	15	0	100
Sodium	180	mg/L	41.9	20	63	15	0	100
Sulfate	250	mg/L	9.06	7	10	15	0	100
Total Dissolved Solids (TDS)	10000	mg/L	129.8	91	193	15	0	100
Total Hardness as CaCO3	200	mg/L	58.4	40.1	85.4	15	0	100
True Colour	15	Hazen Units	1.06	0.5	2	15	0	100
Turbidity	5	NTU	0.6	0.1	1.3	15	0	100
Uranium	0.02	mg/L	0.0001	0.00005	0.00005	15	0	100
Zinc	3	mg/L	0.016	0.005	0.04	15	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	26	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	26	0	100
Free Chlorine	0.2 - 5	mg/L	0.97	0.32	1.58	26	0	100
Total Chlorine	5	mg/L	1.09	0.44	1.72	26	0	100
pH	6.5 - 8.5		7.24	6.78	7.89	26	0	100
Temperature	30	C	19.5	11.9	24.6	26	0	100
Turbidity	5	NTU	0.51	0.01	1.64	26	0	100

Table C.7 Bellbrook Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.011	0.005	0.02	15	0	100
Antimony	0.003	mg/L	0.0003	0.00005	0.0012	15	0	100
Arsenic	0.01	mg/L	0.0006	0.0005	0.002	15	0	100
Barium	2	mg/L	0.0119	0.0089	0.0174	15	0	100
Boron	4	mg/L	0.0103	0.0032	0.0203	15	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00005	15	0	100
Calcium	10000	mg/L	17.7	11.3	33.4	15	0	100
Chloride	250	mg/L	25.3	16	33	15	0	100
Chromium	0.05	mg/L	0.0011	0.0005	0.008	15	0	100
Copper	2	mg/L	0.0113	0.002	0.03	15	0	100
Fluoride	1.5	mg/L	0.0533	0.05	0.1	15	0	100
Iodine	0.5	mg/L	0.0107	0.01	0.02	15	0	100
Iron	0.3	mg/L	0.0127	0.005	0.04	15	0	100
Lead	0.01	mg/L	0.0006	0.0001	0.0014	15	0	100
Magnesium	10000	mg/L	5.72	4.22	9.17	15	0	100
Manganese	0.5	mg/L	0.0032	0.0003	0.0251	15	0	100
Mercury	0.001	mg/L	0.0004	0.0004	0.0004	15	0	100
Molybdenum	0.05	mg/L	0.0007	0.00005	0.0089	15	0	100
Nickel	0.02	mg/L	0.0023	0.0002	0.0299	15	1	93.33
Nitrate	50	mg/L	1.83	0.5	5	15	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	15	0	100
pH	6.5 - 8.5		7.70	7.40	8.00	15	0	100
Selenium	0.01	mg/L	0.0035	0.0035	0.0035	15	0	100
Silver	0.1	mg/L	0.0001	0.0001	0.0001	15	0	100
Sodium	180	mg/L	22.3	17	41	15	0	100
Sulfate	250	mg/L	8.46	6	10	15	0	100
Total Dissolved Solids (TDS)	10000	mg/L	105.1	86	126	15	0	100
Total Hardness as CaCO3	200	mg/L	67.7	48.1	121.2	15	0	100
True Colour	15	Hazen Units	0.73	0.5	1	15	0	100
Turbidity	5	NTU	0.36	0.05	1.3	15	0	100
Uranium	0.02	mg/L	0.0001	0.00005	0.0001	15	0	100
Zinc	3	mg/L	0.02	0.01	0.03	15	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	26	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	26	0	100
Free Chlorine	0.2 - 5	mg/L	1.27	0.86	1.78	26	0	100
Total Chlorine	5	mg/L	1.37	1.01	1.96	26	0	100
pH	6.5 - 8.5		7.46	7.31	7.70	26	0	100
Temperature	30	C	20.5	14.2	26.7	26	0	100
Turbidity	5	NTU	0.286	0.06	0.74	26	0	100

Table C.8 Thunggutti Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.008	0.005	0.01	2	0	100
Antimony	0.003	mg/L	0.0001	0.0001	0.0001	2	0	100
Arsenic	0.01	mg/L	0.0005	0.0005	0.0005	2	0	100
Barium	2	mg/L	0.0116	0.0111	0.0121	2	0	100
Boron	4	mg/L	0.0182	0.0175	0.0188	2	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00005	2	0	100
Calcium	10000	mg/L	7.2	6.1	8.2	2	0	100
Chloride	250	mg/L	19.5	19	20	2	0	100
Chromium	0.05	mg/L	0.0013	0.0005	0.002	2	0	100
Copper	2	mg/L	0.037	0.027	0.046	2	0	100
Fluoride	1.5	mg/L	0.05	0.05	0.05	2	0	100
Iodine	0.5	mg/L	0.01	0.01	0.01	2	0	100
Iron	0.3	mg/L	0.0075	0.005	0.01	2	0	100
Lead	0.01	mg/L	0.0011	0.0006	0.0016	2	0	100
Magnesium	10000	mg/L	4.39	3.82	4.96	2	0	100
Manganese	0.5	mg/L	0.0022	0.0011	0.0032	2	0	100
Mercury	0.001	mg/L	0.0004	0.0004	0.0004	2	0	100
Molybdenum	0.05	mg/L	0.0013	0.0002	0.0024	2	0	100
Nickel	0.02	mg/L	0.005	0.0002	0.0097	2	0	100
Nitrate	50	mg/L	0.75	0.5	1	2	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	2	0	100
pH	6.5 - 8.5		7.35	7.30	7.40	2	0	100
Selenium	0.01	mg/L	0.0035	0.0035	0.0035	2	0	100
Silver	0.1	mg/L	0.0001	0.0001	0.0001	2	0	100
Sodium	180	mg/L	24	23	25	2	0	100
Sulfate	250	mg/L	9.5	8	11	2	0	100
Total Dissolved Solids (TDS)	10000	mg/L	79	78	80	2	0	100
Total Hardness as CaCO3	200	mg/L	35.95	31	40.9	2	0	100
True Colour	15	Hazen Units	0.75	0.5	1	2	0	100
Turbidity	5	NTU	0.75	0.05	0.1	2	0	100
Uranium	0.02	mg/L	0.0001	0.00005	0.00005	2	0	100
Zinc	3	mg/L	0.015	0.01	0.02	2	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	25	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	25	0	100
Free Chlorine	0.2 - 5	mg/L	1.45	1.14	1.98	25	0	100
Total Chlorine	5	mg/L	1.59	1.33	2.08	25	0	100
pH	6.5 - 8.5		7.19	6.81	7.53	25	0	100
Temperature	30	C	20.0	14.5	26.3	25	0	100
Turbidity	5	NTU	0.27	0.06	0.53	25	0	100

Appendix D Continuous Improvement - Implementation Plan (IP) Actions

KSC Implementation Plan_ December_2023